

State of the Interconnection 2025



The Independent Voice of Bulk Power System Reliability in the Western Interconnection



2024 was marked by significant change. Set against a backdrop of shifting energy policies, new regulations, extreme effects of aridification, and ongoing reshaping of the power system, the Western Interconnection continues to face challenges in key areas like the integration of IBRs, proliferation of large loads, and ever-increasing cyber and physical security threats. Working through these challenges without industry partners reaffirms our mind-set about the critical role the electric system plays in sustaining the health, prosperity, and daily lives of the people and communities in the West.

This year's State of the Interconnection report looks at the forces that shaped the power system over the last year. The report evaluates the health of the system through key indicators of system performance and highlights some of the ways WECC and its partners are addressing challenges.

Through this report, WECC aims to share an overview of how the Western Interconnection—one of the most complex machines ever built—meets the challenges of a changing world while ensuring reliable power for millions of people.



—Melanie Frye, WECC President & CEO



WESTERN INTERCONNECTION AT A GLANCE



State of the Interconnection 2025

Load

WESTERN INTERCONNECTION
LOAD AT A GLANCE

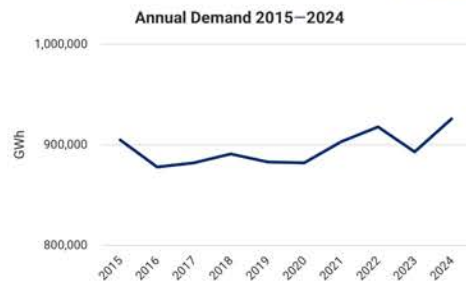
Key Takeaways

Load growth is a primary driver of power system planning and an important factor to consider in evaluating system performance. In 2024, the Western Interconnection broke records for both annual demand and peak demand.

- 2024 annual demand was 926,000 GWh, surpassing the previous record of 918,000 GWh set in 2022.
- Peak demand was 168.2 GW in 2024. The West has broken peak demand records in three of the last five years (2020, 2022, 2024).

The sharp increase in annual demand in 2024 reflects some early effects of large load development. As the development of large loads grows, particularly data centers, forecasting accuracy will become increasingly critical. There is high uncertainty about future large loads, which makes planning for them difficult. The West must find a way to deal with this uncertainty to plan an adequate system.

Historical Demand



In 2024, the Western Interconnection reached an all-time high annual demand of 926,000 GWh. This was an increase of 3.7% over 2023's annual demand of 893,000 GWh. The increase in annual demand between 2023 and 2024 is greater than any single-year increase in the last decade and far surpasses the annual average growth rate of 0.4% over the last 10 years.



Peak demand in the Western Interconnection has increased 8.5% in the last 10 years, from 155 GW in 2015 to 168.2 GW in 2024. Set on July 10, 2024, this is a record high for the Western Interconnection. Record peak demand highs have been set in five of the last 10 years.



Large Loads

The interconnection is already experiencing the effects of large loads. The magnitude of the annual demand increase in 2024 reflects the early effects of new large loads and increased uncertainty. Demand growth is higher today than at any other time in the last 20 years. In 2024, WECC partnered with Elevate Energy Consulting to create the [Assessment of Large Load Interconnection Risks in the Western Interconnection](#). The report points out several challenges associated with large loads:

- Modeling challenges in representing the dynamics of large load behavior
- Planning challenges associated with different timelines for adding large load, resources, and transmission
- Data challenges with predicting how many of the planned large loads will come to fruition
- Operational challenges with large load demand fluctuations
- Lack of well-defined interconnection requirements

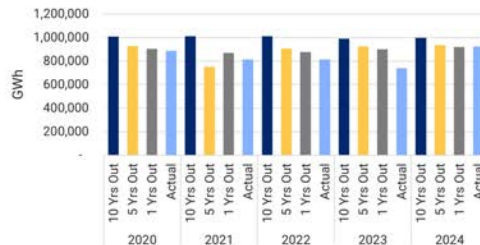
Arizona Public Service contends with influx of large loads

Arizona has become a hub for large loads in recent years. Arizona Public Service (APS), the state's largest electric utility, has experienced this trend firsthand. The utility expects its annual energy needs to grow by almost 24 GWh between 2023 and 2038, with almost 80% of that growth tied to data centers and large industrial and manufacturing facilities, particularly in the semiconductor chip manufacturing industry. 

Although there is some uncertainty regarding the rate of growth, APS projects that its annual peak demand will grow by nearly 40% from 2023 to 2031. This poses challenges to APS in both operations and planning.

APS plans to meet this future demand by using current and new resource technologies that balance reliability and affordability with increasingly clean energy resources. Even with current forecasts that show additional customer on-peak resources of more than 750 MW of distributed solar generation and 1,300 MW of energy efficiency by 2038, APS expects it will need to add more than 12,000 MW to meet peak load requirements over this period.

Comparison of Forecast v. Actual Demand
2020–2024



Demand Forecasting Accuracy

Over the last five years, annual demand forecasts have been relatively close to actual demand when aggregated to the interconnection-wide level. Ten-year forecasts are typically more conservative, tending toward overestimating demand, and as the operating year nears, demand forecasts improve. However, at the individual Balancing Authority (BA) level, there is a significant range in the accuracy of forecasts. A review of demand forecasting accuracy showed one BA's forecasts averaged 32% over its actual demand for all forecast years, while another BA's forecasts were only 5% over actual demand. In some cases, BAs forecast less than the actual demand they experienced.

While the range in forecasting accuracy at the BA level is smoothed out at the interconnection-wide level, it could be a concerning indicator that demand forecasting practices vary widely. Historically, annual demand growth has been fairly predictable; however, annual demand is forecast to grow at an unprecedented rate over the next decade, increasing by 20%. Large loads and electrification, and changing weather and climate patterns, drive load changes, increase uncertainty, and create challenges to forecasting load. This can affect the lead time available to plan and build new resources and transmission, making improved forecasting critical to alleviating the risk of energy inadequacy. 

State of the Interconnection 2025

Resources

WESTERN INTERCONNECTION
RESOURCES AT A GLANCE

Key Takeaways

Actual-to-Planned Resource Additions

Entities forecast a 20% increase in annual demand over the next decade. This will require unprecedented resource growth. Recent resource additions may indicate how well the Western Interconnection may meet this challenge. Industry added more than 24 GW of new resources in 2024. While this is only 80% of the new resources entities planned to build in 2024, it is significantly more than the 10-year annual average build rate of 7.4 GW. The West will have to build at the 2024 rate at least to meet forecast demand.

Resource Portfolio

The Western Interconnection's resource portfolio continues to transform, heavily driven by energy policy.

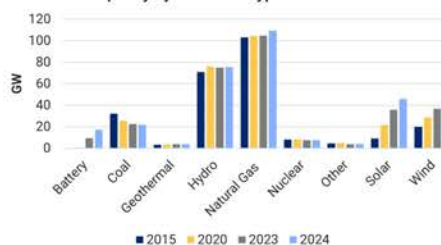
- 75% of the new generation added in 2024 was inverter-based resources (IBR).
- 5.5 GW of natural gas generation was added in 2024, a ten-fold increase over what was added in 2023.
- 921 MW of coal was retired, down from 1.2 GW in 2023.



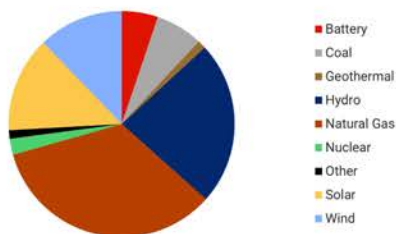
Capacity

Approximately 24.3 GW of new generation capacity were added in 2024, mostly solar, battery storage, and natural gas resources. That is up from 15 GW added in 2023. Since 2015, more than 70 GW of IBRs have been added to the system, while more than 11 GW of coal resources have been retired.

Capacity by Resource Type 2015–2024

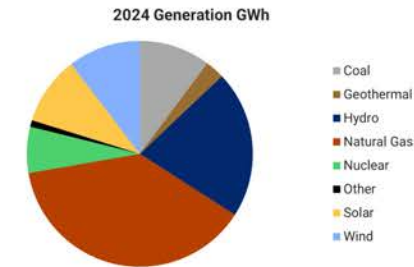


2024 Resource Capacity (GW)





Generation 0



Inverter-based Resources

Over the last five years, installed capacity of IBRs has risen from 52 GW in 2020 to 100 GW in 2024. In 2024, approximately 18 GW of IBRs were added in the Western Interconnection, including:

- 8 GW solar generation, totaling 44 GW as of 2024
- 3 GW wind generation, totaling 39.3 GW as of 2024
- 7 GW battery storage, totaling 16.7 GW as of 2024



Natural Gas

In 2024, entities added 5.5 GW of new natural gas capacity, 10 times the amount added in 2023 and more than has been added during any year in the last decade.



Retirements

In 2024, entities retired 1.4 GW of generation capacity. Most of the retired capacity was coal (920 MW) and natural gas (413 MW). Coal retirements slowed in 2024, decreasing from 2 GW in 2022 and 1.2 GW in 2023. Over the next decade, entities plan to retire an additional 12 GW of coal, which accounts for 46% of the 26 GW of generation planned for retirement over the next 10 years.



New Resources

The capacity of new resources added in 2024 (24.3 GW) is approximately 80% of what was planned for 2024 (30.65 GW). Between 2014-2023, the average generating capacity added annually was approximately 7.4 GW.



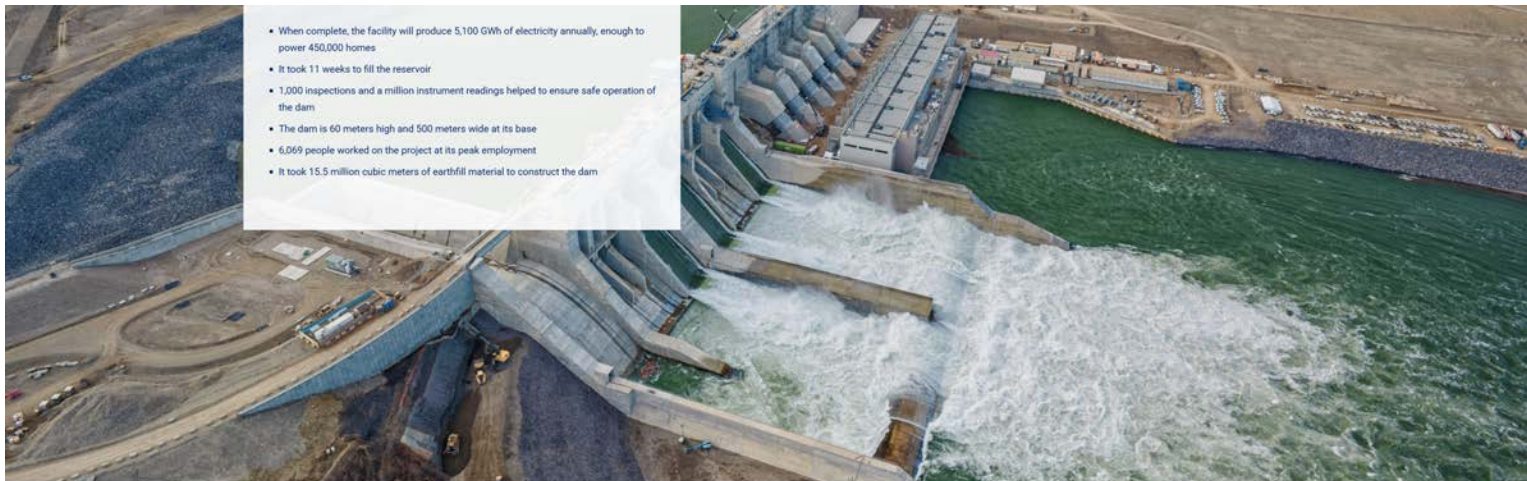
Stakeholder Spotlight

New dam in British Columbia begins generating electricity

In October 2024, the [Site C hydroelectric project](#) in northeast British Columbia began generating electricity at one of its six generating units. The second unit came into service in December, and the remaining units are on track to be operational by fall of 2025. Once complete, the new facility will have a nameplate capacity of 1.1 GW and add about 8% more supply to British Columbia's electricity grid, making it one of the largest new hydro facilities built in North America in decades. The \$16 billion project was first envisioned in the 1950s and revived in 2010.

Additional facts





- When complete, the facility will produce 5,100 GWh of electricity annually, enough to power 450,000 homes
- It took 11 weeks to fill the reservoir
- 1,000 inspections and a million instrument readings helped to ensure safe operation of the dam
- The dam is 60 meters high and 500 meters wide at its base
- 6,069 people worked on the project at its peak employment
- It took 15.5 million cubic meters of earthfill material to construct the dam



IBR Registration Initiative

After several IBR-related system disturbances in recent years, FERC issued a directive in November 2022 requiring NERC to identify and register the owners and operators of IBRs that have an "aggregate, material impact on the reliable operation" of the bulk power system (BPS). NERC modified its rules of procedure accordingly. Throughout 2024, WECC worked to identify applicable facilities in the Western Interconnection. WECC continues to analyze 322 facilities to determine whether they need to register. Key deadlines for the initiative include:

JUN 2024	FERC approved modifications to NERC Rules of Procedure requiring registration for IBRs that impact the bulk power system.
MAY 2025	Identify and notify qualifying generator owners and operators about the new process.
MAY 2026	Register qualifying entities.



FERC Order 901

FERC issued Order 901 in October 2023, directing NERC to develop new or modified Reliability Standards addressing reliability gaps related to IBRs in the following areas: data sharing, model validation, planning and operational studies, and performance requirements. In response, NERC created a [work plan](#) with four key milestones outlining how it would address the problem:

JAN 2024	Filed the work plan with FERC.
NOV 2024	Developed Reliability Standards for IBR performance.
NOV 2025	Develop Reliability Standards that enhance data sharing and model validation.
NOV 2026	Develop Reliability Standards to address planning and operational studies requirements.

State of the Interconnection 2025

Transmission

WESTERN INTERCONNECTION
TRANSMISSION AT A GLANCE

Key Takeaways

Transfer Capability

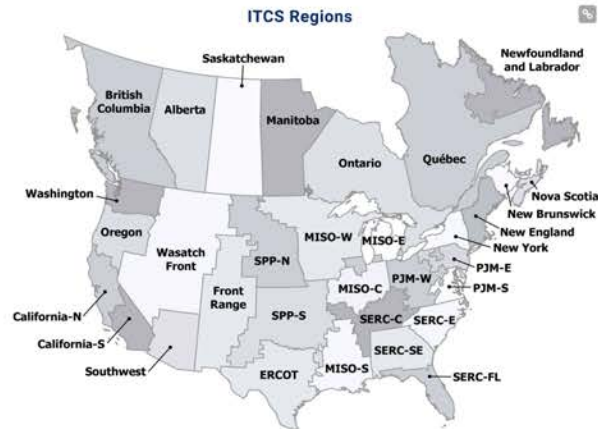
Transfer capability is an important measure of the system's ability to move power from resources to load. The Interregional Transfer Capability Study (ITCS) showed some potential energy concerns under extreme weather conditions for Northern California and Alberta and recommended prudent transfer capability increases or other actions to address the concerns.

Coordinated Planning

WECC has asserted that in order to identify and meet the challenges of the future, entities need to engage in coordinated transmission and resource planning. WECC, the ERO Enterprise, and FERC have stated the importance of coordinated, wide-area planning, and entities like the California ISO and partnerships like WestTEC are already performing coordinated planning.

Interregional Transfer Capability Study

In 2023, as a result of the Fiscal Responsibility Act of 2023, WECC and other members of the Electric Reliability Organization (ERO) Enterprise began work on the ITCS to examine the ability to transfer electricity between regions of the country during extreme weather or unexpected outages. The ITCS was filed with FERC in November 2024, and the supplemental Canadian analysis was filed in April 2025. The study broke new ground in evaluating transmission across the continent, including potential transmission additions to bolster transfer capability.



ITCS Highlights

General Findings

- In addition to limited transfer capability between the interconnections, transfer capability is generally lower in the Mountain States, Great Plains, Southeast, and the Northeast regions. Transfer capability is greatest in the West Coast, Great Lakes, and Mid-Atlantic areas.
- The vulnerability of the North American power system to extreme weather was evident in all twelve of the years studied, with wide variation in potential impact and import capacity needs across regions.
- The study identified both recommended prudent transfer capability increases and alternatives to addressing potential energy inadequacy, including resource development, transmission enhancement, and demand-side management initiatives.
- The study recommends prudent transfer capability increases between all interconnections.

The West

- Under large-scale heat events—such as the 2020 heat event—the California North study region experienced energy adequacy challenges in the analysis. The study recommends prudent transfer capability increases between the California North and Wasatch Front study regions.
- Alberta experienced energy adequacy challenges in the study. Additional transfer capability with Saskatchewan could alleviate the deficiencies, as could strengthening existing connections to the U.S. or British Columbia.
- The study identified no other prudent additions to transfer capability within the Western Interconnection.

20-Year System Planning



20-Year Study

In 2022, WECC identified a need for transmission planning beyond the traditional 10-year planning horizon. In 2024, WECC released the [10-year Transmission](#) to identify risks in the years scenarios and compared the results to identify trends in transmission use and energy flows. The report shares key lessons learned, including

- Improvements to battery modeling are needed to more accurately evaluate the effect of battery charging and discharging during peak load times
- To make up for the lack of 20-year system planning information, WECC created a simplified capacity expansion dataset. More detailed evaluation of risks in the 20-year future will require additional information from planning entities in the 20-year time frame
- Most subregions required increased imports during both the extreme cold and extreme heat events
- Transmission path utilization increased on several paths and in some cases, flow on transmission paths reversed directions



Order 1920

planners to conduct 20-year planning. Following its adoption, states, utility regulators, and clean energy groups opposed the order based on concerns that the rule undermined state authority in transmission planning and could lead to unfair rates. After a rehearing, FERC revised the rule to give state regulators a larger role in the transmission planning and cost allocation processes. The order encourages and in some instances requires increased collaboration with state regulators, particularly on the matter of cost allocation. The order requires transmission planners to

- Conduct regional transmission planning at least every five years, using a 20-year planning horizon.
- Develop at least three plausible scenarios considering various factors like resource mix, decarbonization goals, and technology trends
- Consider and quantify a comprehensive set of benefits, including reliability, cost, and environmental factors.



WestTEC

needs of the future electric grid and identifies benefits such as enhanced reliability and improved economic efficiency.

The plan consists of two components. The first looks at a 10-year planning horizon and is focused on feasible solutions such as grid-enhancing technologies and the use of existing rights-of-way. This report is expected to be completed in summer 2025.

The second component examines options 20 years in the future and focuses more on portfolio solutions, or new transmission projects that will be more complex and take longer to build. This report is expected to be completed in early 2027, providing an actionable plan based on strategic, long-term analysis of the entire Western Interconnection.

Coordinated Transmission & Resource Planning

Coordinated planning of transmission and resources is critical for understanding how the interconnection may be affected by and should plan to overcome increasingly complex reliability risks. This need is being discussed in several areas:

- Concerns about both resource adequacy and transmission availability during events like the recent intense, prolonged, and widespread heatwaves led WECC to include the lack of coordinated planning in its top priority reliability risks in 2024
- The ITCIS recommends that system planning work holistically to evaluate transmission and resources over a wide area to assess whether resources in neighboring areas are available during times of need
- In Order 1920, FERC asked transmission planners to incorporate "state-approved utility integrated resource plans and entities' expected supply obligations" when developing the scenarios they use to identify long-term transmission needs and regional transmission facilities needed to meet those needs



Transmission Project Highlights in 2024

[SunZia](#): 525-kV DC line spanning 550 miles from central New Mexico to south-central Arizona with the capacity to transport 3,000 MW of wind energy from a 3,500 MW facility in New Mexico. Expected to be operational by 2026.

[Power Pathway](#): Five-segment project covering 550 miles across 12 counties, mainly in eastern Colorado. The first segments are expected to be in service by 2025, with the remaining work completed in 2026 and 2027.

[Energy Gateway South](#): 416-mile, 500-kV line connecting wind farms in Wyoming to southern Utah. It was completed in November 2024.

[Energy Gateway West](#): 1,000 miles of new high-voltage transmission lines in Wyoming and Idaho. It consists of three segments, one of which was completed in 2020, another in November 2024, and the third is scheduled to be in service in 2024 at the earliest.

[Boardman to Hemingway](#): Proposed 500-kV line running approximately 290 miles from eastern Oregon to southwestern Idaho. Construction is expected to begin in 2025 and finish in 2027.

[TransWest Express](#): Construction began in 2023 on the 732-mile line running from a wind facility under construction in Wyoming, through Colorado and Utah, to near Las Vegas. The power will be available for use in Arizona, southern California, and Nevada when the line is completed in 2029.

[Greenlink West](#): 525-kV line spanning 350 miles from Las Vegas, Nevada, to Yerington, Nevada. Construction is expected to begin in early 2025, with the line in service by spring 2027.



Cross-Tie: Proposed 500-kV line spanning 214 miles through Utah and Nevada to relieve congestion on other transmission lines in the region and increase the ability of several states to import and export renewable energy.

SWIP-North: 500-kV line covering 285 miles from southern Idaho to Ely, Nevada. It is the final link in a transmission corridor that will enable the bidirectional flow of about 2 GW between the Desert Southwest and Pacific Northwest. Construction is expected to begin in 2025 and completed in 2027. In 2024, it was selected as a participant in DOE's Transmission Facilitation Program.

Southline Transmission Project: 278-mile line connecting the existing transmission systems of the metro areas in El Paso, Texas, and Tucson, Arizona. Construction is expected to begin in 2025, with its two phases complete in 2027 and 2028. In 2024, it was selected as a participant in DOE's [Transmission Facilitation Program](#).

Bonneville Power Administration: In October, BPA announced plans for 13 transmission, substation, and line projects. The projects include a 500-kV line from northern Oregon to Nevada. The projects are in the early stages of development and will not affect work on several [transmission projects](#) BPA announced in summer 2023.

Boardman to Hemingway project breaks ground this year

In the works since the mid-2000s, the Boardman to Hemingway (B2H) transmission project is on track to break ground this year.

B2H is a proposed 290-mile, 500 kV transmission line that will run from a substation near Boardman, Oregon, to the Hemingway Substation near Melba, Idaho. The line is co-owned by Idaho Power and PacifiCorp. It will connect the winter-peaking Pacific Northwest and summer-peaking Intermountain West to provide customers in both areas reciprocal benefits. In the winter, when hydropower generation is low, Pacific Northwest customers will be able to use power from wind facilities in the Intermountain West. During summer demand peaks, customers in the Intermountain West will benefit from hydropower and other resources in the Pacific Northwest.

The project first appeared in Idaho Power's Integrated Resource Plan in 2006. Permitting issues have been the primary source of delay. Idaho Power is the lead developer of the project, which spans more than 100 miles of federal land, requiring approval from the Bureau of Land Management, U.S. Forest Service, U.S. Navy, and the Bureau of Reclamation. It also covers state land in Idaho and Oregon, as well as tribal and private land. As of December 2024, the project was awaiting final approval of federal, state, and local permits. There is also an appeal pending before the Oregon Supreme Court related to a site certificate approved in summer 2024.

According to Idaho Power, B2H is crucial to meeting soaring demand and achieving its goal of 100% clean energy by 2045. The project is on track to break ground this spring and to be in operation in 2027.



State of the Interconnection 2025

System Events

WESTERN INTERCONNECTION
SYSTEM EVENTS AT A GLANCE

Key Takeaways

Reportable Events

System events are a measure of the health of the system and are an indication of where the system may be challenged. The number of reportable events on the system increased slightly in 2024 due to a rise in incidents involving IBRs.

Protection System Misoperations

The correct operation of protection systems is a key measure of system performance. The misoperations rate has decreased over the last four years. This continues a decade-long decline in misoperations resulting from a concerted effort between WECC and industry.

Energy Emergency Alerts

The number and duration of Energy Emergency Alerts (EEA) increased in 2024. Extreme weather events can drive an increase in EEAs; nearly half of the EEAs issued in 2024 occurred during the winter storms Geri and Heather.

System Events

Reportable Events 2020–2024



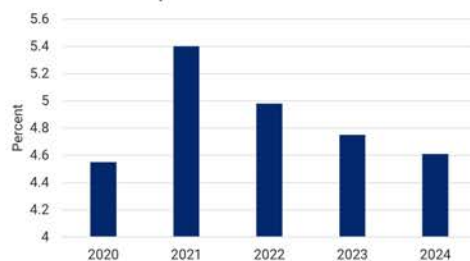
Reportable Events

There were 35 reportable events on the bulk power system in the Western Interconnection in 2024, up from 34 events in 2023. This includes the first Category 2 event or higher since 2021.

Four of the events in 2024 were related to IBRs. Most of the events were tied to poor coordination between relay settings. The slight increase in events in 2024 indicates a need for better coordination between systems and pieces of equipment. The severity of events on the bulk power system had not increased since 2021.

The Category 2 event was due to an incorrect equipment setting following maintenance. This resulted in the forced outage of a wind facility but no loss of load. The rest of the events were Category 1.

Misoperations Rate 2020–2024



Protection System Misoperations

Misoperations involve the unexpected performance of protection systems, which are critical components of the grid that remove faults from the system and protect sensitive equipment. Misoperations occur when the protection equipment does not perform as designed for a range of reasons. They can contribute to generation and transmission outages.

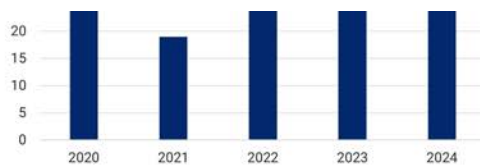
The misoperations rate has declined each year since 2021, and the 2024 rate (4.6%) was the lowest since 2020.

Transmission Events 2020–2024



Unplanned Transmission Outages of Three or More Elements

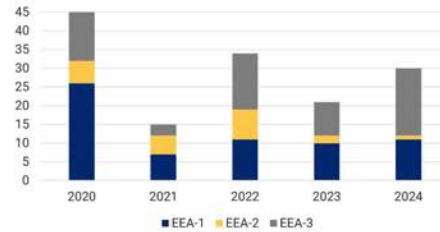
Although most unplanned transmission outages involve only a single element, outages involving three or



more elements pose a higher risk to reliability. The number of outages involving three or more elements decreased in 2024 for the third consecutive year. This decline is not significant, but it has been steady, and it coincides with a similar decline in the number of protection systems misoperations. Outages involving three or more transmission elements are usually tied to the misoperation of a protection system, so the improved performance of the protection system may be the reason for the decline in transmission system events.

Energy Emergency Alerts

Energy Emergency Alerts, 2020–2024



In 2024, there were 30 Energy Emergency Alerts (EEA), up from 21 in 2023. Eighteen of the EEAs reported in 2024 were EEA-3s, the most severe level. However, all but one of the EEA-3s occurred in two Balancing Authorities, and nearly half of the EEA-3s occurred during winter storms Heather and Gerri in January 2024.

The duration of EEAs also increased from an average of 2.47 hours in 2023 to 4.28 hours in 2024. The duration of EEA-1 events increased to 4.47 hours in 2024, up from 1.94 in 2023.

Extreme weather (variability and extreme temperatures) continues to be the biggest driver of EEAs across the interconnection as it leads to surging demand and the potential to impact generation. NERC's 2024 *Long-Term Reliability Assessment* found that over half of the continent faces a potential shortage of electricity in the coming years, due to a confluence of factors including surging demand growth, the retirement of baseload generation, and the increase in energy-limited generating resources. Uncertainty related to extreme weather compounds this risk.

Stakeholder Spotlight

CAISO's proactive collaborative approach to mitigating IBR disturbances

The California Independent System Operator (CAISO) is collaborating with resource owners to better understand how recent IBR-related incidents have occurred to improve reliability of IBRs. This is following a number of incidents in which IBRs tripped offline during minor disturbances.

A root cause analysis of a 2023 California event identified several energy storage resources that did not respond properly to a low-frequency event. CAISO worked with resource owners and managers of the storage assets to investigate the disturbance and determined that incorrect settings on the storage resource caused the problem. CAISO identified a lack of clarity and understanding about the settings and worked with the owner and operator to help them better understand and correct the issue.

Although the need to provide industry-wide awareness for the appropriate settings required for IBRs to ride through minor grid disturbances remains, CAISO's swift work to understand and help resolve the problem serves as a model for mitigating future events involving IBRs.



State of the Interconnection 2025

Security

WESTERN INTERCONNECTION
SECURITY AT A GLANCE

Key Takeaways

Physical Security Intrusions

There were 220 physical security intrusions in the Western Interconnection reported to DOE in 2024, more than double the number reported in 2023. Although very few of these incidents resulted in loss of load or otherwise affected the grid, the increase in these attacks forces entities to devote more resources to combating them.

Cybersecurity Incidents

The number of cybersecurity incidents rose in 2024 as hackers deployed AI to increase the precision and speed of their attacks, using the technology to outsmart traditional security measures and target more victims. This trend is expected to *accelerate* in 2025. One element to combat cybersecurity threats is education and information sharing through events like GridSecCon, GridEx, and WECC's Power Systems Security Conference. These types of events foster the collaboration that is key to keeping the system secure.

Power System Security



Physical Security Update

In 2024, there were 220 physical security incidents in the Western Interconnection reported through Department of Energy form 417 (DOE-417). While the 2024 number is more than double the number of incidents reported in 2023 (107), the increase can largely be attributed to a big increase in the number of minor incidents reported by a single entity. The 220 incidents include assaults, ballistic damage, intrusion, vandalism, theft, and suspicious activity.

The Electricity Information Sharing and Analysis Center (E-ISAC) collects physical security incidents as well, using a different classification system that ranks the risks from Level 0 to Level 3. The vast majority of events in 2024 were Level 1, criminal activity with no impact on the grid. Much less than 1% were classified as Level 3.



Cybersecurity Update

In 2024, in the Western Interconnection, there were four cybersecurity intrusions reported through the Electric Emergency Incident and Disturbance Report (DOE-417). These attacks can cause system interruptions and loss of load while diminishing resilience and recovery measures. Nearly half of the risks listed in the WECC Risk Register are related to cybersecurity, including risks related to insider threats, malware, phishing, and artificial intelligence. Through monitoring and enforcing Critical Infrastructure Protection standards, training and educating entities about best practices, and sharing information about events and threats, WECC and the ERO Enterprise help entities address this risk.

Stakeholder Spotlight

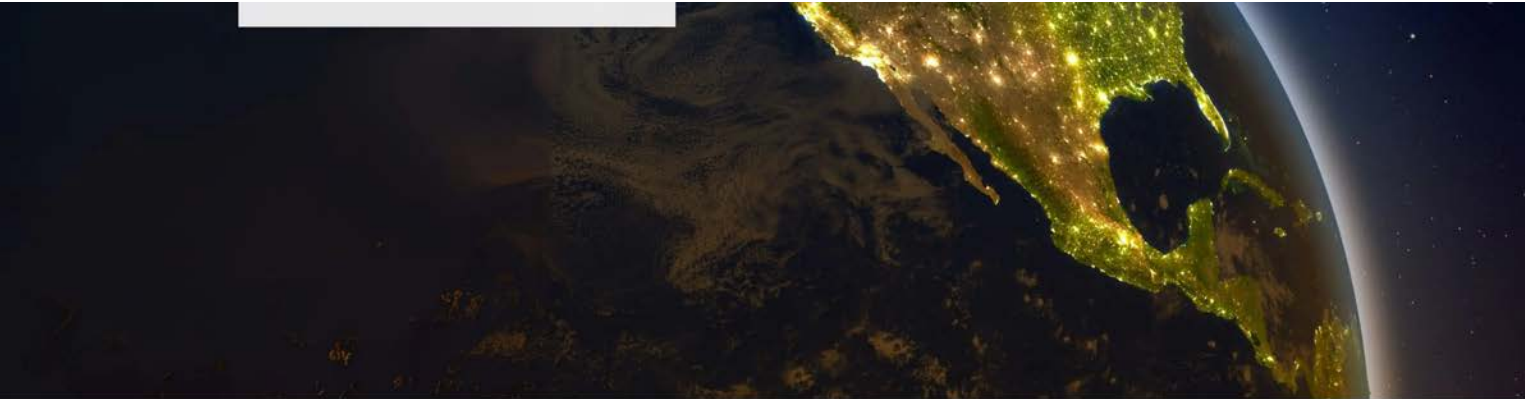
E-ISAC launches educational partnership to combat security threat

In December 2024, E-ISAC bolstered its cybersecurity efforts by partnering with the SANS Institute, the world's largest global provider of cybersecurity training, certification, and research. This partnership is designed to provide E-ISAC members with free access to the SANS Institute's electric-sector specific content, including white papers, webcasts, and webinars.

The partnership, through the E-ISAC Vendor Affiliates Program, will also provide discounted access to SANS Institute's cybersecurity training and courses.

The SANS Institute specializes in training cybersecurity practitioners and leaders. Its work with E-ISAC will bring world-class cybersecurity expertise to the electric sector, providing real-time technical insights and access to a range of courses, certifications, content, and events.

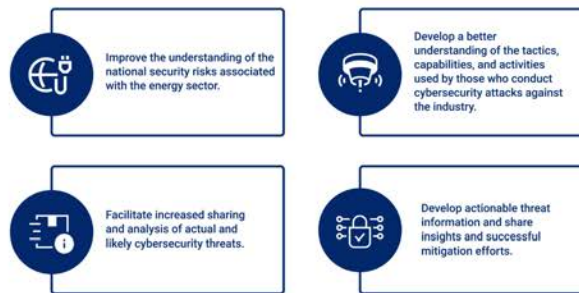




DOE Energy Threat Analysis Center

Recognizing the threat that cyberattacks pose to the energy sector, Congress directed DOE to develop a program to mitigate the risk as part of the Bipartisan Infrastructure Law in 2021. As a result, DOE launched the *Energy Threat Analysis Center (ETAC)* as a pilot in 2023, and it became fully operational in October 2024. Led by the *Office of Cybersecurity, Energy Security, and Emergency Response (CESER)*, ETAC uses a collaborative approach with experts from the federal government, national laboratories, and the energy industry working together to protect critical infrastructure and respond to threats to the bulk power system.

The Center's Goals



2024 Security-focused Events



WECC Power Systems Security Conference

WECC's second annual *Power Systems Security Conference* took place in Salt Lake City in August 2024. The three-day event featured panelists sharing information on cyber- and physical security threat vectors, detection, management, and industry best practices. Presenters came from a range of agencies, including Department of Homeland Security, FBI, Idaho National Laboratory, and the Cybersecurity and Infrastructure Security Agency.

The *Power Systems Security Conference* is scheduled for August 12-14, 2025 in Salt Lake City.



GridSecCon

The 13th annual *GridSecCon* security conference occurred over three days in October 2024 in Minneapolis, bringing together a cross section of representatives from industry and government to discuss grid security threats and planning. The event featured:

- Education and training to promote the reliability of the bulk power system
- Cutting-edge discussions on security threats, vulnerabilities, and lessons learned from senior industry and government leaders
- Sharing security best practices for reliability concerns, risk mitigation, and cyber- and physical security threat awareness

WECC is co-hosting *GridSecCon 2025* with NERC and E-ISAC October 7-10, 2025 in Las Vegas.



GridEx VII Report

In April 2024, NERC released the *GridEx VII Lessons Learned Report*. The report provides a detailed review of the *GridEx VII* exercise, which occurred in November 2023. More than 15,000 participants from approximately 250 North American organizations participated in the virtual exercise. The report provides recommended actions for industry, policy, and government partners, E-ISAC, and other stakeholders to prepare for and respond to security incidents that affect the bulk power system, including:

- Electric utilities should increase coordination with non-federal government partners
- The ability to communicate accurate and timely information to stakeholders when responding to events is critical

The *GridEx VIII* exercise is scheduled for November 18-19, 2025 across North America.

State of the Interconnection 2025

Extreme Natural Events

WESTERN INTERCONNECTION

EXTREME NATURAL
EVENTS AT A GLANCE

Key Takeaways

Manual Load Shed During Extreme Weather Events

One measure of the system's ability to handle extreme weather events is the number of times system operators must shed load (manual load shed) to preserve the system. During the winter storms and summer heatwaves in 2024, no manual load shed occurred.

Public Safety Power Shutoffs

By the end of 2024, 16 entities included Public Safety Power Shutoffs (PSPS) in their wildfire mitigation plans. That number increased to 24 in early 2025, with four additional entities working on including PSPS in their plans later this year.

The number of PSPS issued in 2024 increased over the three previous years but did not reach historic 2020 levels.

2024 Extreme Natural Events



Record-breaking Winter Storms

In January 2024, arctic storms Geri and Heather swept through North America in quick succession, bringing frigid cold, high winds, heavy snow, and, in some places, freezing precipitation. Record low temperatures affected the western portions of Oregon and Washington—where winters are typically mild.

Overall, the system performed well, with no system operator-initiated load shed or extended generation outages. Ahead of the storms, entities had improved winter preparedness and there was improved communication and coordination between the electric and natural gas industries. In addition, proactive generator commitment, improved gas generator stability, and customer response to Energy Emergency Alerts (EEA) likely contributed to system performance. Nearly half of the EEA-3s issued in 2024 occurred during these storms. 1



Extreme Summer Heat Events

During July, August, and September 2024, the Western Interconnection experienced multiple extreme heat and high demand events. In many cases these events were exacerbated by wildfire threats to major transmission facilities, which impacted the ability to import energy to serve demand. During these events, entities issued advanced notices of energy supply deficiencies and declared Restricted Maintenance Operations or No Touch Days to restrict or eliminate scheduled outages and/or avoid inadvertent outages of key transmission and generation facilities. In two separate instances, a local transmission emergency was declared due to high demand, transmission loading, and local transmission outages; however, there was no report of system operator load shed or customer outages.



Bomb Cyclone & Atmospheric River

From November 19-23, 2024, the Pacific Northwest and Northern California experienced a Bomb Cyclone Event (when a storm rapidly intensifies, and its central barometric pressure drops significantly during a 24-hour period) combined with an Atmospheric River (a narrow corridor of concentrated atmospheric moisture). The combination of these phenomena created extreme high winds and large amounts of rain and snow. The bulk power system remained stable during this event with interruptions primarily affecting the distribution system. Approximately 895,000 customers lost power for varying periods of time periods, with most restored by November 26, 2024.

Standards

Two revised NERC standards took effect in October 2024. These standards revisions were undertaken to address reliability-related findings from the joint FERC, NERC, and Regional Entity Staff Report, [February 2021 Cold Weather Outages in Texas and the South Central United States](#). In December 2024, NERC adopted two new standards to mitigate the impact of extreme weather on the bulk power system.

EOP-011-4

EOP-012-2

TPL-008-1

BAL-007-1

Revised Standard

EOP-011-4 requires Transmission Operators and Balancing Authorities to develop plans to mitigate operating emergencies, which can include extreme weather, and implement those plans in coordination with their Reliability Coordinator.

Revised Standard

EOP-012-2 requires Generator Owners to develop and implement plans to mitigate the reliability impacts of extreme cold weather on generating units.

New Standard

TPL-009-1 improves the way Planning Coordinators and Transmission Planners prepare for the potential impacts of extreme temperatures on the transmission system.

New Standard

BAL-007-1 requires Balancing Authorities to perform reliability assessments in preparation for emergencies, including extreme weather events, and develop corrective action plans to address identified risks.

Wildfires



2024 Wildfires

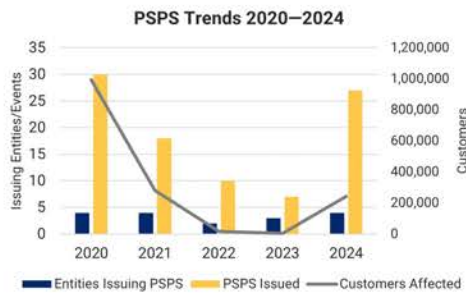
In 2024, there were four wildfire-related events during which major transmission facilities were affected, putting the system into a "Potential Open Loop" condition. While no open loop conditions developed, major transmission paths were derated, affecting the ability to transfer energy to serve demand during peak periods.

- A summer wildfire burning through a transmission corridor tripped two transmission lines. This caused several IBR plants to trip offline unexpectedly and drop over 900 MW of generation.
- In fall 2024, a wildfire in the Pacific Northwest caused a loss of transmission lines, which in turn activated a protection scheme that dropped 2,000 MW of generation.

Public Safety Power Shutoffs Increase

As wildfires continue to threaten the West, many entities are including PSPS in their wildfire mitigation plans. In 2024 there were 16 entities with plans that included PSPS. Currently, that number is 24, with four more entities planning to include PSPS in their plans this year.

During 2024, there were 20 wildfire events in which entities initiated their PSPS programs. In some cases, multiple PSPS were issued for a single wildfire, for a total of 27 PSPS. Twelve of the events interrupted customer power from a few hours to five days.



Wildfire Risk

Wildfires continued to pose an occasional threat to the bulk power system in 2024. The location of wildfires, more than their size, determines the risk they pose to the bulk power system. This makes determining the overall risk of wildfires difficult to discern because wildfire locations are difficult to predict.

In 2024, 10.1 million acres burned, with Alberta, British Columbia, California, and Oregon losing over one million acres each. By comparison, wildfires burned roughly 3.3 million acres in 2022 and nearly 14.9 million acres in 2023, with Alberta (5.4 million) and British Columbia (7 million) being most affected.

The **WECC Wildfire Risk Dashboard** provides information on current wildfires and bulk power system elements at risk. The interactive format allows users to explore rich data on wildfires across the West.

Stakeholder Spotlight

Xcel deploys Public Safety Power Shutoff for first time

In April 2024, Colorado experienced a severe wind event that produced significant impact to electric infrastructure on the distribution system. Approximately 275,000 customers experienced outages during the event. The event prompted Xcel Energy to implement a PSPS that affected approximately 680 miles of distribution lines and an additional 52,000 customers.

"Shutting off the power in response to extreme weather and wind events will always be done as a last resort to achieve what we can all agree matters most - public safety."

—Robert Kenney, President, Xcel Energy Colorado

Using lessons learned from the April event, Xcel's 2025-2027 Wildfire Mitigation Plan includes a PSPS program for use in cases where risk is not adequately addressed by other methods. According to the plan, Xcel will base the decision to initiate PSPS on an analysis of extreme weather conditions, data intelligence models, drone inspection, and expert analysis of public safety. In its plan, Xcel committed to keep customers informed by:

- Proactively communicating about extreme weather events;
- Educating customers about PSPS, when they occur, and how to prepare for them; and
- Quickly publishing maps of affected areas, outages, and status of restoration efforts.