RELIABILITY FIRST

PUBLIC

Theme: *Managing Unavoidable Risks*

Agenda
Board of Directors • Risk and Compliance Committee

December 3, 2025 • 12:30 PM – 3:00 PM (ET)

North American Electric Reliability Corporation (NERC)
1401 H Street NW, Suite 410
Washington, DC 20005

Room: Capital Room
Attire: Business Casual

Closed Agenda

1. Risk and Data Initiative Update — 12:30 pm

Presenter: Atif Usman, Director, Analytics and Risk, and Jeff Craigo, SVP Operations and Risk, ReliabilityFirst (RF)

Description: Mr. Usman and Mr. Craigo will discuss plans and updates relating to operationalizing risk identification, monitoring, and mitigation efforts.

Action: Information and Discussion

2. Confidential Compliance and Enforcement Matters — 12:45 pm

Presenter: Kristen Senk, Deputy General Counsel and Director, Legal and Enforcement, Matt Thomas, Director, Compliance and Monitoring, and Tom Scanlon, Senior Managing Counsel, Enforcement, RF

Description: Ms. Senk, Mr. Thomas, and Mr. Scanlon will present confidential matters.

Reference:
a) Confidential Enforcement Documents
b) ReliabilityFirst's 3-Year Strategy to Meet NERC's Real-Time Processing Targets

Action: Information and Discussion

3. 2025 FERC and NERC Oversight Activities — 1:15 pm

Presenter: Matt Thomas, Director Compliance Monitoring

Description: Mr. Thomas will provide an update on the status and findings of the 2025 FERC and NERC Oversight of RF.

Reference:
a) Summary
b) FY2024 FFT/CE Survey (FERC and NERC)
c) 2024 NERC Findings Verification Program: ReliabilityFirst
d) Preliminary Screening and Closure Oversight (NERC)

4. Adjourn Closed Session — 1:20 pm

Open Agenda

5. Call to Order and Appoint Secretary to Record Minutes 1:30 pm
Presenter: Ken Seiler, Chair

6. Antitrust Statement 1:30 pm
Presenter: Ken Seiler, Chair

7. Consent Items 1:35 pm
Presenter: Ken Seiler, Chair
Reference:
a) Draft Minutes for the August 27, 2025 Risk and Compliance Committee Meeting
b) Enforcement Data (Reference Materials)
c) Registration Update (Reference Materials)
d) Stakeholder and Technical Committee Update (Reference Materials)

Action: Approve Consent Items

8. Keynote Speaker 1:40 pm
Presenter: Mike Benn, Director, Energy Procurement, Stack Infrastructure
Description: Mr. Benn will explain where Stack Infrastructure sits in the data center ecosystem, and discuss trends and challenges relating to increased demand for data centers, and potential opportunities for collaboration to find solutions that recognize the extent of potential load growth while appreciating impacts on the system.
Reference:
a) Bio
b) Presentation

Action: Information and Discussion

9. Guest Speaker 2:05 pm
Presenter: Sunny Wescott, Chief Meteorologist, Federal Emergency Response and Operations Support
Description: Ms. Wescott will provide a briefing on the latest trends in extreme weather and their effects on energy systems. Topics include atmospheric pressure dynamics, high-impact weather events, infrastructure stressors, and wildfire risks.
Reference: Presentation
Action: Information and Discussion

10. Standards Update 2:30 pm
Presenter: Mallory Carlone, Manager, Operations and Planning, RF
Description: Ms. Carlone will provide updates on major standards projects and initiatives, with a focus on IBRs, recent FERC orders, and drivers of current high-priority standards projects.
Reference: Presentation
Action: Information and Discussion

11. Charter Review and Evaluation of Committee's Performance 2:55 pm

Presenter: Matt Thomas, Director Compliance Monitoring, RF

Description: Mr. Thomas will lead the annual review of the Committee Charter and Performance of Specific Duties for 2025.

Reference:
a) Risk and Compliance Committee Charter
b) Summary of Performance of Specific Duties for 2025

Action: Accept Summary of Performance of Specific Duties for 2025

12. Next Meeting 3:00 pm

- April 29, 2026 • RF Offices

13. Adjourn 3:00 pm

Roster • Risk and Compliance Committee

Ken Seiler, Chair • Independent (2026)
Joanna Burkey • Lead Independent (2025)
Melika Carroll • Independent (2027)
Dr. Renuka Chatterjee • MISO (T • 2027)
Lesley Evancho • Independent (2025)
Craig Grooms • Buckeye Power (S-LSE • 2026)
Mark Mroczynski • FirstEnergy (T • 2027)

a) Draft Minutes for the August 27, 2025 Risk and Compliance Committee Meeting

RELIABILITY FIRST

DRAFT - Minutes
Board of Directors • Risk and Compliance Committee

August 27, 2025

Nemacolin • Farmington, PA

Closed Session

Confidential Compliance & Enforcement Matters – Kristen Senk, ReliabilityFirst's (RF) Deputy General Counsel and Director of Legal & Enforcement, Matt Thomas, RF's Director of Compliance Monitoring, and Tom Scanlon, RF's Senior Managing Counsel, Enforcement presented on confidential matters.

System Events Discussion – Diane Holder led a confidential discussion on system events.

Adjourn – Chair Ken Seiler adjourned the Closed Committee session at 1:20pm (ET).

Open Session

Call to Order – Chair Ken Seiler called to order a duly noticed open meeting of the Risk and Compliance Committee (Committee) on August 27, 2025, at 1:28 pm (ET). A quorum was present, consisting of the following members of the Committee: Ken Seiler, Chair; Joanna Burkey; Melika Carroll; Dr. Renuka Chatterjee; Lesley Evancho; Craig Grooms; and Mark Mroczynski. A list of others present during the Committee meeting is set forth in Attachment A.

Appoint Secretary to Record Minutes – Chair Seiler designated Niki Schaefer, RF's Vice President and General Counsel, as the secretary to record the meeting minutes.

Antitrust Statement – Chair Seiler advised all present that this meeting is subject to, and all attendees must adhere to, RF's Antitrust Compliance Guidelines.

Approve Compliance Committee Meeting Minutes – Chair Seiler presented draft minutes for the April 30, 2025 Committee meeting and the Enforcement Data Reference Materials (both included in the agenda package). Upon a motion duly made and seconded, the Committee approved the minutes.

Artificial Intelligence Evolution and Energy Trends – Sudip Roy, Senior Director of Inference at Cohere, presented on AI trends. He began by discussing AI capabilities and usage patterns, which have evolved from basic text completion and prediction in 2021 to complex problem solving and research in 2025. Mr. Roy showed a chart of the computing demand required by various AI tasks, with deep research tasks requiring far more computing power than other tasks. He then discussed the difference between AI training and inference, noting that computing power is moving over time from training to agentic inference. He walked through sample generative AI use cases for the energy industry, including knowledge assistance for field engineers, marketing content generation, and demand forecasting assistance. There was then discussion among the Committee about AI's impact on energy demands going forward, and the importance of continued learning in this space.

Iberian Peninsula and NERC State of Reliability Report – Mark Lauby, NERC's Senior Vice President and Chief Engineer, discussed NERC's State of Reliability Report, with a focus on the ReliabilityFirst region. He discussed key risks such as severe weather, resource adequacy concerns, and reliability challenges associated with data centers and inverter-based resources (IBRs). He also noted successes in risk reduction, including that the RF region's misoperations rate has improved over time and that generator performance during winter storms has improved from 2022 to 2024.

Mr. Lauby then provided an overview of the Iberian Peninsula blackout. He provided a detailed sequence of events and shared that the primary contributing factors were 1) poor voltage ride-through performance of resources, 2) insufficient dynamic voltage regulation, 3) unreliable voltage regulation of conventional generators, and 4) potential gaps in operations planning.

Mr. Lauby discussed the post-event recommendations, noting that the U.S. already requires all generation to be capable of voltage regulation under VAR-002-4 and FERC Order No. 827. The other recommendations are to review overvoltage protection settings (which NERC has Level 2 and Level 3 Alerts out on), enhance voltage control resources (which are used in the U.S.), and define minimum monitoring requirements for incident analysis (addressed by the new PRC-028 standard on disturbance monitoring).

During Committee discussion, Dr. Chatterjee shared that forced generator outages for equipment issues have been happening in the warmer months, and expressed concern. Mr. Seiler commented on the value of information sharing and learning from reliability issues in other countries to prevent issues in the U.S.

DTE Technology and Security Challenges and Updates – Steve Ambrose, Vice President and CIO at DTE Energy, and Jason Smith, Director of NERC Compliance at DTE Energy, discussed DTE's grid modernization efforts and its internal compliance program. The grid modernization efforts include smart device deployment (such as automated reclosers), infrastructure rebuild (such as voltage upgrades), grid automation, and accelerated vegetation trimming. There was also discussion on the company's culture, and its focus on continuous improvement, quality management, and enterprise safety. Mr. Smith discussed how a strong focus on internal controls strengthens compliance due to earlier detection of issues. Mr. Ambrose noted that using a compliance and internal controls framework, similar to frameworks the company uses for other important initiatives, is helpful for employee engagement and execution. Mr. Smith also discussed how DTE's Governance, Risk and Compliance tool is at the center of its NERC compliance activities.

Next Meeting – Chair Seiler noted that the next Committee meeting will occur on December 3, 2025 in Washington, DC at the NERC Offices.

Adjourn - Chair Seiler adjourned the Committee meeting at 2:56 pm.

As approved on this third day of December, 2025
by the Compliance Committee,

Niki Schaefer
Vice President General Counsel & Corporate Secretary

Attachment A

Others Present During the Risk and Compliance Committee Meeting

Steve Ambrose • DTE
Allison Archer • MISO
Jeff Craigo • ReliabilityFirst
Craig Creamean • Exelon
Michael DelViscio • PJM
Beth Dowdell • ReliabilityFirst
Chelsey Eppich • ReliabilityFirst
Tim Foster • PJM
Tim Gallagher • ReliabilityFirst, President & CEO
Vinit Gupta • ITC Holdings
Diane Holder • ReliabilityFirst
Christie Klein • ReliabilityFirst
Mark Lauby • NERC
Marcus Noel • ReliabilityFirst
Nelson Peeler • Duke Energy
Sudip Roy • Cohere
Tom Scanlon • ReliabilityFirst
Niki Schaefer • ReliabilityFirst
Kristen Senk • ReliabilityFirst
Jason Smith • DTE
Joan Soller • Wabash
Robert Taylor • Invenergy
Brian Thiry • ReliabilityFirst
Matt Thomas • ReliabilityFirst
Jody Tortora • ReliabilityFirst
Joe Trentacosta • SMECO
Jim Uhrin • ReliabilityFirst
Atif Usman • ReliabilityFirst
Becky Webb • Exelon
Ken Zapinski • PittsburghWorks

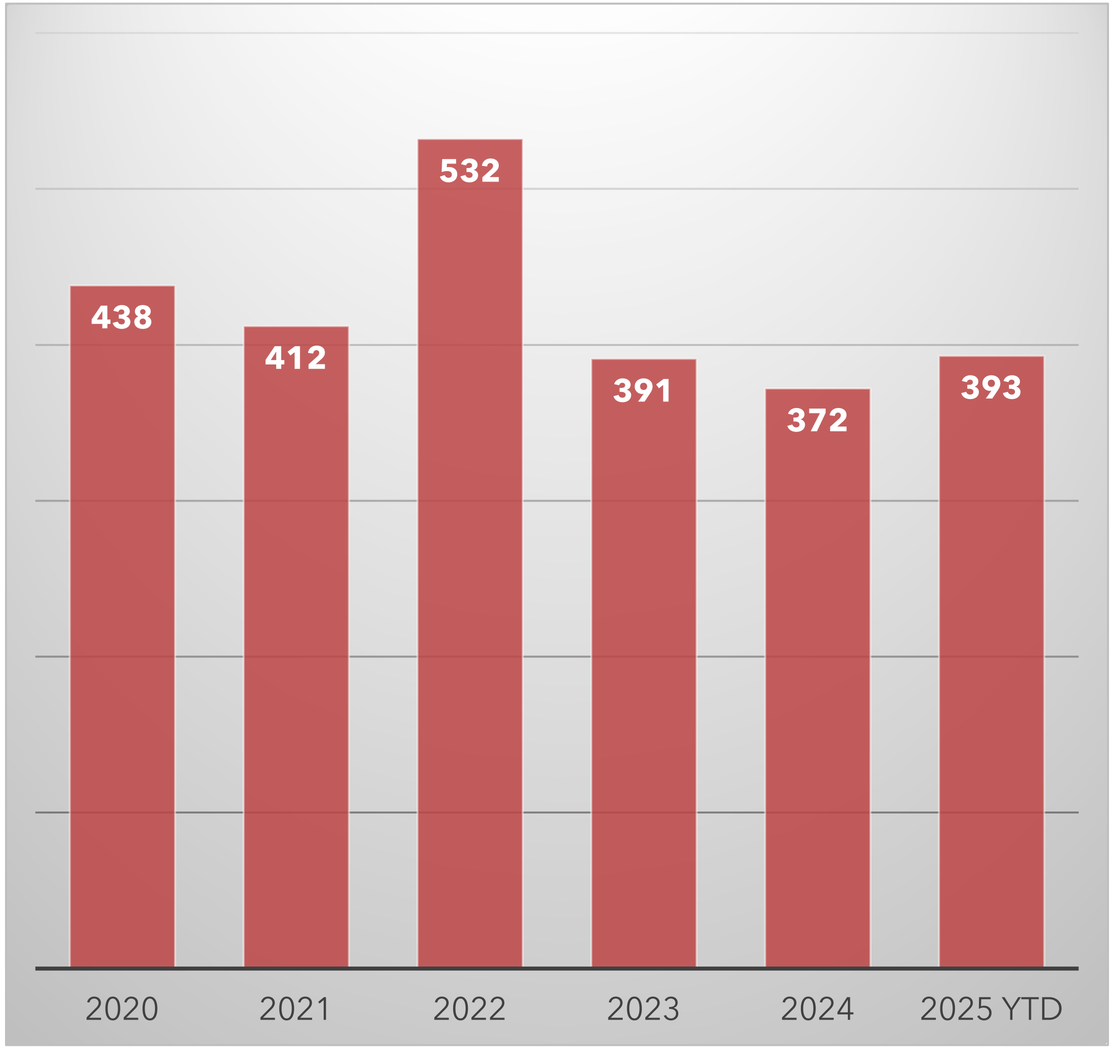
b) Enforcement Data (Reference Materials)

SUMMARY – ENFORCEMENT DATA

The following slides include some key enforcement metrics that ReliabilityFirst tracks.

The data shows that violation intake remains high. At the current pace, ReliabilityFirst is on track to receive approximately 440 violations in 2025. A significant majority of violations were self-reported or self-logged as opposed to identified through a compliance monitoring engagement. Regarding violations processed (i.e., filed with NERC) between January 1, 2025, and November 20, 2025, most were lower risk violations. The team expects to process approximately 500 violations by the end of 2025. There is a slide summarizing ReliabilityFirst's violation inventory – most of the cases are considered relatively new, with 82% identified in 2024 and 2025, 16% identified in 2023, 2% identified in 2022, and less than 1% identified in 2021.

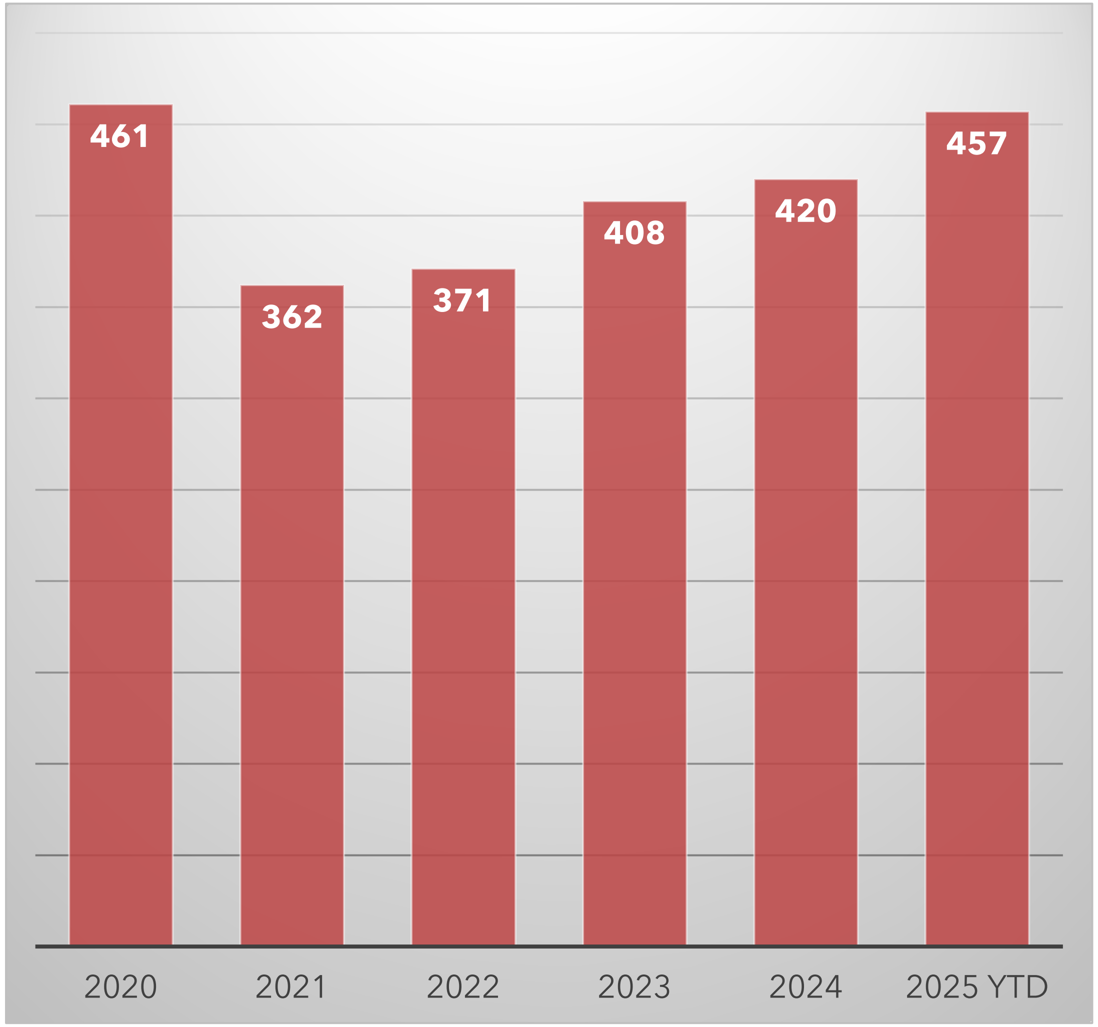
RF ANNUAL VIOLATION INTAKE



2025 Commentary:

- Year-to-date as of 11/20/2025; and
- Majority self-reported/self-logged (~80%).

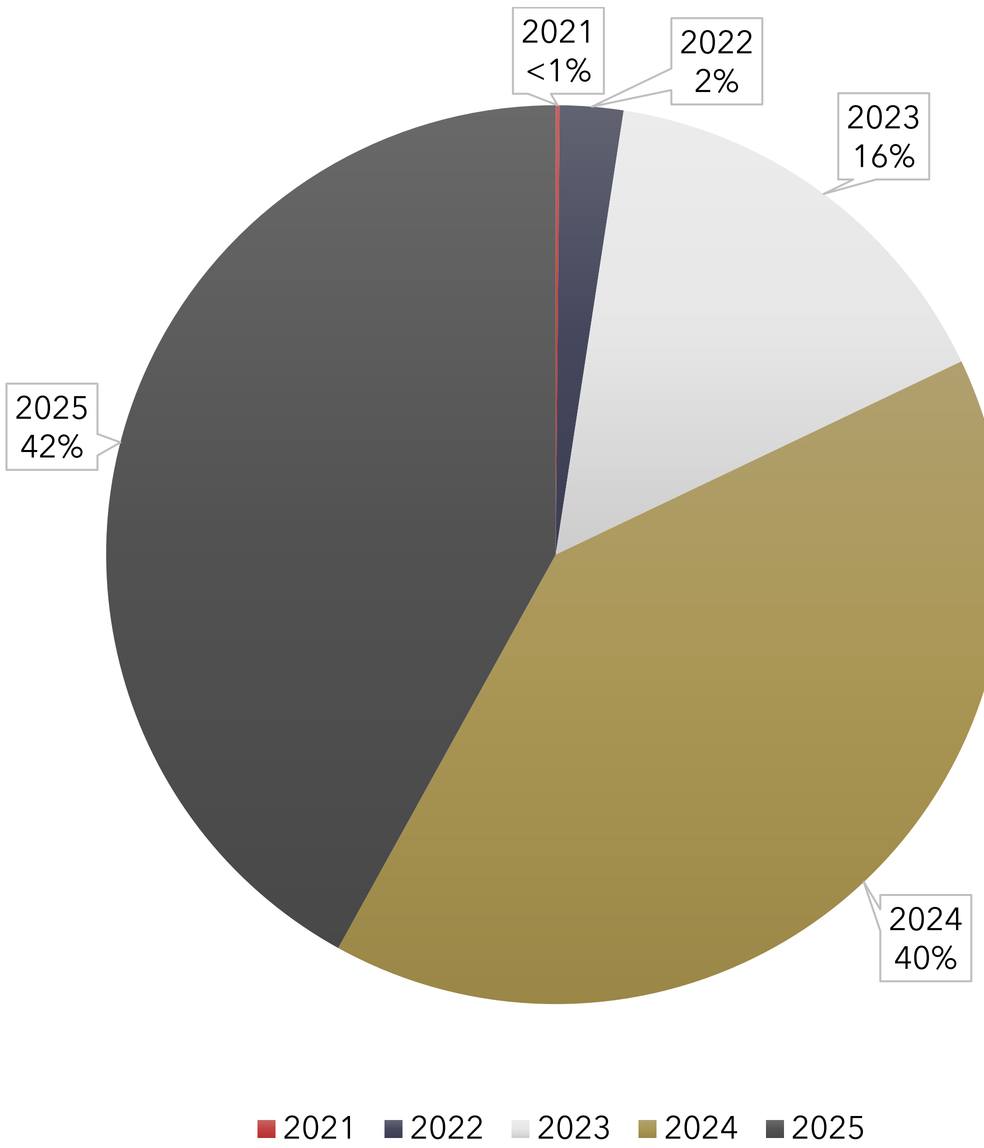
RF ANNUAL VIOLATIONS PROCESSED



2025 Commentary:

- Year-to-date as of 11/20/2025; and
- ~92% were processed as Compliance Exceptions or Find, Fix, and Track Report.

RF INVENTORY BY YEAR REPORTED



c) Registration Update (Reference Materials)

Annual Update of Registration Activities

In 2025, the total number of ReliabilityFirst registered entities increased to **333**, up from **313** in 2024 (see Figure 1, Appendix A). A majority of these registrations belong to **Generator Owners and Operators**, representing **75.2%** of the total. The next largest class of functional registrations include **Distribution Providers (7.3%)** and **Transmission Owners (6.5%)** which have remained steady (see Figure 2, Appendix A). To date, there have been **32 new Solar registrations**, **9 new Fossil registrations**, **3 new Battery registrations and 3 new Wind registrations**. A new registration is considered as a new NCR and/or new assets added to an existing entity's generation portfolio. 2025 saw a notable rise in new Solar registrations, while registrations for Fossil and Wind resources have slowed. Additionally, **10 entities were deregistered** during this period. Pending registration requests for the remainder of the year include:

- 4 new solar entities totaling approximately **480 MW**
- 1 new natural gas entity totaling **950 MW**
- 1 new wind entity totaling **200 MW**

The registration staff at ReliabilityFirst have also been highly engaged in **Phase 2** and **Phase 3** of the **ERO Inverter Based Resource (IBR) Registration Initiative**. Phase 2 (May 2024 – May 2025) consisted of working towards the completion of the identification of Category 2[1] Generator Owner and Generator Operator candidate entities along with participation in continued outreach. Phase 3 (May 2025 – May 2026) consists of completing registration of Category 2 candidates and continued entity specific outreach.

Starting in August 2025, the staff began registering verified Category 2 Non-BES IBR sites and submitting these registrations to NERC for approval in a staggered manner ahead of the official NERC registration effective date set for May 15, 2026.

The process begins with an initial discussion with identified entities, some of which may be new to NERC requirements. In these cases, staff provide guidance on compliance processes and share informational resources tailored for new GO/GOP entities. When registration is required, staff assist the entity in establishing access to the ERO Registration Portal. Subsequently, key documentation—such as one-line diagrams and Asset Verification Forms—is collected. The process concludes with a thorough review and verification, RF approval, and final submittal for NERC approval.

As of October 29, 2025, **19 Category 2 Non-BES IBR sites** have been registered, accounting for approximately **30% of total (64) candidate sites**. These registrations were processed under **five new**

[1] Entity who owns and/or operates non-BES inverter-based generating resources that have an aggregate nameplate capacity of greater than or equal to 20 MVA delivering such capacity to a common point of connection at a voltage greater than or equal to 60 kV to register with NERC.

Entity registrations and **seven footprint changes** of existing entities. As a result of Category 2 sites becoming NERC applicable in 2026 and the expected continued rise in renewable generation,

ReliabilityFirst anticipates a notable increase in registered entities next year (see Figure 3, Appendix A).

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Appendix A

Figure 1:

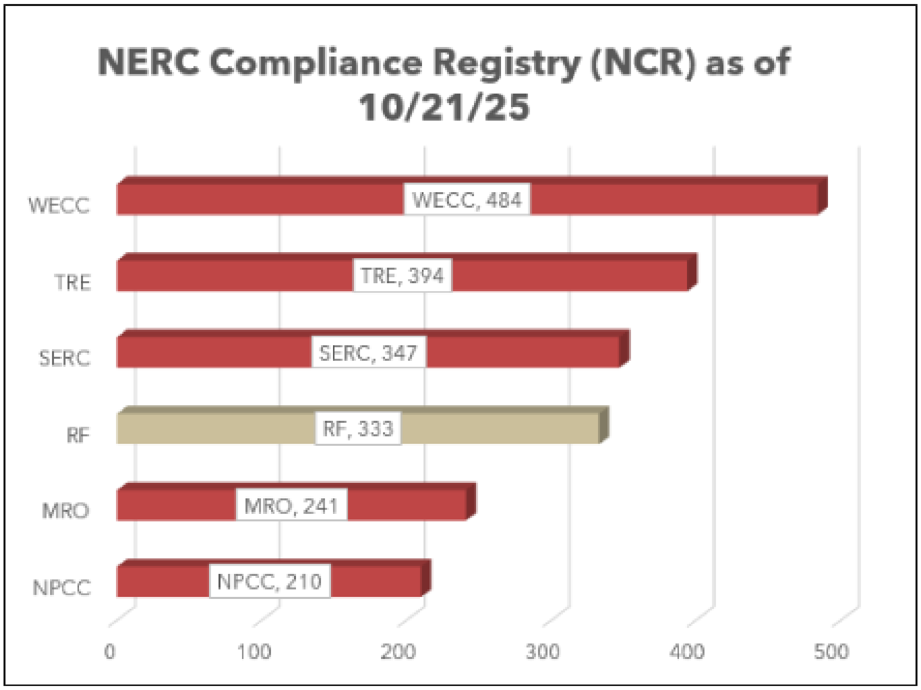


Figure 2:

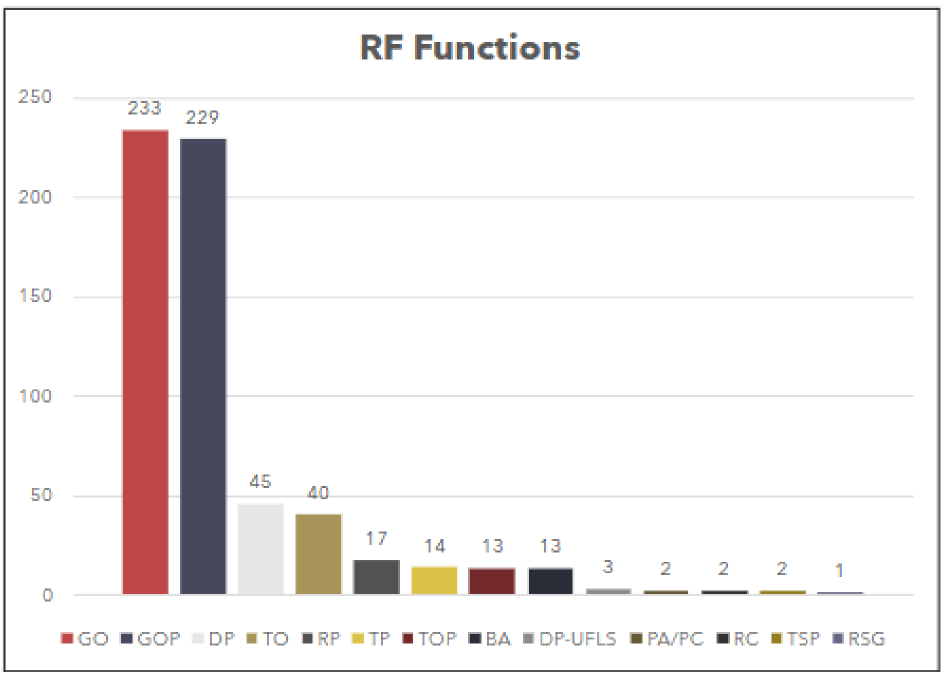
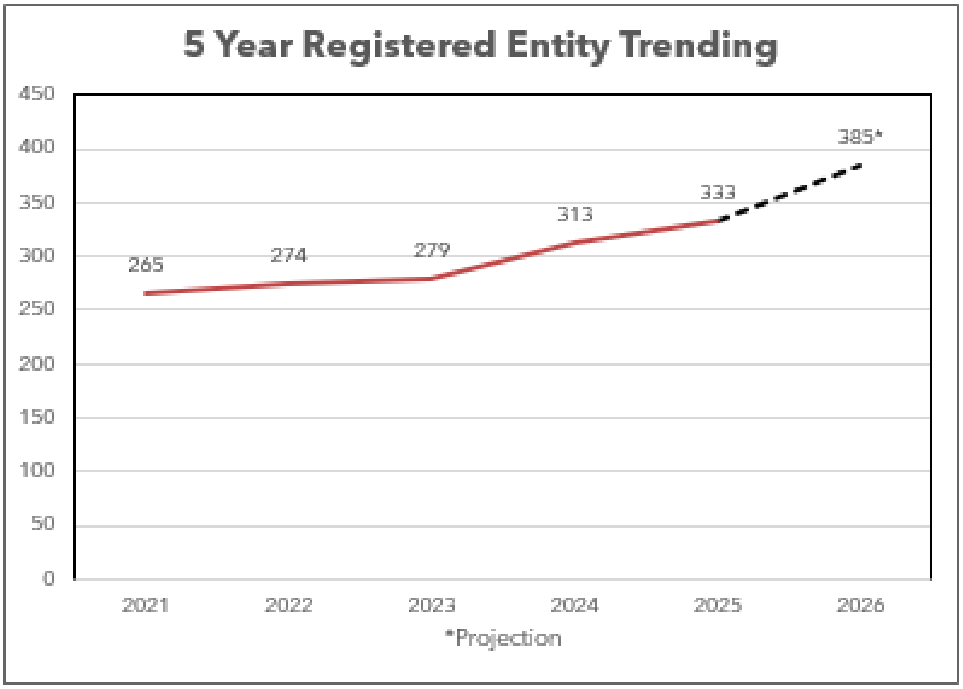


Figure 3:


5 Year Registered Entity Trending
450
400
350
300
250
200
150
100
50
0
265
274
279
313
333
385*
2021
2022
2023
2024
2025
2026
*Projection

d) Stakeholder and Technical Committee Update (Reference Materials)

Annual Update of the ReliabilityFirst Stakeholder Advisory and Technical Committees

Summary

This annual update is to provide the Risk and Compliance Committee visibility into some of the work occurring in the ReliabilityFirst (RF) stakeholder advisory and technical committees, which the Risk and Compliance Committee oversees. The Committees worked on various items including Risk Management by shaping the Regional Risk Priorities and performing critical assessments. They also focused on reliability enhancements through targeted studies and guidance, and improving stakeholder engagement through governance measures. Below are some highlights from each group for the year and additional background and detail are captured in the Appendices.

Reliability Committee (RC)

- Regional Risk Assessment (RRA):
  - Participated in the biennial RRA by prioritizing and providing input from committee and subcommittees.
  - Adopted streamlined meeting cadence; conducted risk ranking survey.
  - Approved key deliverables for inclusion in RRA.
- Governance: Enforced participation rules; voting membership reduced from 26 to 13.
- Leadership transition: Vice Chair moved to Chair; new Vice Chair recruitment underway.

Transmission Performance Subcommittee (TPS)

- RF Staff delivered seasonal transmission assessments for industry use in their reliability planning.
- Advanced dynamic analysis guidance (white paper in final stages).
- Supported NERC initiatives (energy analysis pilot, TPL-008 review).

Protection Subcommittee (PS)

- Continued quarterly misoperation reviews; recommendations to reduce failures.
- Collaborated with NERC on standards and disturbance mitigation.
- Joint engagement with MRO on misoperation reduction strategies.

Generator Subcommittee (GS)

- Improved engagement through structured planning and leadership succession.
- Addressed emerging reliability topics:
  - Inverter-Based Resource (IBR) registration and compliance.
  - Reviewed lessons learned from Winter Storm Enzo.
  - Discussed Black Start recommendations and PRC-028 observations.
  - Reviewed FERC orders and NERC alerts impacting generator operations.

Appendix A

Stakeholder Advisory Committee Background

The RC serves as an advisory body to the ReliabilityFirst Board of Directors (Board). The RC's role is to provide input and advice on reliability related issues and activities and may make recommendations for improvements or enhancements. The RC also provides a forum in which to discuss current and emerging technical issues and risks associated with the reliability of the Bulk Power System.

The RC's responsibilities include the following:

- Provide support, expertise, and guidance to ReliabilityFirst (RF).
- Serve as the designated Pre-Qualified Organization pursuant to the NERC Compliance Guidance Policy, for Operations and Planning related issues.
- Provide a forum for Committee Member discussion on reliability issues to promote stakeholder communication, understanding, and consensus.
- Provide assignments to and oversight of the Subcommittees and Task Forces.
- Review and approve deliverables (e.g., reports and studies) from the Subcommittees and Task Forces for presentation to the Board.
- Provide support, expertise, and guidance to the Subcommittees and Task Forces.

The TPS, PS, and GS all report to the RC.

- TPS – provide a Transmission Owner/Planner forum to address transmission planning and/or performance issues (e.g., transmission assessments, outages, maps). Suppliers and marketers are not permitted to participate in Transmission Performance Subcommittee proceedings

- PS – provide a protection related forum to identify, discuss, and address protective relay and control issues including both generator and transmission protection. Discuss and provide solutions to help minimize transmission protection system misoperations. Conduct a peer review of misoperations reported via the NERC MIDAS process.

- GS – provide a generator related forum to identify, discuss, and address Bulk Power System generation related issues.

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Appendix B

Stakeholder Advisory Committee Details for 2025

<u>Reliability Committee</u>

RF is performing its RRA this year, which is done on a biennial basis. The RRA's workplan and completion is targeted for the end of 2025. The RRA workplan now includes discussion, feedback, and deliverables from the RC, TPS, and PS. The RC has the responsibility of providing discussion and feedback around the larger risks that impact the RF footprint. Based on these discussions, the risk categories that are included in the RRA are reviewed and updated. The RC broke from its normal quarterly meeting cadence and met several times for a shorter duration in Q1 and Q2 in 2025. This seemed to be a more effective strategy to execute the RRA workplan. In Q3, RC members (with RF staff) also participated in a survey to rank the risk categories included in the RRA. In addition to the survey, the RC will review and approve the work products from the TPS and PS (i.e., the Transmission Outage Assessment and Misoperation Assessment, respectively) that will be included as part of the RRA.

RF also decided to work with the Chair and Vice Chair of the RC to better enforce rules within the RC Charter document to encourage more robust participation. One of these rules pertained to regular attendance and otherwise suspension of membership and voting rights. Within the RC charter is state that "*Each Committee Member may select one primary representative to the Committee and one alternate representative. However, multiple personnel from one company are welcome to attend meetings that are open to the public. Membership in the Committee will be suspended following a Committee Member's absence from two consecutive meetings. A suspended Committee Member may be reinstated at the discretion of the Committee leadership or following its attendance at two consecutive meetings.*" If a member is suspended, communication from RF was sent to RC members explaining the process to regain membership. Ultimately, this resulted in voting RC membership being reduced from 26 to 13 companies. RF continues to reach out to those suspended companies to solicit participation.

In July the RC Chair departed his company for another opportunity and RF worked with the Vice Chair to move into the Chair role. At the next RC meeting, RF will be soliciting a for new Vice Chair.

<u>Transmission Performance Sub-Committee</u>

The TPS holds three annual meetings during the spring, summer, and fall of each year. The winter meeting is held virtually and the Spring and Fall meetings are typically held in-person. In 2025, the group held meetings in February, May, and October. Items of interest that were discussed at each meeting are listed below.

<u>February</u>

1) Understanding the Inception of 14.7 Hz Oscillations Emerging from a Data Center - Chetan Mishra (Dominion) discussed frequency oscillations observed during a 2022 event which originated from data centers.

2) Modeling Practices - John Idzior (RF) provided an overview of the MMWG data checking program, the NERC Casee Quality Metrics Report, and the metrics that RF will be focusing on for 2025.
3) NERC LTRA Energy Analysis Pilot - John Idzior (RF) presented the plan for the ERO to conduct an energy analysis pilot in 2025 and the plans to incorporate energy analysis into the 2026 NERC LTRA.

May
1) ERC and Argonne National Labs Natural Gas Study - Gerad Freeman (NERC) provided an overview of the natural gas study performed with Argonne. This study identifies interstate natural gas asset outages that could cause base generator dispatch outages large enough to warrant further BPS analysis.
2) MISO Reconfiguration Process - John Boudreaux (MISO) discussed the reconfiguration process which allows their members to submit projects that will provide economic or reliability benefits.
3) Summer 2025 Transmission Assessments - Scott Goodwin (MISO) and Stan Sliwa (PJM) presented the results of their annual summer assessments.
4) Presentation of the Transmission Outage Assessment in which the content sent to the RC for approval and output is utilized for the Regional Risk Assessment.

October
1) MISO 2024/25 Winter Transmission Assessment
2) PJM Winter 2024/25 Transmission Assessment
3) RF Winter 2025/26 Transmission Assessment
4) NERC LTRA Transfer Analysis/Energy Assessment
5) NERC TPL-008
6) RF Studies - Review scope of studies RF staff will perform in 2026

A new initiative the TPS took on this year is the development of a dynamics white paper. This white paper is in the final stages. A subgroup was formed to create guidance for what constitutes good dynamic analysis. This will be useful for entities when performing their analysis to meet the requirements of various standards. This paper is scheduled to be completed in 2025.

Protection Sub-Committee
The PS holds four annual meetings per year as follows: Winter, Spring, Summer, Fall. The Winter and Summer meetings are held virtually and the Spring and Fall meetings are typically held Face to Face at the request and at the discretion of the PS. Items of note that were discussed at each meeting are listed below:

January
1) The SPCWG representative for the RF Protection Subcommittee gave an update to the group on what the SPCWG has been working on and described how these projects will affect the Protection Subcommittee.
2) The Regional Reliability Assessment (RRA) current scope was covered by Johnny Gest and the Protection Subcommittee was given the opportunity to discuss and weigh in on the scope of the report.

3) The PS had two of its members give presentations on PS Operations and Misoperations so the group could benefit from the Lessons Learned.

April

1) The Vice Chair of the Protection Subcommittee Mark McKenzie from Duke departed from Duke, and Duke substituted in Scott Fink to proceed with the Vice Chair position.
2) The SPCWG representative for the RF Protection Subcommittee gave an update to the group on what the SPCWG has been working on and described how these projects will affect the Protection Subcommittee.
3) A PS member from the Misoperation Peer Review Team gave a presentation on the type of Misoperations the region had during this quarter, highlighting any Misoperations that the PS might need to watch out for in their footprints.
4) NERC gave a presentation on Large Load Disturbances and Industry efforts in this area. NERC also gave the group a Standards update in regards with the FERC order and the Standards being created and/or modified.
5) Lew Folkerth gave a presentation on the CIP aspect of relay end of life and what happens when a relay no longer gets software updates.
6) RF staff gave an update on the required changes requested to the Short Circuit Survey by the ERAG and described how this will affect the survey going forward.
7) RF staff gave a presentation on the upcoming PRC-027 standard and gave insights on what the audit team may be looking for when they come out to audit on the Standard
8) RF staff gave an in-depth analysis on the major causes for Relay Failures according to the MIDAS data.
9) Two PS members gave presentations on PS Operations and Misoperations so the group can benefit from the Lessons Learned.

July

1) The SPCWG representative for the RF Protection Subcommittee gave an update to the group on what the SPCWG has been working on and described how these projects will affect the Protection Subcommittee.
2) A PS member from the Misoperation Peer Review Team gave a presentation on the type of Misoperations the region had during this quarter, highlighting any Misoperations that the PS might need to watch out for in their footprints.
3) GE Vernova gave a presentation on the Virtual 86 Lockout and what the future will look like as technology progresses.
4) Two PS members gave presentations on PS Operations and Misoperations so the group can benefit from the Lessons Learned.

October

1) Joint meeting with the MRO Protection Relay Subcommittee at the MRO office to coincide with the ERO Misoperation Reduction Workshop.
2) SPCWG representatives for the MRO PRS and RF PS gave an update to the group on what the SPCWG has been working on and described how these projects impact the PS.
3) RF and MRO staff gave presentations on the Misoperation trends in the RF footprint.
4) PS members gave presentations on PS Operations and Misoperations so the group can benefit from the Lessons Learned.

5) A PS member from the Misoperation Peer Review Team gave a presentation on the type of Misoperations the region had during this quarter, highlighting any Misoperations that the PS might need to watch out for in their footprints.
6) RF staff presented the recommendations section of the Misoperation Assessment report and requesting the PS to weigh in to improve the recommendations.

Generation Sub-Committee

RF and the Generation Sub-Committee Steering Group (GSG) continue to meet to lay out the agendas for the larger Generation Sub-Committee (GS) meetings. These meetings entailed brainstorming topics for the agenda and looking at methods to get better involvement and participation during the meetings. This activity will continue in 2026 to ensure engagement continues. A summary of the GSG and larger GS meetings is shared below.

April (Generator Steering group)

1) Discussed possible topics for the larger Generator Subcommittee

May (Generator Subcommittee)

1) RF Registration of IBRs - overview of the GO Category 2 criteria, timeline to register, timeline to become compliant with applicable Standards
2) Winter Storm Enzo - overview of Winter Storm Enzo and the impacts on operations.
3) High-level overview of some the FERC orders and NOPRS issued by FERC and how they pertain to GO/GOPs
4) Summer weather outlook

September

1) Met with current chair one on one with a candidate to serve as Vice Chair of the GS. Ethan Spence accepted the vice chair role of the Generator Subcommittee.

September (Generator Steering Group)

1) Finalized the topics for the larger Generator Subcommittee and create the agenda
2) Finalized the date of the GS
3) Developed topics for 2026 meetings

October (Generator Subcommittee)

1) Discussed the recommendations of NERC Black start report
2) Discussed the basics of PRC-028 and observations or lessons learned
3) Provided a high-level overview of FERC orders and NOPRS issued by FERC and how they pertain to GO/GOPs
4) Discussed the progress of the ERO lead Energy Assessment.
5) NERC Alert: Essential Actions for Inverter-Based Resource (IBR)

Mike Benn
Director of Energy Procurement, STACK Infrastructure

Mike is an energy professional and lawyer with 15 years of policy and commercial experience, focusing on wholesale electricity markets, renewable & clean energy, carbon markets, data centers, grid decarbonization, transmission policy, energy procurement, retail rate design, and climate change.

Mike is currently the Director of Energy Procurement of STACK Infrastructure, one of the largest privately held data center developers in the world, and focuses on STACK's energy strategy, energy procurement, on-site & alterative generation solutions and connecting GWs of load to the grid. Mike also currently serves as Co-Chair of the Energy Leadership Council for the Data Center Coalition, the main trade association for the data center industry, where he helps shapes energy policy strategy for the industry.

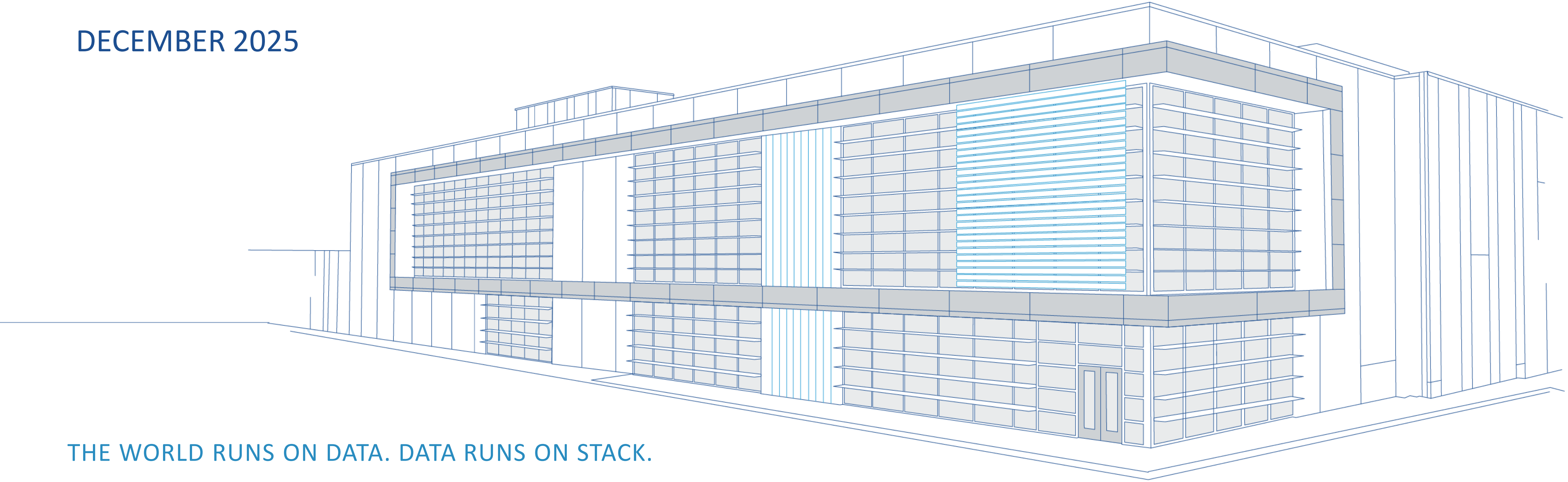
Prior to joining STACK, Mike was Senior Manager, Energy Markets and Policy for Microsoft, where Mike managed commercial, policy and regulatory energy strategy and power capacity delivery for Microsoft's largest data center region in the world (Virginia - US East/US East 2). Mike started his energy career at Powerex Corp., the wholesale trading and marketing subsidiary arm of BC Hydro. Beyond his law degree, Mike also has Bachelor of Applied Science in Mechanical Engineering.

STACK INFRASTRUCTURE

STACK Infrastructure

ReliabilityFirst Board Meeting

DECEMBER 2025



THE WORLD RUNS ON DATA. DATA RUNS ON STACK.

Introduction

Mike Benn – STACK Infrastructure, Director of Energy Procurement

Experience

- Jan 2024 – STACK Infrastructure, Director of Energy Procurement
- 2022-2023 – Microsoft (CO+I), Senior Manager Energy Markets and Policy
- 2014-2021 – Powerex Corp., Energy Markets & Policy Manager
- 2013-2014 – Lindsay LLP, Attorney
- 2011-2012 – McCarthy Tétrault LLP, Attorney

Education

- 2008-2011 **–** J.D., Peter Allard School of Law (UBC)
- 2002-2006 – B.ApSc. (Mechanical Engineering), University of British Columbia

STACK'S EVOLUTION

STACK INFRASTRUCTURE

2019

6 MARKETS

8 ACTIVE DATA CENTERS

2021

10 MARKETS

12 ACTIVE DATA CENTERS

2025

24 MARKETS

44 ACTIVE DATA CENTERS

5.5+GW BUILT OR UNDER DEVELOPMENT

7.5+GW PLANNED & POTENTIAL DEVELOPMENT

2019 — STACK Infrastructure is founded by IPI

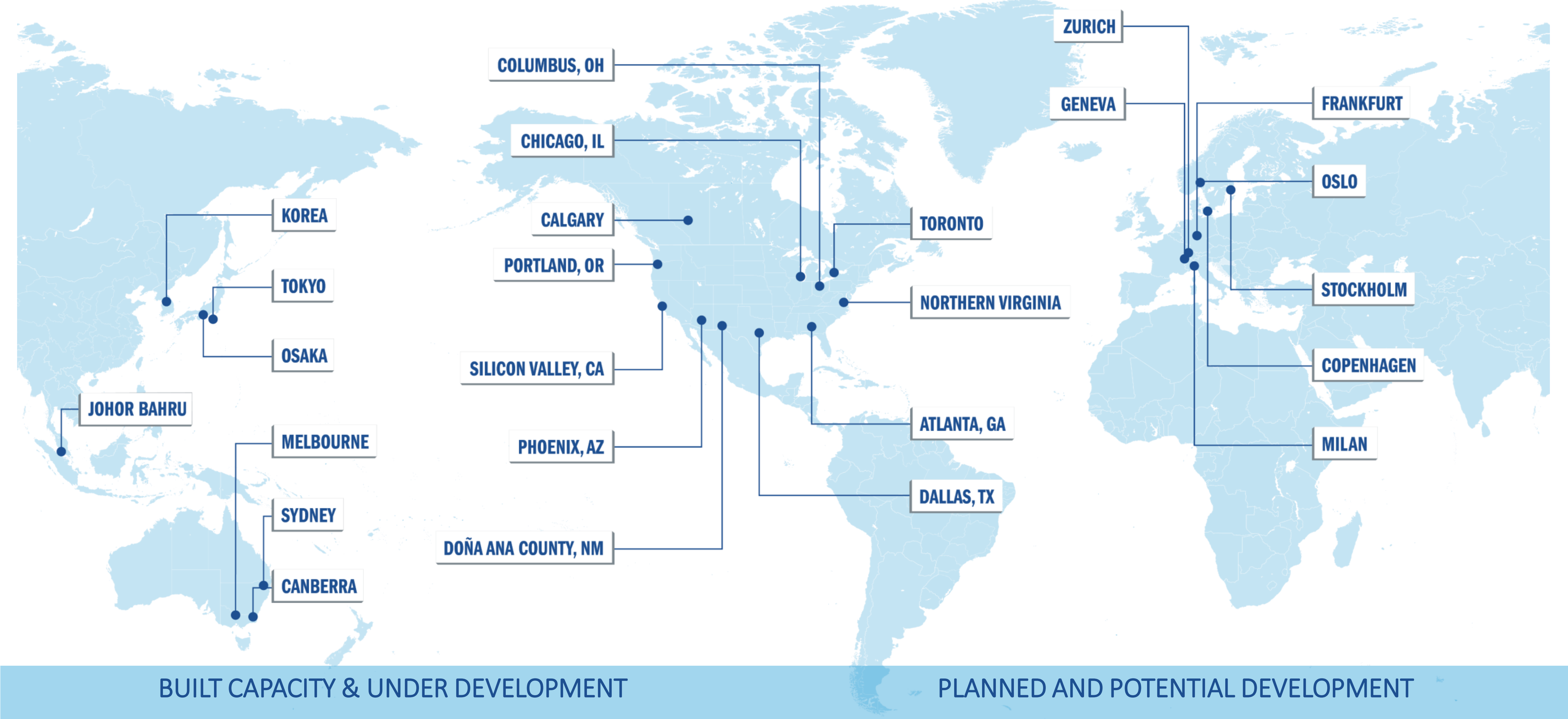
2020-2021 — STACK expands across the U.S. and internationally into Toronto, and announces its entrance into Asia Pacific

2022 — STACK becomes one of the largest privately held data center operators globally. STACK enters EMEA in 5 countries

2025 — STACK begins the year with a footprint spanning 4 continents, 12 countries, and 24 markets

STACK'S GLOBAL FOOTPRINT

STACK INFRASTRUCTURE



BUILT CAPACITY & UNDER DEVELOPMENT	PLANNED AND POTENTIAL DEVELOPMENT
5.5+GW	**7.5+GW**

RESPONSIBILITY

ENVIRONMENTAL SUSTAINABILITY

CARBON
Measure and reduce greenhouse gas (GHG) emissions.

ENERGY
Operate efficiently and procure clean energy.

WATER
Conserve potable water through efficiency and reuse.

WASTE & CIRCULARITY
Use less, maximize reuse, and increase waste diversion through recycling in both operations and construction.

LAND USE & BIODIVERSITY
Support natural ecosystems through habitat protection and restoration.

STEWARDSHIP

COMMUNITY IMPACT
Positively impact the communities in which we operate through engaging local stakeholders, supporting public infrastructure projects, and participating in philanthropic initiatives.

STEM EDUCATION
Foster a pipeline of STEM-educated talent to develop and grow the data center workforce of tomorrow through apprenticeships, university partnerships, and community education enrichment programs.

PEOPLE & CULTURE

EMPLOYEE ENGAGEMENT
Through thoughtful engagement at all levels, attracting and retaining the best talent strengthens STACK's culture and service delivery. We take pride in our comprehensive benefit, professional development, and team-building programs, which enhance the employee experience.

LEADERSHIP APPROACH
Foster a culture of leadership where individuals at every level are empowered to lead with purpose, integrity, and a commitment to growth, building a resilient, innovative organization.

BUSINESS INTEGRITY
Doing business with integrity, enforcing a zero-tolerance policy on conflicts of interest and other ethical violations.

HEALTH & SAFETY

DESIGN
STACK integrates risk-reduction into its designs, aiming to eliminate hazards through engineering and controls from the project's start.

CONSTRUCTION
Facilities are designed with hazard mitigation in mind, supported by strict contractor pre-qualifications and regular safety inspections during construction

OPERATIONS
Daily operations follow detailed policies, reinforced by routine inspections, recurring training, and active employee engagement.

We aim to design, construct, and operate data centers that scale digital progress, protect the natural world, and strengthen communities.

RESPONSIBILITY

ENVIRONMENTAL SUSTAINABILITY

CARBON, ENERGY, WATER

WASTE & CIRCULARITY

LAND USE & BIODIVERSITY

STEWARDSHIP

COMMUNITY IMPACT

STEM EDUCATION

PEOPLE & CULTURE

EMPLOYEE ENGAGEMENT

LEADERSHIP APPROACH

BUSINESS INTEGRITY

HEALTH & SAFETY

DESIGN

CONSTRUCTION

OPERATIONS

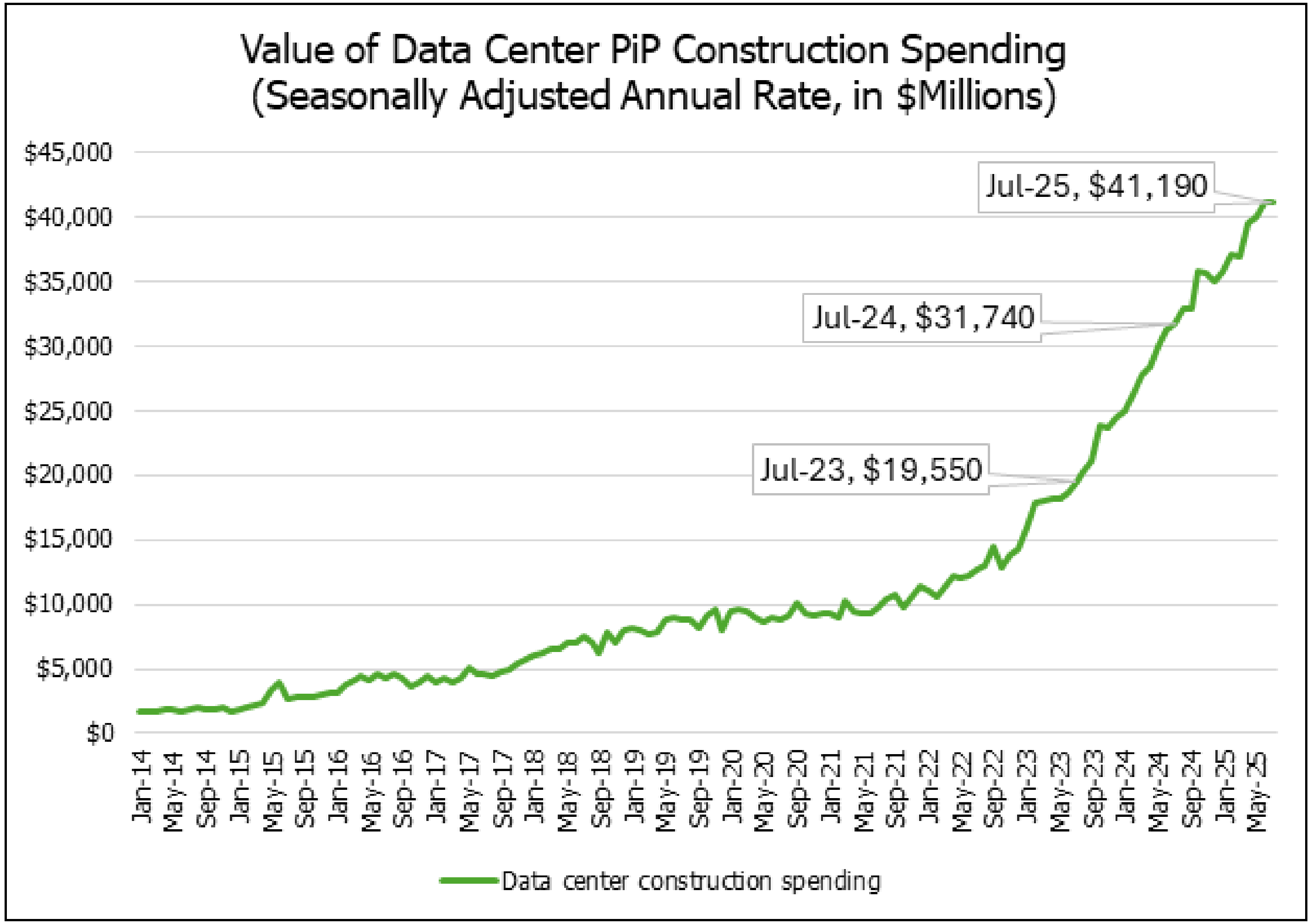
We aim to design, construct, and operate data centers that scale digital progress, protect the natural world, and strengthen communities.

WHY DATA CENTERS MATTER

Data centers power the digital services that drive our economy, from banking and healthcare to public safety and education

- 5.4 billion people online globally; 21 connected devices per US household
- Over 95% of Fortune 500 companies use cloud services
- $7 trillion global DC investment by 2030; 40% in the US

DATA CENTER CONSTRUCTION SPENDING



Source: U.S. Census Bureau Construction Spending Data: Historical Value of Private Construction Put in Place (PiP), July 2025

STACK INFRASTUCTURE IN THE DC ECO-SYSTEM

STACK is one of the largest privately held data center developers in the world.

- Wholesale provider (data hall, building, campus level customers)
- Type of customers:
  - Hyperscalers (i.e., large cloud providers)
  - Financial institutions
  - Airlines
  - Railroads
  - Telecoms
  - Neocloud
- STACK does not own, operate, or control the servers within the data centers

PRIORITIES WHEN THINKING OF POWER SUPPLY

STACK INFRASTRUCTURE

Grid Reliability

- 99.999% uptime SLAs (~5.25mins of allowed downtime/year)

Just and reasonable rate design

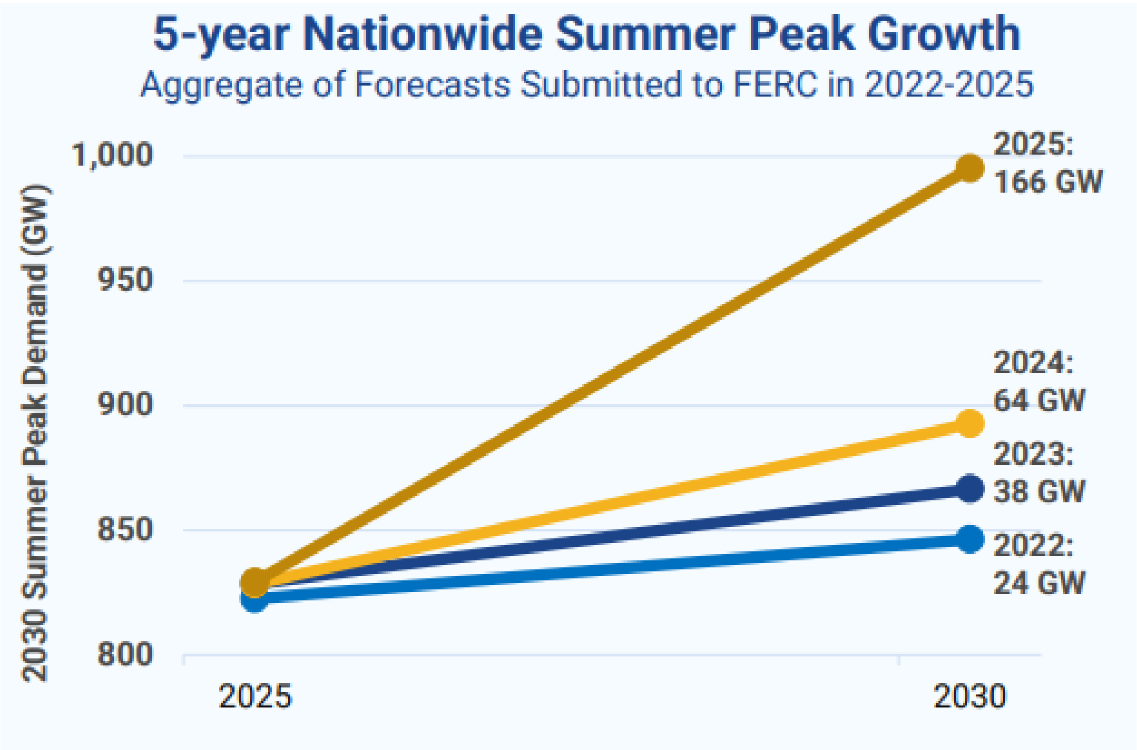
Sustainability

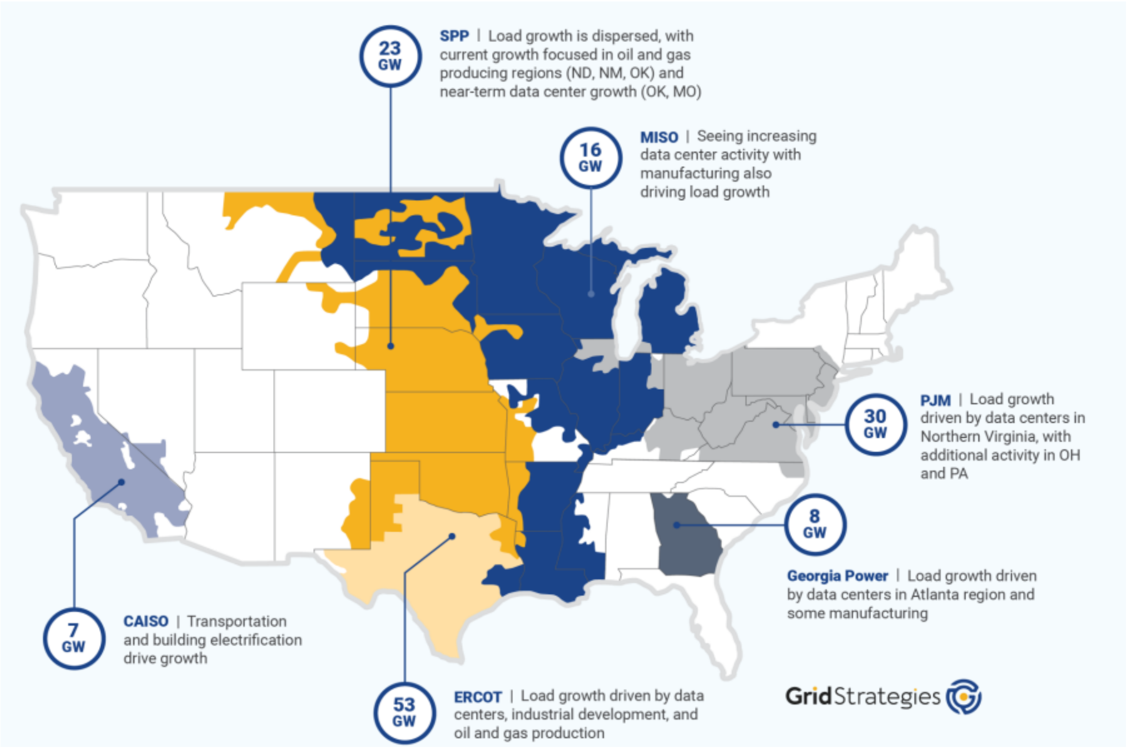
Availability of capacity for speed to market

- Generation constraints
- Transmission constraints
- Long lead equipment

GRID CAPACITY NEEDED FOR THE ECONOMY

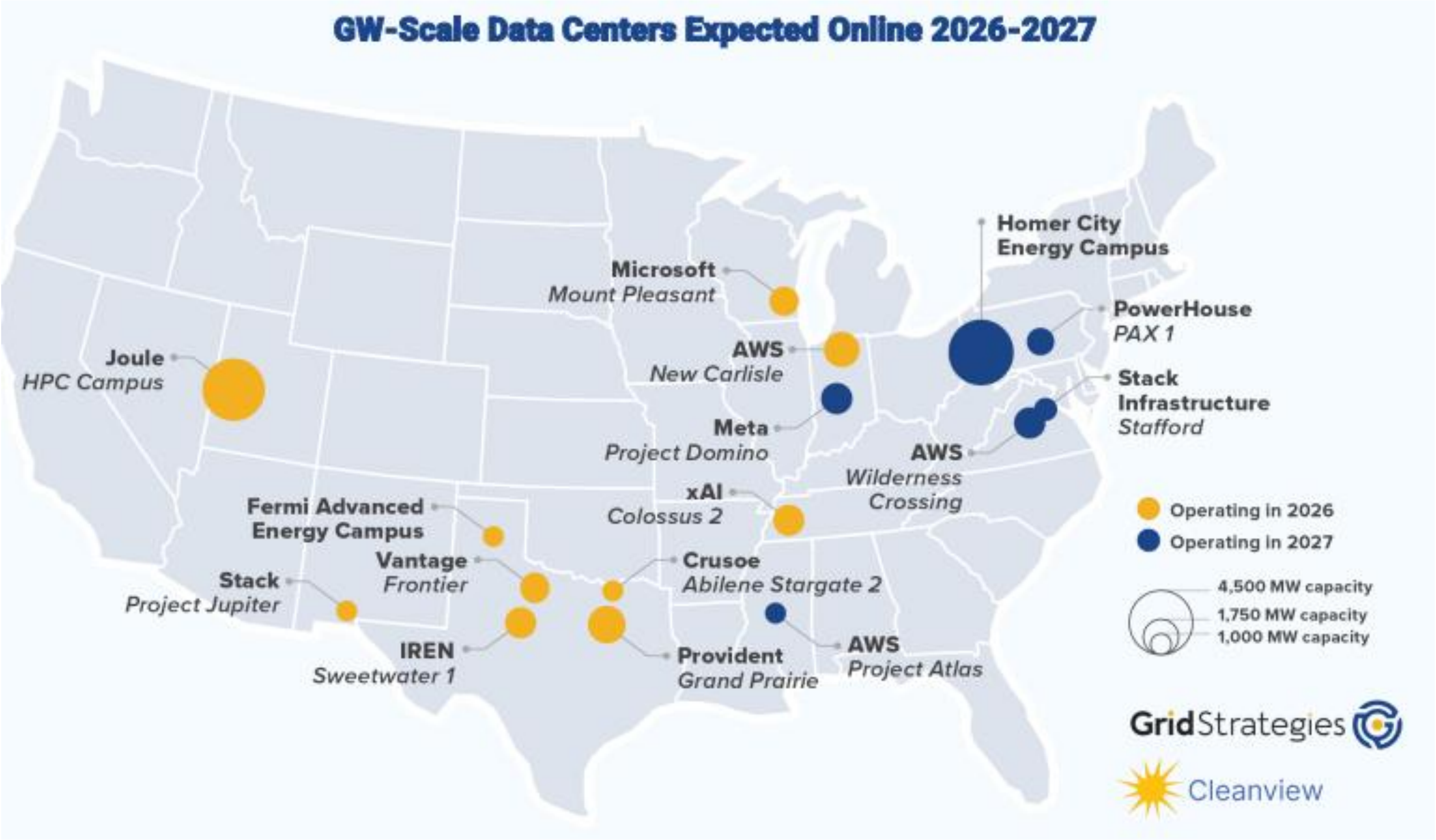
STACK INFRASTRUCTURE





Source: *Grid Strategies – Power Demand Forecast Revised up for Third Year Running, November 2025 available at https://gridstrategiesllc.com/wp-content/uploads/Grid-Strategies-National-Load-Growth-Report-2025.pdf*

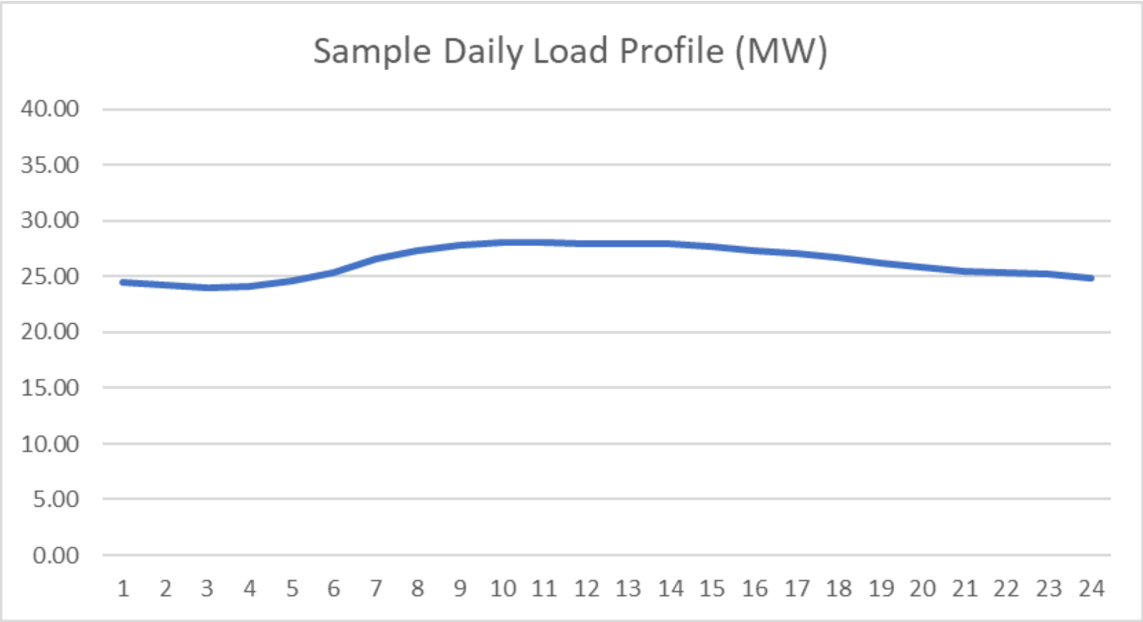
AI TRAINING FACTORIES SEEKING GW SCALE CAMPUSES



Source: Grid Strategies – Power Demand Forecast Revised up for Third Year Running, November 2025 available at https://gridstrategiesllc.com/wp-content/uploads/Grid-Strategies-National-Load-Growth-Report-2025.pdf

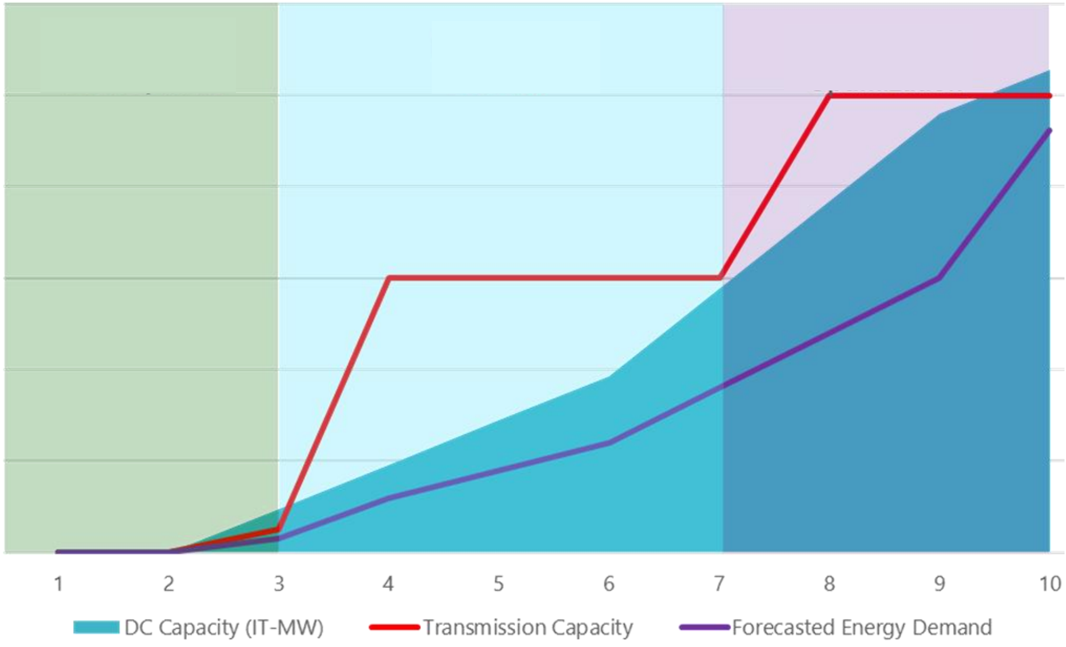
DATA CENTER LOAD PROFILE

SHORT-TERM



- Corporate cloud data center load is generally flat on a 24-hour basis
- AI training load may have unique load profile with large sub-second fluctuations

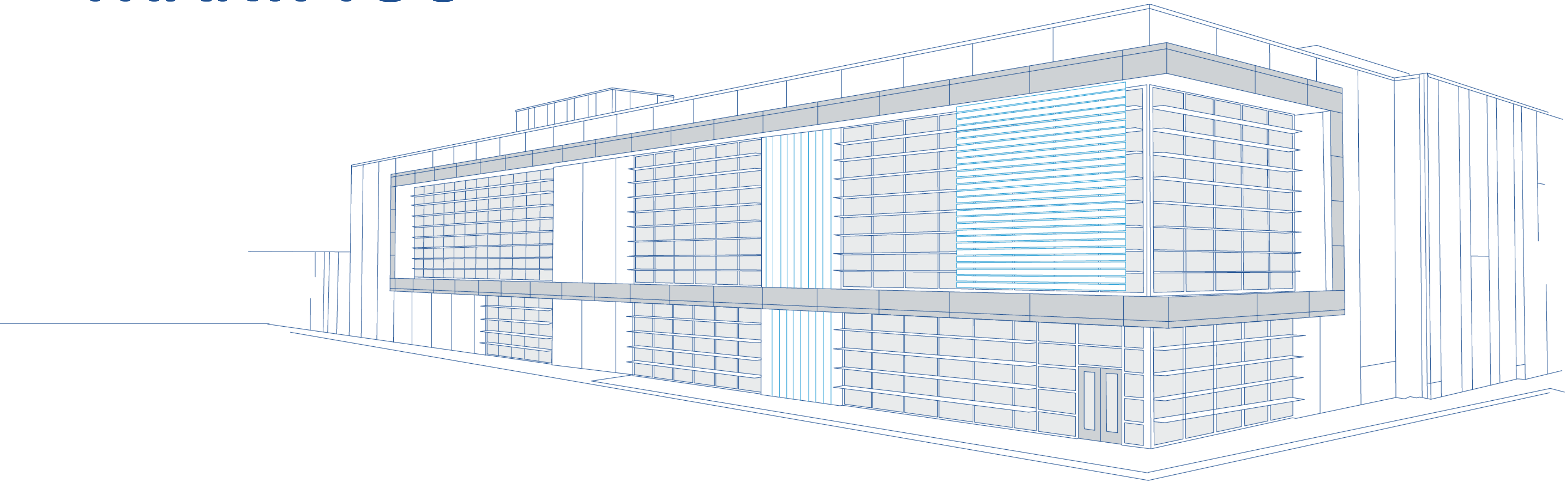
LONG-TERM



- Data Center campus load grows over time, but needs full energy infrastructure up front to support each individual data center building

Q&A

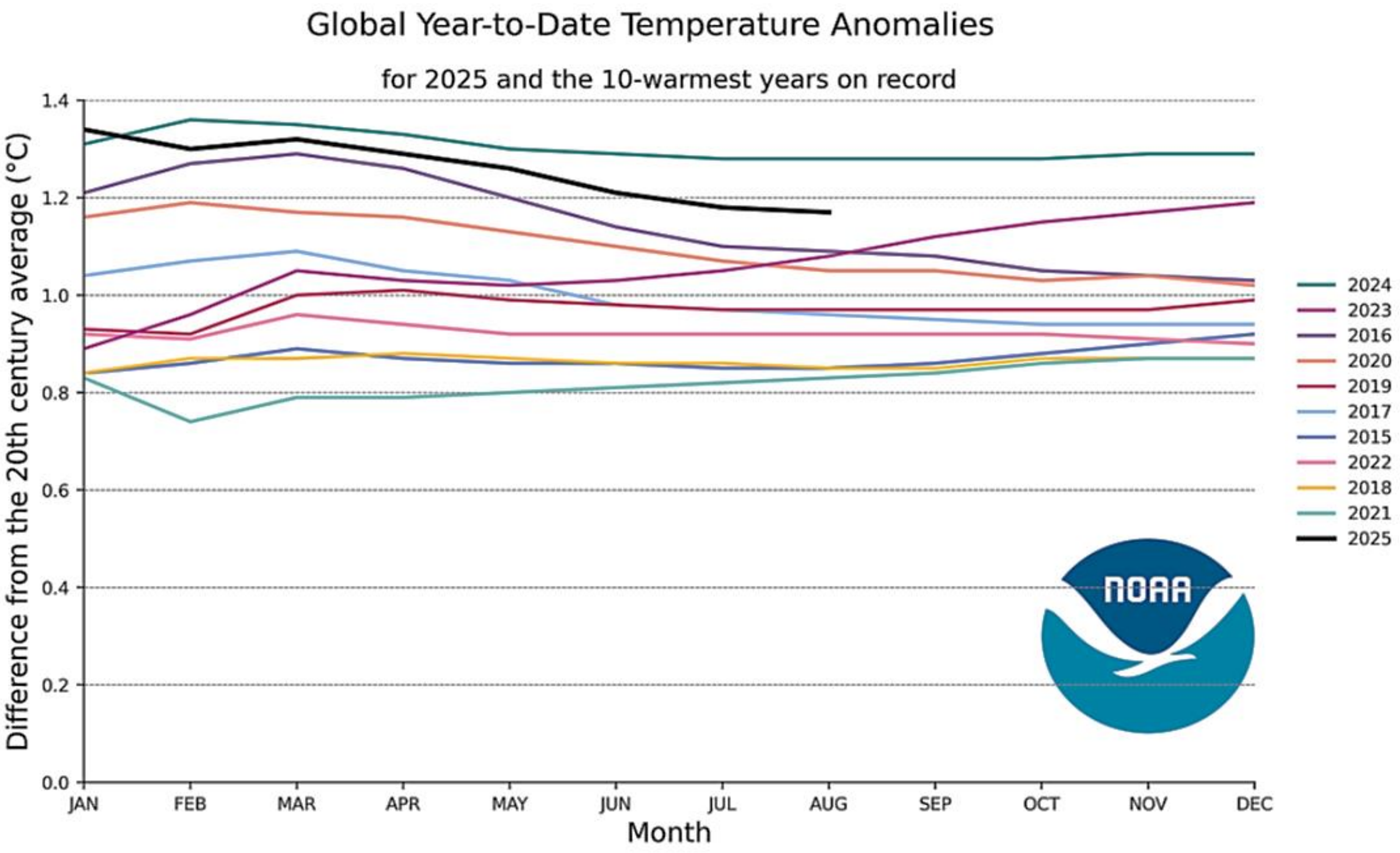
THANK YOU



Sunny Wescott

Amplifying Barometric Swings Yield Extreme Weather: Impacts to Energy Infrastructure, Staff, Security, and Supply Chain

“The 10 warmest years in the 143-year record have all occurred ***since 2015****. The 2024 January–December 2024 global surface temperature ranked warmest in the 175-year record at 1.29°C (2.32°F) above the 20th century average” (NOAA).*



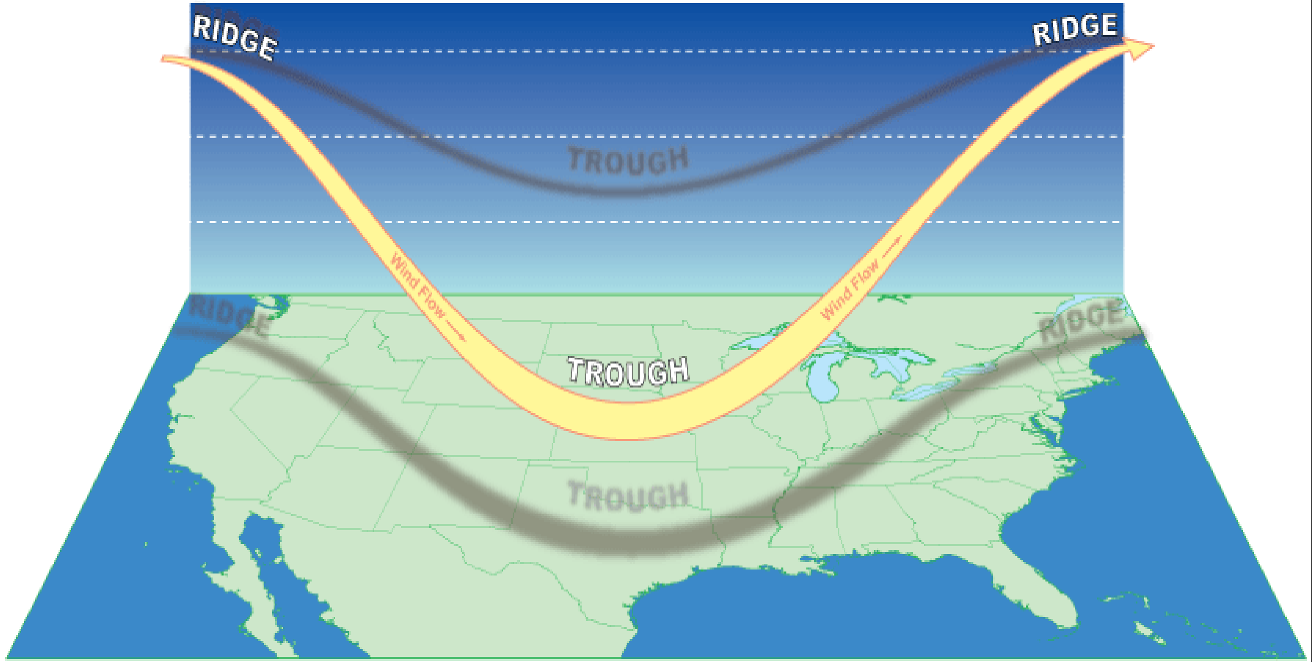
Chief Meteorologist Ms. Sunny Wescott
Critical Infrastructure and Emergency Response Operations

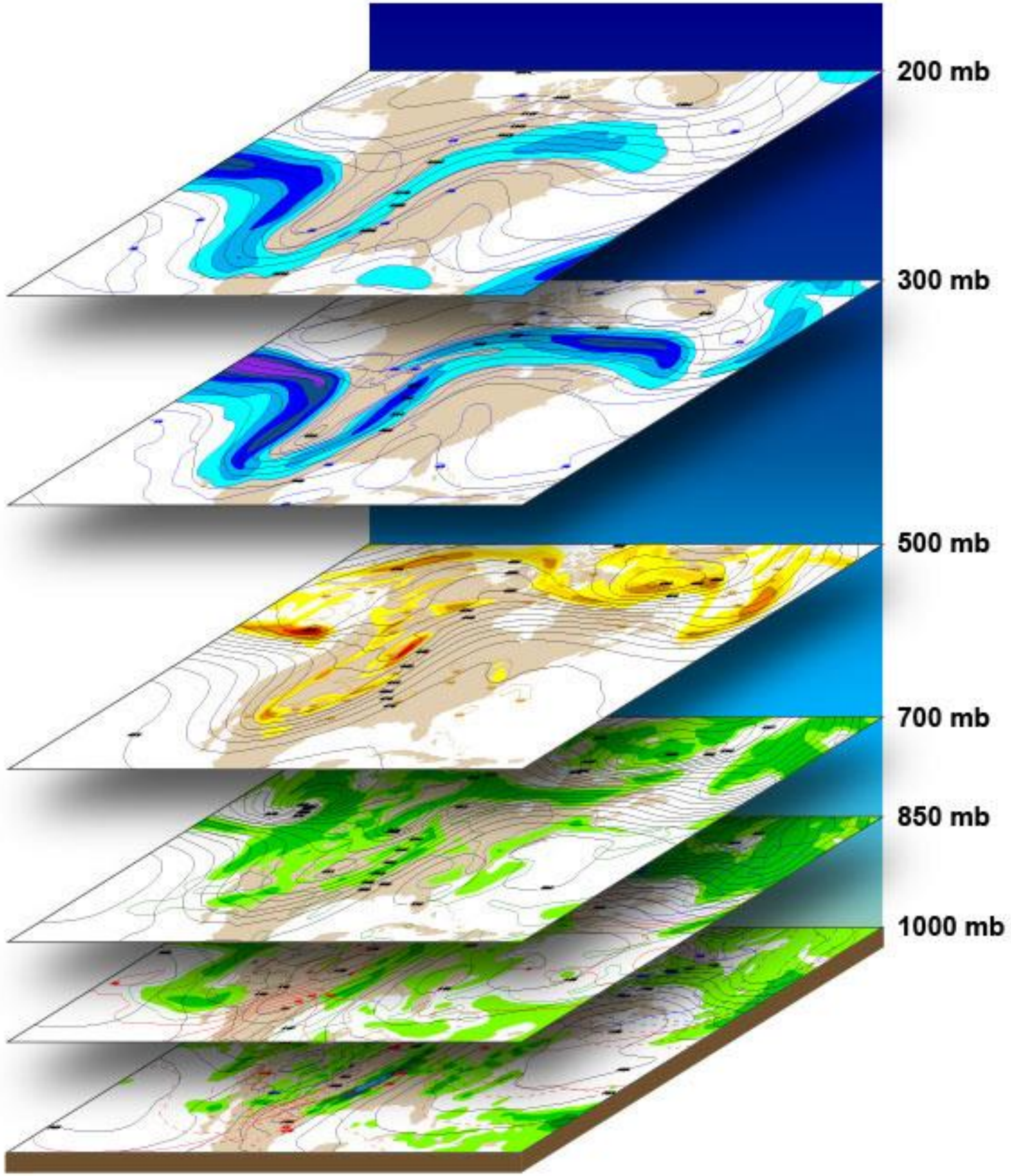
Atmospheric Pressure - Millibar 101

In essence, upper air charts show the atmosphere in three dimensions.

- Wind flowing from a ridge toward a trough is decreasing in height above the surface. Conversely, wind flowing from a trough into a ridge is increasing in height.
- Between the colder, more dense air and the warmer, less dense air is the location of the greatest change (gradient) in heights of any pressure level. (NWS Jet Stream)
- By looking at these contours, we observe patterns of higher heights (**called ridges**) and lower heights (**called troughs**). These ridges and troughs drive the weather we experience at the surface.

Atmospheric Pressure is measured with an instrument called a barometer, which is why it is also referred to as barometric pressure.





High and Low Pressures: the Carousel of Weather

A **low-pressure system** has lower pressure at its center than the areas around it. Winds blow towards the low, and the air rises in the atmosphere where they meet.

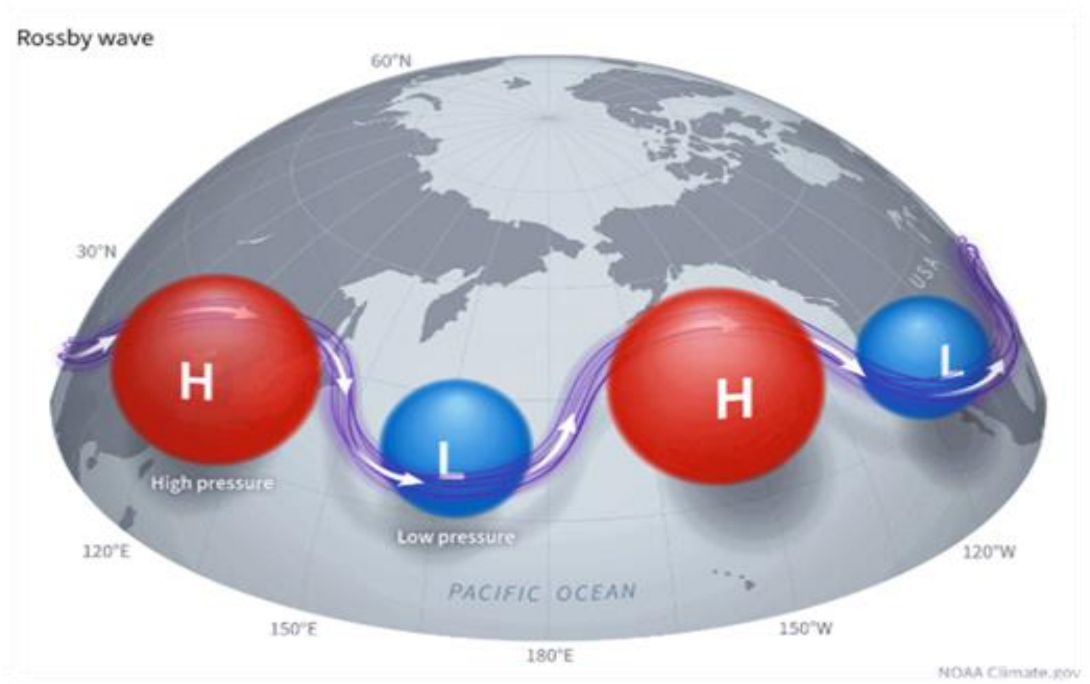
- Because of Earth's spin and the Coriolis effect, winds of a low-pressure system swirl counterclockwise north of the equator.
- As the air rises, the water vapor within it condenses, forming clouds and often precipitation.
- On weather maps, a low-pressure system is labeled with red L.

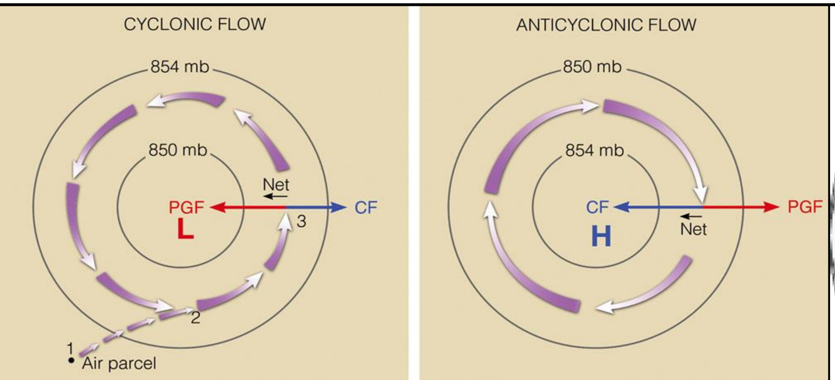
A **high-pressure system** has higher pressure at its center than the areas around it. Winds blow away from high pressure.

- Swirling in the opposite direction from a low-pressure system, the winds of a high-pressure system rotate clockwise north of the equator (anticyclonic flow).
- Air from higher in the atmosphere sinks down to fill the space left as air is blown outward. On a weather map, you may notice a blue H, denoting the location of a high-pressure system.

Air pressure depends on the temperature of the air and the density of the air molecules. Air masses differ based off their prevailing fields.

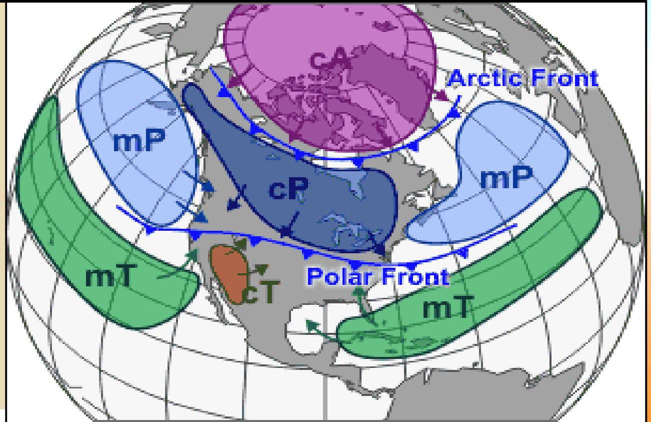
The tighter the gradient between the high and the incoming low, the stronger the winds will be as they mix down from the upper levels.

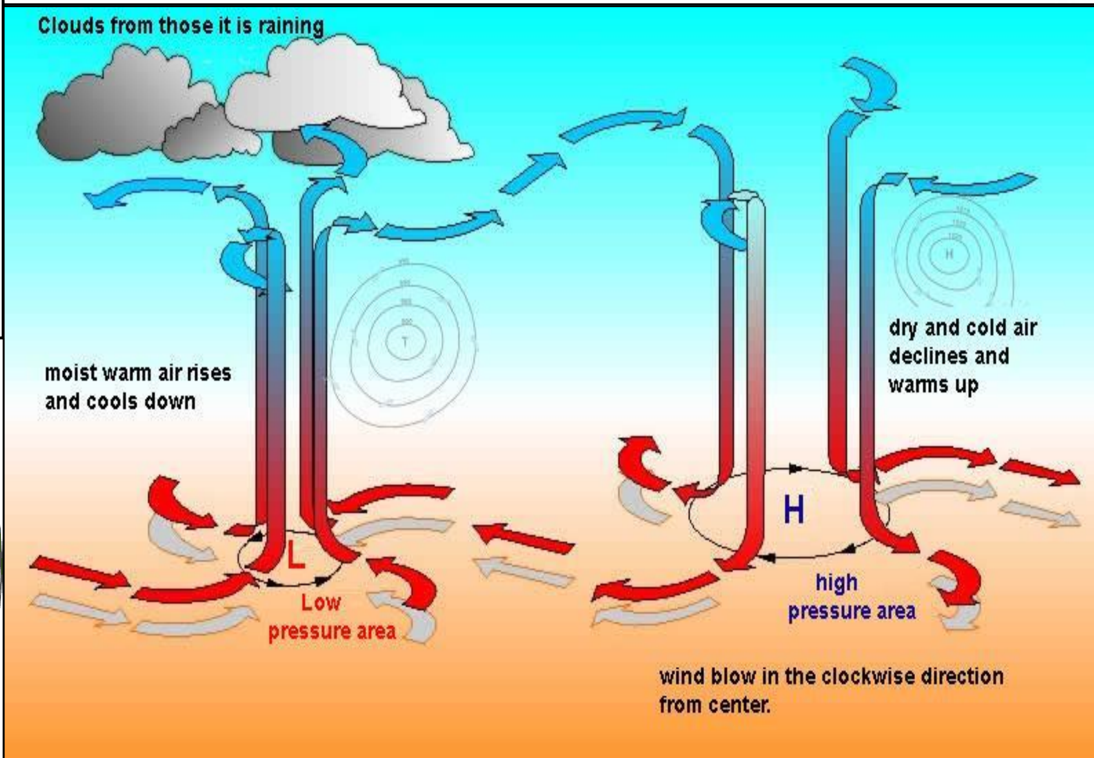




(a) Low pressure area (cyclone) aloft

(b) High pressure area (anticyclone) aloft



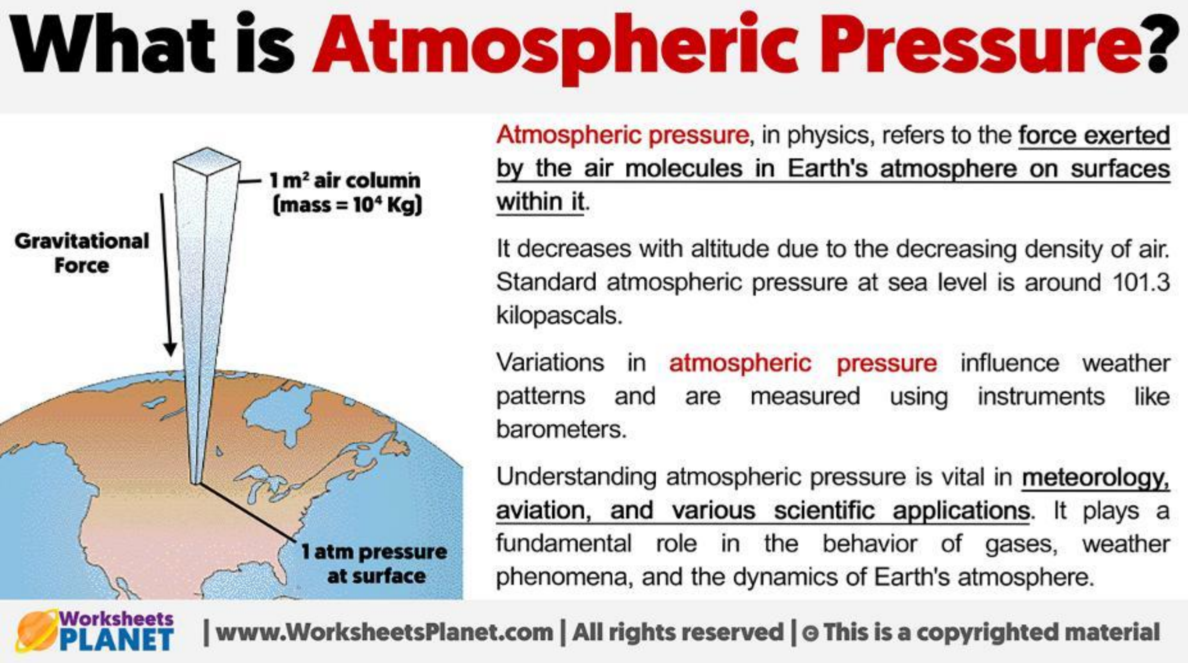


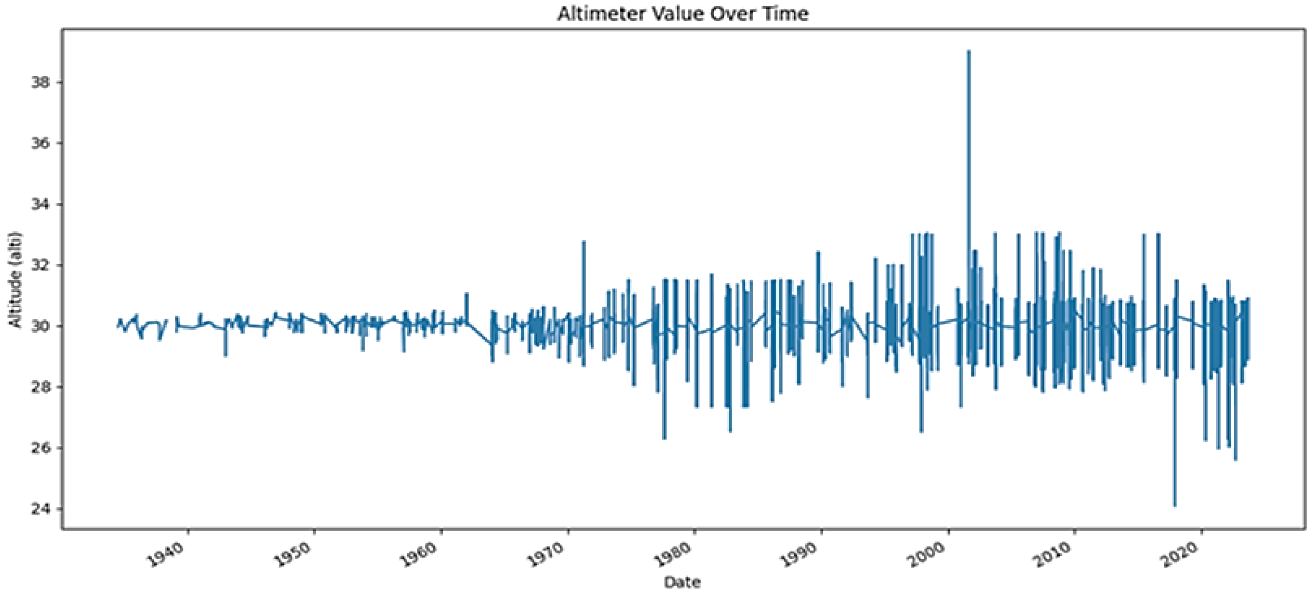
Major Pressure Swings Begin

As low pressures continue to change in depth and intensity, the high-pressure events are left to dominate for longer periods, increase coverage area, and promote significant levels of humidity and water vapor adding to trapped heat.

- The low-pressures drive global cooling winds, bring rainfall and storm events, and are responsible for all notable cloud coverage.
- High-pressures yield clear skies, heat domes, haze, stagnant air, and even the cold air damming periods.

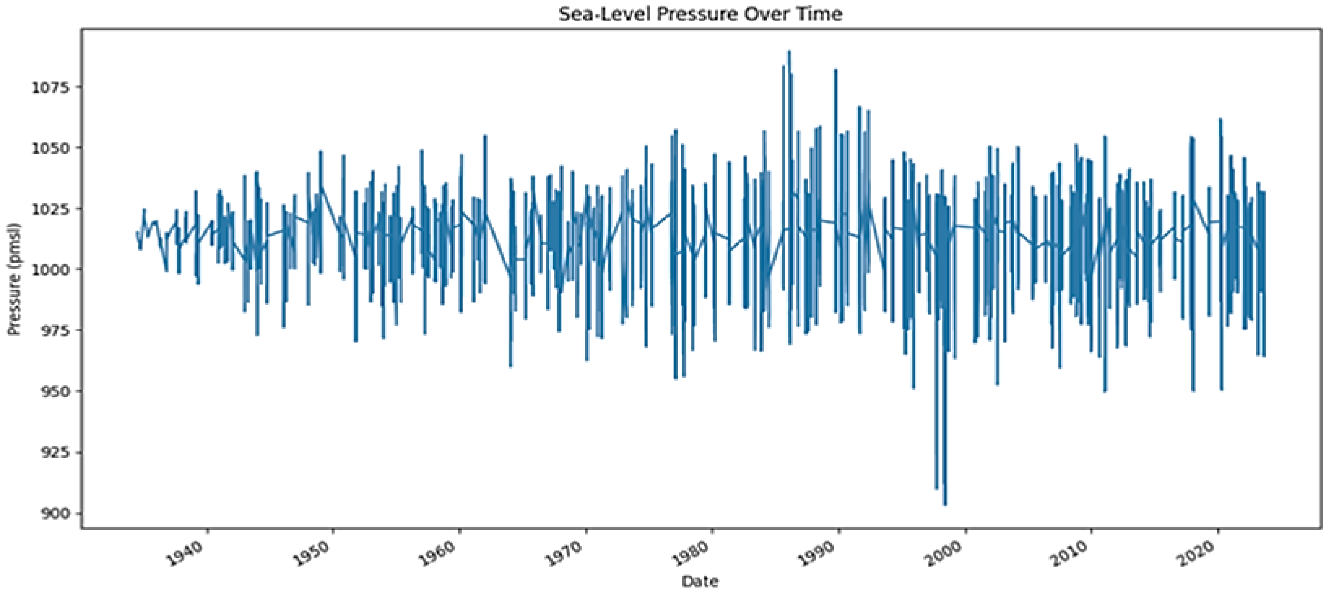
This means a change in either pressure consistency or strength brings immediate consequences for the water cycle.





ASOS Raw Data
National Overview

Generated on 2024-11-09 05:48:34.466552



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Upper-Level Winds

A recent study, in *Nature Climate Change,* suggests that the fastest upper-level jet stream winds will accelerate by about 2% for every degree Celsius (1.8° Fahrenheit) that the world warms.

- Furthermore, the fastest winds will speed up 2.5 times faster than the average wind.

The Intergovernmental Panel on Climate Change (IPCC) states that climate change will affect aggregate global windspeeds with projected average annual wind speeds dropping by 10% by 2100.

- A 2019 study found that in the preceding nine years the global average wind speed increased nearly 6%.

Extreme regional wind events such as the Santa Ana, Diablo, and Chinook, have increased in general over the last 60 years.

- Shifts in winds carrying major seasonal precipitation like Atmospheric Rivers and Monsoons are forecast to amplify while variations in frequency and timeliness emerge.

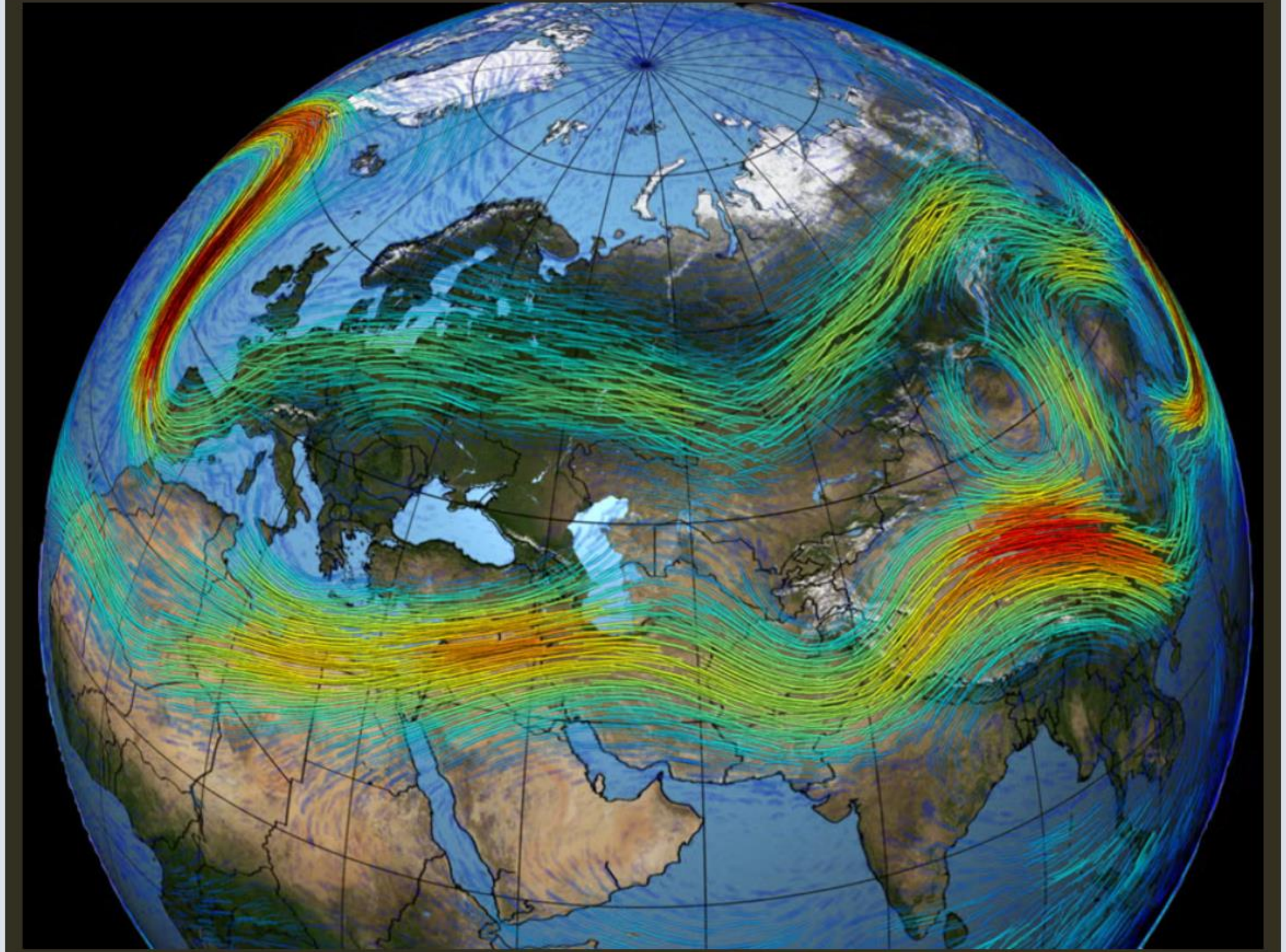
Studies over the past 45 years indicate changes to the tropopause, the top of the troposphere, and the width of the tropical belt may be shrinking, changing the overall storm pattern across the globe.

- The tropopause, has climbed about 50 to 60 meters per decade in the past 20 years.
- The troposphere is the bottom layer of Earth's atmosphere and contains most of the atmosphere's mass, clouds and weather phenomena, and is where the global population and wildlife lives.

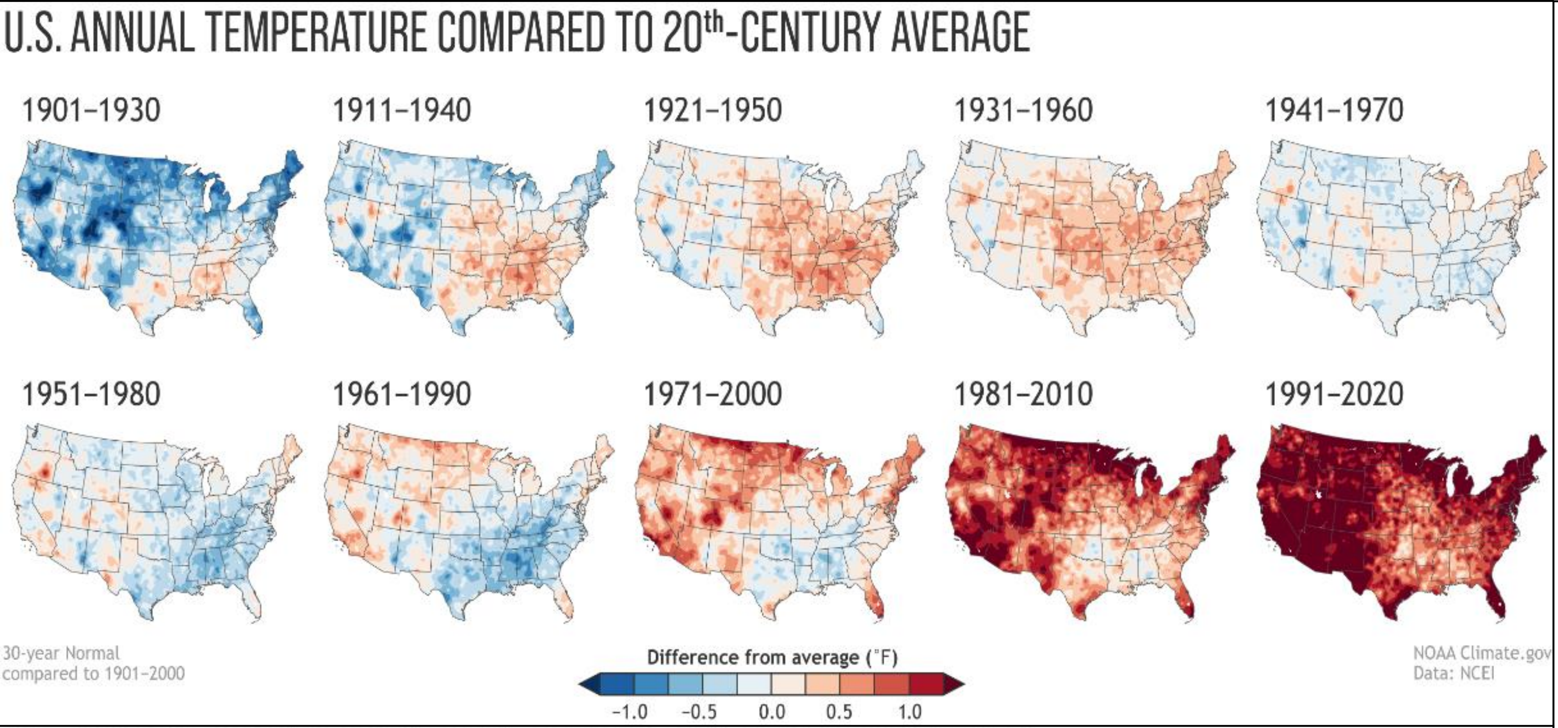
JET STREAM WINDS WILL ACCELERATE WITH WARMING CLIMATE

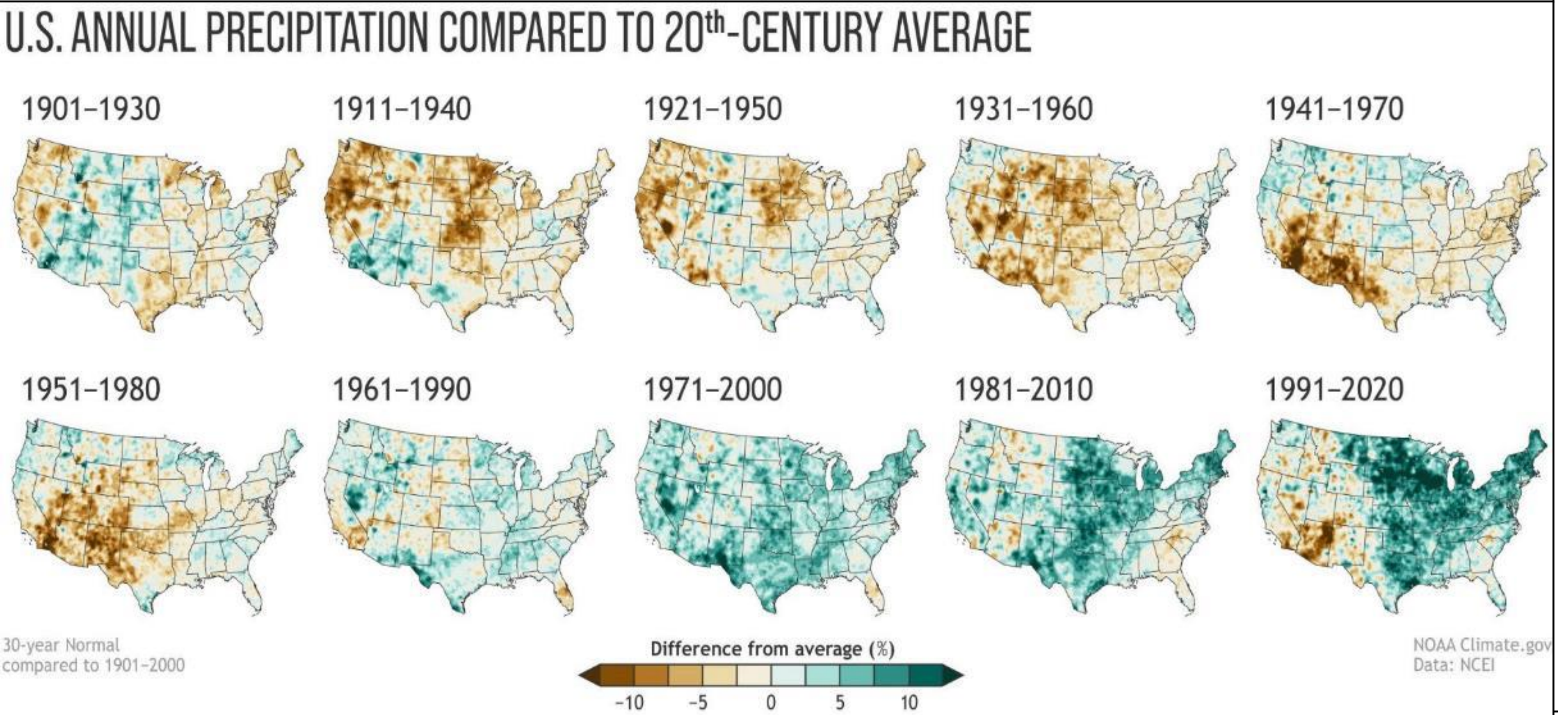
Faster winds likely to cause bumpier flights, more severe weather

DEC 6, 2023 – BY STAFF



New research shows that the fastest jet stream winds will accelerate with climate change. (Image by NASA/Goddard Space Flight Center Scientific Visualization Studio.)





By 2050, about 63% of the US may be forced to endure temperatures over 100°F. Areas where triple-digit temperatures are seasonal already, will see baseline temperatures and frequency of high heat events increase.

As average temperatures at the Earth's surface rise, **more evaporation occurs**, which increases overall precipitation. For every 1.8°F of warming, the atmosphere can hold about 7% more moisture.

- Warmer air holds more water because the water vapor molecules it contains move faster than those in colder air making them less likely to condense back to liquid.
- Sea surface temperatures have risen by 0.5–0.6°C since the 1950s, and over the oceans this has led to 4% more atmospheric water vapor since the 1970s.
- As water vapor condenses to form rain it produces heat, brings warm air down and causing friction on impact, heating the surface.

As temperatures increase, short-burst heavy rainfall events will increase. The air is on average warmer and moister than it was prior to 1970, leading to a 5-10% effect on precipitation and storms causing extreme downpours.

Extreme Weather Impacts Economic Stability

On June 24, temperatures near or above 100°F covered most of the Interstate 95 corridor from Washington, D.C., to Portland, Maine. Many state June high temperature records were set on June 24, 2025, and several all-time (any-day) records were set or tied on June 23-24.

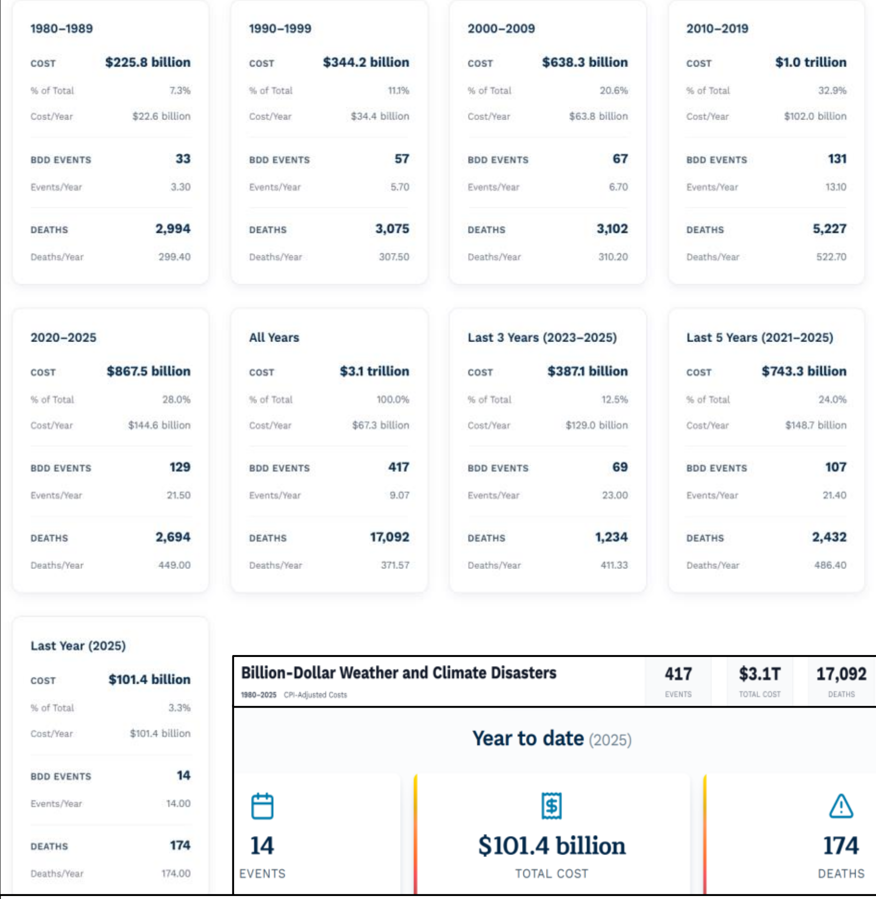
Lightning strikes last summer caused 60 datacenters in Virginia to drop off the grid due to an arrestor trigger, a similar issue repeated in January 2025 for Brazil in January when a datacenter was struck by lightning and taken offline.

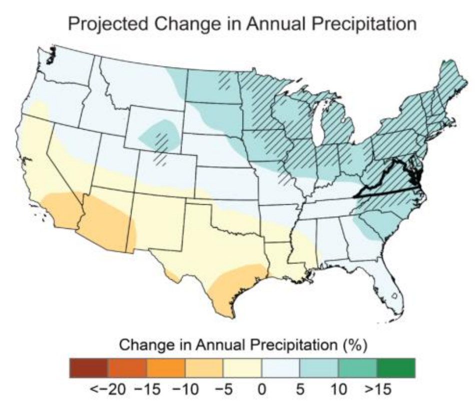
January-June 2025: The US reported 14-billion-dollar severe weather disasters (tornadoes, hail, wind, and flash flooding: severe thunderstorms); two others cost over $900 million and are pending their final tallies.

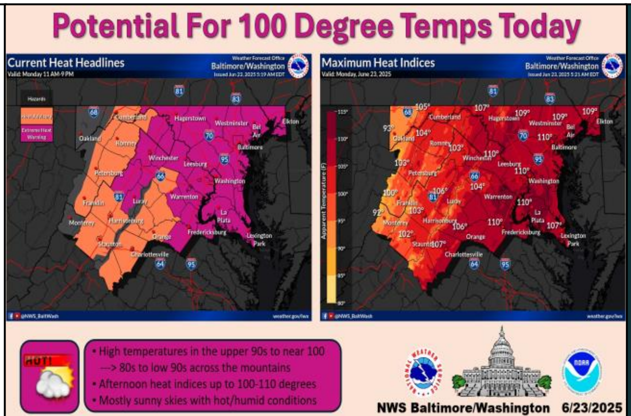
- The third most expensive weather disaster **globally** of 2025 was a March 13-16 severe weather outbreak in the US that cost $9.5 billion.

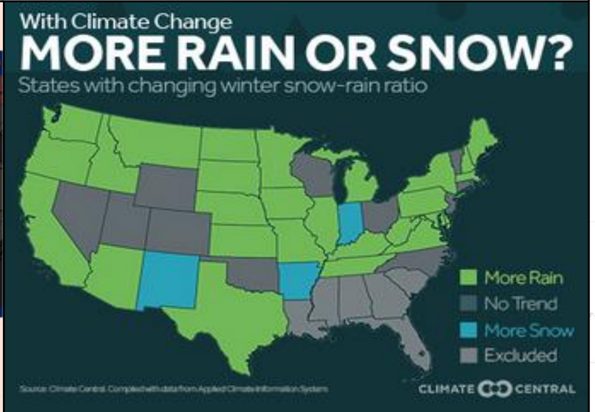
The 2025 Jan-June economic losses from severe thunderstorms are the 4th-costliest on record, behind 2024 ($62 billion), 2023 ($61 billion), and 2011 ($50 billion).

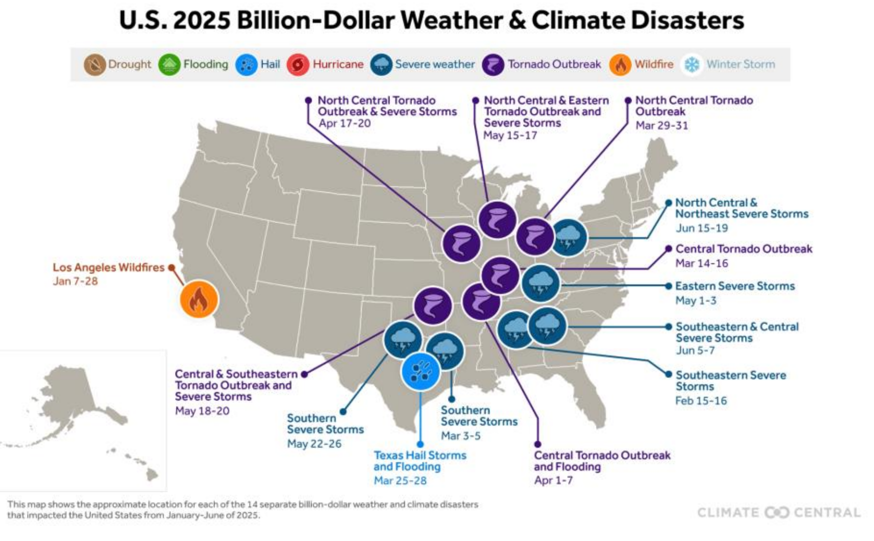
- Over 2.6 million acres have burned through mid-July, as +40K fire incidents, the most on record in the past decade.
    - The U.S. has also suffered over $1 billion in drought costs so far in 2025.











Warming Fall – Threats to Energy and Ecology

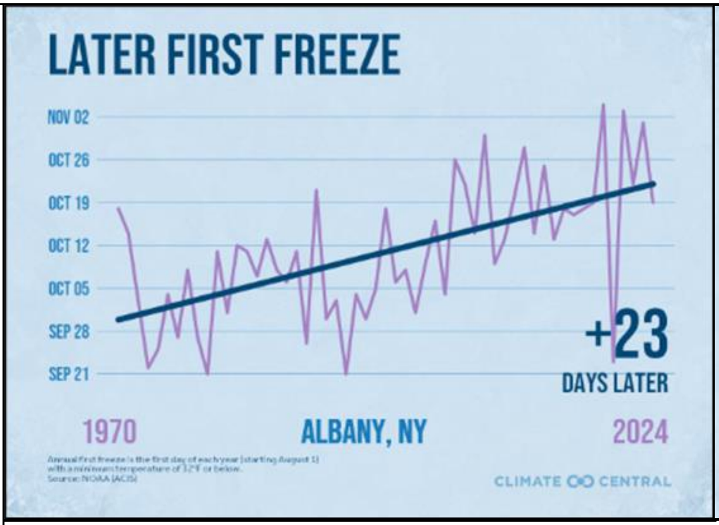
September 1st is the start of meteorological fall. The season has warmed in every county across the contiguous U.S. since 1970 and is warming fastest in the Southwest.

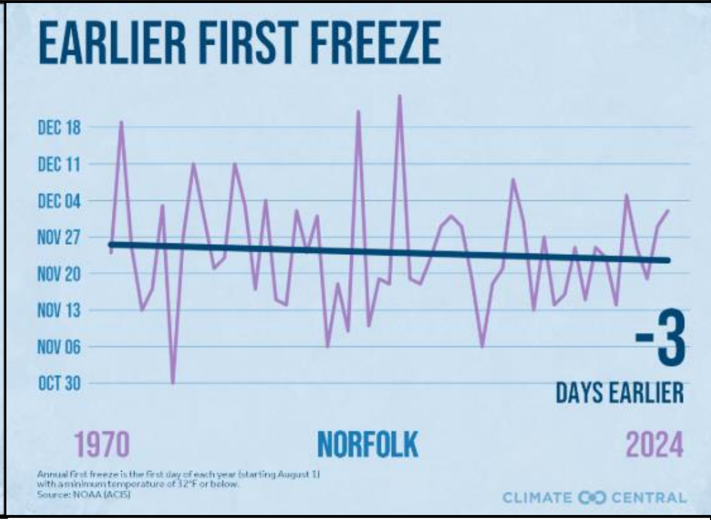
Fall has warmed in 237 US cities by 2.8°F on average from 1970 to 2024.

- Unusually warm fall days now happen more often in 238 cities, or 98% of the 243 cities analyzed.
- 103 (42%) of those locations have warmed by 3°F or more since 1970.

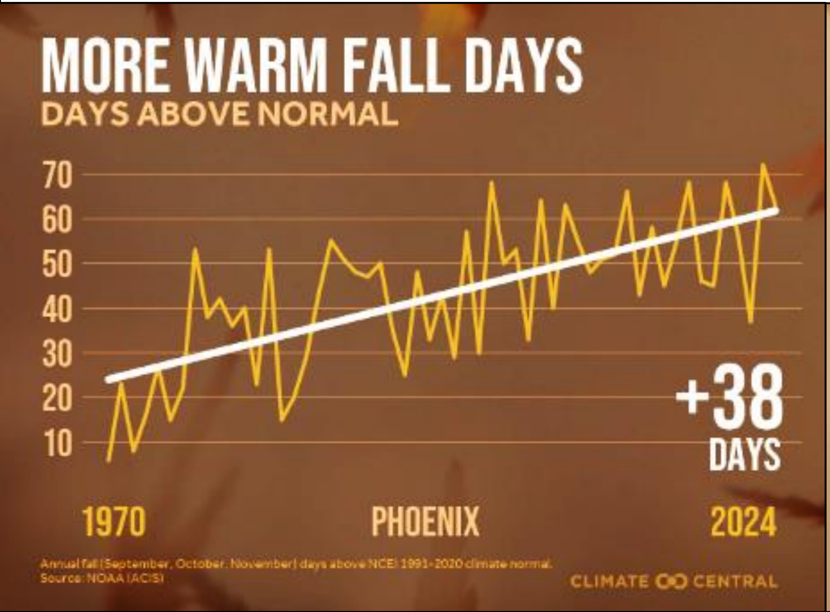
A warmer fall season means that the risky heat, high cooling demand, wildfires, and allergies of summer linger later into the year affecting health, ecosystems, and the economy.

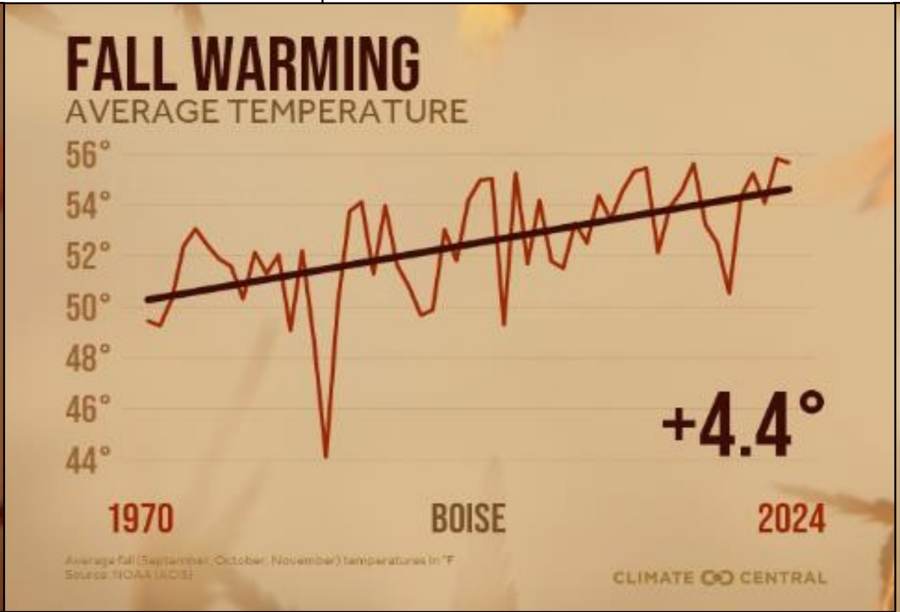
- Top five fall warming locations: Reno, NV (7.7°F); El Paso, TX (6.5°F); Las Vegas, NV (6.2°F); Tyler, TX (5.8°F); and Tucson, AZ(5.8°F).
- Almost half of the cities analyzed (119, or 49%) now experience at least two more weeks' worth of above-normal fall days than in 1970. Over the last 10 years, back-to-school cooling demand increased by about 34%

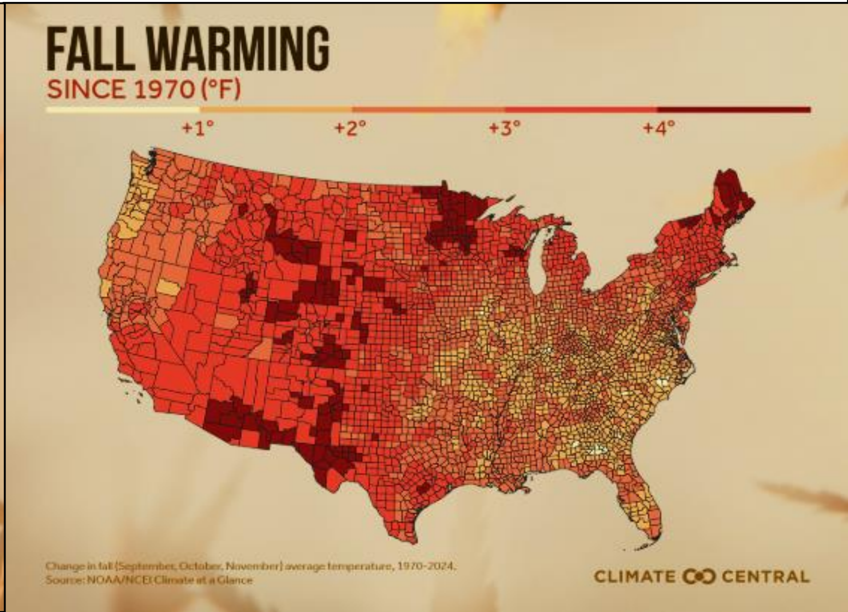




The first freeze now arrives later in 88% (179) of cities analyzed: 12 days later, on average, than in the early 1970s. A later freeze can worsen allergies, change migration, lengthen pest seasons, and reduce summer fruit yields and lead to more heat-driven drought and water stress. Ice cover on the Great Lakes has been consistently reducing, declining by ~25% from 1973 to 2023.







Changing Spring Conditions

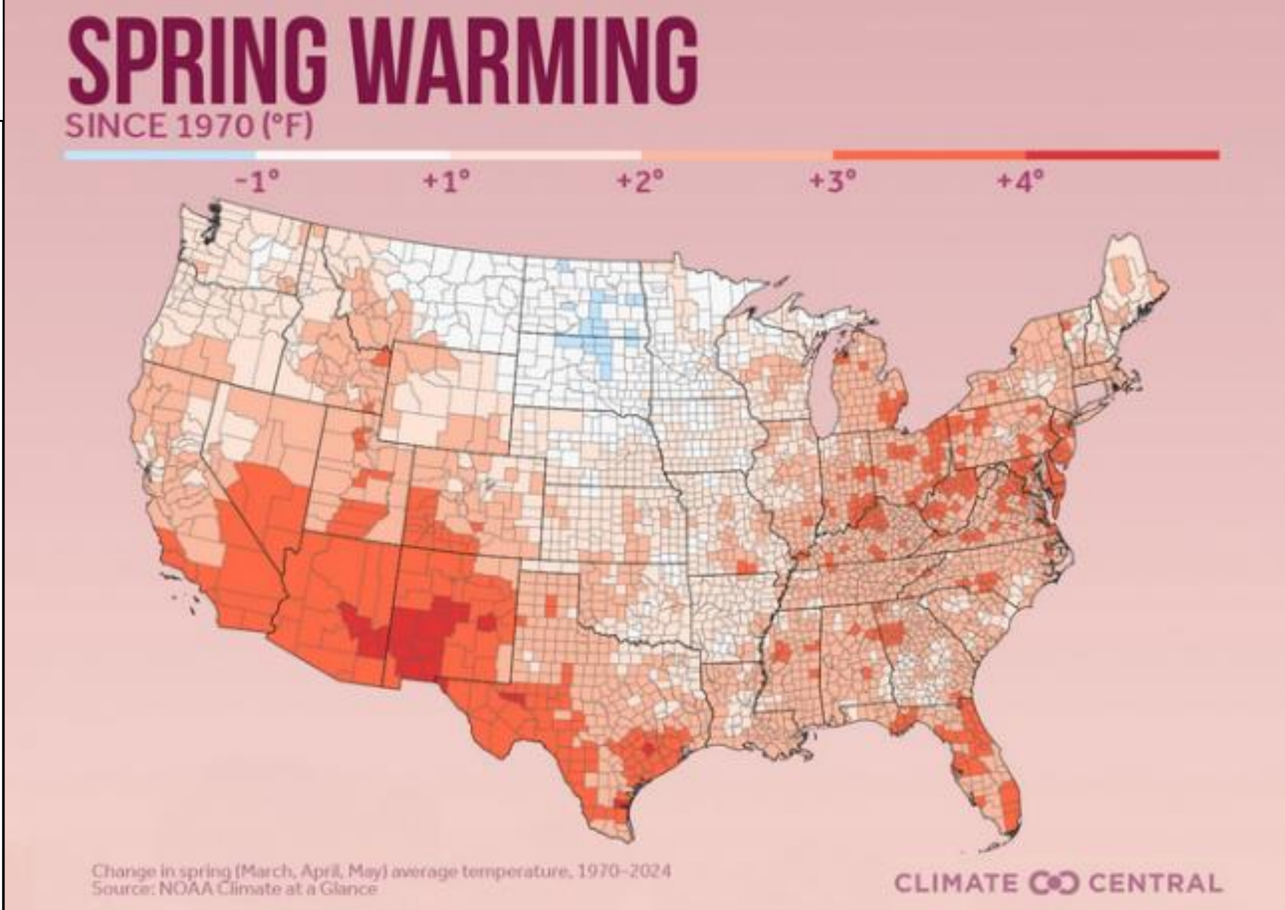
The spring season has warmed in 234 (97%) of the 241 U.S. cities analyzed — by 2.4°F on average.

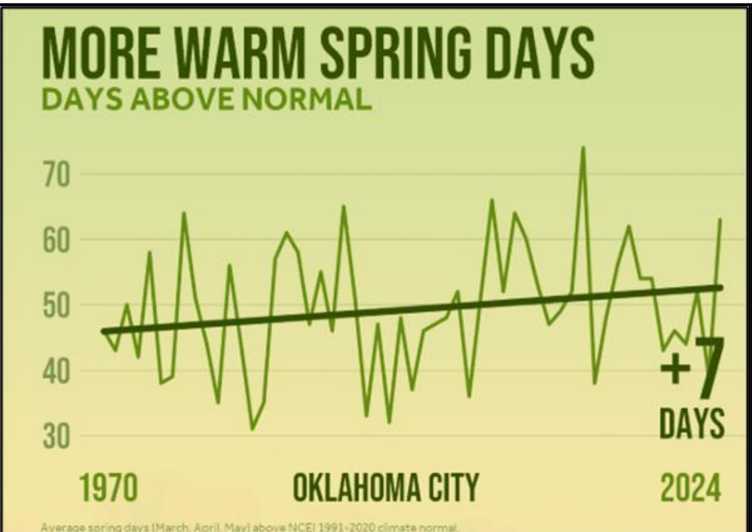
- Unusually warm spring days now happen more often. Four out of every five cities now experience at least one more week of warmer-than-normal spring days than in the 1970s.
- Spring has warmed the most across the southern tier of the country, particularly in the Southwest.
- Spring warming can prolong seasonal allergies, worsen wildfire risk, and limit snow-fed water supplies.

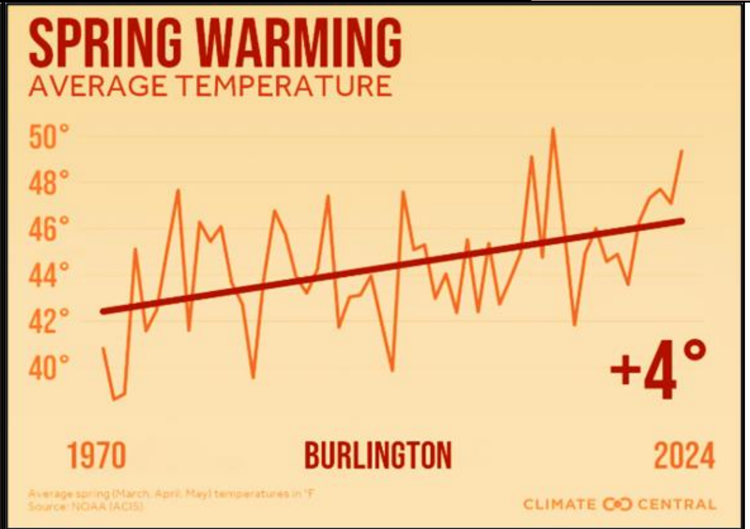
Spring warmed the most, on average, in locations across the southern tier of the country: Southwest (3.4°F), South (2.7°F), Southeast (2.5°F), and Ohio Valley (2.5°F).

- Most locations (80%, or 194) now experience at least seven additional warmer-than-normal spring days than they did in the early 1970s.

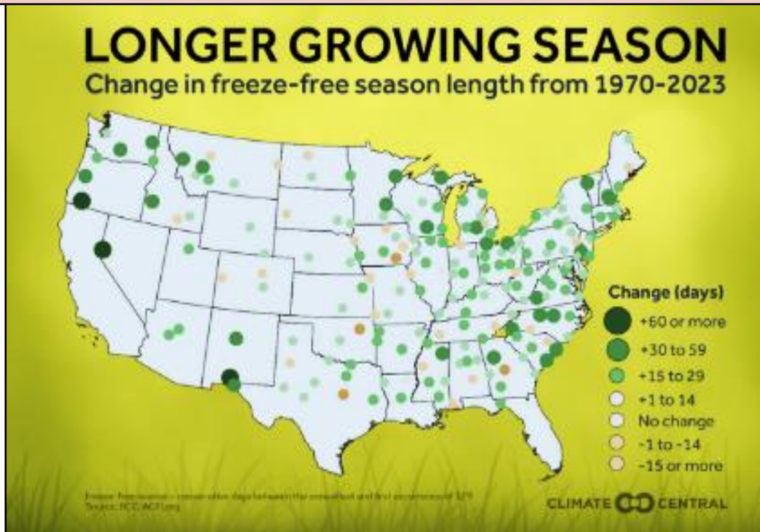
Warmer, shorter winters mean an [earlier spring thaw and later fall freeze].







Warmer spring temperatures result in earlier thaws, heavier spring rainfall, longer growing seasons, double blooms, river system changes, marine and wildlife shifts, and changes to energy needs.

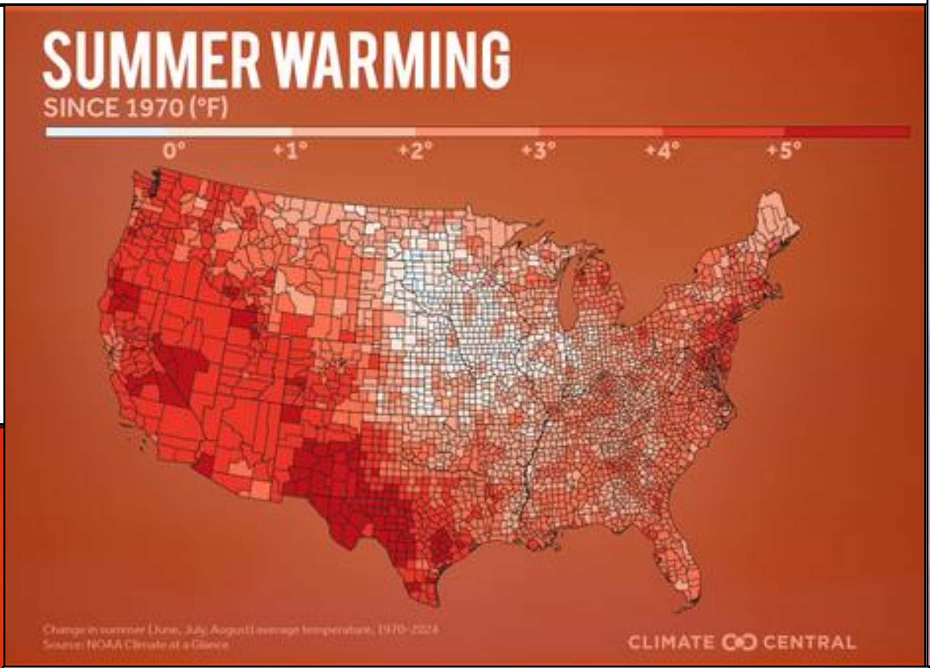


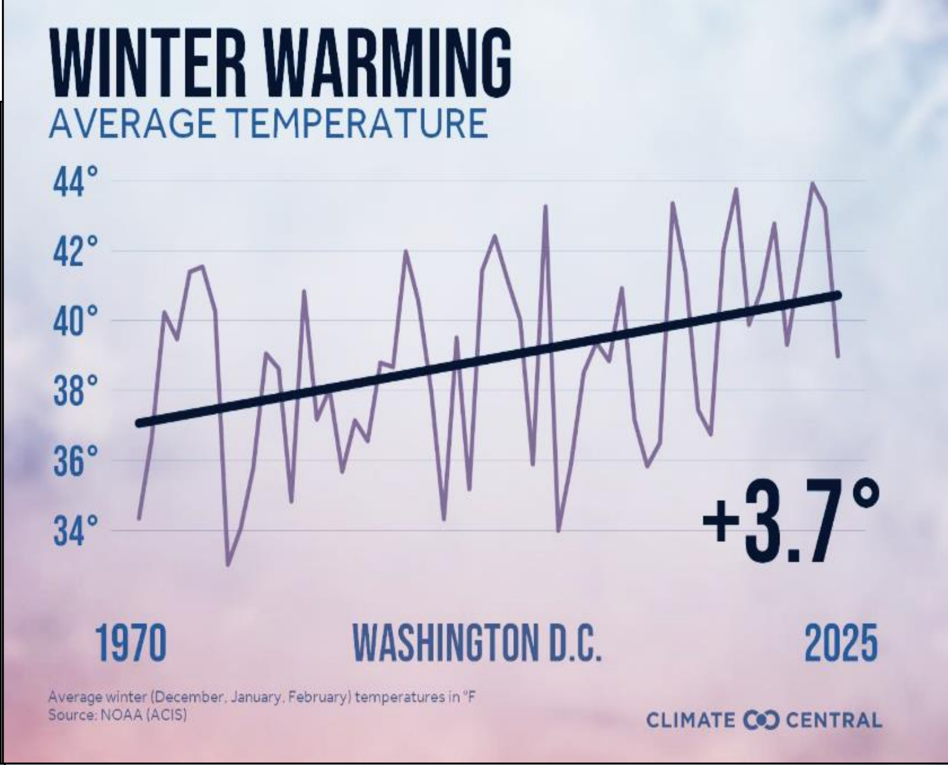
Climate Central’s Warming Seasons Graphics

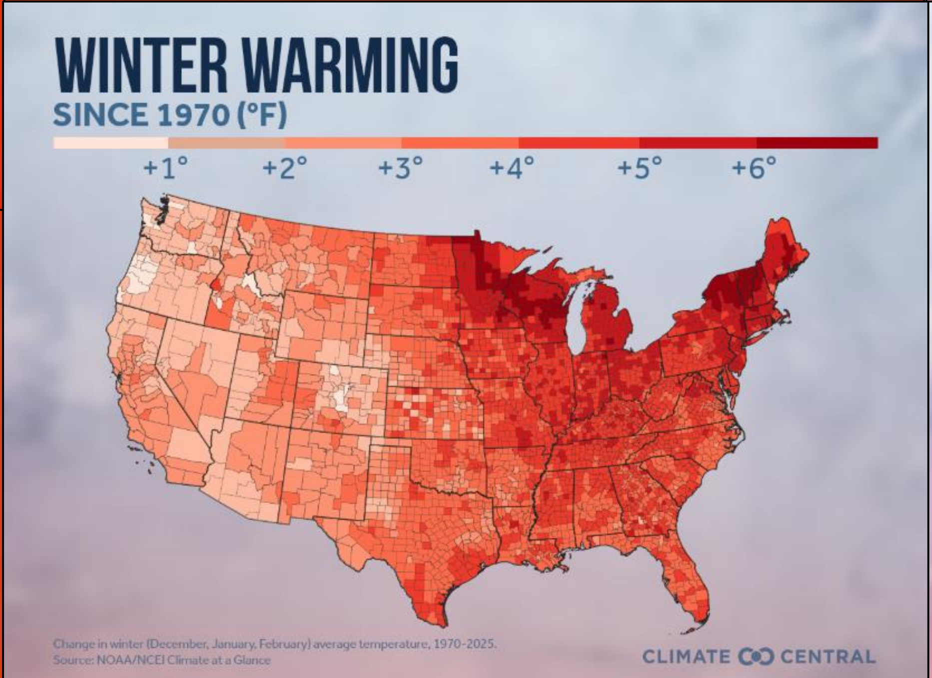
Winters have warmed by 4°F on average across 235 US cities since 1970. Warmer, shorter winters have lingering effects on health, water supplies, and agriculture throughout the year.

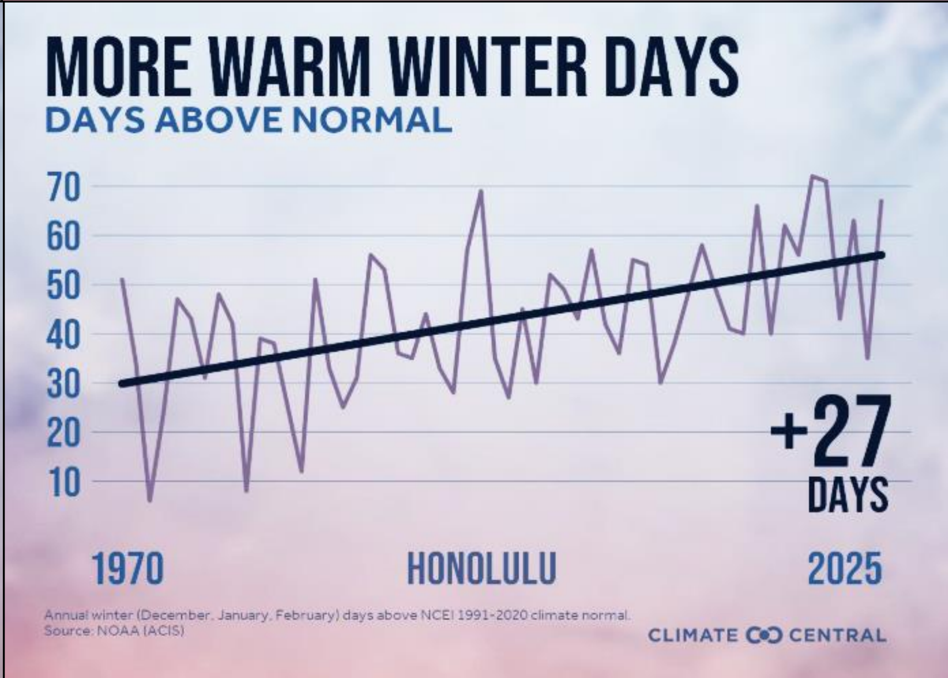
Summers are heating up in 234 of major US cities by an average of 2.6°F since 1970.

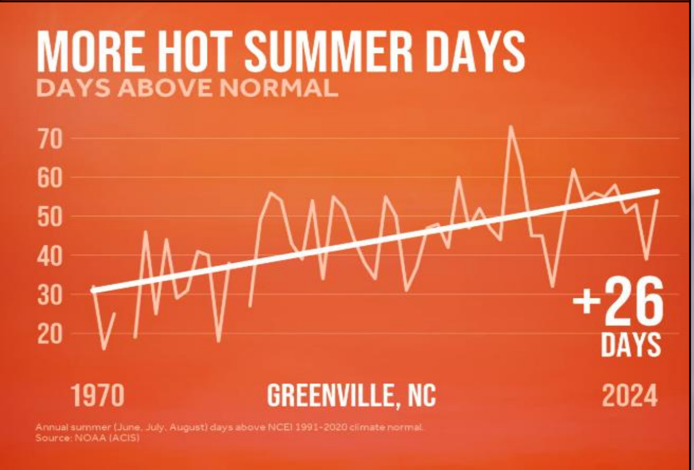
Analysis also shows persisting warmer-than-normal summer nights since 1970 in 246 major US cities.



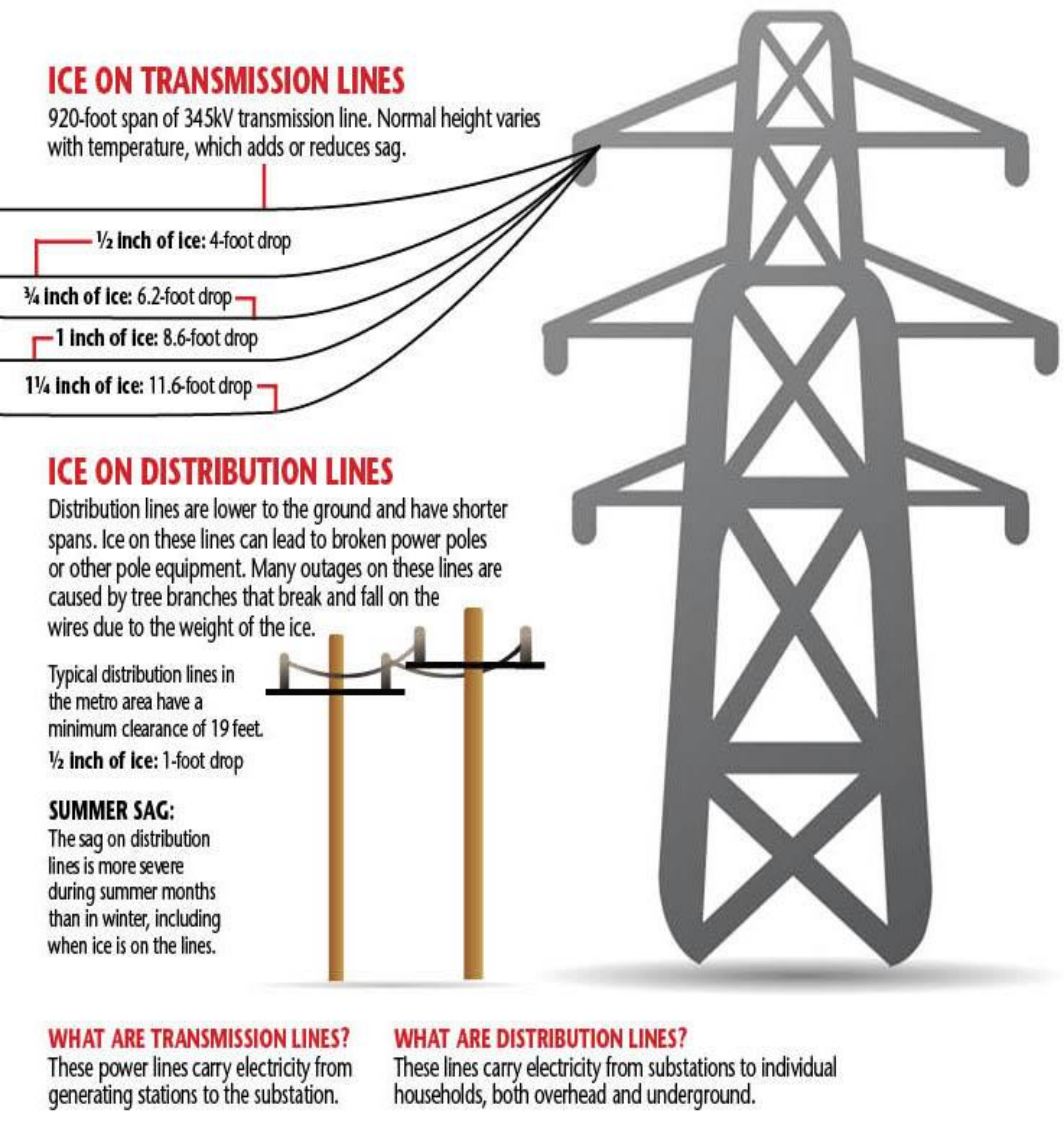


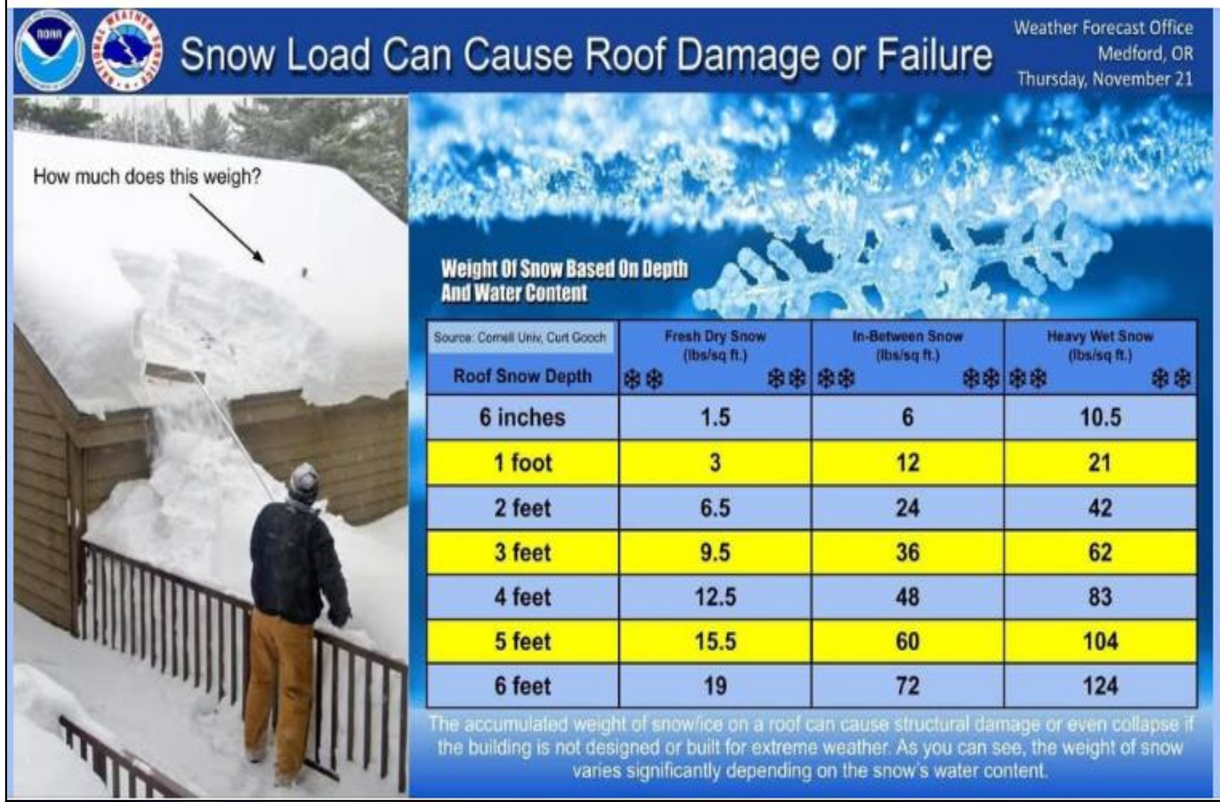




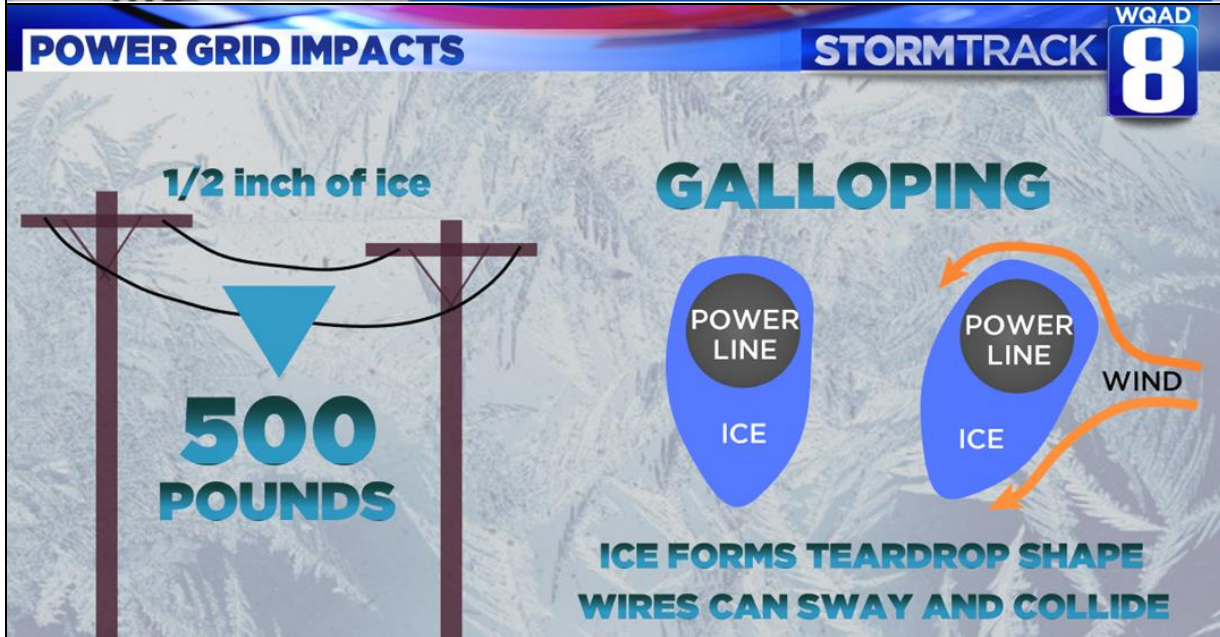


Created by DHS CISA Chief Meteorologist: Sunny Wescott



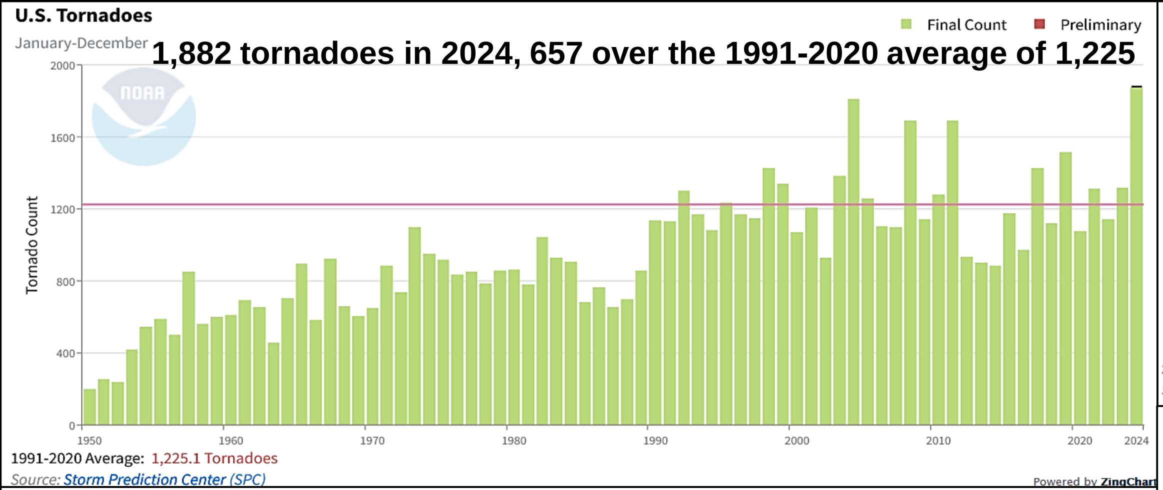


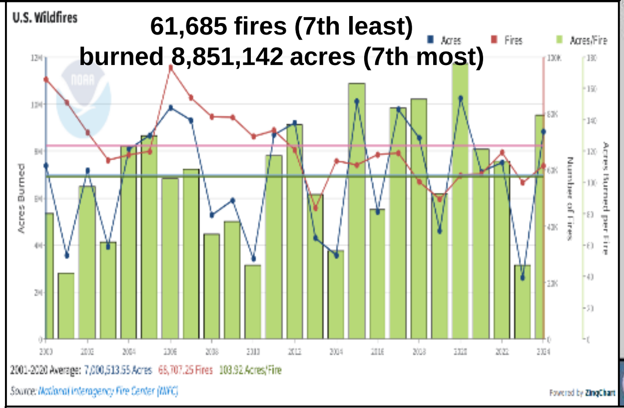
Source: Cornell Univ, Curt Gooch Roof Snow Depth	Fresh Dry Snow (lbs/sq ft.)	In-Between Snow (lbs/sq ft.)	Heavy Wet Snow (lbs/sq ft.)
6 inches	1.5	6	10.5
1 foot	3	12	21
2 feet	6.5	24	42
3 feet	9.5	36	62
4 feet	12.5	48	83
5 feet	15.5	60	104
6 feet	19	72	124

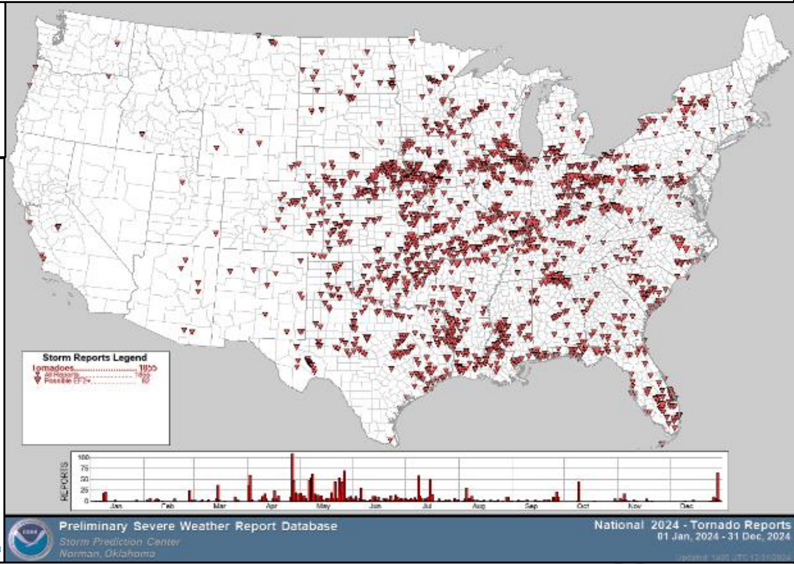


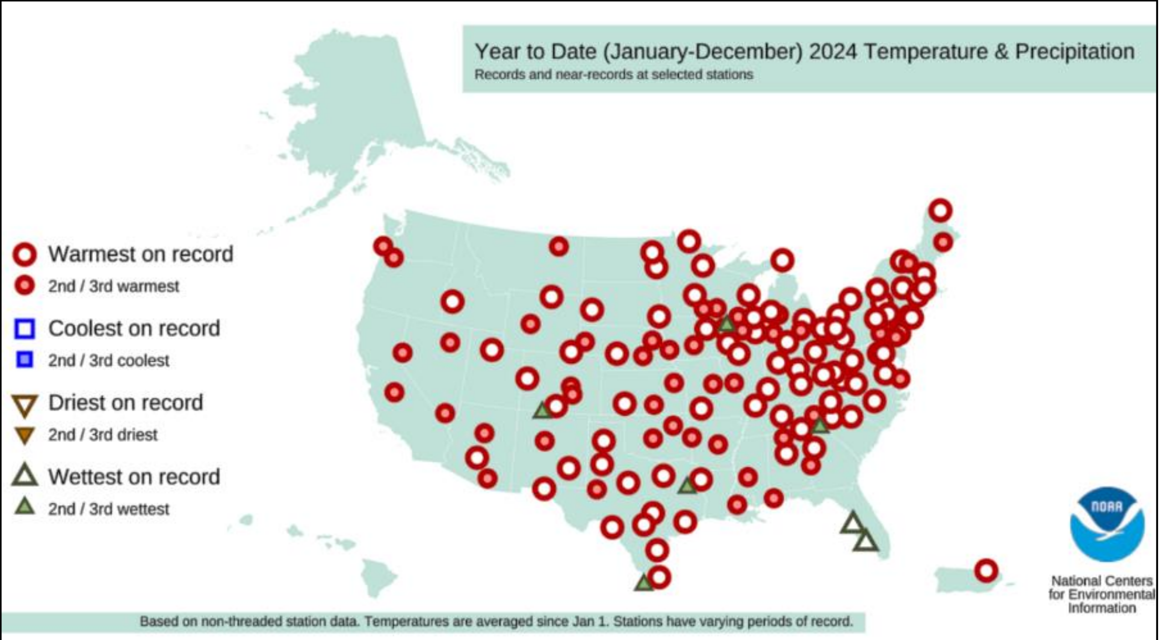
National Temperature Swings Yield Extremes

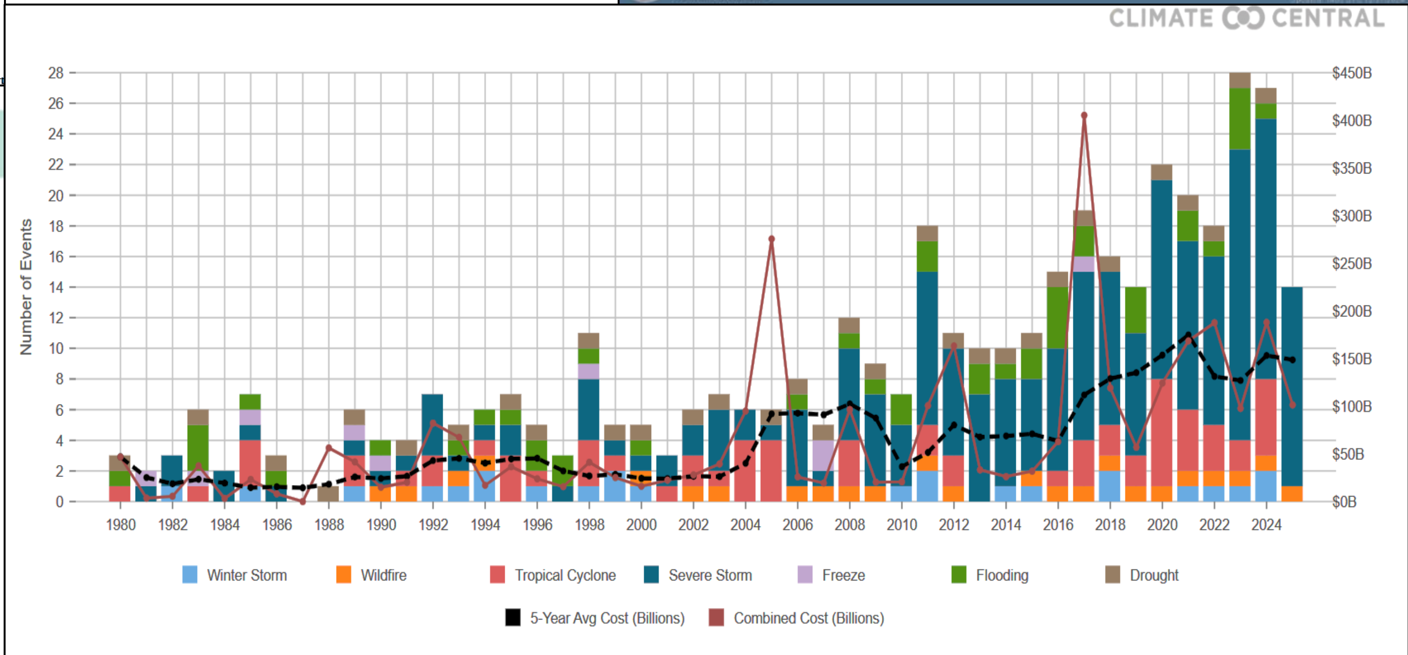
In 2024, there were 27 confirmed weather/climate disaster events with losses exceeding $1 billion each to affect US following the 2023 record 28 billion-dollar events. The total cost from 2024 was $182.7 billion via *17 severe storms, 5 Tropical Cyclones, 1 wildfire, 1 drought/heat event, and 2 winter weather events.*







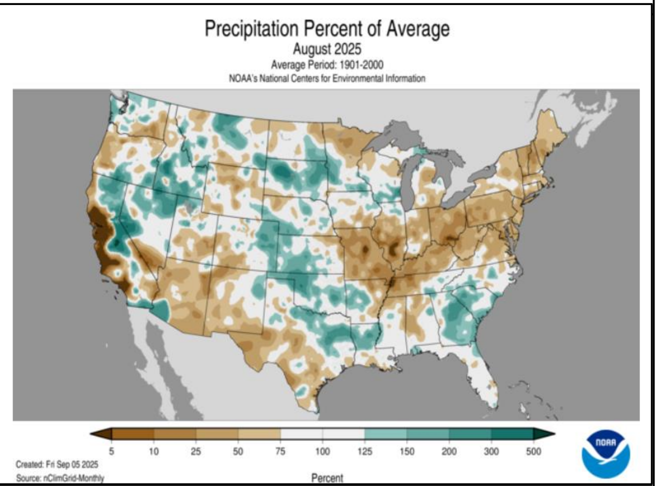


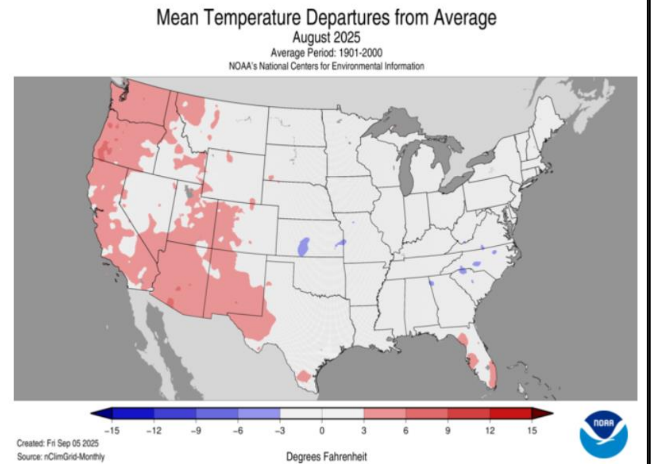


The history of billion-dollar disasters in the United States each year from 1980 to 2025, showing event type (colors), frequency (left-hand vertical axis), and cost (right-hand vertical axis) adjusted for inflation to 2025 dollars.

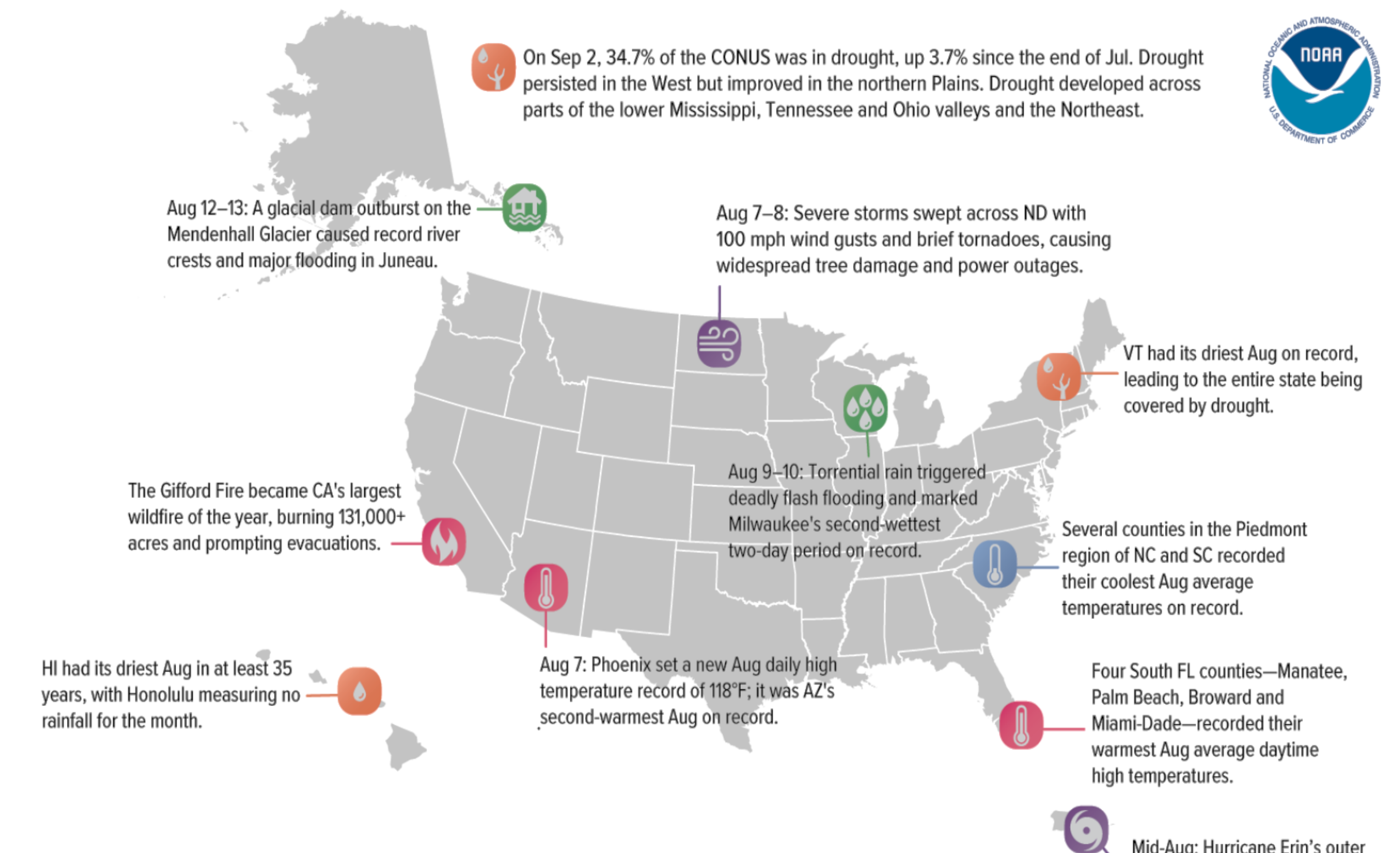
In July, 1,434 flash flood warning, the second-highest July total in 40 years, and 17 flash flood emergencies were issued nationwide, along with over 2,000 preliminary flood-related storm reports.

Average temperatures in August were above average throughout the West, with Arizona recording its second-warmest August on record at 4.6°F above average, behind only August 2020. Washington and Oregon recorded temperatures over 4°F warmer than long-term monthly average.





Notable Weather and Climate Events: August 2025



The average U.S. temperature for Aug was 73.4°F, 1.3°F above average, ranking in the warmest third of the 131-year record.
The U.S. precipitation average for Aug was 2.30 in., 0.32 in. below average, ranking in the driest third of the record.
The average U.S. summer (Jun–Aug) temperature was 73.3°F, 2.0°F above average, ranking in the warmest third of the record.
The U.S. precipitation summer total was 8.69 in., 0.37 in. above average, ranking in the middle third of the record.

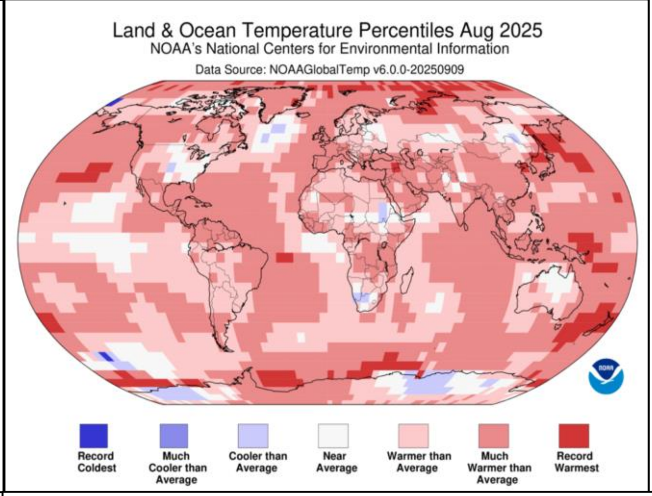
Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: https://www.ncei.noaa.gov/access/monitoring/monthly-report/

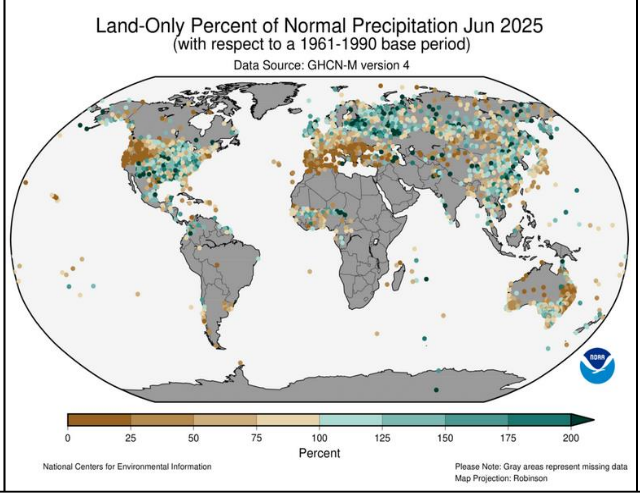
August 2025 was the third-warmest August globally since records began in 1850. The monthly temperature anomaly was +1.07°C (+1.93°F), ranking just below the warmest Augusts of 2023 and 2024 (+1.27°C / +2.29°F).

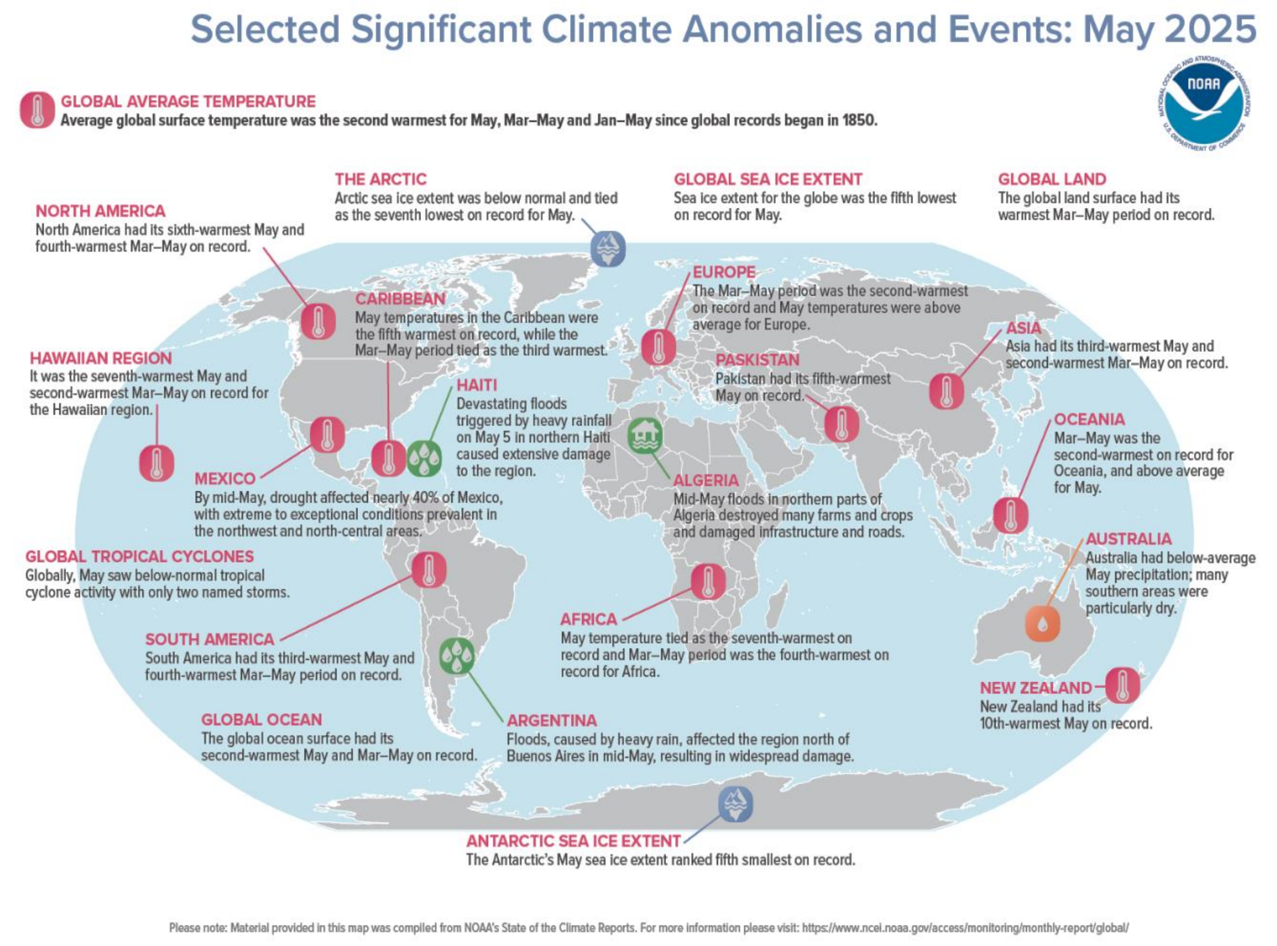
- August 2025 marks the 47th consecutive August with global temperatures at least nominally above average. The ten warmest Augusts have all occurred since 2015.

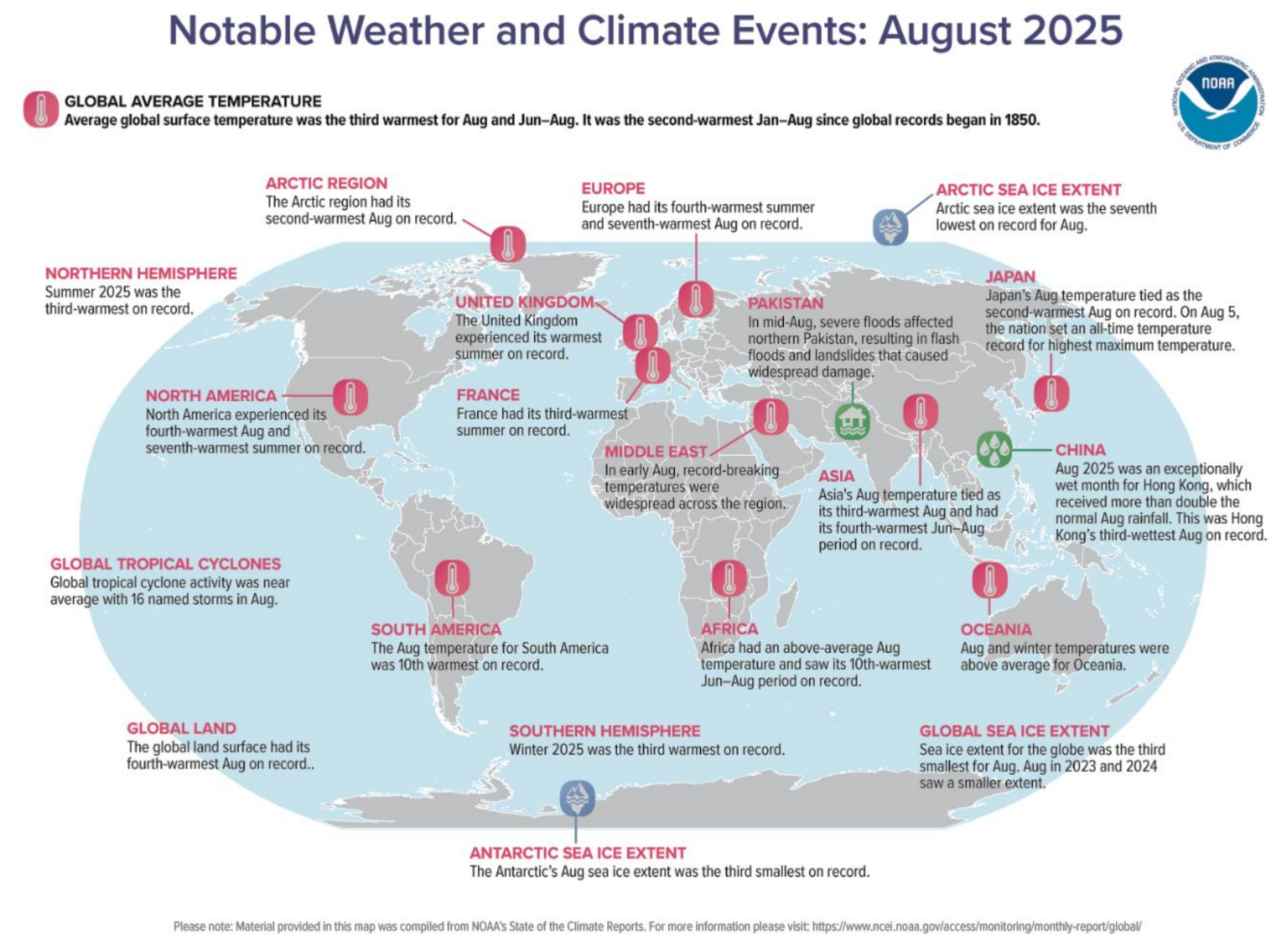
The global ocean-only surface temperature for August 2025 was the third-highest on record for August, with a temperature 0.91°C (1.64°F) higher than the 20th-century average. Only Augusts of 2023 and 2024 were warmer.

August temperatures were above average across much of the globe's surface, and parts of every continent. The most significant warm temperature departures were in the Northern Hemisphere's northern latitudes, as well as central Antarctica. Record-high August temperatures covered 6.3% of the world's surface.









Extreme Heat vs Infrastructure

Infrastructure Impacts from Heat: Impacts are likely to carry across all industries.

- Security – Staff and Systems
- Emergency Services/Medical – Staff, Supply Chain, and Equipment
- IT Sector – Heat vs Datacenters
- Water Sector – Quantity and Quality
- Energy Sector – Cooling and Capacity
- Critical Manufacturing – Supply Chain and Sites
- Food/Ag – Crops and Livestock
- Financial/Commercial Facilities – Materials and Operations
- Nuclear – Cooling and Stability
- Government Facilities – Sites, Staff, Society
- Transportation – Functionality and Stability
- Telecommunications – Connection Sites and Interdependencies
- Dams/Chemical – Structural Integrity and Risk

Heat fueled rains: Extreme rainfall events will increase in number and severity in the future because of climate change.

- By the end of the century, cities could experience as much as 30% more annual rainfall than today, and 1.5 times as many days with more than one inch of rain.

The University of Bristol study forecasts average annual flood losses would increase by 26.4% from $32 billion currently to $40.6 billion in less than 30 years.

- The national floodplains are expected to grow by approximately 45% by 2100.
- Just one inch of floodwater can cause up to $25,000 in damage (FEMA).

Concrete: In high heat environments over 80°F, concrete should not be poured, or it will not set effectively. This can increase setting time from 2-3 days up to 7 days in hot weather.

- Thermal cracking is found particularly in thick slabs, or mass concrete, where the temperature differential between different areas of the concrete is too high. (Examples: airport aprons, bridge headsticks, and highways where repaving needs have been increasing).

Epoxy: Most heat-resistant epoxies need to be cured at temperatures at or beyond the temperature it will need to endure. If temperatures exceed these maximum service temperatures, the material could start to distort. At a temperature of 135°F or higher, the epoxy may begin to exhibit heat damage.

- Epoxy faces the same concerns of needing a few days to cure but in persistent high heat/humidity levels it could take up to two weeks.
    - If Epoxy cures in too high of a temperature it can become too solid, resulting in less give during temperature swings and may crack.

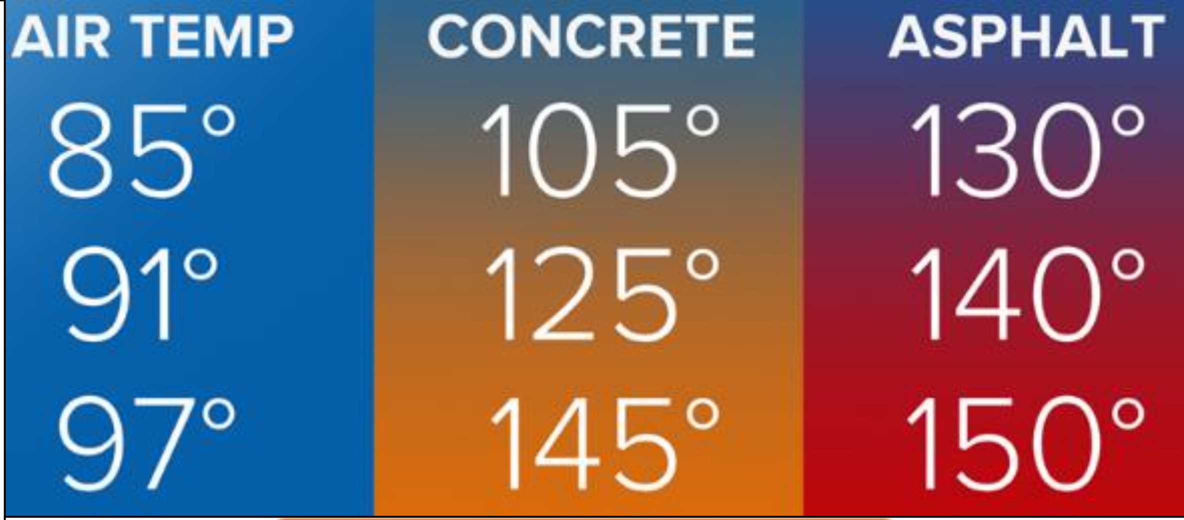
Metals: Extreme heat causes various metals to expand in addition to impacting the structure, electrical resistance, and magnetism. When metal heats, the bonds begin to break.

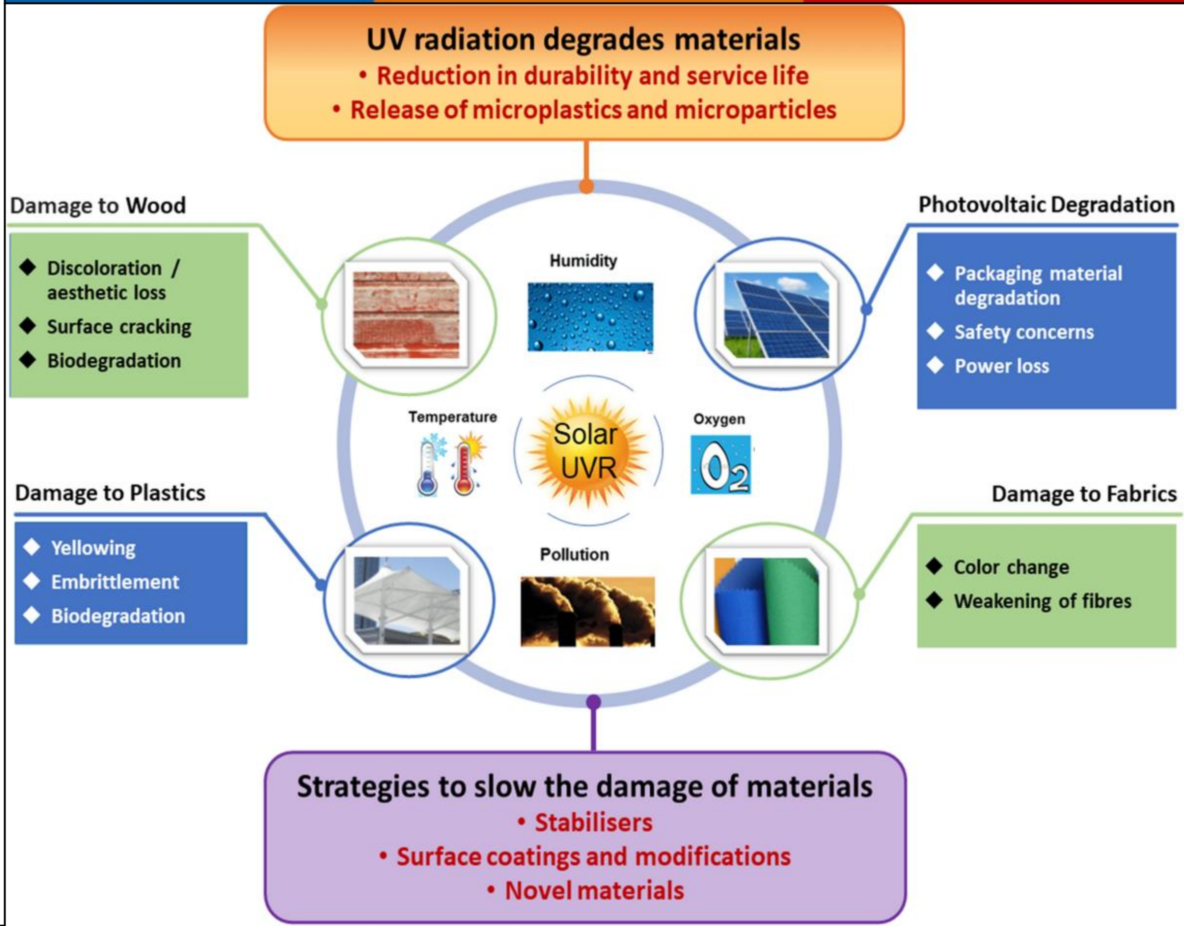
- Bridges in New York, Sacramento, and London have faced thermal expansion or cracking– 95°F in New York, 103°F in Sacramento, and 65°F in London.

Powerlines: Heat and smoke - Smoke can pose a serious hazard near power lines because it is conductive and can cause electricity to arc.

- Despite a below-average total area burned globally, fires were more intense, leading to a 10% increase in emissions compared to the average since 2003.
- Transmission lines lose up to 5.8% of their capacity to carry electricity in extreme heat. Wind turbines can be 25% less efficient in high temperatures.

The combined effects of extreme heat cost the US over $162 billion in 2024 – equivalent to nearly 1% of the U.S. GDP.





Radiative Heat Threats: Cities + Canals

In the 1980s, concurrent heat waves only occurred for 20-30 days each summer. Recent warming has driven a sixfold increase in the frequency of simultaneous heat waves over the last 40 years. The study also found that concurrent heat waves covered about 46% more space and reached maximum intensities that were 17% higher than 40 years ago.

Concrete is a great material for absorbing and storing heat from the sun, meaning it can warm to higher temperatures then most other materials and releases that heat more slowly as direct heating stops. On a hot summer day, concrete that’s in the shade can easily average 70°F, however, concrete that’s in direct sunlight can reach 135°F. Due to the higher temperature, these mixtures are at risk of expansion-triggered water incursion, weakening the structural integrity of various sites and foundations.

- Grass rarely exceeds 80°F, wood peaks around 90°F, composite decking about 100°F, but concrete can reach a hotter temperature and hold onto that heat longer. In cities, the developed areas of cityscapes may have cooler temperatures due to additions of vegetation and shading, creating significant heat disparities.

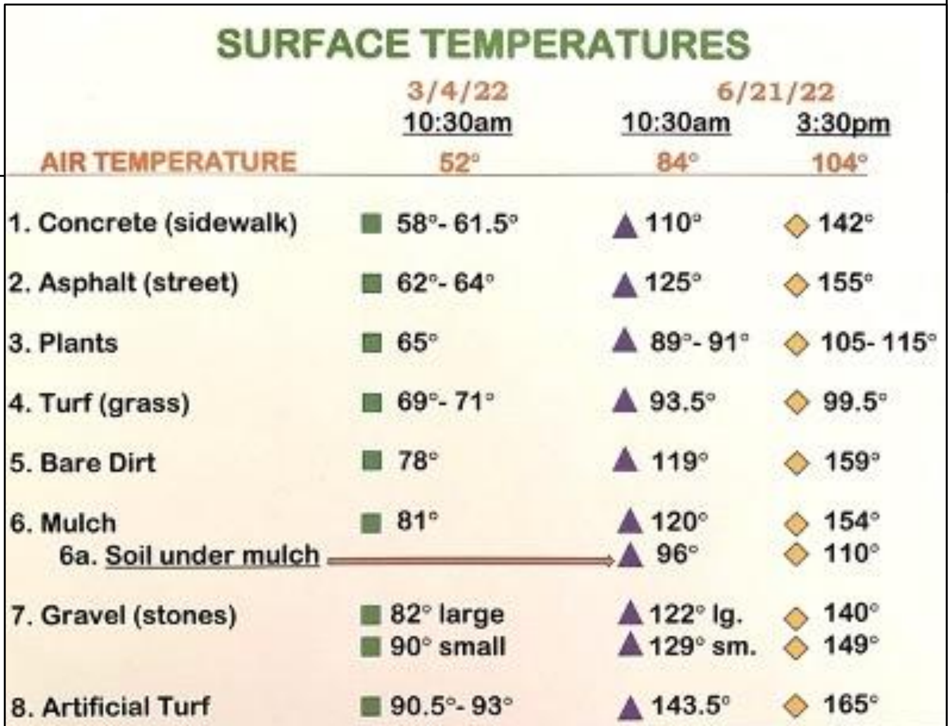
City Landscapes: Park benches in direct sunlight during summer months can easily reach temperatures of 125°F when ambient air is around 82-83°F. Metal benches can reach 136°F with coated benches still exceeding 108°F. Marble benches comparable can range up to 105°F while limestone can reach 116°F in sunlight. Shade drops the temperature by 16-18°F. Water fountains can reach 95°F, bus stop signs/posts can reach 105°F, bicycles can range to 104°F for seats, 102°F for handles, and crosswalk buttons near 98°F.

Without cooling centers staying open overnight, at-risk populations are purged back into an abnormally warm city where pollution concentrations remain high due to lingering heat.

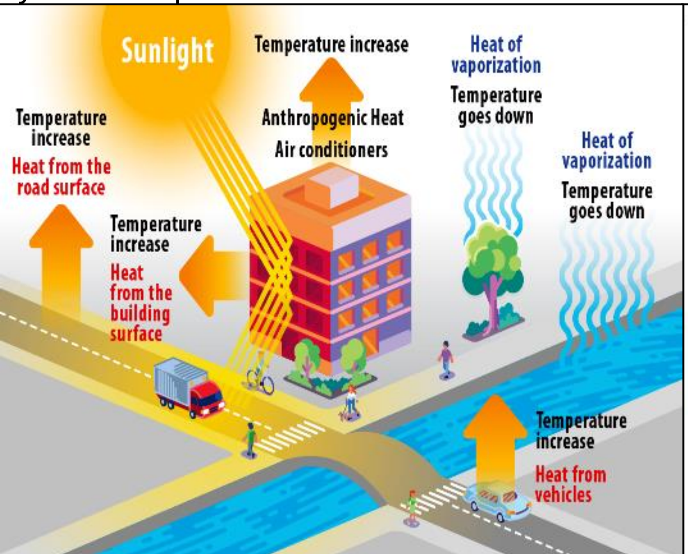
- The more densely packed a metro car is or a bus is, the greater the ambient temperature will become making it more difficult to cool down between stops.

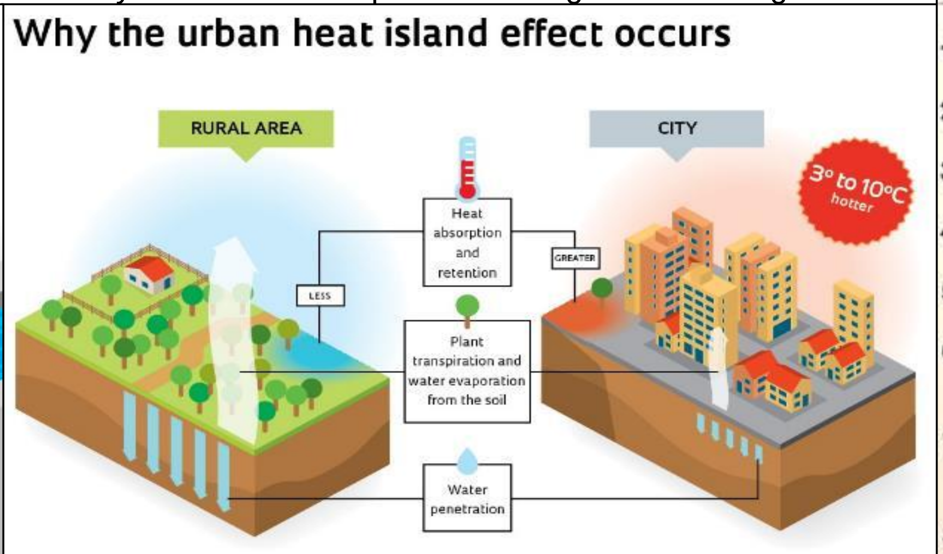
When asphalt heats it becomes more malleable, making it soft and able to compress under weight and become disformed. High heat also rapidly ages the material, making infrastructure on or near it weaker.

At the current rate of heating, the expansion buffer will not stop the material from buckling more often. This will yield more potholes and lower income communities may not be able to repair at the heightened damage rate.


SURFACE TEMPERATURES

	3/4/22 10:30am	6/21/22 10:30am	6/21/22 3:30pm
AIR TEMPERATURE	52°	84°	104°
1. Concrete (sidewalk)	58°- 61.5°	110°	142°
2. Asphalt (street)	62°- 64°	125°	155°
3. Plants	65°	89°- 91°	105- 115°
4. Turf (grass)	69°- 71°	93.5°	99.5°
5. Bare Dirt	78°	119°	159°
6. Mulch	81°	120°	154°
6a. Soil under mulch		96°	110°
7. Gravel (stones)	82° large 90° small	122° lg. 129° sm.	140° 149°
8. Artificial Turf	90.5°- 93°	143.5°	165°





Transportation Impacts

Extreme heat can degrade the structural integrity of roadways, railways, runways, and pipelines resulting in pivots of resource movement methods.

- When the Mississippi River runs low due to drought events and heat triggered evaporation of the surface waters, the barges must reduce loads and speed causing notable delays in shipments and trucking needs to reduce increasing costs.
    - Heat causing railways to warp can also cause reduced operations by requiring slower movement and reduced loads.

Extreme heat for railways threatens railcars with prolonged exposure to solar radiation when stalled on the tracks and may see material combustion risks or degraded shipping conditions which may impact the supply chain.

- Warped railways under direct heating may increase derailments.
    - Stalled materials in transport can overheat, damaging the products.

These events are occurring globally, resulting in loss of supply for key materials, minerals, metals, increased demand, rising costs, and subsequently delayed delivery.

As temperatures rise, the performance of the aircraft and their engines can deteriorate which can be amplified in major metropolitan areas due to the surrounding ambient temperatures.

- Planes get 1% less lift with every 5.4°F (3°C) of temperature rise.
- Refueling can be delayed due to heat while internal aircraft temperatures can rise rapidly during gate delays or takeoff delays.
- Thermal turbulence occurs due to uneven surface heating by the sun.
- Like railways and barges, the aircraft also cannot take on additional weight during the summer, resulting in higher transportation costs and delays.

Major outdoor events like concerts/festivals, sport games, racing, vacation destinations, amusement parks, and competition-based events cause an upswing in transportation system use and more individuals outside/commuting placed at a higher risk to include waiting on train platforms, bust stops, stalled in traffic, longer plane boarding times, etc.

Physical Security, Site, and Staff Impacts

As severe weather increases the frequency of power outages, causes supply chain delays, amplifies impacts from personnel shortages, damages larger areas causing prolonged restoration times, *negative impacts will increase* for key security personnel and necessary physical security systems.

- Power outages can lead to badging and verification delays, record storing lapse, or loss of site access
- Extreme heat reduces the physical efficiency and mental capability of security staff (lethargy)
- Severe weather can halt drone monitoring operations and obscure video monitoring
- Flooding can result in sensor delays or destruction
- Evacuations being televised may result in exploitation of decreased security presence
- Damages to physical barriers (fences/) gates will likely be an evident security risk
- Extreme heat and frequent staff rotations may cause gaps in external physical security

- High heat periods may cause loss of sleep further reducing the capabilities of staff
- Extreme heat may cause burns or melt certain materials or cause foundations to crack/dimple
- Supply chain or resource hub damages from heat or storms may cause replacement part delays and heightened demand/cost
- Hail can damage or destroy backup generators
- Resource restrictions may result in targeted violence or theft of site resources (e.g. water)
- Theft of backup generators during recovery from storms
- Extreme heat can impede helicopter operations

- Amplified events may reduce emergency response availability (e.g. fire/EMS)
- Battery backups for security systems and control panels may deplete during prolonged outages
- Disaster scams, misinformation, and timed weather/cyber events may increase
- Increased rates of depression during low pressures and aggression during heat waves may lead to workplace violence events
- Theft of larger metal structures such as rural telecom towers or water systems in cages on external apartment or condo buildings have noted a rise in theft
- Attacks on restoration crews are increasing




Inches Per Hour and Peak Wind Risks Rise

With 2°C (3.6°F) of global warming, the majority (85% or 2,645) of 3,111 total U.S. counties are likely to experience a 10% or higher increase in precipitation falling on the heaviest 1% of days.

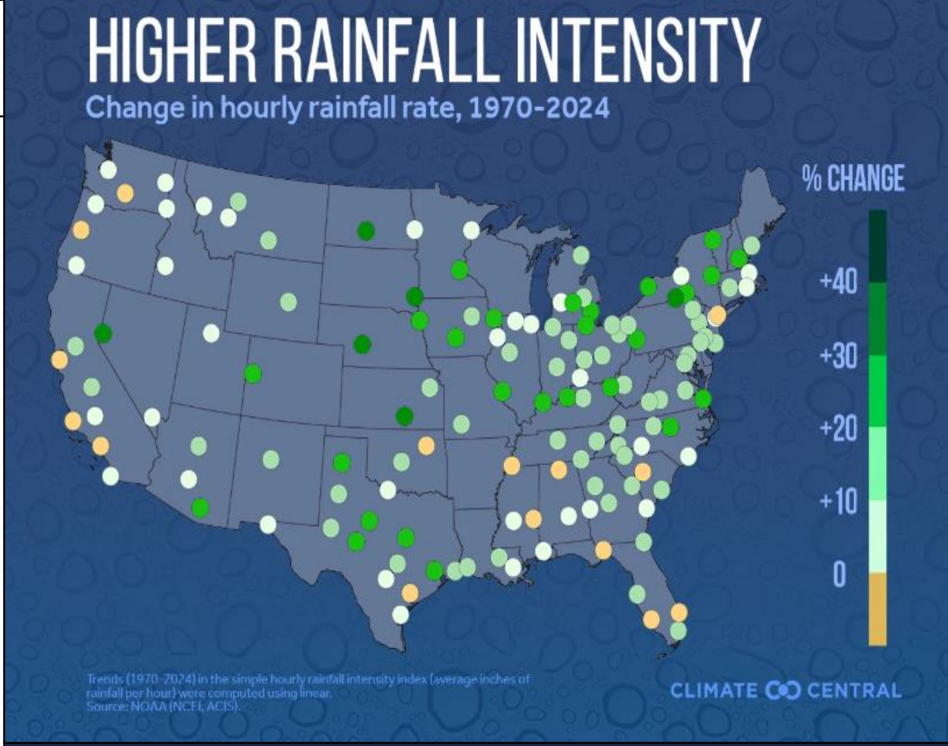
- By the end of the century, cities could experience as much as 30% more annual rainfall than today, and 1.5 times as many days with over an inch of rain.

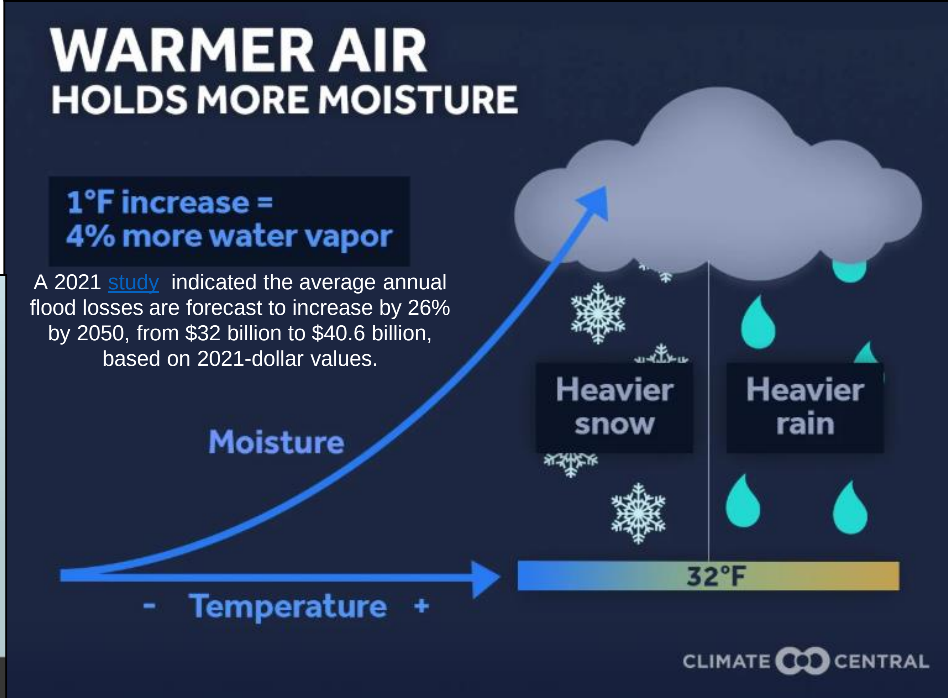
A 2024 study by Climate Central found that 126 of 144 US cities they examined saw an increase in hourly rainfall intensity from 1970 to 2022.

- Rainfall hours became 15% wetter on average across the 126 cities studied with an 88% increase in hourly rainfall rates.
  - The highest known 1-minute total is also held by the US in Unionville, Maryland at 1.23 inches in 1956.
  - The highest known one-hour rainfall total in the US is 12 inches in Holt, Missouri, on June 22, 1947. This rainfall occurred in just 42 minutes.
  - The record 6-hour rainfall was in Smethport, PA at 34.5 inches. A record 42 inches were reported in 24 hours in Alvin, Texas in 1979.

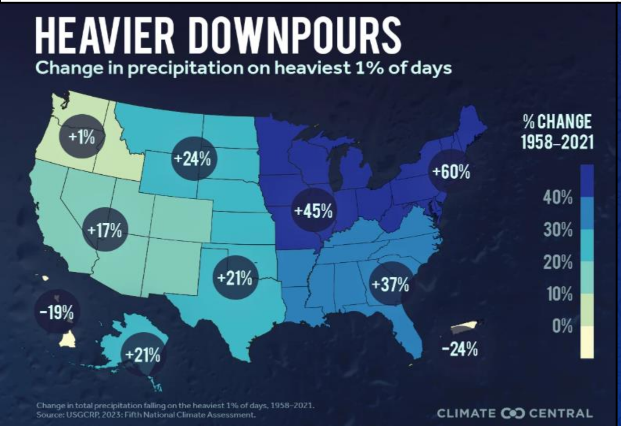
A new study finds the strongest nor'easters have intensified over the last 80 years, with a 6% increase in peak wind speeds resulting in a nearly 20% increase in destruction potential.

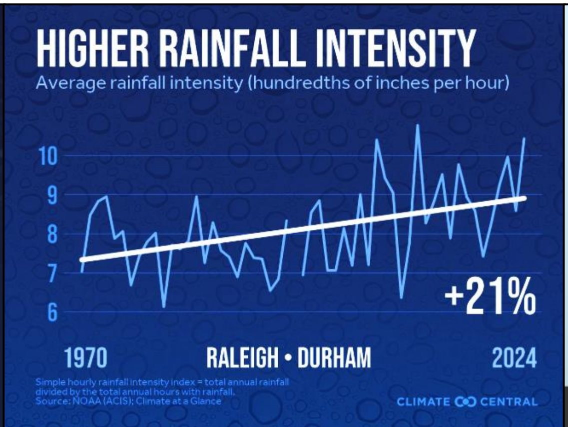
Previous studies published have predicted an increase in the intensity of extratropical storms close to the northeastern US due to warming during the cool season.

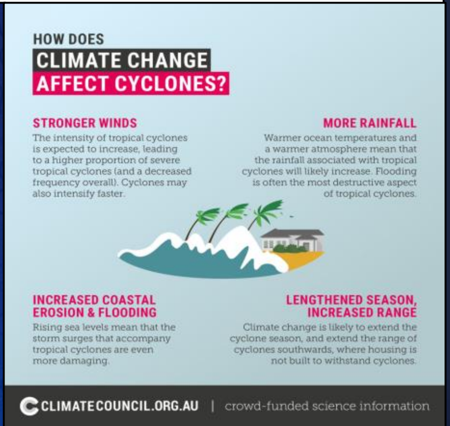




A 2021 study indicated the average annual flood losses are forecast to increase by 26% by 2050, from $32 billion to $40.6 billion, based on 2021-dollar values.



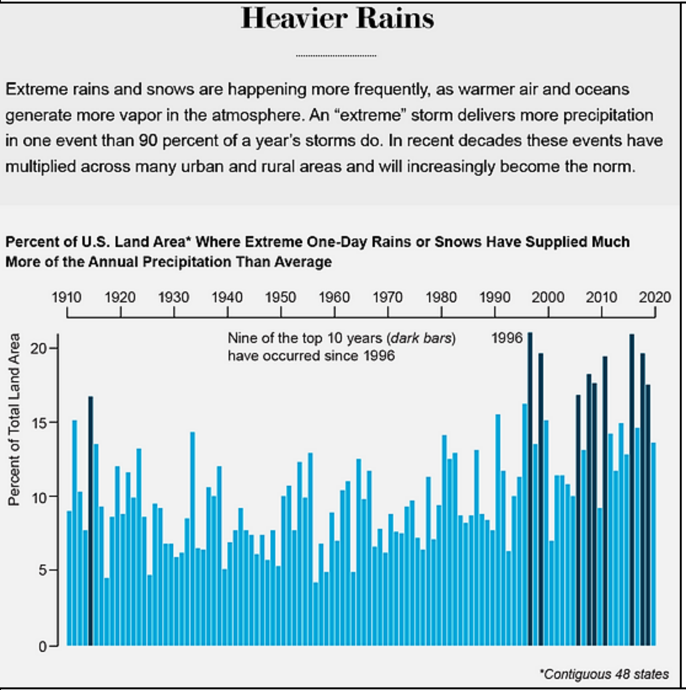




Increases in 1 Hour / 6 Hour / 24 Hour Rainfall Totals

Increases in atmospheric water vapor also amplify the global water cycle. They contribute to making wet regions wetter and dry regions drier. The more water vapor that air contains, the more energy it holds. This energy fuels intense storms, particularly over land. This results in more extreme weather events (NASA).

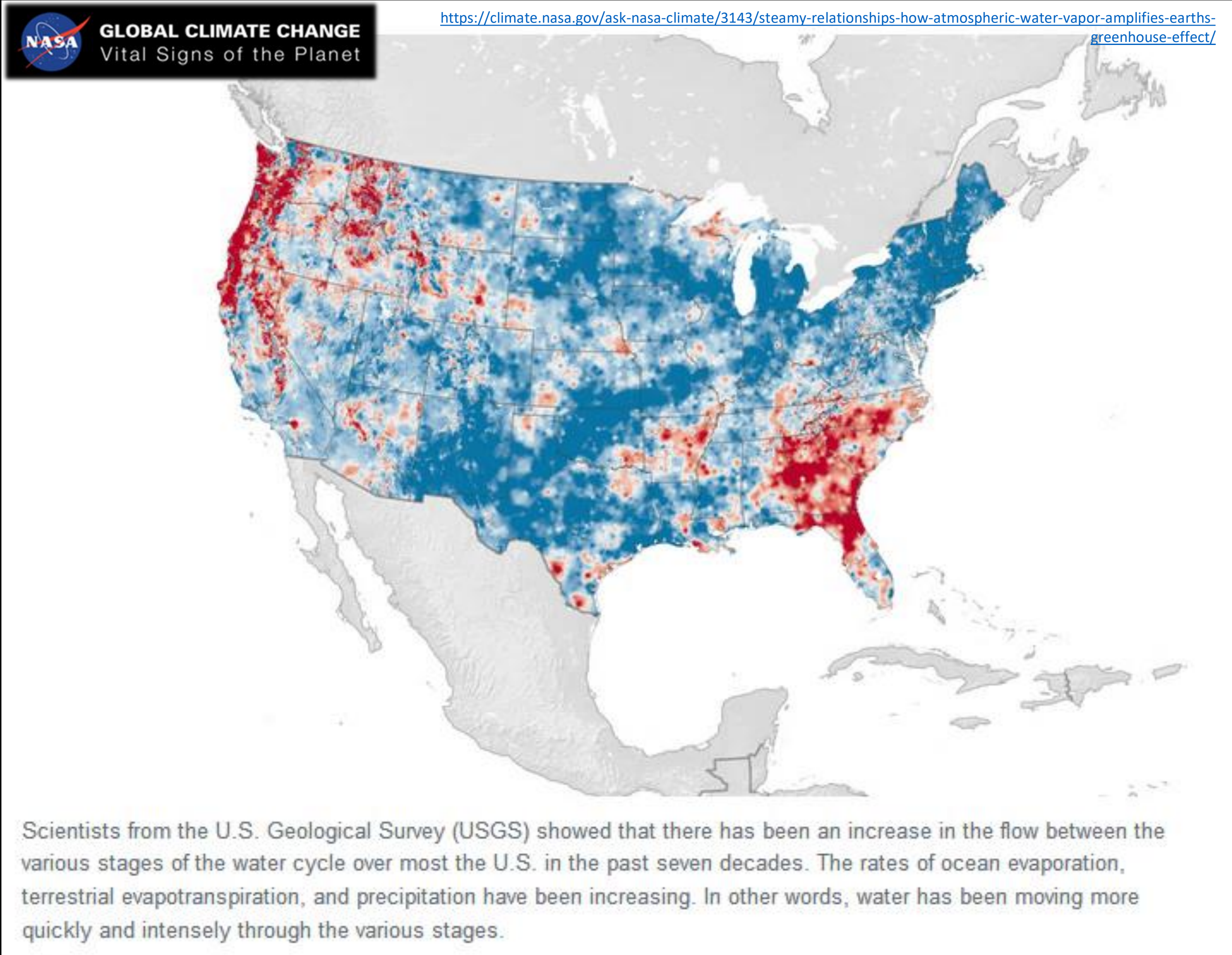
- More evaporation from the land also dries soils out. When water from intense storms falls on hard, dry ground, it runs off into rivers and streams instead of dampening soils. This increases the risk of drought and floods.



- The average change in hourly rainfall intensity across all 150 stations from 1970 to 2021 was +13%.
- 63% (95/150) of stations had an increase in hourly rainfall intensity of +10% or more (Climate Central).
- 90% of the 150 locations analyzed now experience more average rainfall per hour than in 1970.
- A 2021 report found that one-fourth of critical infrastructure is at risk of failure by flooding.
- Nine of the top 10 years for extreme one-day precipitation events have occurred since 1996 (EPA).

The water-vapor feedback is weakest where vapor is most abundant. In humid areas, the infrared energy absorbed by water vapor is already near its physical limit, so adding some extra moisture has minimal effect. In dry places, however, such as polar regions and deserts, the amount of infrared energy absorbed is well below its potential maximum, so any added vapor will trap more heat and increase temperatures in the lower atmosphere.

https://climate.nasa.gov/ask-nasa-climate/3143/steamy-relationships-how-atmospheric-water-vapor-amplifies-earths-greenhouse-effect/



This map shows where the water cycle has been intensifying or weakening across the continental U.S. from 1945-1974 to 1985-2014. Areas in blue show where the water cycle has been speeding up—moving through the various stages faster or with more volume. Red areas have seen declines in precipitation and evapotranspiration and experienced less intense or slower cycles. Larger intensity values indicate more water was cycling in that region, primarily due to increased precipitation. Credit: NASA Earth Observatory image by Lauren Dauphin, using data from Huntington, Thomas, et al. (2018).

Hydroelectric Dams Impacts

A study published in the journal *Earth's Future* found that hydro availability and summer air temperatures are likely the biggest determinants in Western electricity prices.

In 2021, a historic drought that affected much of the western US led to reduced water supply and, as a result, lower hydropower generation in the Pacific Northwest and California.

- Electricity generation at California's hydropower plants was 48% below the 10-year average (2011–2020). The Lake Oroville Dam was shut down for the first time since 1967 due to low water levels and Lake Shasta's dam was generating about 30% less power than usual.
- St. Cloud hydroelectric dam shut down in August 2021 when Mississippi River flows fell below 700 cubic feet per second for first time since 1988 when it was last shut down due to low flows.

The hydropower shortfall from January 2021 to July 2022 caused WAPA to spend $78m of a $146m buffer fund as it had to buy alternative power for its customers in times of shortages. Customers faced a 40% price increase.

- Navajo Tribal Utility Authority reported its operating costs rose by $4.5m in 2022 due to drought.

In 2022, The Hoover Dam was down 25% while the Glen Canyon output reduced about 35%.

- In the Pacific Northwest hydropower generation was 14% below the 10-year average with the Grand Coulee dam at 12% below the 10-year average.

--The six mainstem hydroelectric power plants for the Missouri River System generated 832 million kWh of electricity in September 2022, compared with typical 902 million kWh September generation.

- The power plants generated 7.4 billion kWh of electricity by the end of 2022, compared to the annual long-term average of 9.4 billion kWh. The region saw 2x the drought coverage of normal.

In 2025: According to ISO-New England records, average daily hydropower generation went from more than 23,000 megawatt hours in June to about half that in August.

At current reservoir sedimentation rates, the existing global reservoir storage capacity could be nearly halved by 2100. Sedimentation rates vary widely according to the river basin's geologic and physical condition. Causing some dams to age faster than others due to sedimentation alone.

- The estimated loss of storage capacity in reservoirs in the US due to sedimentation ranges to a loss of $100 million. The annual cost for promoting the removal sediments is about $6 billion. Semi-arid locations are more susceptible for reservoir problems as they have higher capacities.

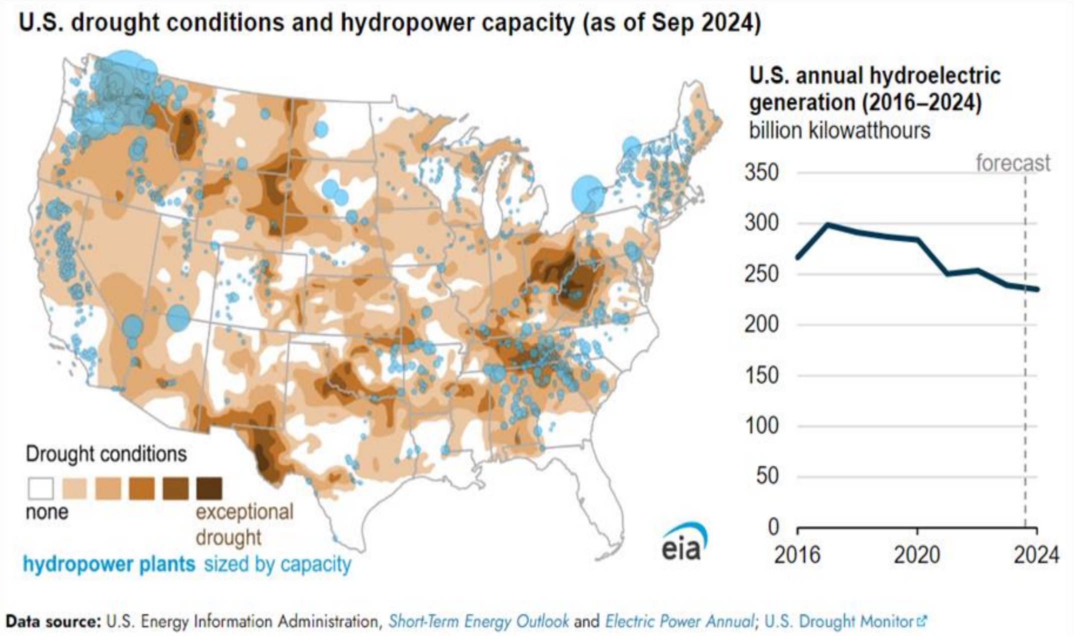
A 2022 study published in 'Water' assesses the risks of floods and water scarcity to hydropower projects and how those risks may shift due to climate change with regions highlighted for risk of water scarcity by 2050.

- By 2050, 61% of all global hydropower dams will be in basins with very high or extreme risk for droughts, floods or both. By 2050, 1 in 5 existing hydropower dams will be in high flood risk areas because of climate change, up from 1 in 25 today.
- Only 2% of planned dams are in basins that currently have the highest level of flood risk, but by 2050, nearly 40% of this same group of dams will be in basins with the highest flood risk.

Water flow in the Colorado river could drop 30% by 2050 and 55% by 2100 due to greenhouse gas emissions. ~1.9 million acre-feet (13% of the water from the reservoirs across the entire river) evaporates each year.

In 2022, drought forced factories in the hydropower-reliant province of Sichuan, China to close temporarily due to a lack of electricity.

In 2025, multiple African nations like Zambia and Zimbabwe reported their reservoir levels fell with immediate hydroelectric losses and resulting power cults triggering a boom in solar panel purchases.



Fire Weather

Nationwide, the number of existing properties facing at least a 1% risk will almost quadruple, to 2.5 million by 2050; not accounting for subdivisions to be built in the intervening years.

Over 7 million American homes currently have a "major" risk of wildfire damage, increasing to 13 million over the next 30 years, according to a national wildfire assessment by the First Street Foundation in May 2022.

Fire Factor

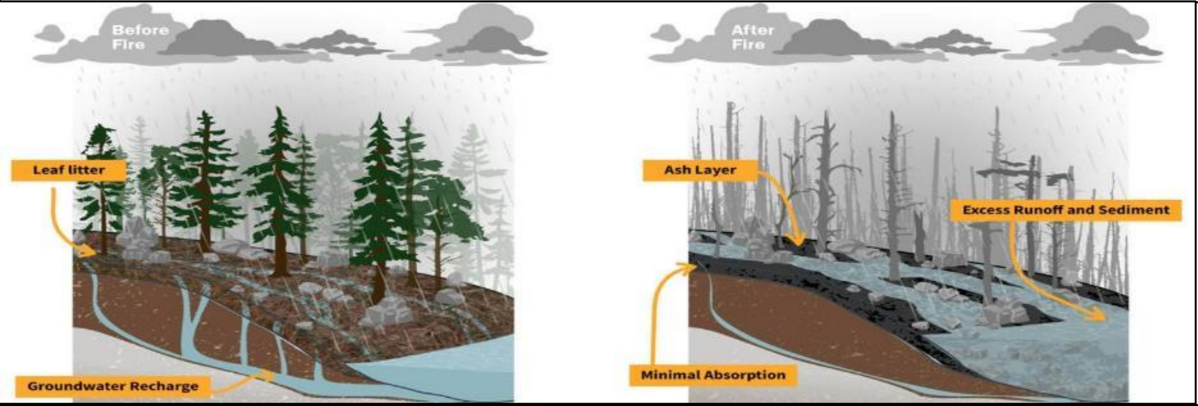
A study from the University of Colorado states wildfires have become larger, more frequent, and more widespread since the year 2000.

Analysis of coincident 1000-hour fuel moistures indicated that as fuels dried out, satellites detected increasingly larger and more intense wildfires with higher probabilities of nighttime burns.

A new study from the University of Montana highlights burn scar impacts to tree regrowth across various regions, indicating new tree seedlings are unable to survive in hotter climates where parent trees remain. The study indicated that if large areas of the forested parts of the Rocky Mountains burned, only 50% would recover.

Satellite imagery and state/federal fire history records from 28,000 fires in 1984-2018 showed more fires occurred in the past 13 years than the previous 20 years. On the West and East coasts, fire frequency **doubled**. In the Great Plains, fire frequency **quadrupled**.

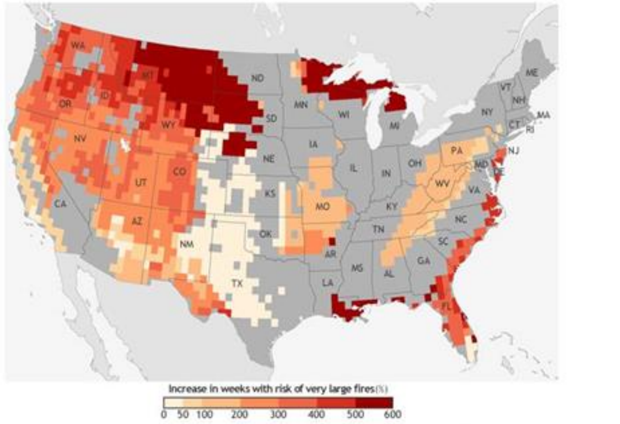
Burned vegetation and charred soil form a water repellent layer which blocks water absorption along with compacted soil from months to years of drought which also inhibits water absorption regionally. These major soil changes cause short rainfall events to be less beneficial for long term



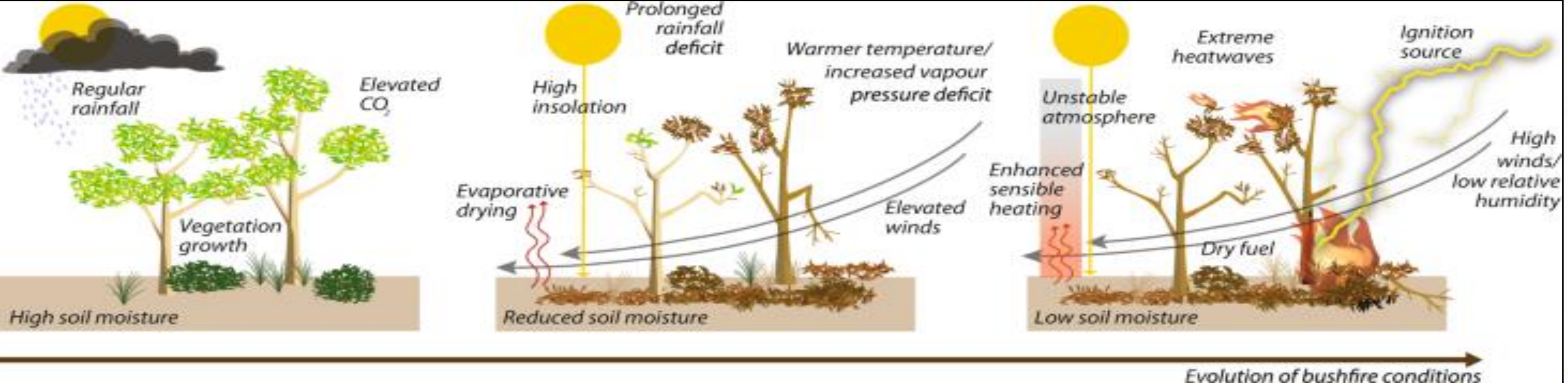
Disasters related to weather, climate, or water hazards happen five times more often now than they did in the 1970s. Droughts that may have occurred only once every decade or so now happen 70% more often.

- The IPCC states heavy rainfall that used to occur once every 10 years now occur 30% more often.
- 61% of western wildfires have occurred since 2000 with a steady increase in the number of wildfires the last 60 years.

The map below shows the projected increase in the number of "very large fire weeks"—periods where conditions will be conducive to very large fires—by mid-century (2041-2070) compared to the recent past (1971-2000). The projections are based on scenarios where carbon dioxide emissions continue to increase.



Source: NOAA Climate.gov map, based on data from Barbera et al, 2015.



Severe Weather on the Rise

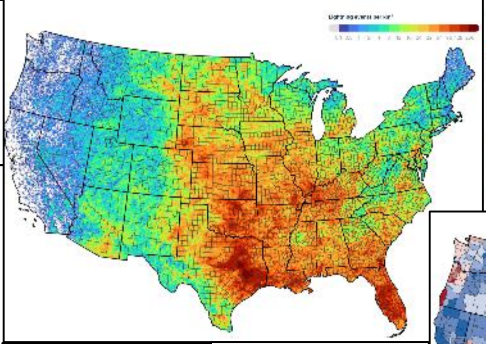
Hail events throughout the US are forecasted to intensify regarding size of the hailstones as warmer seasons across multiple regions can enable stronger updrafts for supercell storms responsible for large hail especially across less hardened areas.

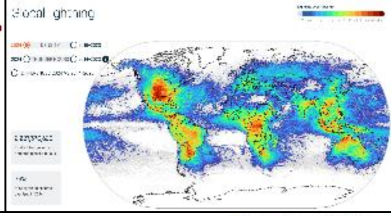
- Insured U.S. hail losses average $8 billion - $14 billion per year, or $80-140 billion per decade.

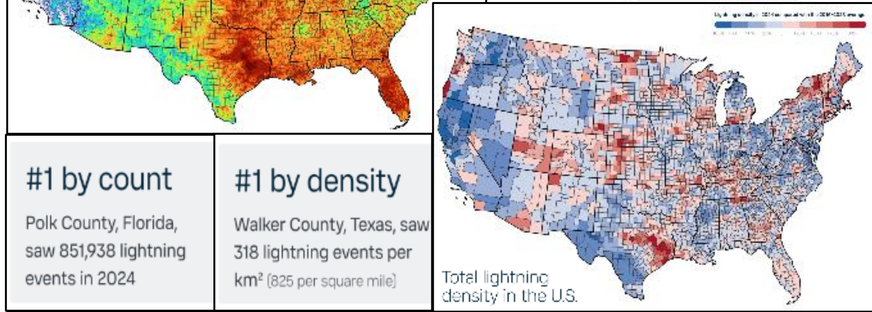
A new study published by the National Center for Atmospheric Research finds there has been "a fivefold increase in the area affected by straight-line winds since the early 1980s" in the central U.S. Straight-line winds are often produced by thunderstorms and can impacts like that of a tornado. These winds have increased at a rate of 13% per degree of warming.

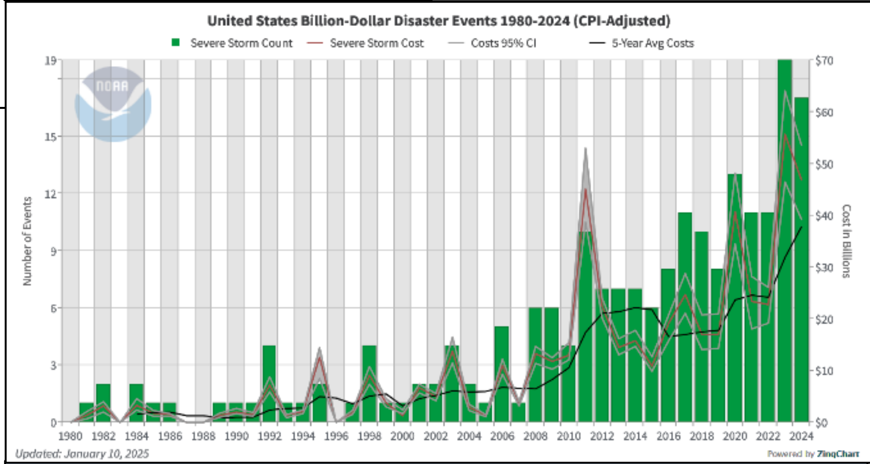
Tornado activity from 2008-2021 in comparison with 1991-2010 indicates the seasonal frequency has remained the same but the location and intensity of tornadic supercells has expanded from "Tornado Alley" to "Dixie Alley" producing larger, longer supercells. Dixie Alley includes Eastern TX, AR, LA, TN, KY, MS, AL, GA, South MO, Southeast OK, and the FL panhandle.

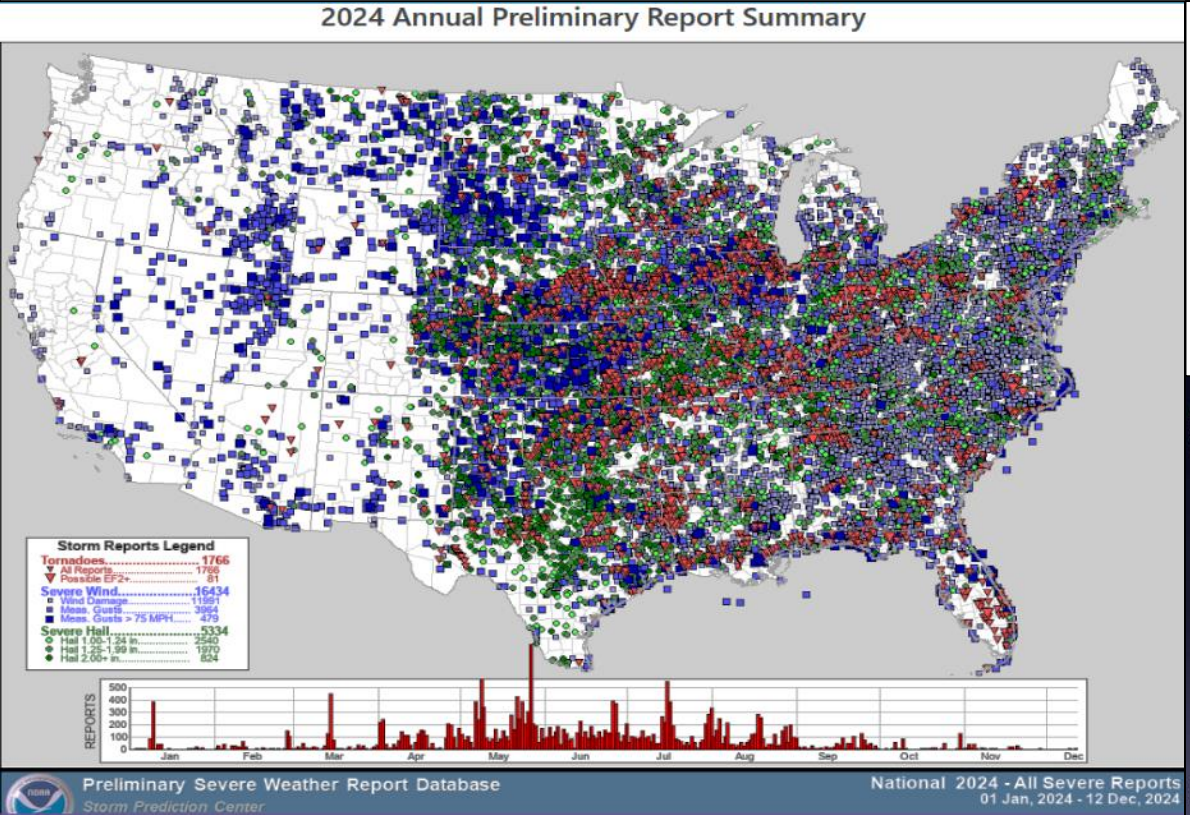
A recent study predicts a nationwide 6.6% increase in supercells and a 25.8% expansion in the area and time supercells remain over land by the year 2100. This may result in areas which do not often see tornadic activity reporting an increase in events too.



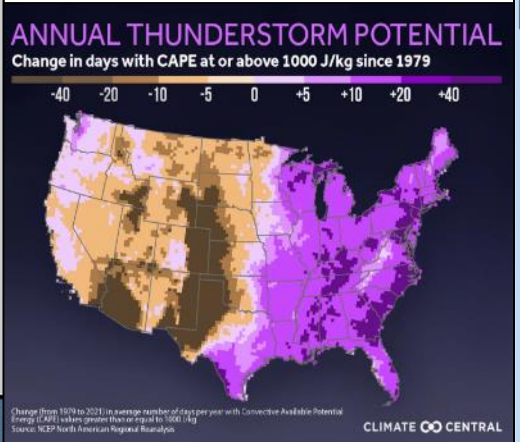


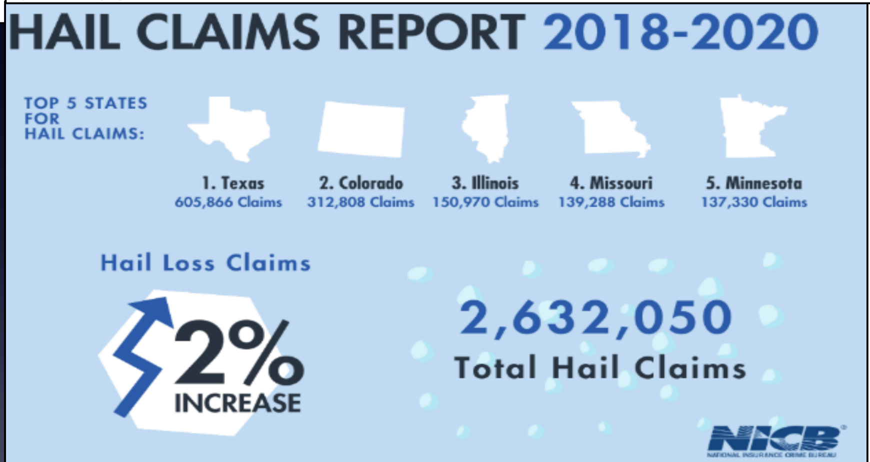






March 2025 produced a new record for tornadic activity in the US while April yielded 2x the average tornado count. Hail reaching DVD size (4-5 inches) aka grapefruit size, was reported in multiple states at increasing rates with last year producing melon size (+6 inches). May 2025 is in the top 10 for most tornadic activity on record and June produced over 215 tornadoes, placing the first 6 months of 2025 +1,200 tornadoes.





Hail Records Continue to Rise

2010: A hailstone was discovered in South Dakota measuring 8.0 inches in diameter, 18.625 inches in circumference, and weighing 1.94 pounds.

2016/2022/2024 Colorado reports 2-feet of hail requiring plow trucks to move and triggering flooding as the ice melted quickly at the surface.

2023-2025: Multiple states report melon-size hail (+6-inch diameter).

2025: Texas's new record hailstone reported at 7.25-inch diameter.

Pollution can influence hail formation and potentially lead to larger hailstones.

Pollutants provide cloud condensation nuclei, affecting the size and number of stones.

Hail severity will increase in most regions of the world while Australia and Europe are expected to experience more hailstorms.

Insured U.S. hail losses now average **$8 billion to $14 billion per year,** or $80-140 billion per decade (as of 2022).

This outpaces the total of $14.1 billion in insured US property loss from tornadoes over the decade from 2010 to 2020.

TEXAS Record MONSTER Hailstone!

Documented 7.25" hailstone 3 miles WNW of Vigo Park, Texas at 7:37pm Sunday set a new state record (pending) shattering the previous record of 6.4" in Hondo, TX in 2021.

Permission: Val and Amy Castor

7:25 PM · Jun 4, 2024

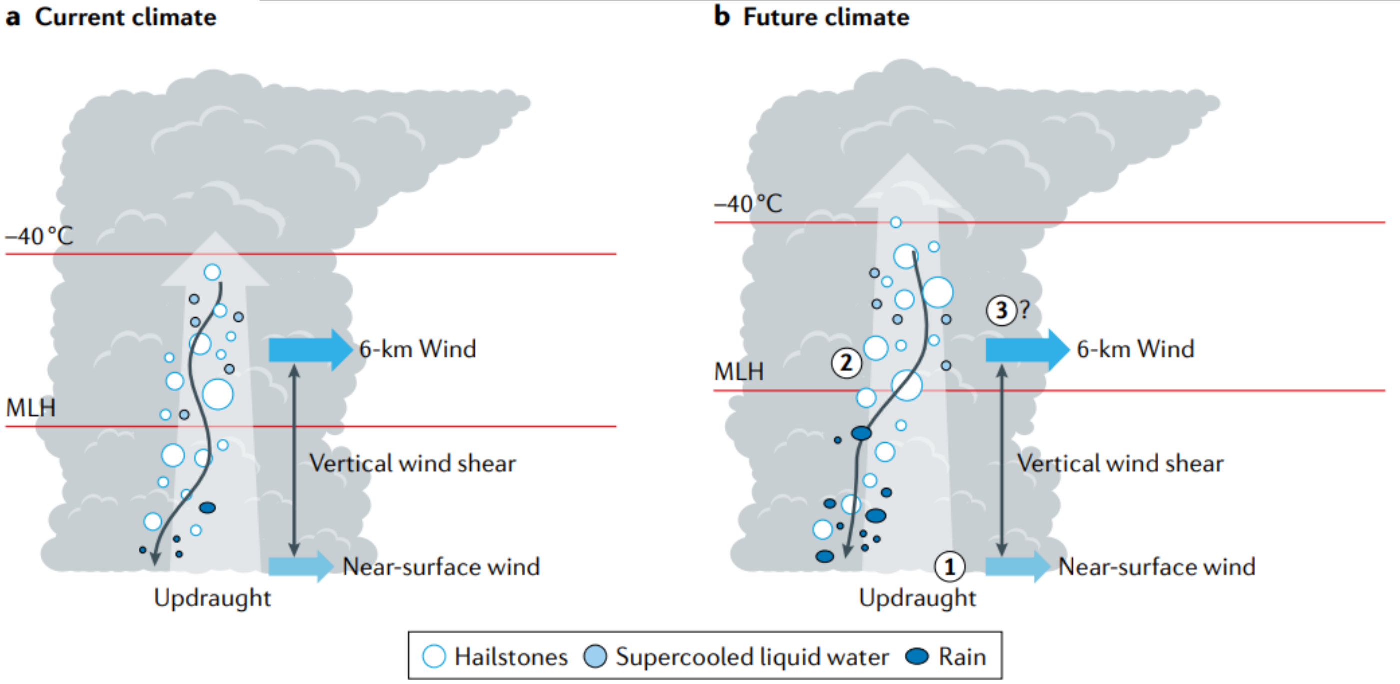


Fig. 1 | **Hail-relevant atmospheric phenomena in current and future climates.** The expected changes in hail-relevant atmospheric phenomena between the current (panel **a**) and future (panel **b**) climates. The numbers in panel **b** correspond to the following changes: (1) increased low-level moisture leads to increased convective instability and updraught strength; (2) an increase in the melting level height (MLH) leads to enhanced melting of hailstones and a shift in the distribution of hailstone sizes towards larger hailstones; and (3) changes in vertical wind shear may affect storm structure and hailstone trajectories, but are generally overshadowed by instability changes.

Tropical Cyclone Changes

Over the recent 2013–2022-decade, rainfall flooding accounted for 57% of all U.S. deaths from tropical cyclones, according to a 2023 report from the NHC.

- From 1980 to 2023, 177 landfalling Atlantic tropical cyclones rapidly intensified.
  - In the North Atlantic, the number of storms that quickly intensified from Category 1 (or weaker) into a major hurricane has more than doubled in 2001-2020 compared to 1971-1990.
  - Most (72%) of the 67 total billion-dollar tropical cyclones in the U.S. since 1980 rapidly intensified.
- Since 1979, warming has increased the global likelihood of a tropical cyclone developing into a major hurricane (+Category 3) by ~8% per decade.
- Warm ocean waters that fueled Hurricane Beryl are up to 400 times more likely.
- The Atlantic hurricane season is expected to be about a month longer by 2100.

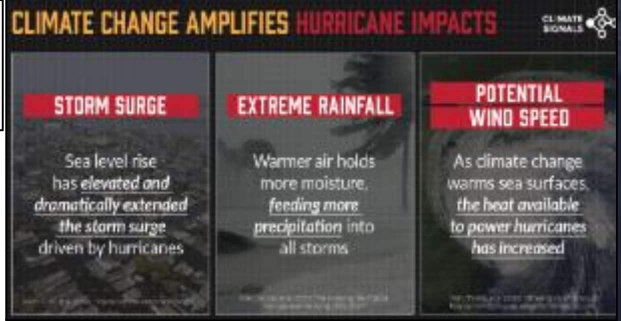
Research shows Atlantic hurricanes are experiencing a reduction of roughly 17% in forward motion speeds than in previous decades, which translates into an increase of about 25% in rainfall.

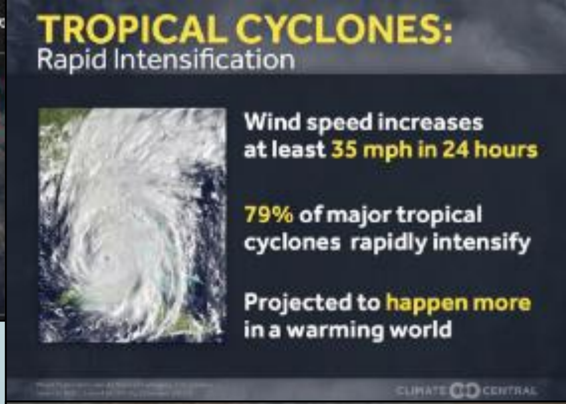
- Extreme rainfall rates (focusing on *hurricane strength only)* saw increases for 3-hourly rainfall rates of 11% and 3-day total accumulated rainfall by 8%.

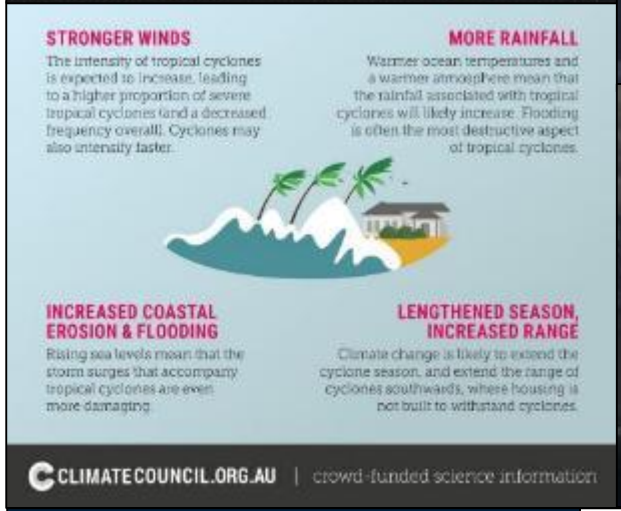
A recent assessment indicated an increase of global tropical cyclone rainfall rates at 7% per degree of warming with an observational finding of a 1.3% global increase in tropical cyclone rainfall rates per year since the early 1900s.

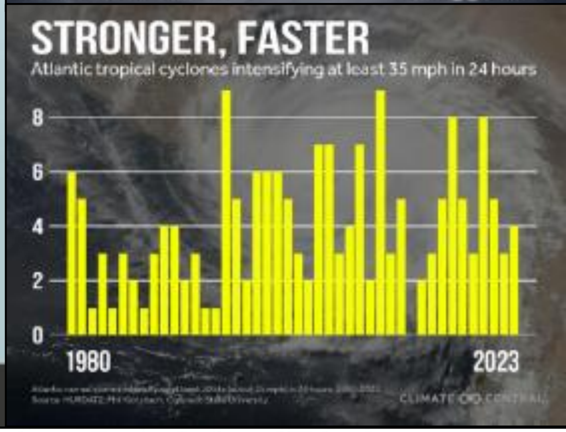
- A study on the 2020 North Atlantic hurricane season found that hourly hurricane rainfall totals were around 10% higher compared to hurricanes recorded in the pre-industrial (1850s) era.

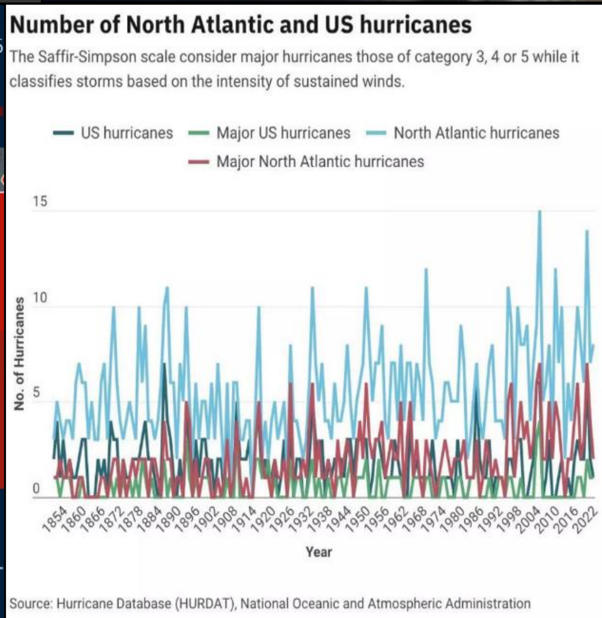
By 2080, significant tropical cyclone formation and intensification increases in likelihood between 30ºN – 40ºN to include New York, Boston, Beijing, Tokyo, etc.











Energy Sector Losses – Ex Wx

Between 2000 and 2023, 80% of reported major outages in the U.S. were due to weather-related events. Severe hailstorms can damage renewables like wind turbines and solar power.

- The average annual number of weather-related power outages increased by roughly 78% during 2011-2021, compared to 2000-2010.

The US experienced about two times more weather-related outages during the 10 years 2014-2023 versus the first 10 years analyzed of the 2000's (2000-2009).

- Future impacts: A two-week outage could cause a hit to the gross domestic product of the greater Chicago metropolitan area as high as $17.1 billion, with more than 70% of those costs coming from resilience tactics.

Solar panels and turbines exposed to icing, freezes, or hail may see significant output loss, damage, or exponential deterioration rates.

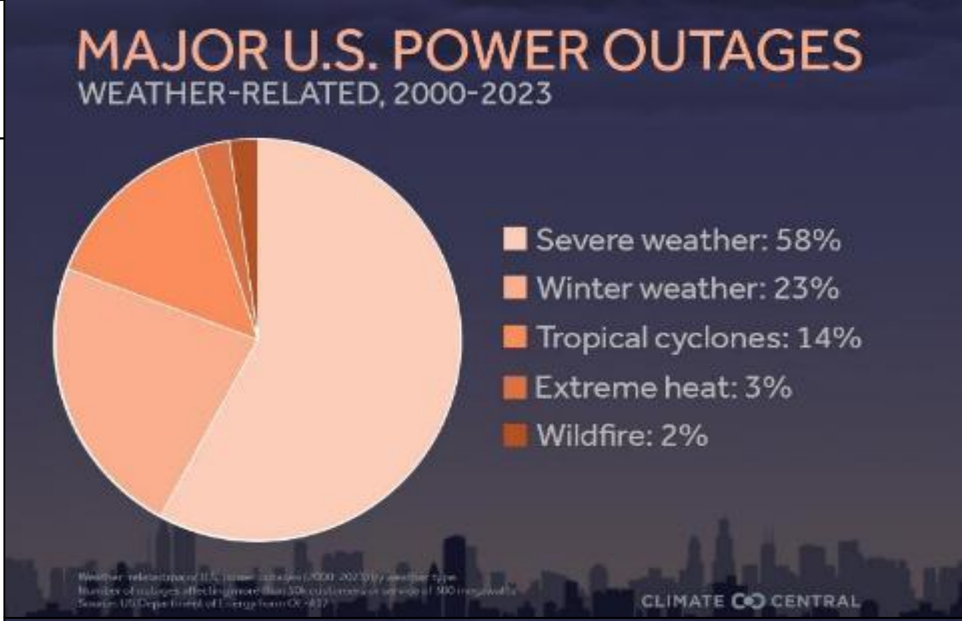
- Wind turbines also face significant costs from lightning at +$100 million a year and accounts for about 60% of the blade losses.

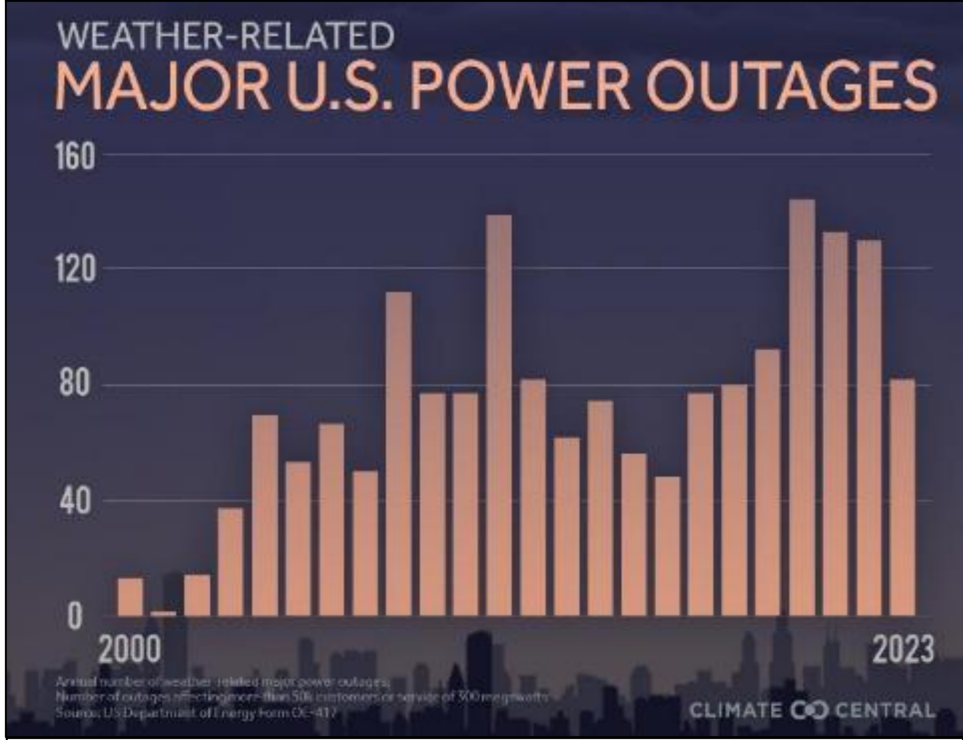
A new survey from the USC Center for Risk and Economic Analysis of Threats and Emergencies on power outages increasing nationally showed that 71% of large enterprises had some backup capacity, compared to only 22% of small businesses and 12% of residential customers.

- Researchers estimate that doubling the number of customers with generation capacity could reduce losses to gross domestic product by up to 14%

Texas Freeze 2021: Widespread power outages knocked out electricity service for more than 10 million people, some for more than three days.

- The state suffered economic losses estimated to be as high as $130 billion.





The Southeast (360), South (352), Northeast (350), and Ohio Valley (301) experienced the most weather-related outages from 2000 to 2023.

Transmission Impacts from Extreme WX

Shifting the scale of the grid system to being more impervious to weather events requires an expansion of the grid in a localized approach.

- Interconnecting hubs to improve resiliency across multiple states and regions, ideally creating a national system of transmission.
- As storms get larger in size and intensity, the grid will need resiliency to feed through the backside of the storm, being able to locally respond from unimpacted areas in transmission needs.
- Ensuring a diversified portfolio of energy generation within renewables will prevent any one storm from reducing production in full and will disperse supporting energy infrastructure efficiently.

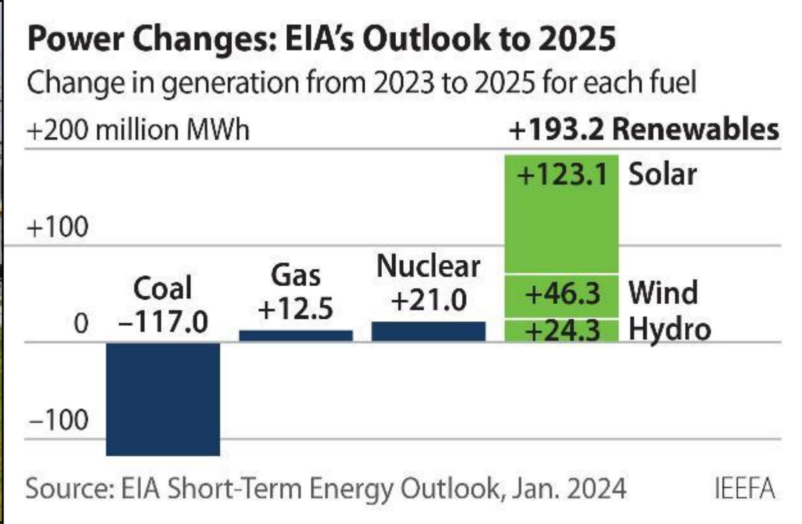
As supercells propagate across larger regions, worsening intensities outside of built norms, matching innovation progress and failure will cost more than past decades.

- A study by Texas A&M and Potsdam Institute showed that storm-proofing just 1% of the power lines in an electricity grid could reduce the chance of hurricane-induced blackouts by between fivefold and 20-fold in a study done using the Texas electricity grid.

As drought continues to prematurely decay vegetation across the nation, wildfire threats will rise, and the number of downed trees will increase.

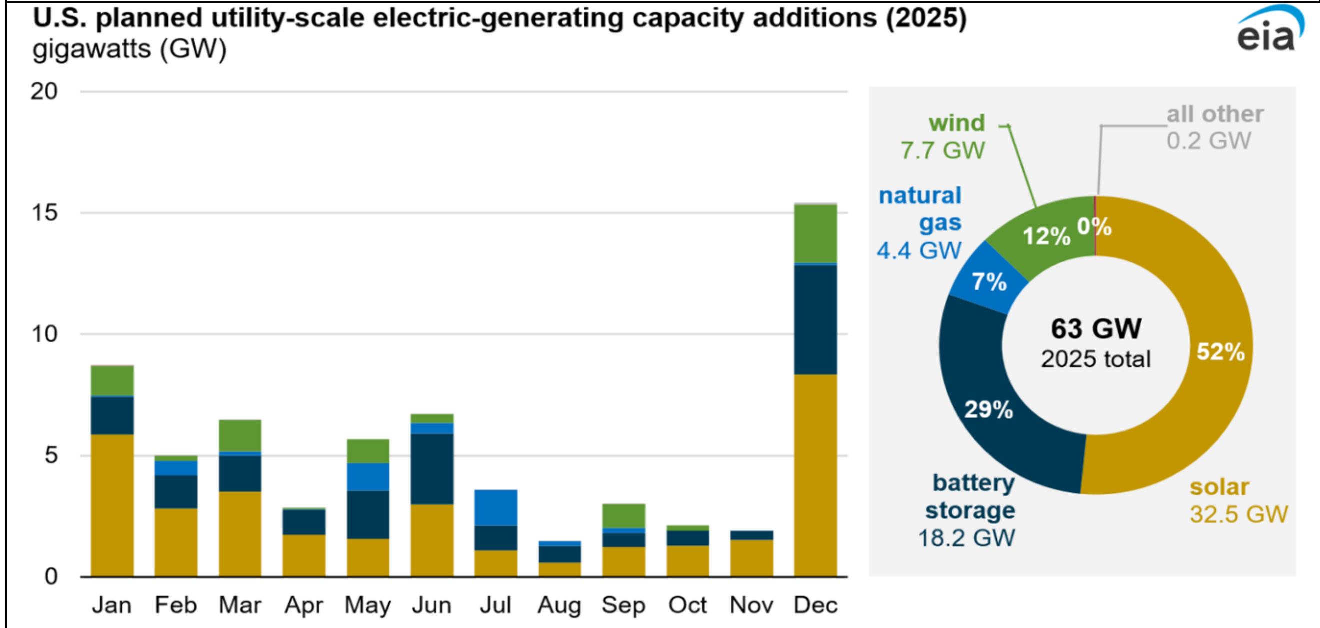
- The climate crisis is driving more extreme weather which means more heat-stressed power lines, fallen trees, flooding, and more AC usage.
- Combined, the stress on the aging infrastructure and weakening of vegetation results in more damage from each storm causing more frequent and often longer lasting outages more likely as concrete crumbles and branches fall.
- Not every region of the US will have the same level of benefit from each renewable, this will require attention to the shifts in weather patterns when planning new generation methods and ensuring to interlink and dual-purpose projects, such as floating solar on reservoirs or solar mounted dam walls.

As nations race to meet clean energy goals and combat climate change, investing in hardened assets isn't just a smart business decision—it's crucial for safeguarding the transition to a sustainable power system.



The two largest natural gas plants expected to come online in 2025 were the 840-MW Intermountain Power Project in Utah and the 678.7-MW Magnolia Power in Louisiana. Two large offshore wind plants to come online this year: the 800-megawatt (MW) Vineyard Wind 1 in Massachusetts and the 715-MW Revolution Wind in Rhode Island.

- Indiana, Arizona, Michigan, Florida, and New York each to account for more than 1 GW of added solar capacity in 2025 and collectively account for 7.8 GW of planned solar capacity additions.



Energy Use: Global Rise

New ICF Study: The global consulting and technology services company predicted that electricity demand could jump at least 25% in the next five years and as much as 78% by 2050 — findings that far outpace historical trends over the past two decades.

- Demand-side management can handle 10% of U.S. load in 2030, but annual generation deployments need to double to keep pace with expected longer-term demand.
- Service territories covering parts of Virginia, Georgia and West Texas could all see 6% growth in overall and peak load through 2035

Threat level: The consumption surge could raise retail rates by 15% to 40%, depending on the market, ICF finds.

- Demand management, efficiency and behind-the-meter tech (think home solar and storage) will be key to mitigate price spikes, ICF said.
- "Broad promotion of these programs could help meet 10% or more of electricity demand by 2030 compared to 8% in 2025."

Stunning stat: On the generation side, new power-producing capacity additions need to rise to roughly 80 gigawatts per year from 2025-2045 — around double the pace of the past five years.

- The report notes that the Energy Information Administration's 2025 annual outlook saw a 12% demand rise in 2030 in their "high" economic growth case and 9% in their "reference" case.

But adding newer data from regional grid planners — including PJM, ERCOT, MISO and parts of SERC — paint a very different picture, ICF said.

- In California, 35% of the increase through 2040 is EVs, building electrification and data centers.
- In Texas, new "large loads" like crypto-mining lead.
- In PJM, the huge mid-Atlantic and Midwest region, it's a combo of new manufacturing (including semiconductors), data centers, building electrification, EVs and more.

Electricity costs are also expected to rise and outpace inflation, with experts predicting a jump of 6% in 2025 — an average of $784 per household for the summer period.

- That would mark a 12-year record, according to a new analysis from the National Energy Assistance Directors Association.

Power Outages in US Metros

Average outage minutes per customer per month, with outliers removed.

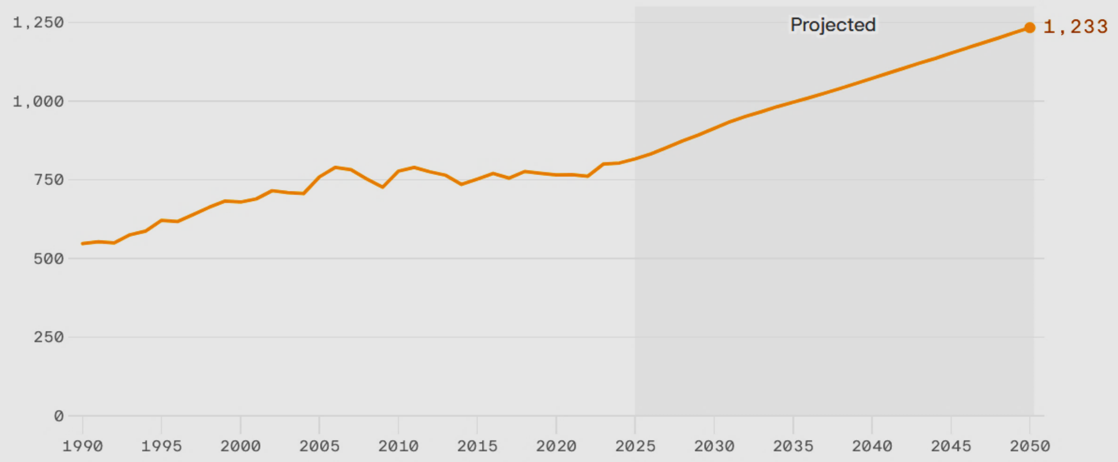
City	2018	2019	2020	2021	2022	2023	2024
Atlanta	9.9	10.9	14.9	11.1	15.3	11.0	17.5
Phoenix	5.1	6.5	6.2	7.2	8.3	6.6	7.1
Bay Area	9.6	17.1	20.2	15.4	17.2	22.2	22.9
Boston	11.4	8.5	19.9	8.7	11.1	13.2	8.5
Philadelphia	12.4	17.9	12.2	14.9	9.4	12.1	18.2
DC	9.6	11.9	10.6	12.8	13.1	9.1	10.8
Miami	9.6	9.4	9.9	9.3	8.7	10.5	9.4
Houston	14.1	23.4	20.4	19.7	21.6	21.6	19.7
Dallas	11.3	13.0	12.9	12.4	17.1	16.0	13.8
Chicago	7.4	8.9	6.3	7.5	7.2	6.3	6.4
LA	12.8	12.6	12.8	14.2	14.1	15.0	12.0
NYC	8.3	9.6	9.6	9.9	9.3	8.5	10.1

Table: Brian Potter • Source: Poweroutage.us

IFP

U.S. peak electricity demand

In gigawatts; Annually, 1990-2024, 2025-2050 projected



Data: ICF; Chart: Axios Visuals

U.S. electricity needs are slated to rise 25% by 2030 and 78% by 2050 compared to 2023, sinus-clearing estimates from the consulting firm ICF seen first by Axios show.

Meteorological Intelligence

Power outages can significantly impact physical bank locations by disrupting essential services like ATMs, payment processing, and security systems, potentially leading to temporary closures and hindering customer access to funds

According to a recent study, hackers are leveraging these weather trends to target energy systems when they are at their most critical.

The study, titled "*Operational and economy-wide impact of compound cyber-attacks and extreme weather events on power networks*", concluded that an attack carried out in the wake of a weather event increased the potential impact 3x more than a standalone cyberattack.

- Local economies could experience a 37% drop-in economic activity if faced with a compound threat.
- These events led to a 12% of energy demand going unmet and a daily GDP reduction up to 3.1%.

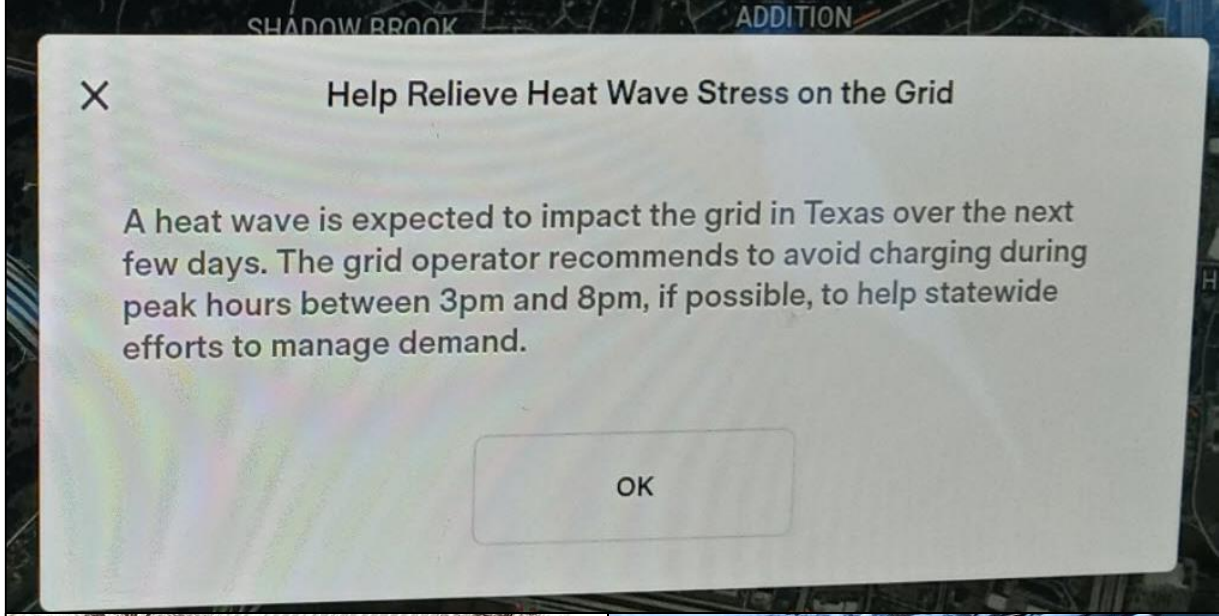
Example Event in Long Island:

- One conclusion listed a 9% increase in demand during a heatwave.
- A lone cyberattack could lead to 4% of demand going unmet.
    - Combined they could yield 12%, or nearly 200,000 customers.

HHS Office of Civil Rights states ransomware attacks on healthcare have surged by 264% over the last five years.

Vehicles may also see their touch screens lifting due to extreme temperatures as heatwaves continue to intensify in longevity and intensity.

- Many electric vehicles do not have bypass physical systems installed where users can still access certain features or in some cases even turn on the vehicle without the main dashboard screen functioning.



In 2019 a 19-year-old security researcher gained access to the digital car keys of more than 25 Tesla EVs scattered across the globe.

- From a remote location, the hacker ran programs that disabled the vehicles' security mode, unlocked their doors and opened their windows.

The 2022 Broken Wire attack: hackers wirelessly send signals to targeted electric vehicles. This causes electromagnetic interference and interrupts the connection between the EV charging station and the vehicle.

- The charging station won't provide the vehicle with a charge until the attack ends.
- There are ransomware attacks possible that could lock out the owner from operating the vehicle until the fee is paid.
- Extreme temperatures can cause electric vehicles (EVs) to charge slower and potentially for a longer duration resulting in a greater window of cyber risk.

Cross-Border Transmission System Risks

Electricity Canada: Canadians and Americans share a highly integrated electricity grid, connected by 37 cross-border transmission lines. Every Canadian province along the US border is electrically interconnected with at least one neighboring US state.

International supply chain strain: The CEO of the industry association Electricity Canada, said there is virtually nowhere the electricity grid isn't vulnerable to the rising severity and duration of climate change-related extreme weather.

A 2023 WAPA (Western Area Power Authority) study revealed: Among the highest priority items are circuit breakers and large power transformers.

- Circuit breakers interrupt fault current, protect equipment and isolate transmission lines within WAPA's area of responsibility.
    - Lead times have escalated from six months to 4.5 years for voltage classes 245-kilovolt and below and 5.5 years for 345-kV voltage classes and above.
        - Supply and demand have bumped up circuit breaker costs by 140% over the past two years.
- Transformer cost has also sharply increased to over 200% of the original pricing, surpassing the Consumer Price Index.

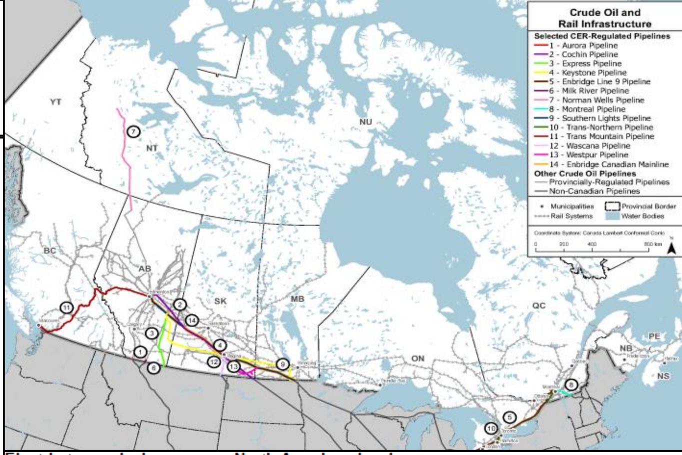
A 2022 study stated a pad-mount transformer now costs 3x more than 2019 with delivery times rising by 12 months. Large transformer manufacturing will also face major long-term issues, with demand expected to double by 2027 and the steel industry already hitting maximum capacity.

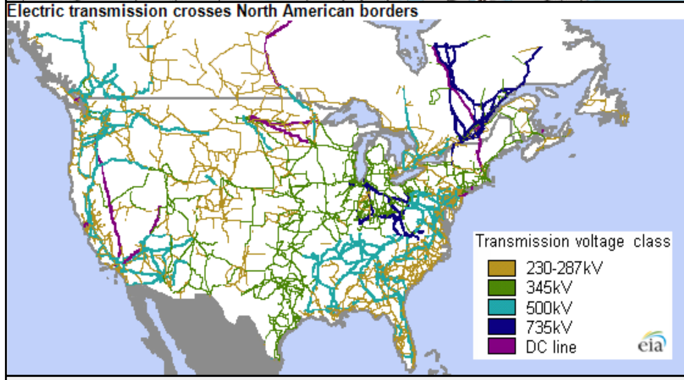
- In 2023 Canada had to cut exports to the US and even switch to import energy from the US for three months due to shortfalls in hydropower production in Canada and abroad.
- The International Energy Agency said 2023 marked "a record decline" in global hydropower generation, with other major producers like China, Turkey and the US also impacted. The IEA tied the declines to "severe and prolonged drought" in major producing regions.
    - Up to 50% of the country's dams are more than 50 years old and not designed to cope with extreme weather swings.

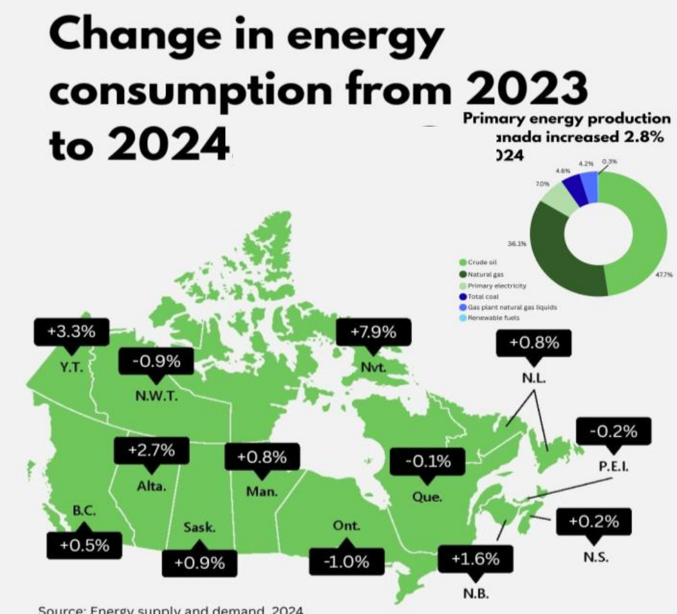
While the electric system operator issued only four provincial grid alerts in the four-year period from 2017 to 2020, there has been a significant increase, with an additional 17 alerts issued since 2021.

- Over a million customers lost *power* and hundreds of *electrical* poles were damaged when an ice storm tore through Ontario in March 2025.
    - The Canadian Disaster Database has 800 events from 1900-2024 from extreme weather events, with 305 occurring in from 2000-2024, or 38% of all reported weather disasters.

Without access to Canadian electricity, Americans could face higher costs or even blackouts and system failures, potentially affecting grid reliability.







SwissRE: Extreme Heat and Insurance

Extreme heat poses a growing threat to the insurance industry, with property, specialty and L&H business most exposed. It increases the risk of electrical outages and wildfire risk, and can damage and cause disruption to transport, water and energy infrastructure, thus driving up property and specialty claims.

- During June 2023-April 2024, there were 76 heat waves in 90 countries impacting over 6 billion people (about 78% of the global population) with at least 31 days of extreme heat.
    - Since 1991, such conditions have become twice as likely to occur.

According to the World Economic Forum (WEF), conditions of extreme heat will likely cause damage to corporate fixed assets, driving annual losses of USD 404-448 billion across all listed companies by 2035.

- As of 2020, around 71% of the world's working population was exposed to excessive heat.
    - Hot weather has impacted ambulance call-out response times and led to cancellations of surgeries and overheating in surgical theatres.
- Global insured losses due to wildfires have risen in the last decades, reaching $74 billion during 2014-2023.

Impacts of extreme heat by sector

Energy

- Extreme heat increases demand for electricity demand, stressing the power grid and increasing the risk of blackouts and power shortages.
- It affects thermoelectric power generation by impacting water availability and temperature, both critical for cooling operations.
- Power transmission becomes inefficient in high temperatures, reducing the capacity of generators, transformers and transmission lines.
- Solar panels and wind turbines also experience reduced efficiency.

Transportation

- High heat can cause road ruts, buckling and pavement cracking, leading to damage to rail tracks, bridges, and power cables for railways and streetcars.
- Train rails and bridges are vulnerable to heat-induced deformation.

Construction

- Extreme heat can damage building materials, accelerate rust, and cause steel and iron beams to expand, leading to structural vulnerabilities.

Telecommunications

- High risk due to sensitivity of data centers and network infrastructure to extreme heat, more so where there are limitations to access to water.
- Fixed asset losses projected at USD 518-563 million/year by 2035.
- Extreme heat can cause terrestrial cable materials to expand and contract, leading to sagging, equipment malfunction, and insulation degradation.
- Strain on data center cooling systems, potentially leading to overheating or equipment failure.

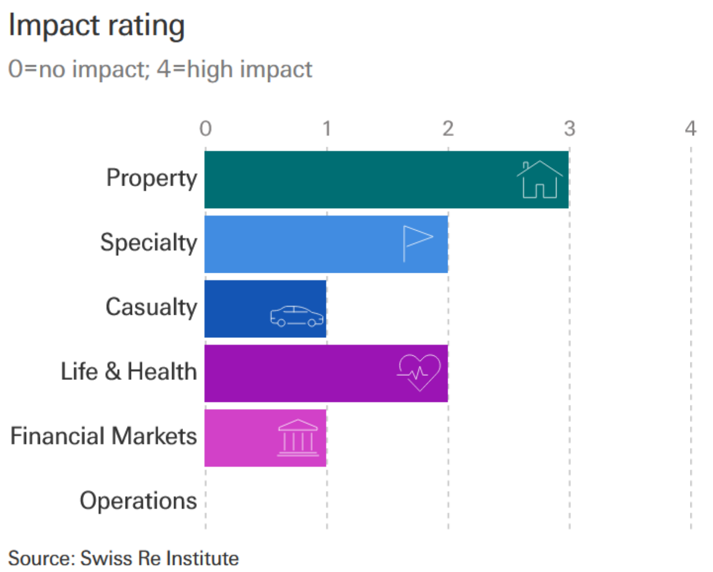
Batteries

- Prolonged exposure to temperatures above 30°C can cause pre-mature degradation of lithium-ion batteries.
- Battery degradation can reduce electric vehicle range by 20%. Elevated risk of thermal runaway, which can potentially lead to battery fire or explosion.

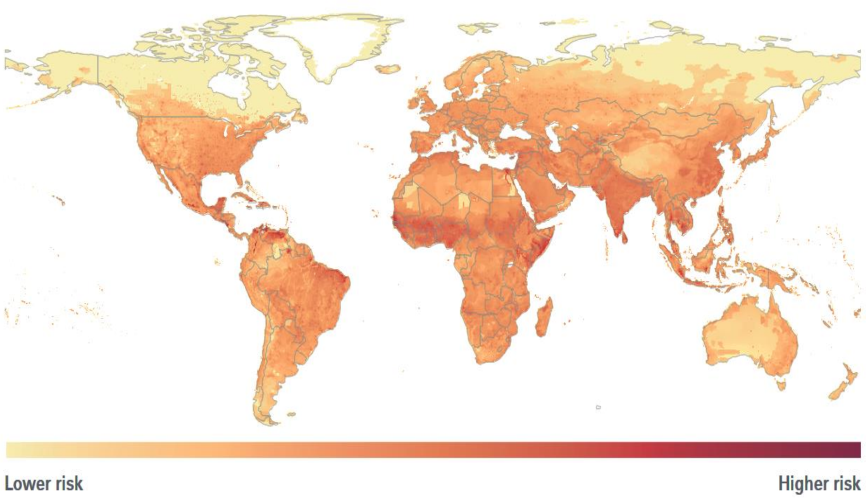
Agriculture

- Extreme heat and drought cause economic losses in forest productivity and also crop and livestock farming.

Potential insurance impacts



Regions of extreme heat risk by 2040*



*Note: as a function of a) population in 2040 (as a proxy for people and assets exposed; this would exclude agricultural assets and nature) and b) change in number of days per year above 35°C between 2005 and 2040 for "intermediate" climate change scenario SSP2-4.5. Source: Gao J. GeoTIFF_SSP2_total_2010-2050.zip, Global 1-km Downscaled Population Grids, SSP-Consistent Projections and Base Year, v1.01 (2000–2100), Harvard Dataverse, vol 1, 2020; CMIP6 climate projections, 2021 and ERA5 hourly data on single levels from 1940 to present, 2023, Copernicus Data Store, Climate Change Service; Swiss Re

NOV 12, 2025 12:43 PM ET

How Climate Change Can Lead to Earthquakes

Article | Open access | Published: 10 November 2025

Accelerated rifting in response to regional climate change in the East African Rift System

Hydropower Is Getting Less Reliable as the World Needs More Energy

Demand for power is growing fast, but hydro plants, the oldest source of clean energy, are struggling because of droughts, floods and other extreme weather linked to climate change.

Coldest winter in decades about to hit Delhi, Gurgaon, Noida, Ghaziabad and Faridabad? Experts reveal how La Niña could chill India in 2025–26

TOI Trending Desk / etimes.in / Updated: Sep 30, 2025, 16:31 IST

Share

AA

Meteorologists predict a possible La Niña event. This climate pattern could bring colder winters to India in 2025-26. The US Climate Prediction Center issued a La Niña Watch. The India Meteorological Department also sees signs of a colder winter. La Niña may

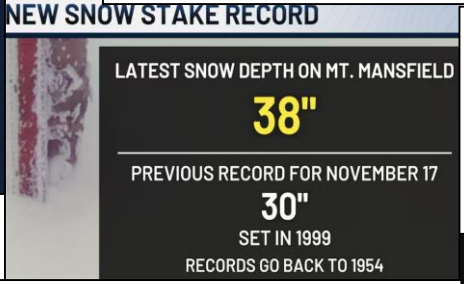
Santa Barbara Drenched in Historic Rainfall, Breaking 127-Year Record

County Sees 460 Percent of Normal-to-Date Rainfall with More Rain Still to Come This Week

By **Ella Heydenfeldt**
Mon Nov 17, 2025 | 2:41pm

Taps run dry as water crisis forces Iran to consider evacuating its capital

A prolonged drought along with years of overconsumption, an inefficient agricultural sector and mismanagement have led to the problem, analysts say.



Record-breaking November heat wave expands across the South after major deep freeze for millions

The heat surge isn't done yet, with the warmth shifting to the Southern Plains and Southeast this week. Over 100 million Americans are expected to experience warmer-than-normal temperatures to start the week.

Rainfall causes floods in parts of drought-stricken Iran

By **Reuters**

November 17, 2025 9:54 AM EST · Updated November 17, 2025

October 2025 was the planet's third-warmest October on record

Only October 2023 and October 2024 were warmer.

by JEFF MASTERS
NOVEMBER 10, 2025

Giant hail causes injuries and damage to cars, homes across south-east Queensland

By Queensland reporters

Weather Warnings

Sat 1 Nov

Strong winds in New Zealand leave tens of thousands without power

23 October 2025

Koh Ewe

Salt Lake breaks all-time record for amount of rain in October two weeks into month

by Aubree B. Jennings, KUTV | Tue, October 14, 2025 at 8:14 AM

WEATHER

A wild weather ride: From storms to a record-challenging freeze!

by: Miller Hyatt
Posted: Nov 9, 2025 / 12:35 AM EST
Updated: Nov 9, 2025 / 12:35 AM EST

Global Data Centers: Extreme Weather Risks

China: At least 41% of China's national data center racks are in regions that are highly prone to drought and at least 28% are in areas that are highly prone to floods; at least a fifth are very prone to both. CWR estimates China's data center water consumption to be ~1.3 billion m3 today but could exceed 3bn m3 by 2030.

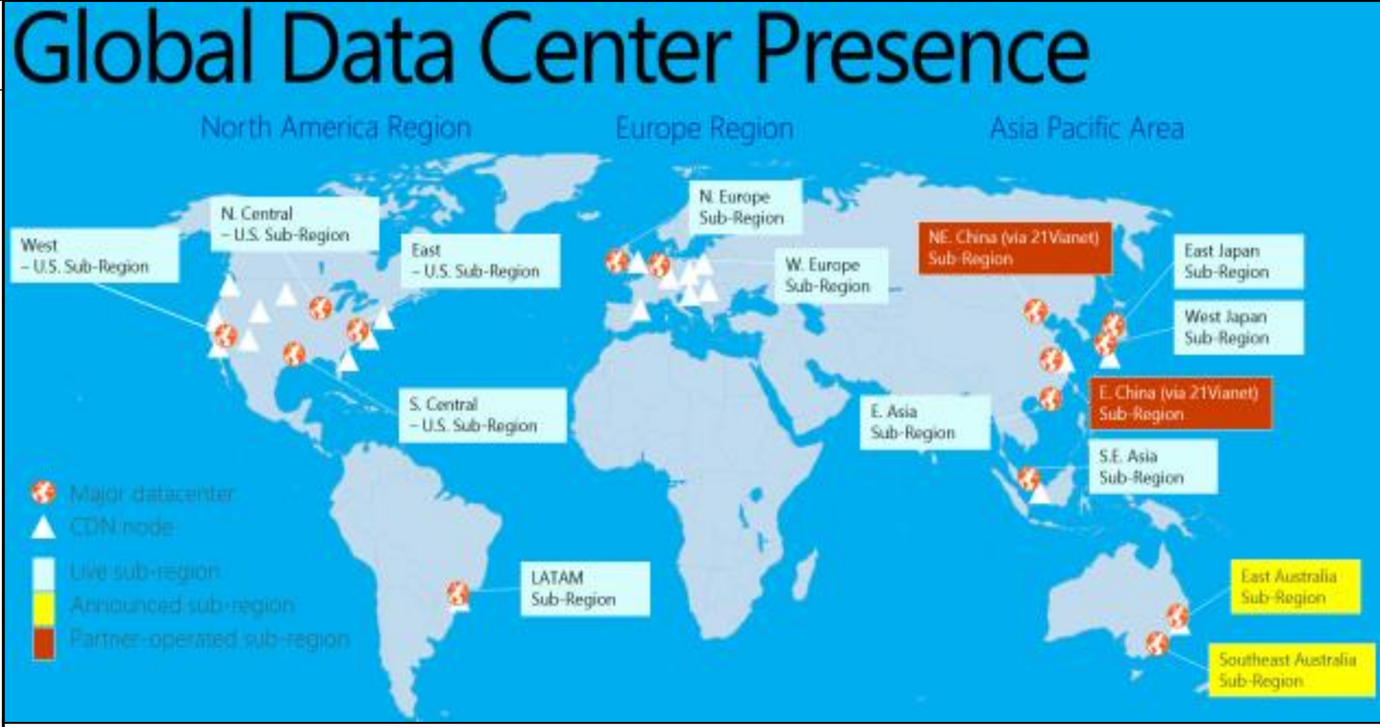
- 56% of China's data center racks are in coastal regions which are vulnerable to storm surge and sea level rise.
- The number of data center racks in China grew 27% from 4.3 million in 2020 to 5.4m in 2021 and expects racks to grow to 11.3m by 2030.

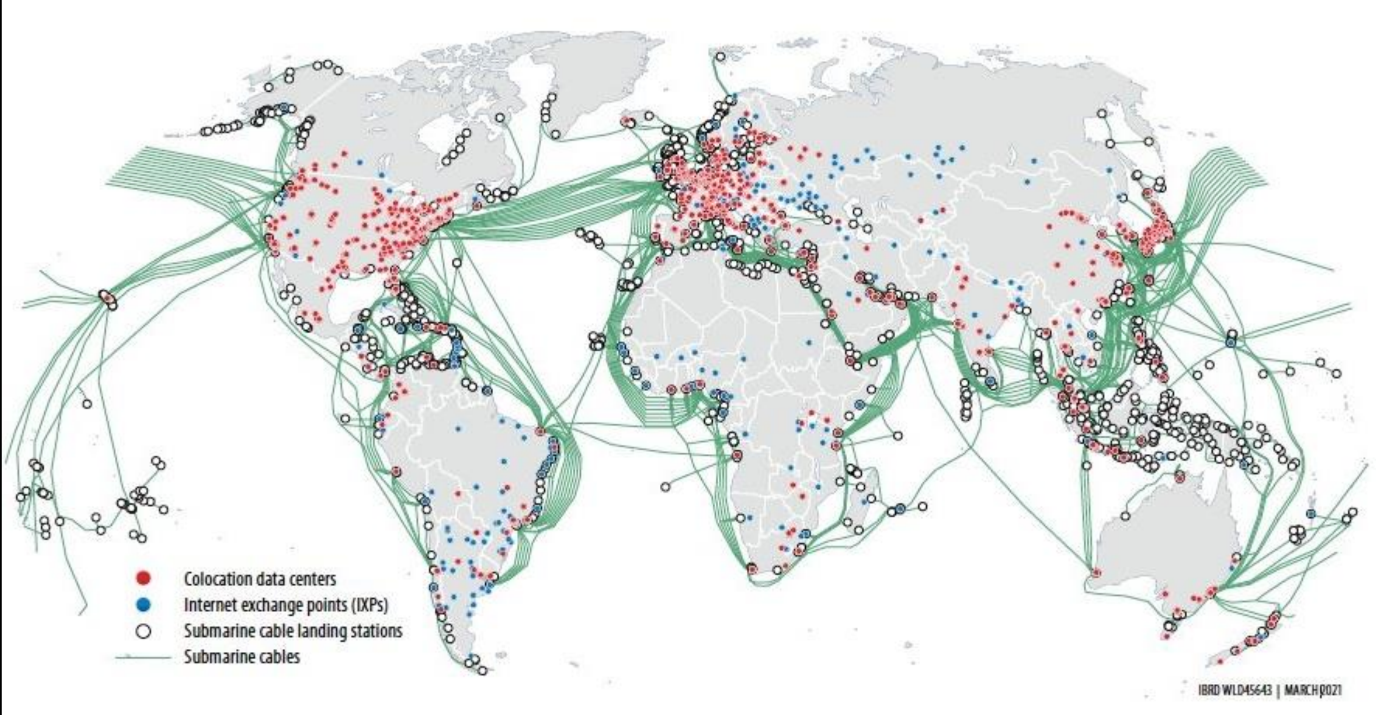
India: India's drought-prone regions have increased by 57% since 1997. Much of the country's data center infrastructure is in drought-prone or flood-risk areas like Mumbai, New Delhi, Bangalore, Pune, and Chennai. India's data center capacity is set to increase 4x to 2.01 thousand MW in 2024.

- Bengaluru, India's Silicon Valley, faces acute water shortage, with a daily deficit of 500 million liters impacting 16 data centers for banking, e-commerce, and cloud services.

Ireland: April 2024 drought, heat, and overall energy requirements resulted in Eirgrid, Ireland's power network, to limit supply to larger users such as data center operators. Amazon's cloud platform subsequently periodically limited access to its Ireland-based eu-west-1 region.

- Ireland is home to +80 data centers and is one of Europe's most active markets. Amazon has multiple campuses in Dublin, in Blanchardstown, and one further south in Tallaght. Last year it received planning permission for three new data centers at its existing site in Dublin.
- Figures published last year by Ireland's Central Statistics Office showed that data center power consumption in the country increased by 31% in 2022, accounting for 18% of all electricity used in Ireland.
- In 2021 data centers used near 17% of the country's power generation and use more metered electricity than all of Ireland's homes combined.
    - International Energy Agency stated data centers could use 32% of Ireland's power by 2026 due to the number of new builds planned.



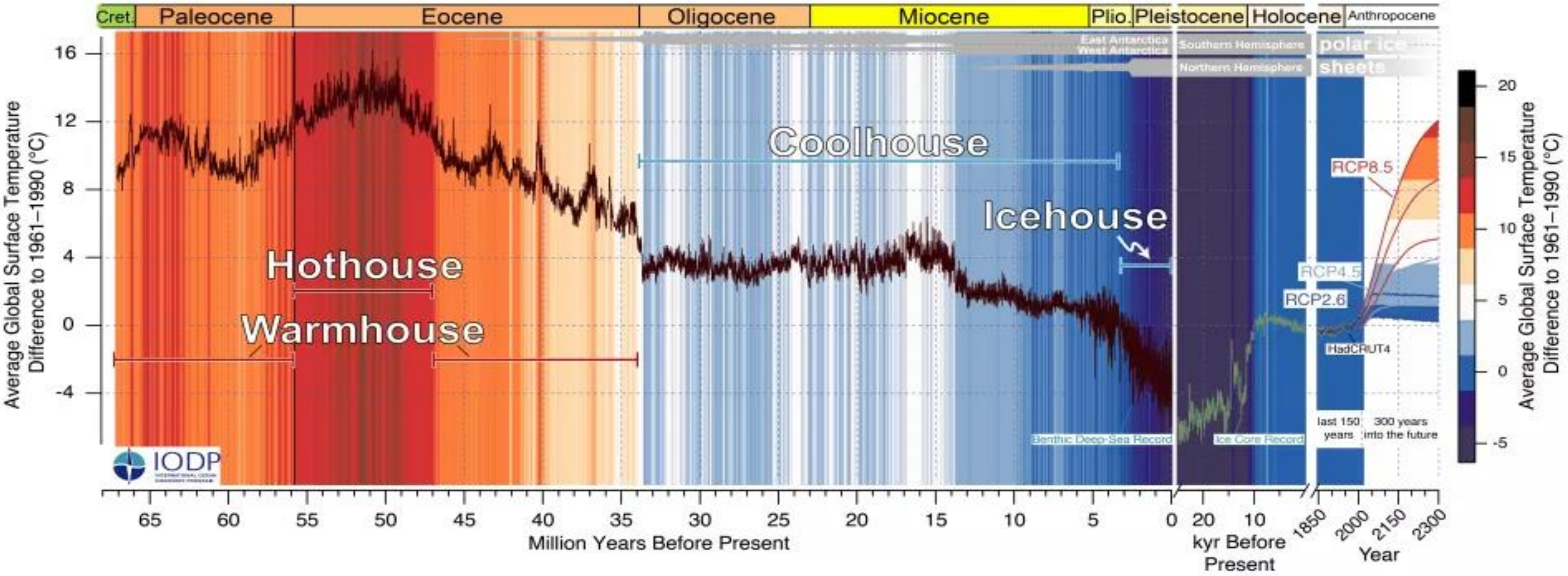


Defined Threat: Condensed Period to Adjust

The change in heating is not just that it is baseline creeping upwards, it is that we built to norms from a window of time in stable conditions that we will not be returning to during the next few lifetimes. This means infrastructure was simply not build to withstand.

- The weather hazards defined in previously slides will amplify rapidly in coming decades as the temperature continues to rise.
- Acclimation periods will reduce rapidly as temperatures varying outside of human capacity, materials will face comparable strain.

When comparing the historic warming period, it is critical to annotate which materials shift from rapid heating and may push against or pull away from partnered materials or stress the binding type.



CONTACT

Chief Meteorologist Sunny Wescott

LinkedIn: https://www.linkedin.com/in/sunnywescott/

- Email: Sunny@unlimitedweather.com
  - Federal: Sunny.Wescott@cisa.dhs.gov
- Download: https://linktr.ee/swescott

HELPFUL STARTS

- NOAA Repository:

https://www.ncei.noaa.gov/cdo-web/

- Frontal Boundaries:

https://aviationweather.gov/gfa/#progchart

- Infographics:

https://www.climatecentral.org/

- World Meteorological Organization:

https://wmo.int/topics/extreme-weather

Standards

FORWARD TOGETHER RELIABILITYFIRST

STANDARDS UPDATE

Mallory Carlone, Operations and Planning, Compliance Monitoring

December 3, 2025

Washington, DC

RELIABILITY FIRST

OVERVIEW

- FERC Orders
- High Priority NERC Projects
- IBR/DER NERC Projects
- Standards Voting
- Newly Effective Standards

FERC ORDERS

- **Order No. 896 (June 2023):** This directive is to ensure the electric grid can operate reliably during these extreme events by creating benchmark planning cases, performing detailed stability and wide-area analyses, and developing corrective action plans for identified weaknesses.
- **Order No. 901 (October 2023):** This directive requires NERC to develop comprehensive Reliability Standards for IBRs (such as wind and solar generators) over a three-year period.

STANDARDS UNDER DEVELOPMENT

- NERC 2025-2027 Reliability Standards Development Plan
  - Emphasis on **cybersecurity**, **extreme weather resilience**, and **integration of renewable resources**.
  - **High Priority:** Projects linked to FERC directives and NERC Board goals (IBR modeling, CIP-014 risk assessment refinement, etc.).
  - Major initiatives tied to **FERC Order 901 milestones**, extreme weather planning (FERC Order 896), and cybersecurity (CIP-015).
- NERC Projects Page
  - Current ranking of all projects

NERC PROJECTS – HIGH PRIORITY

High Priority Criteria

- NERC or FERC directive with a set due date;
- NERC work plan priority;
- Compliance feedback or study to address a specific risk; or
- Stakeholder feedback to address a specific risk

High Priority Projects

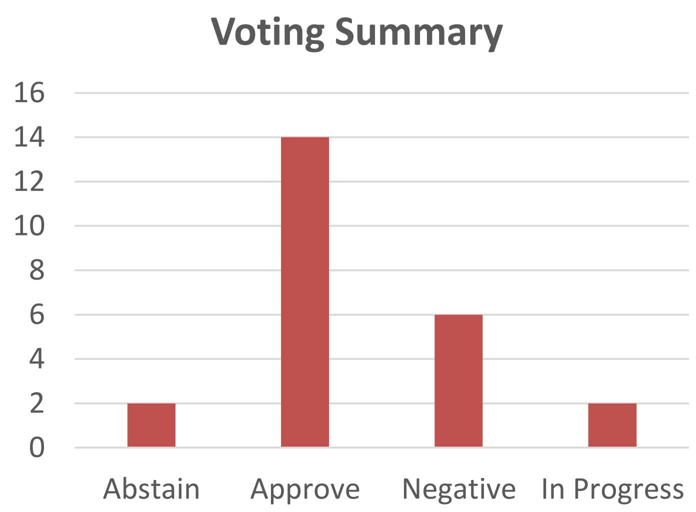
- **Project 2023-06:** CIP-014 Risk Assessment Refinement; CIP-014-3
- **Project 2024-02**: Planning Energy Assurance; TPL-001-5.1
- **Project 2025-02:** Internal Network Security Monitoring (INSM); CIP-002 – CIP-015
- **Project 2025-05:** Ride-Through Revisions; PRC-024-4 and PRC-029-1
- **Project 2025-06:** Supply Chain Risk Management; CIP-005, CIP-010, and CIP-013

NERC PROJECTS – IBR/DER RELATED

- **IBR/DER-related projects to address FERC Order No. 901**
  - **Project 2020-06**: Verifications of Models and Data for Generators; MOD-026, MOD-027
  - **Project 2021-01**: System Model Validation with IBRs; MOD-025, MOD-033, PRC-019
  - **Project 2022-02**: Uniform Modeling Framework for IBR; Phase One: MOD-032, IRO-010, TOP-003 and Phase Two: TPL-001-5.1 and MOD-032-1
  - **2025-03**: Operational Studies; FAC-011, IRO-002, IRO-017, PRC-012, TOP-001, and TOP-002
  - **2025-04**: Planning Studies; TPL-001-5.1, MOD-026, MOD-032, MOD-033, PRC-024, PRC-028, PRC-029
- **IBR/DER Related Projects**
  - **Project 2022-04**: EMT Modeling; FAC-001, FAC-002, MOD-032, and TPL-001 (Med)
  - **Project 2021-02**: Modifications to VAR-002-4.1; VAR-002
  - **Project 2023-05**: Modifications to FAC-001 and FAC-002; FAC-001-4, FAC-002-4
  - **Project 2023-08:** Modifications of MOD-031 Demand and Energy Data; MOD-031

STANDARDS VOTING IN 2025

Project Name	Stage	Vote	Date of Submission
2023-06 CIP-014-4 - Risk Assessment Refinement - Draft 2	Complete	Negative	11/4/2024
Project 2023-07 Transmission System Planning Performance Requirements for Extreme Weather	Complete	Approve	11/21/2024
Project 2022-03 Energy Assurance with Energy-Constrained Resources	Complete	Negative	12/4/2024
Project 2023-07 Transmission System Planning Performance Requirements for Extreme Weather Final Ballot	Complete	Approve	12/10/2024
Project 2024-03 Revisions to EOP-012-2	Complete	Approve	12/20/2024
Project 2022-04 EMT Modeling	Complete	Negative	1/10/2025
EOP-012 review	Complete	Approve	3/12/2025
2024-01 Rules of Procedure Definitions Alignment (GO and GOP)	Complete	Approve	5/7/2025
Project 2020-06 Verification of Models and Data for Generators	Complete	Approve	5/12/2025
Project 2022-02 Uniform Modeling Framework for IBRs	Complete	Approve	5/16/2025
Project 2021-01 System Model Validation with IBRs	Complete	Approve	5/21/2025
Project 2020-06 Verifications of Models and Data for Generators	Complete	Approve	6/18/2025
Project 2020-06 Verifications of Models and Data for Generators	Complete	Approve	7/10/2025
Project 2024-01 Rules of Procedure Definition Alignment	Complete	Approve	7/17/2025
Project 2023-06 CIP-014 Risk Assessment Refinement	Complete	Negative	7/17/2025
Project 2023-07 Transmission System Planning Performance Requirements for Extreme Weather Part II	Complete	Abstain	8/6/2025
2026-2028 Reliability Standards Development Plan	Complete	Approve	9/10/2025
Project 2022-02 - Uniform Modeling Framework for IBR	Complete	Abstain	9/10/2025
Project 2021-01 System Model Validation with IBRs	Complete	Approve	9/10/2025
Project 2025-03 Order No. 901 Operational Studies	Complete	Negative	10/1/2025
Project 2025-04 Order No. 901 Planning Studies	Complete	Negative	10/7/2025
Project 2022-04 EMT Modeling	In Progress		
Project 2024-02 Planning Energy Assurance	In Progress		
Project 2025-05 Ride-through	In Progress		



EXAMPLES OF CONCERNS

2022-03 ENERGY ASSURANCE WITH ENERGY-CONSTRAINED RESOURCES

- Significant concern that a BA could develop a process which would preclude having to perform studies

2023-06 CIP-014-4 RISK ASSESSMENT REFINEMENT

- Standard does not define specific types and/or timing of physical attacks to be evaluated.
- Consideration of minimum voltage and thermal thresholds during generation and load loss.
- Details around frequency expectations.
- Faults that should be run and associated clearing times.

2025-03 OPERATIONAL STUDIES; 2025-04 PLANNING STUDIES

- It is not clear if the SAR is written for Real Time of offline analysis
- PCs/TPs need flexibility to establish consistent modeling guidelines and validation techniques.

NEW STANDARDS 2025

Q1

None

Q2

PRC-002-5;
New Version

PRC-028-1;
New Standard

Q3

IRO-010-5;
New Version

TOP-003-6.1;
New Version

Q4

EOP-012-3;
New Version

TOP-002-5;
New Version

PRC-028-1:

- PRC-002-5 excludes IBRs, which are now covered under PRC-028-1.
- PRC-028-1 requires disturbance monitoring equipment for existing and new facilities with IBRs.

NEW STANDARDS 2026

Q1	Q2	Q3	Q4
None	CIP-003-9; New Version	CIP-012-2; New Version	PRC-024-4; New Version
	TPL-008-1; **New Standard**		PRC-029-1; **New Standard**
			PRC-030-1; **New Standard**
			TOP-003-7; New Version

TPL-008-1:

- Introduces Transmission System Planning Performance Requirements for Extreme Temperature Events.

PRC-029-1:

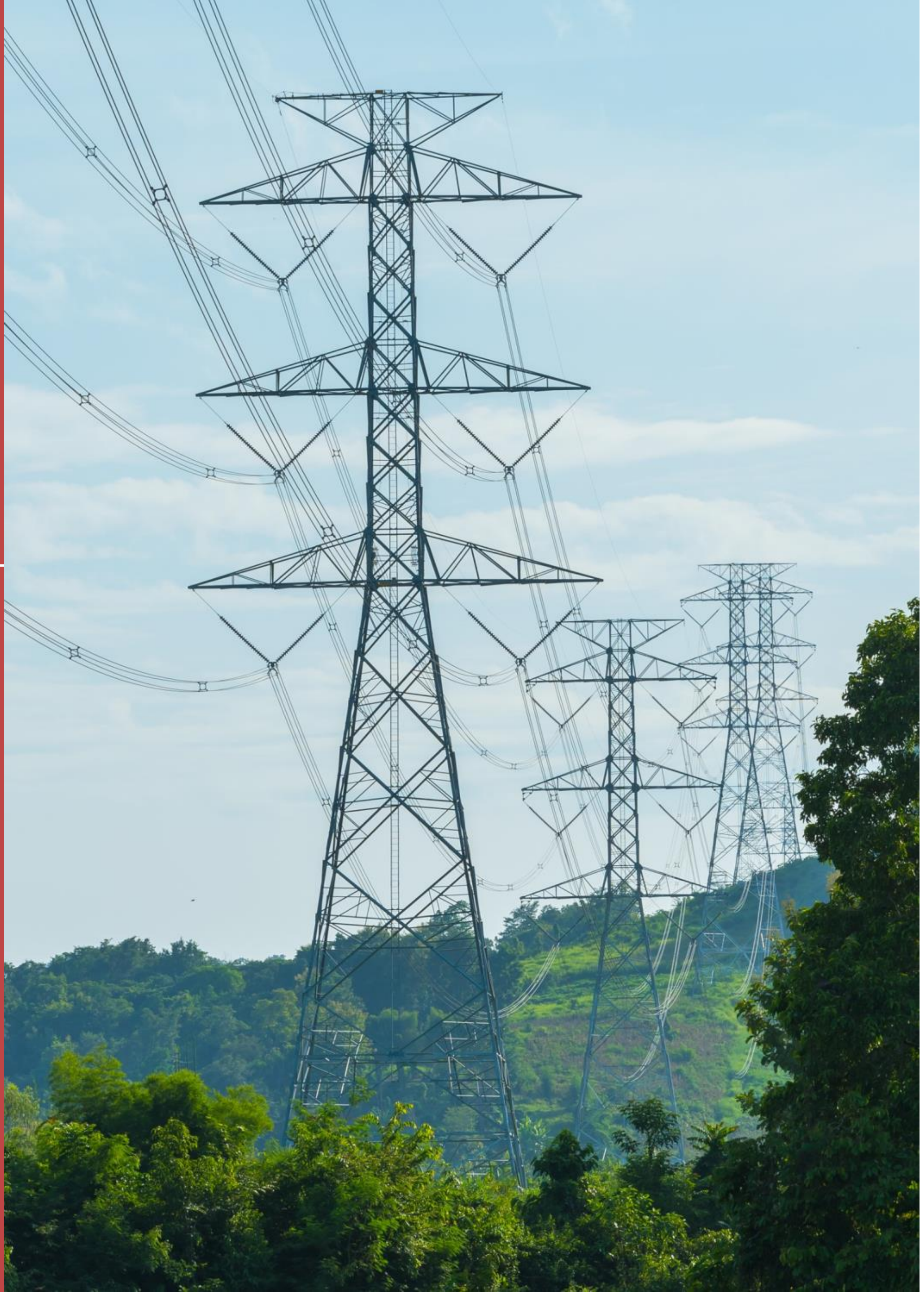
- PRC-024-4 applies only to synchronous machines, while PRC-029-1 adds: Disturbance monitoring and data collection to improve generator ride-through performance during system disturbances.

PRC-030-1:

- Introduces Unexpected Inverter-Based Resource Event Mitigation. Addresses reliability risks from unexpected or unwarranted performance of Bulk Electric System (BES) Inverter-Based Resources (IBRs) during grid disturbances.

NEW IBR STANDARDS

- **Why does it matter?**



QUESTIONS & ANSWERS

RELIABILITY FIRST

RISK AND COMPLIANCE COMMITTEE CHARTER

The Board of Directors of ReliabilityFirst Corporation ("ReliabilityFirst") has established a Risk and Compliance Committee (the "Committee") with the general responsibilities and specific duties as described below.

COMPOSITION

The Committee shall be comprised of a least five (5) directors and all of the independent directors according to independence standards established under the governance guidelines adopted by the Board (the “Governance Standards”). Committee members shall be elected by the Board at its annual meeting and shall serve until their successors are duly elected and qualified. The Committee shall have a chair and a vice chair. The vice chair shall assume the duties of the chair in the absence of the chair at any meeting. The Committee's chair and vice-chair shall both be independent directors designated by the full Board upon the recommendation of the Nominating and Governance Committee.

RESPONSIBILITY

The primary purpose of the Committee will be to: (i) oversee the processes, procedures and program used by ReliabilityFirst to monitor compliance with and enforce Reliability Standards (including Regional Standards) in the Region in an effective, efficient, and risk based manner, (ii) monitor the results achieved through the compliance and enforcement activities of ReliabilityFirst, and (iii) oversee ReliabilityFirst’s approach to addressing significant risks to the grid.

The Committee shall have the sole authority to retain, and approve the fees and other retention terms of, legal and other advisors, as it deems necessary for the fulfillment of its responsibilities.

ATTENDANCE AND VOTING

Members of the Committee should endeavor to be present, in the designated format, (in-person or virtual), at all meetings. Three (3) Committee members shall constitute a quorum, provided a majority of the members at a meeting are independent directors. Each member of the Committee, including the chair, shall be entitled to one vote on each matter presented before the Committee. Action by the Committee may be taken at any duly called meeting at which a quorum is present upon the vote of a majority of the members present.

MINUTES OF MEETINGS

Minutes of each meeting shall be prepared and sent to Committee members for approval at the next regularly scheduled meeting and thereafter publicly posted on ReliabilityFirst's website. The Committee's minutes will be kept by the person so designated by the chair with a copy retained by the Secretary of ReliabilityFirst.

SPECIFIC DUTIES

The Committee will:

1. Review and evaluate the effectiveness, efficiency, and risk-based approach of ReliabilityFirst's compliance monitoring and enforcement programs and ReliabilityFirst's approach to addressing broader grid risks.

2. Recommend for adoption by the Board amendments to or modifications of the compliance monitoring and enforcement program, as necessary or appropriate.

3. Review the current state and composition of the ReliabilityFirst compliance registry for Registered Entities in the Region.

4. Review ReliabilityFirst's regional risk assessment and oversee facilitation and ensure effectiveness of the ReliabilityFirst stakeholder advisory and technical committees.

5. Review ReliabilityFirst's approach to significant enforcement actions relating to violations of Reliability Standards.

6. Consider any input provided by Registered Entities on risk and compliance issues and ReliabilityFirst's activities.

7. Perform other activities as requested by the Board.

8. Conduct an evaluation of the Committee's performance and charter at least annually, and adopt such Committee Charter changes, as the Committee deems appropriate, subject to approval by the Board

9. Report regularly to the Board regarding the Committee's activities.

ADOPTION AND APPROVAL

As adopted by the Compliance Committee on August 23, 2023, approved by the Board of Directors on August 24, 2023.

Summary of Performance of Specific Duties for 2025

RELIABILITY FIRST

SUMMARY OF RISK AND COMPLIANCE COMMITTEE'S PERFORMANCE OF SPECIFIC DUTIES FOR 2025

Revision: November 20, 2025

	Required Activity	Outcome	Performed Activity
1.	Review and evaluate the effectiveness, efficiency, and risk-based approach of ReliabilityFirst's compliance monitoring and enforcement programs and ReliabilityFirst's approach to addressing broader grid risks.	Complete	Accomplished during April meeting by Lindsey Mannion, Distributed Energy Resource (DER) Aggregators and Cybersecurity Risk; Accomplished by Soo Jin Kim in April, Standards Overview and Update; Accomplished in April, August and December by Enforcement Data Consent Agenda item(s).
2.	Recommend for adoption by the Board amendments to or modifications of the compliance monitoring and enforcement program, as necessary or appropriate.	Not Applicable	Not applicable this year to date
3.	Review the current state and composition of the ReliabilityFirst compliance registry for Registered Entities in the Region.	Complete	Accomplished in August by Matt Thomas in closed session through discussion of IBRs. Also, written materials provided to Committee in December.
4.	Review ReliabilityFirst's regional risk assessment (RRA) and oversee facilitation and ensure effectiveness of the ReliabilityFirst stakeholder advisory and technical committees.	Complete	Accomplished in August by Mark Lauby, NERC State of Reliability Report. Note that the RRA is updated every two years. In May, 2024, Mr. Gest provided an overview of the RRA. In addition, RF staff has had multiple discussions in 2025 with the Committee Chair regarding the details of the RRA, the technical committees and their involvement in the RRA, and a process to mature the RRA going forward. Written materials relating to the technical committees also provided to the Committee in December.
5.	Review ReliabilityFirst's approach to significant enforcement actions relating to violations of Reliability Standards.	Complete	Accomplished during May, August, and December meeting (Reviewed Confidential Compliance & Enforcement Matters) by Kristen Senk and Matt Thomas.
6.	Consider any input provided by Registered Entities on risk and compliance issues and ReliabilityFirst's activities.	Complete	Presentation in April on MISO Trends and Challenges by Dr. Renuka Chatterjee; Presentation in August on DTE Technology and Security Challenges and Updates by Steve Ambrose and Jason Smith.
7.	Perform other activities as requested by the Board.	Complete	Accomplished throughout the year.
8.	Conduct an evaluation of the Committee's performance and charter at least annually, and adopt such Committee Charter changes, as the Committee deems appropriate, subject to approval by the Board	Complete	Accomplished in December, presenter Matt Thomas.
9.	Report regularly to the Board regarding the Committee's activities.	Complete	Accomplished during every Board of Directors meeting by Committee Chair or Co-Chair