Clean Energy Education & Empowerment (C3E)

C3E Webinar Series

Leveraging Data and Digitalization to Make the Grid More Visible, Resilient, and Clean

March 27, 1:00 – 2:00 pm ET

MODERATED BY

Lisa Frantzis

Partner, Guidehouse

C3E Ambassador Emeritus

PANELISTS

Silvia Valerio

Associate Director - Energy, Sustainability, and Infrastructure, Guidehouse

Alexina G. Jackson

Vice President, Strategic Development, The AES Corporation

Maria Pope

President and CEO, Portland General Electric

C3E Ambassador

Page Crahan

General Manager, Tapestry at X, The moonshot factory

To register, visit c3e.org/webinars

Followed immediately by optional networking session at 2pm ET

Clean Energy Education & Empowerment (C3E)

- Welcome!
- C3E is a DOE-led initiative in collaboration with MIT Energy Initiative, Stanford Precourt Institute for Energy, and Texas A&M Energy Institute
- Closing the gender gap and increasing the participation, leadership, and success of women in clean energy
- Four pillars: Ambassadors, Awards, Symposium, and Community
- C3E Webinar Series - forum to hear the latest on clean energy topics & foster discussion

C3E

Upcoming C3E Webinar

Clean Energy Education & Empowerment (C3E)

C3E Webinar Series

Advanced Nuclear Energy – Electricity and Beyond

July 11, 2:00 – 3:00 pm ET

MODERATED BY

Marianne Walck

Laboratory Director, National Energy Technology Laboratory

C3E Ambassador

PANELISTS

Shannon M. Bragg-Sitton

Director, Integrated Energy & Storage Systems, Idaho National Laboratory

Christine King

Director, Gateway for Accelerated Innovation in Nuclear (GAIN), Idaho National Laboratory

Erin Searcy

Acting Deputy Laboratory Director for Science and Technology and Chief Research Officer, Idaho National Laboratory

To register, visit c3e.org/webinars

Followed immediately by optional networking session at 3pm ET

Are you looking for a job or hiring in the clean energy field?

Visit our job board to submit a job posting or to search careers and networking opportunities from both within and outside of the C3E network.

c3e.org/career-resources

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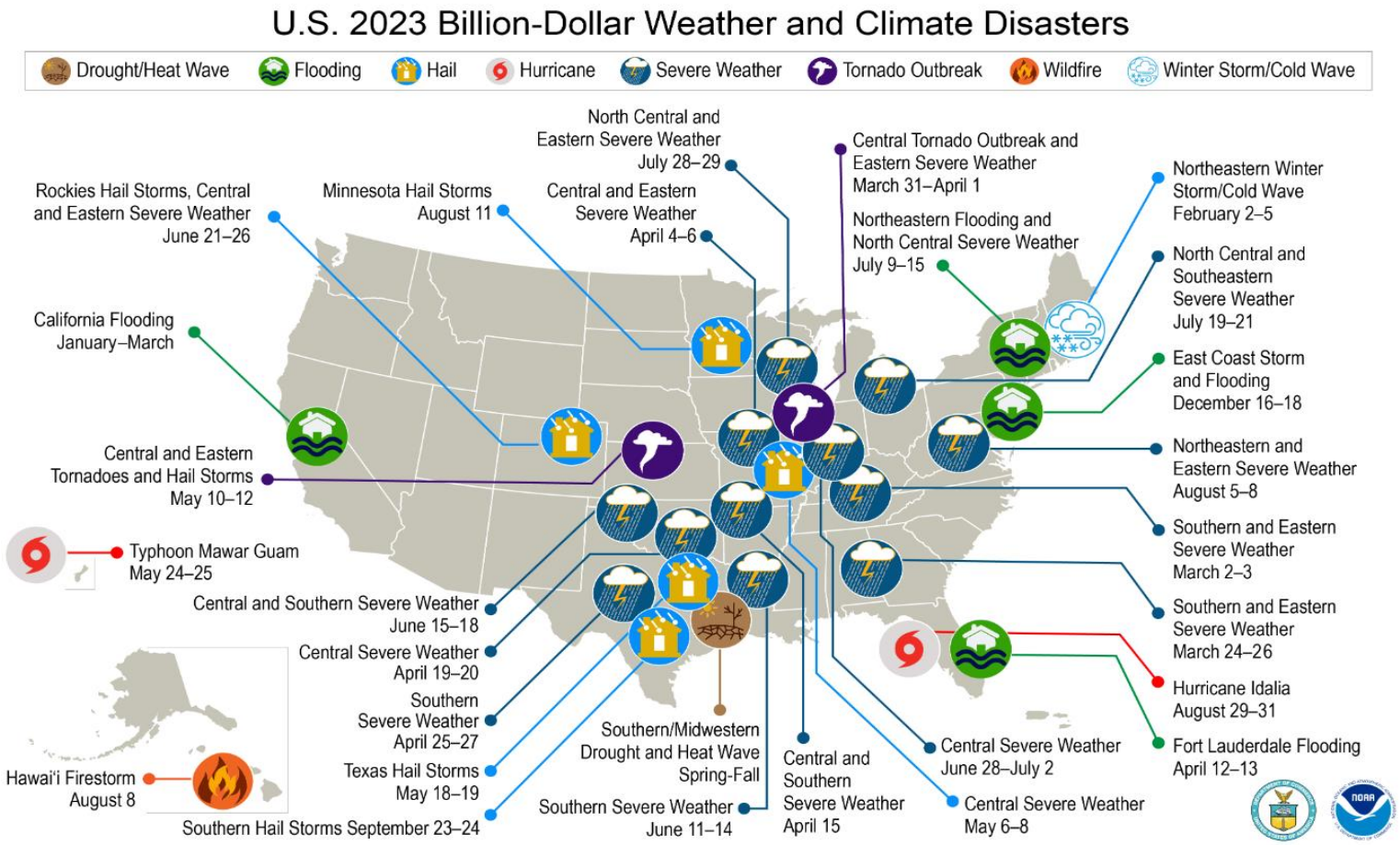
Guidehouse

Grid Resilience and Climate Risk

Silvia Valerio

March 27, 2024

As we move toward electrification to decarbonize the power sector, grid resilience is growing in importance



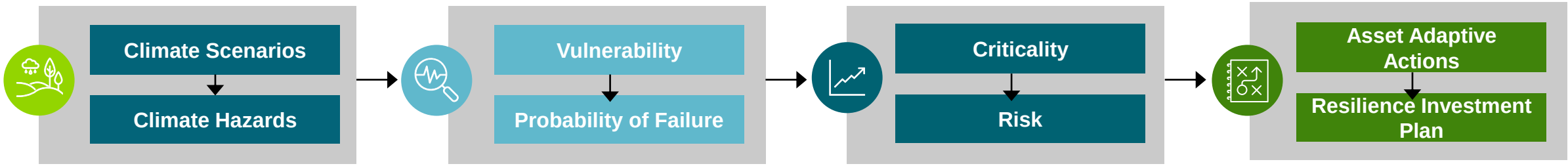
*This map denotes the approximate location for each of the **28 separate billion-dollar weather and climate disasters that impacted the United States in 2023.***

- **Emission reductions in the energy sector are mainly being achieved through deployment of renewable energy, energy efficiency and a move towards electrification**
- **Extreme weather events can threaten the reliability of electrification and are costing utility companies billions of dollars to ensure grid resilience**
- **Access to more downscaled climate data, grid data, and data analytics tools is allowing utility companies to predict where grid assets are most vulnerable**

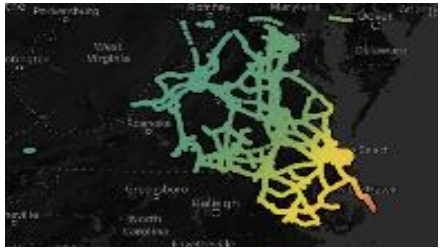
Today we will discuss one approach utilities are using to proactively "harden" the grid

Data that was not available years ago, can now be used to predict which assets are most vulnerable….down to the pole!

Infrastructure Resilience Methodology

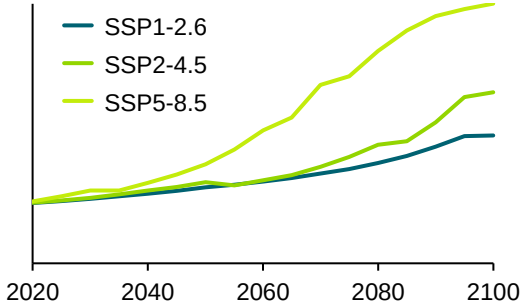


100-Yr Wind Speed (mph), (2050)



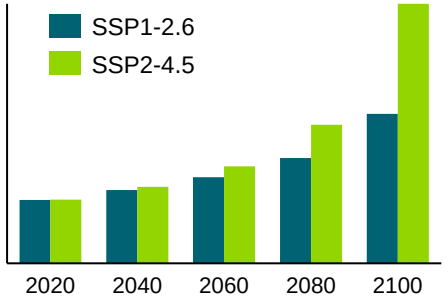
Climate forecast for a broad range of climate hazards and scenarios (SSPs) for screening of assets.

Average Probability of Failure (%)



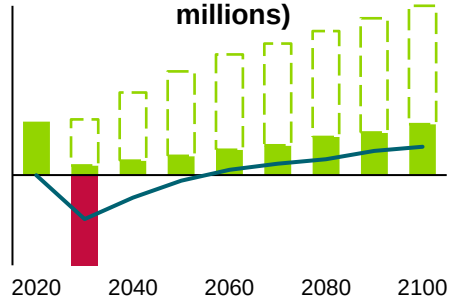
The vulnerability assessment defines the level at which an asset would fail due to a climate hazard and per climate scenario.

Cumulative Risk ($ million)



The risk forecast combines the probability of failure with the cost of the asset's failure.

Resilience Investment Plan Cash Flow ($, millions)

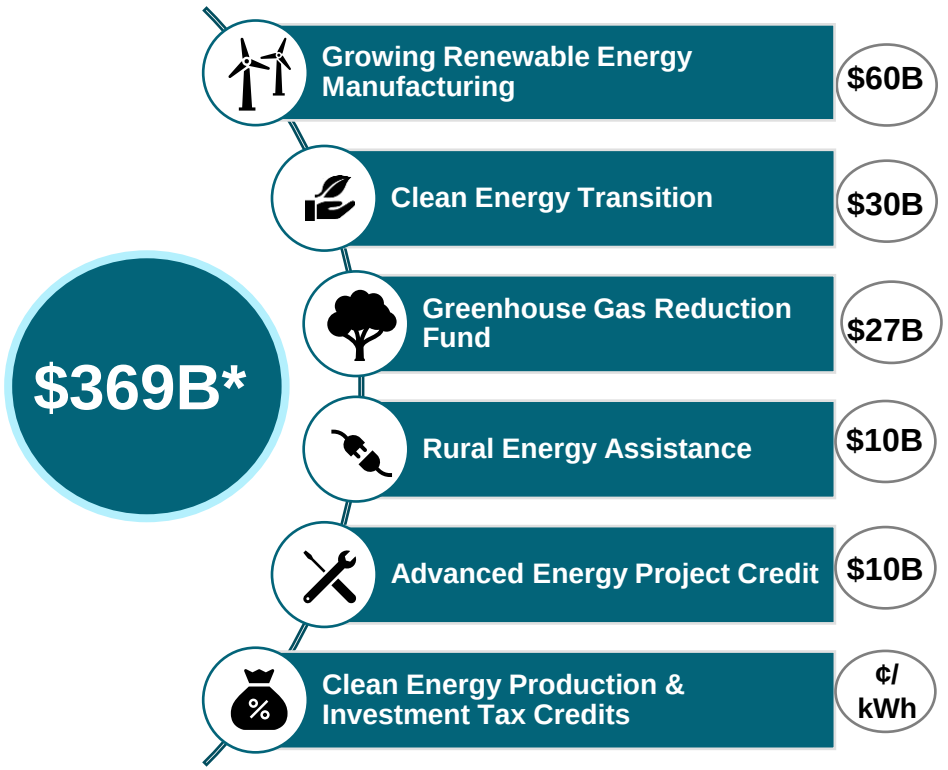


Implement adaptive actions by assessing programmatic investments to mitigate the risk from climate hazards.

Shared Socio-economic Pathways (SSPs): Climate Change scenarios

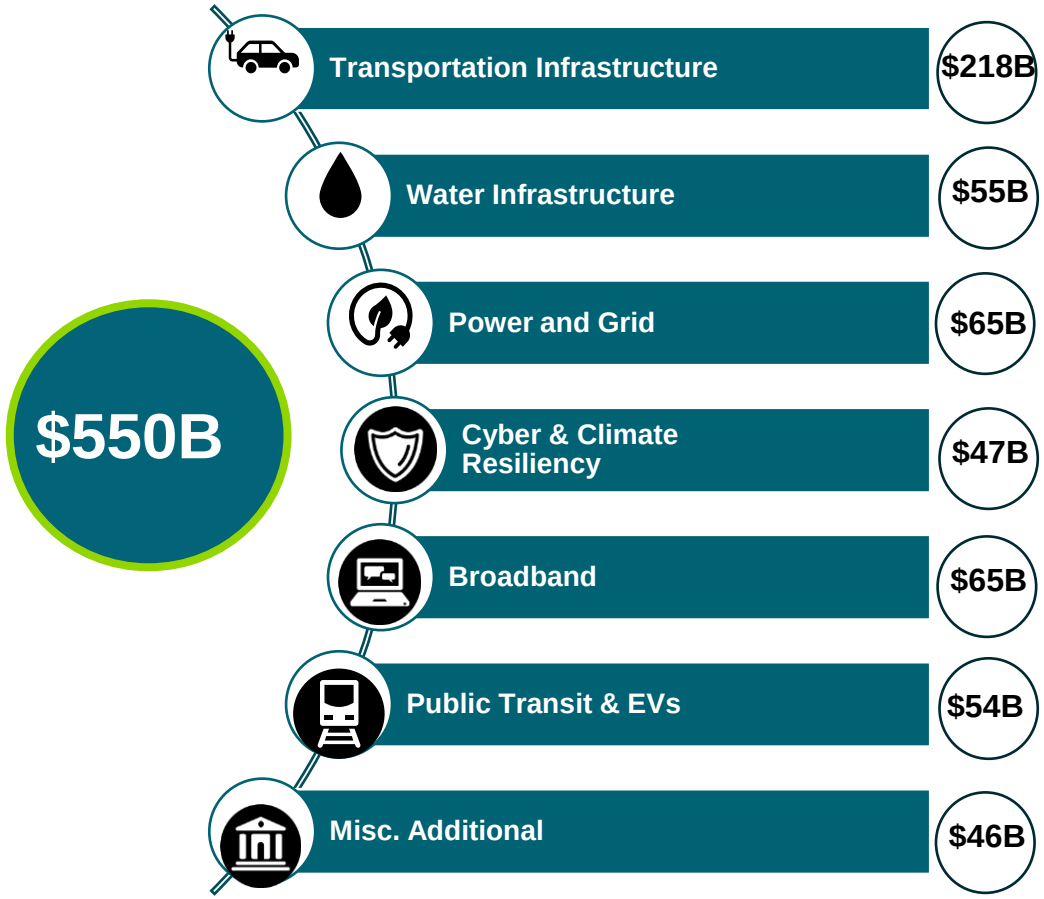
To support the implementation of grid hardening, billions of Federal dollars are now being accessed across the U.S.

Inflation Reduction Act (IRA)



*Estimated total investment in Energy Security and Climate Change as of August 11, 2022 by Joint Committee on Taxation

Bipartisan Infrastructure Law (BIL)



New Spend Areas- BIL, $550B total

Data, along with improved analytics and tools are helping provide more cost-effective solutions to grid resiliency

Building on these tools and analytics provides directional clarity for policymakers and investments

Past

Limited grid & climate data

1. Increased Grid & Climate Data

Improved downscaled climate data to overlay over grid data

2. Better Analytical Tools

Leverage improved data analytic tools (AI, ML) to identify vulnerabilities in grid assets

3. Prioritized Investments

Better cost/benefit analyses for regulators about needed spending

4. Reduced Risks

Less costly utility damages

Outcome

A more resilient grid to support electrification and decarbonization

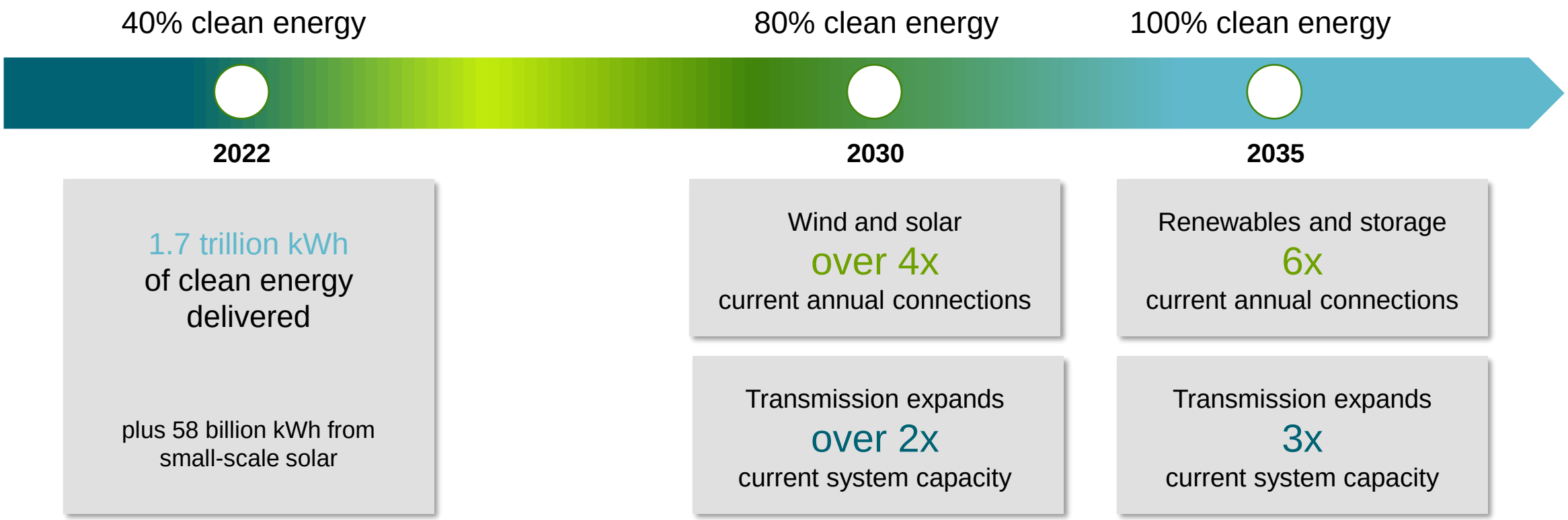
March 27, 2024
C3E Webinar

Transforming the Grid

An electrical network that is digital, distributed, and dynamic

Decarbonization requires us to go faster, build more

U.S. stated decarbonization targets



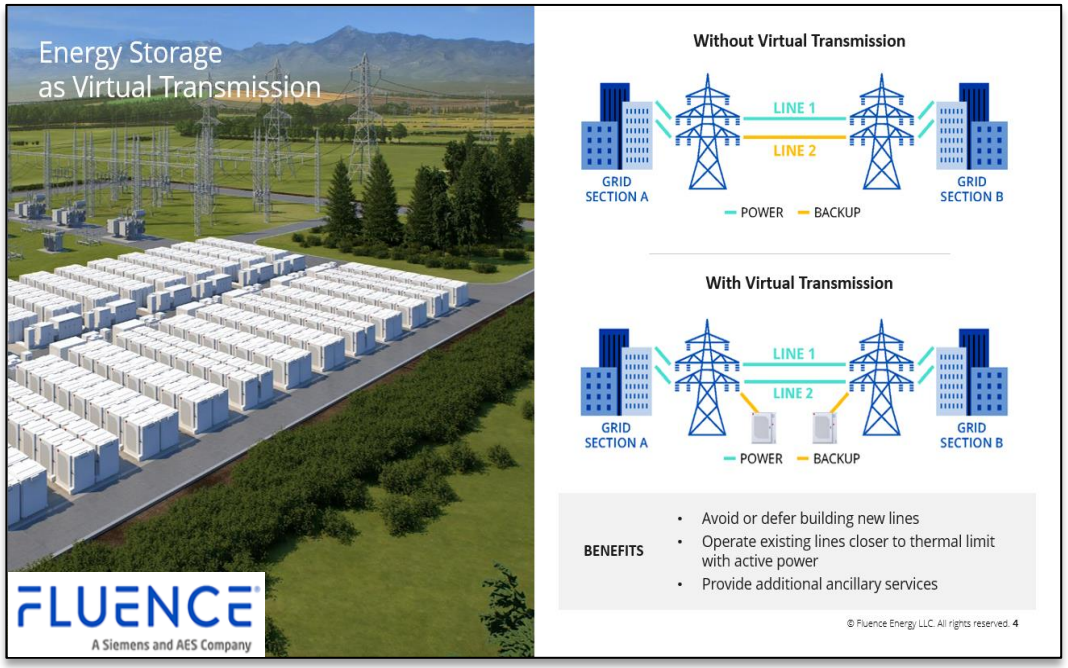
Source: On the Path to 100% Clean Electricity, Department of Energy (May 2023). Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035, NREL (2022). Queued Up…But in Need of Transmission, Department of Energy (April 2022). EIA.gov

To decarbonize the grid needs to become “smarter”

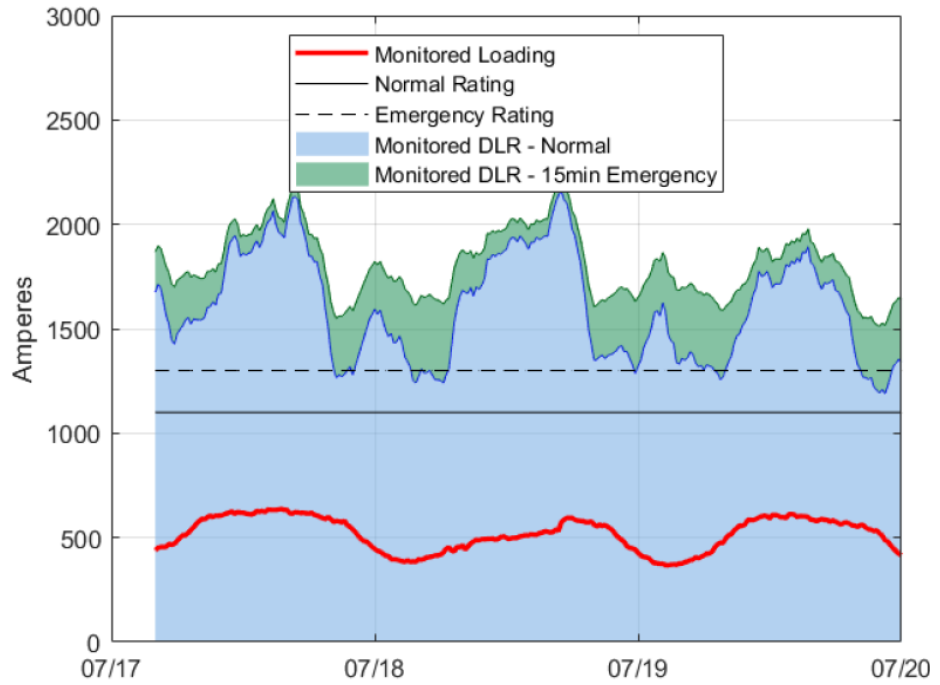
Current Grid	Standards and processes built for large, thermal supply	Limited data means grid reliability is ensured by conservatism	Silos: supply is on transmission and load on distribution
Smart Grid	Technology, market, and regulatory changes for more renewables	Accurate data and dynamic models drive insights and actions	Supply and demand throughout the grid and can be optimized
	Decarbonized 1	Digital 2	Distributed 3

Transmission capacity unlocked at speed, affordably

Storage as Transmission



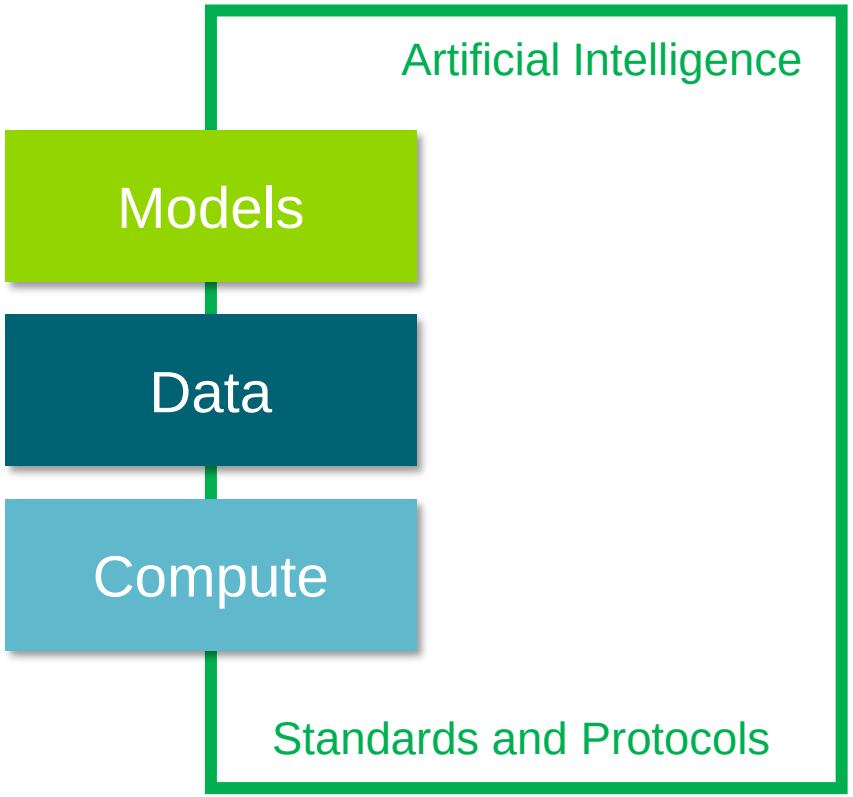
Dynamic Line Rating



Source: LineVision presentation to PJM. URL: [20201113-item-03a-linevision-presentation.ashx (pjm.com)]

Better data and models enable orderly, reliable change

2



- **Faster reliable interconnection**
  Current process improved by a shared, accurate model capable of quick results
- **Operations and planning converge**
  High fidelity data from operations allow continuous evaluation of current and future grid needs
- **Fluid, open, optimal grid**
  Insights from data and models drive optimization of flexible resources and demand across the grid

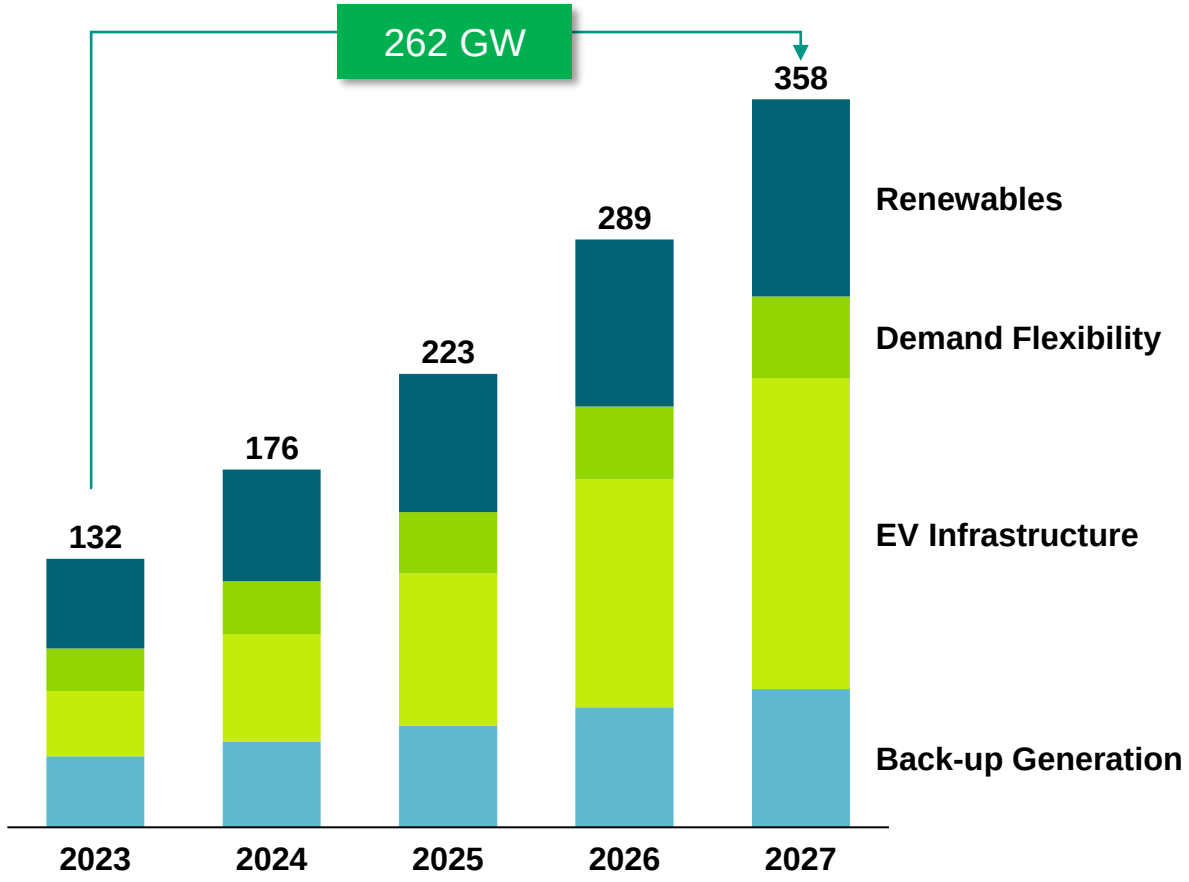
Note: For example, this information process would allow sharing of real-time Dynamic Line Rating data to establish predictable line capacity and allow efficient and dynamic use of the grid

End-consumer assets enable flexibility and resilience

Coordinated DERs:

- Address system peak demand, help resolve resource adequacy
- Avoid interconnection backlogs, reduce peaks to bulk power
- Save utilities 40% to 60% on energy purchase and delivery

DER Cumulative Installed Capacity (GW)



Note: DERs are Distributed Energy Resources

Source: Real Reliability: The Value of Virtual Power, The Brattle Group (May 2023). Pathways to Commercial Liftoff: Virtual Power Plants, Department of Energy (September 2023). US Distributed Energy Resource (DER) Outlook 2023, Wood Mackenzie (June 2023)

Advanced Technology in the Clean Energy Transition

Maria Pope
President and Chief Executive Officer, Portland General Electric

Accelerating the Clean Energy Transition

Policy

Clean

Reliable, Resilient, Secure

Accessible, Affordable

Resource Utilization

Technological Advancement

Funding, Investment, Partnership

Increasing utilization of resources and infrastructure

Serving all customer clean energy needs requires orchestrating all resources through a bidirectional, automation-enhanced grid

Traditional Generation Plants

- Wind
- Solar
- Hydro
- Nuclear
- Battery Storage

Regional Transmission Grid

Integrated Operations Center

- Grid Operations
- Power Operations
- VPP Operations

Two-way Distribution Grid

Virtual Power Plant

- Transportation
- Heating Systems
- Industrial Processes
- Solar
- Battery Storage
- Smart Devices

Technology Advancement

Innovation and technology integration enhances PGE's capabilities to orchestrate resources

"Innovation is the ability to see change as an opportunity – not a threat."

—STEVE JOBS

Inflation Reduction Act

Infrastructure Investment and Jobs Act

Virtual Power Plant

Distributed Energy Resource Management

5G Energy Lab

Anderson Readiness Center Microgrid

Advanced Distribution Management System

Updated Backup Generation Tariff

Energy Impact Partners

Douglas County PUD partnership

Distribution Automation

Beaverton Public Safety Center Microgrid

Incubatenergy

Conservation Voltage Reduction Pilot

Smart Grid Test Bed

Field Area Network

Backup Generation

PSU Electric Avenue

Linde partnership

Wallbox Vehicle to Grid

Daimler Electric Island

Newberg Vehicle to Grid electric bus

Google Nest Renew

Legend

PGE capabilities

Innovations

2002

TODAY

Reliable, Resilient, Secure

Resiliency and security

Cyber, physical security and resilience in the face of extreme weather, wildfires and climate change

- Electricity Subsector Coordinating Council (ESCC)
- State and Local Emergency Response

Infrastructure growth and system reinvestment

Streamlining transmission permitting and siting

- Nine federal agencies, including DOE, signed a MOU to expedite transmission infrastructure
- DOE National Transmission Study and $300M to boost transmission siting and permitting
- Congress passed reforms to the National Environmental Policy Act (NEPA)

Evolving Customer Relationships and the Grid

By 2030, PGE estimates that as much as 25% of flexibility could come from customers and distributed energy resources (DERs)

Electric Vehicles and Building Electrification

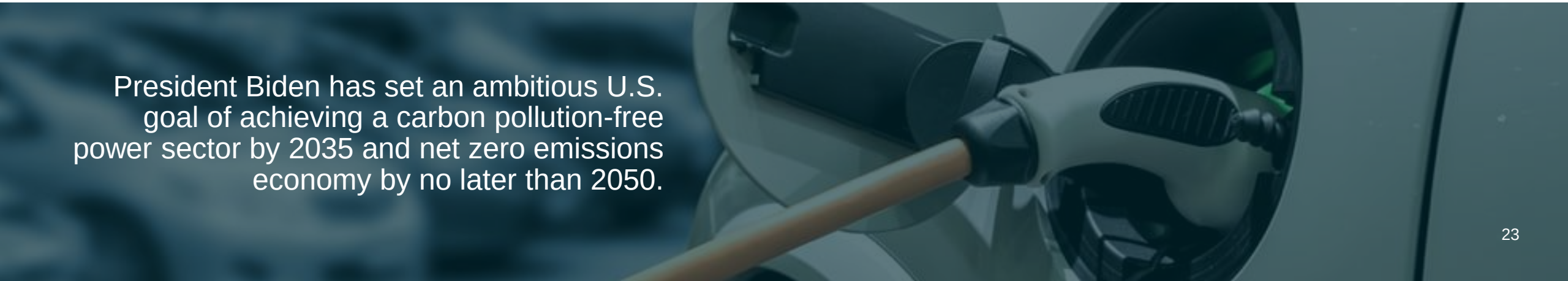
15 to 18% growth through 2030

Data Centers and Generative Artificial Intelligence

8% to 10% growth through 2030

Reestablishing U.S. Manufacturing

5% to 7% growth through 2030



President Biden has set an ambitious U.S. goal of achieving a carbon pollution-free power sector by 2035 and net zero emissions economy by no later than 2050.

Tapestry
C3E

Making the grid visible by weaving together the technologies, information, and partners needed for clean, reliable, and affordable electricity.

Creating the world's best, most complete and precise, model of the grid through multiple data inputs

Blank map

Identified assets & states

Auto-topology turned grid model

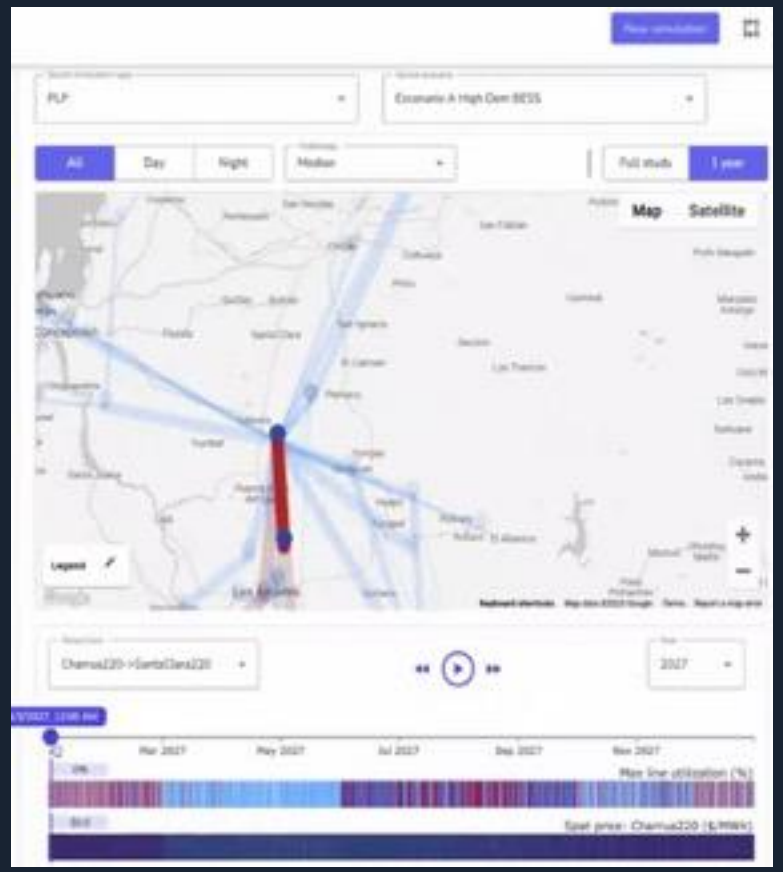
$$V_1 - I_1 R_1 = 0$$
$$V_2 - L_2 \frac{d}{dt} I_2 = 0$$
$$I_3 - C_3 \frac{d}{dt} V_3 = 0$$
$$V_5 - a V_6 = 0$$

Circuit level electricity solvers for power flow over time

Large-scale simulatable grid

Products for a greener and more reliable grid

Grid Planning Tool: A crystal ball for the grid.



30x speedup of simulations. Integrated workflow. Single-click analysis.

GridAware: Google Maps for the grid.

4M real-time assets. 51K overhead lines, 500K images.

Enhanced insights with AI + ML

We’re harnessing the power of AI and ML to analyze hundreds of thousands of data points – faster and more accurately than ever before

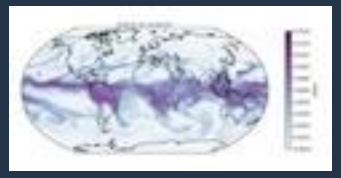
Tapestry x GraphCast

Wind generation

Predict wind magnitude, direction and the resultant power generation at individual wind farm locations.

Severe event forecasting

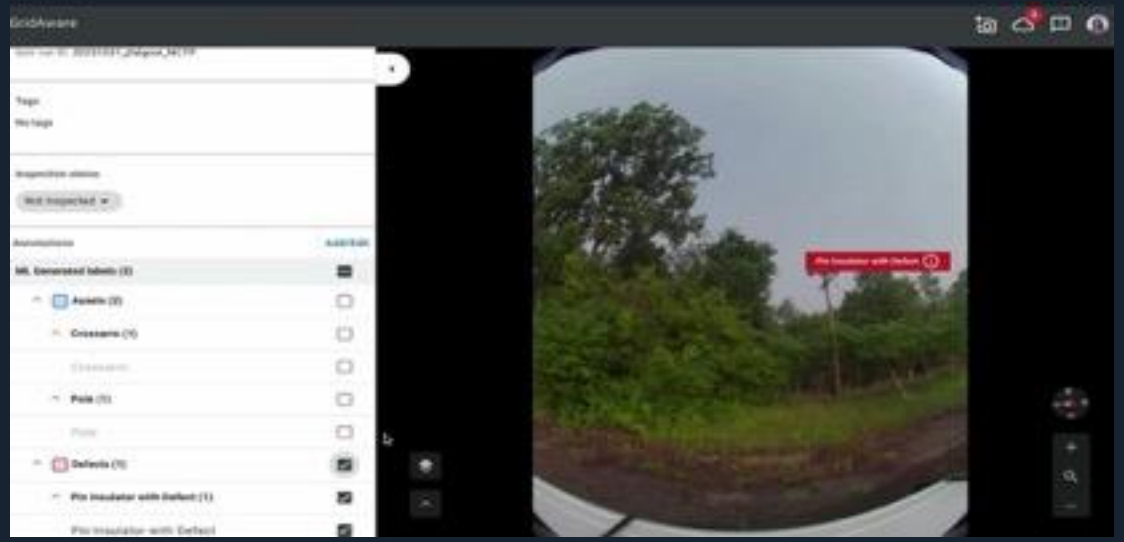
Predict the occurrence of severe events – including tropical cyclones, atmospheric rivers and extreme temperatures.



Economic models

Continuously configure wind generator dispatch and curtailment to create improved generator economic models.

Small defect asset detection



The future (grid) is bright

In the face of a seemingly intractable problem, we're seeing promising early results that are a cause for optimism.

AI-powered load forecasting

- Tapestry applies practical AI/ML technology in products and incubates academic collaboration.
- Tapestry and Google DeepMind's GraphCast AI model outperformed HRES' model by 15%.

100x grid planning

- Tapestry's Grid Planning tool empowers large-scale, long-term grid simulation at hourly resolution that unlocks more efficient planning and reliable interconnection of renewables.
- Our tool transforms a process that takes days into just minutes.

ML for grid reliability

- Smart, automated asset inspection to detect defects and prevent outages.
- 92% average asset detection accuracy.

Questions and Answers