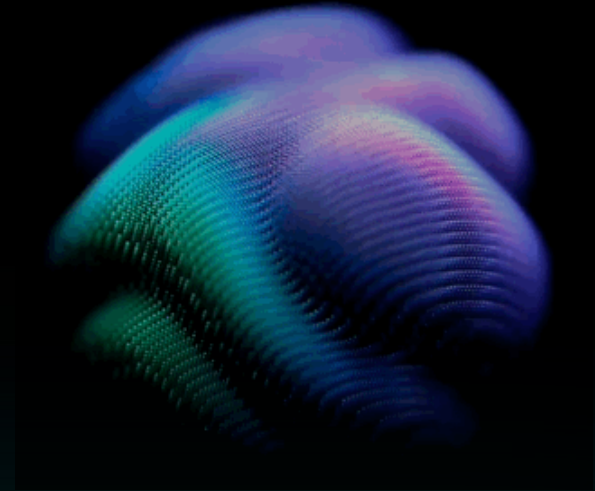




Transforming the Energy System in the Age of AI

TMCES Conference



Neva Espinoza
Chief Generation Officer

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EPRI TOGETHER... SHAPING THE FUTURE OF ENERGY®

Advancing Independent & Objective Research

- World-class researchers and experts
- Three state-of-the-art laboratories including a 37 acre substation for full-scale distribution testing
- More than 50 years of industry-leading research, development, and demonstration

Convening Global Collaboration

- Engagement from the Americas, Asia, Africa, Oceania, and Europe
- Collaborative research to share the risk of technology development
- Technology Innovation scouting and Incubatenergy Labs startup network

What makes EPRI unique?

A robust research portfolio designed to drive innovation through **science and technology** across the energy ecosystem to address the most pressing energy challenges.

700+
UTILITY MEMBERS
300+
COMPANIES

45
COUNTRIES
6 CONTINENTS

50+
YEAR
LEGACY

\$500M
ANNUAL R&D
COLLABORATION

Real-world Impact

EPRI delivers independent, objective thought leadership and industry expertise through a highly collaborative approach to benefit society.

Reliable

Enables dependable and resilient energy around the globe



Affordable

Focused on cost-effective solutions for utilities and communities



Safe

Prioritizes public health, environmental protection, and system integrity

Innovating R&D Across the Value Chain



Make:

Energy Supply and Low-Carbon Resources



Use:

Electrification and Customer Solutions



Move:

Grid Design and Transmission and Distribution Infrastructure

ENERGY IS NOT A 5% SECTOR

THE FOUNDATION OF THE ECONOMY



INDUSTRY & MANUFACTURING

Powering production.
Driving innovation.



DATA & CONNECTIVITY

Fueled by power.
Connected to everyone.



HEALTHCARE

Powering better outcomes.
Powering life.



LOGISTICS & TRANSPORTATION

Moving what matters.
Powered to deliver.



EVERYDAY LIFE & COMMERCE

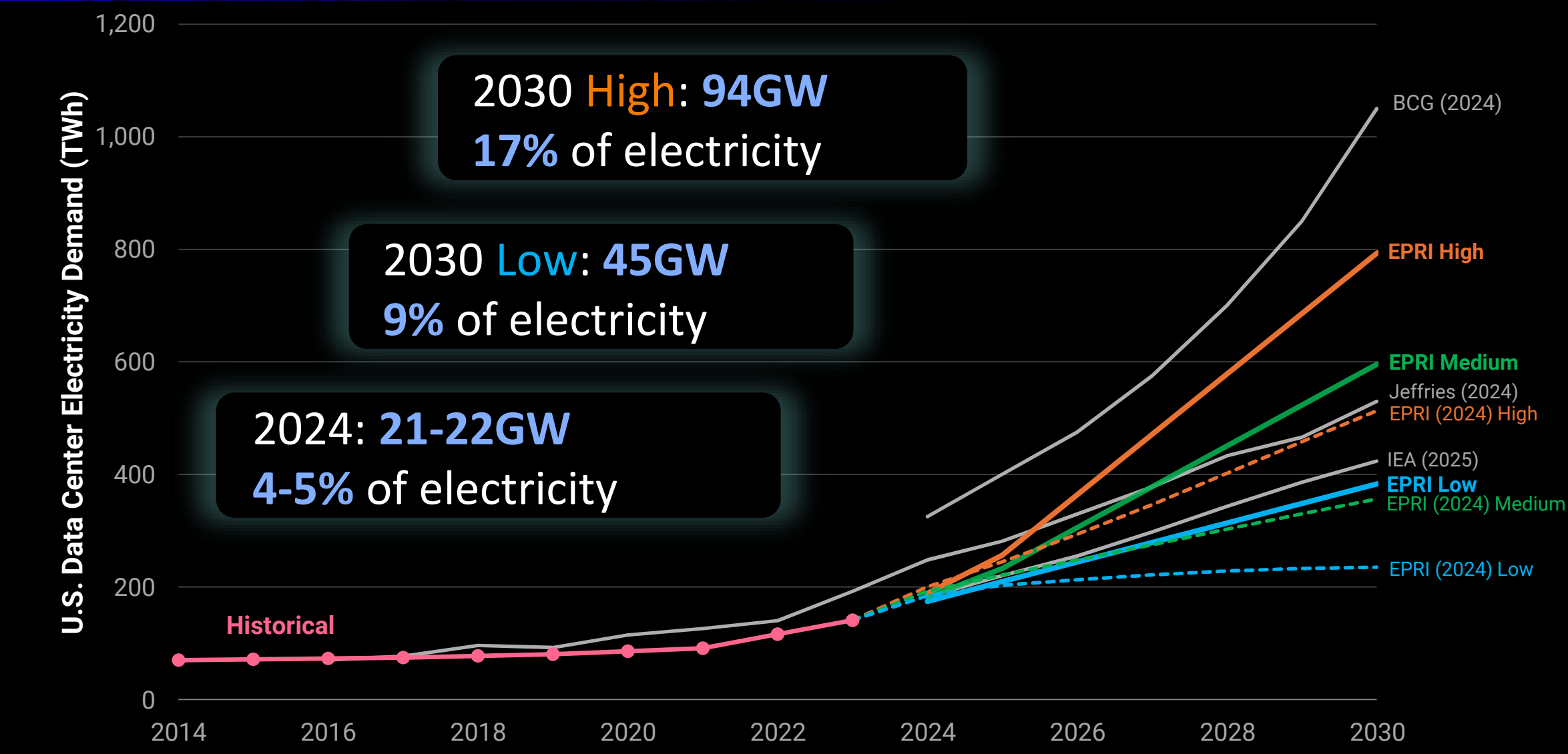
Powering the moments
that power life.



POWER IS THE ENABLER. ENERGY IS THE FOUNDATION.

**KNOWLEDGE IS POWER AND NOW WE HAVE THE
OPPORTUNITY FOR POWER TO CREATE KNOWLEDGE**

New Insights from EPRI on U.S. Datacenter Growth



Source: EPRI Powering Intelligence 2026

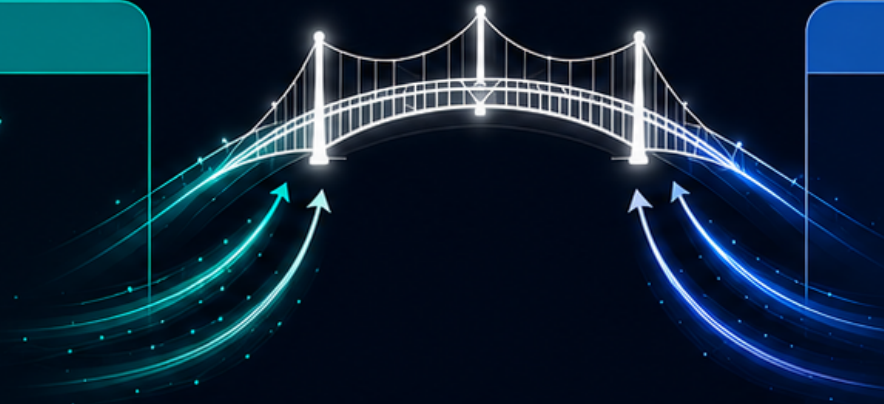
The Bridge to Europe

The U.S. Is Not Alone in This Trajectory

UNITED STATES



EUROPE



4–5% of national demand
(data center electricity share today)



~2–3% of EU demand
(rising)



AI / hyperscale buildout



AI / hyperscale buildout



Interconnection queue backlog



Permitting and deployment lag



6.6–13.7 GW /year
new gas capacity



Comparable pressure on
dispatchable capacity



The load challenge is global.

The execution barriers look different — the outcome is the same.



THREE PRIORITIES. ONE RELENTLESS MISSION.

Build the power system the future demands.

1 MAXIMIZE THE FLEET

The fastest megawatt already runs.

Every installed turbine — run harder, cleaner, longer — holds the system steady.

WHAT IT DEMANDS:

- Advanced materials
- High-fidelity diagnostics
- Fuel flexibility

FOCUS

Extend the installed base through the transition.

2 CLOSE THE GAP

Demand is outpacing firm supply.

The grid needs dispatchable capacity faster than ever — and at unprecedented scale.

THE NEAR-TERM ANSWER:

- Gas turbines, sited fast
- Firm, around-the-clock
- Balancing renewables

FOCUS

Capacity that keeps pace with demand.

3 ACCELERATE SUPPLY

New supply must arrive faster than ever.

Hydrogen combustion, advanced cycles, new architectures — at speed.

THE ENGINEERING TASK:

- Beat the historical curve
- Cut technical risk
- Scale what's proven

FOCUS

Turn emerging tech into bankable options.



Three priorities. Integrated execution. **Powering a reliable, affordable, and resilient energy future.**

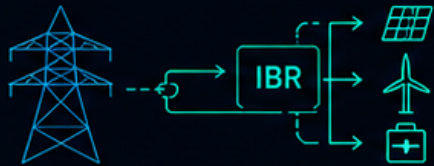
REALIZING IMPACTS OF INCREASING COMPLEXITY

Oscillations are one of the clearest manifestations of that complexity

DRIVERS



Hyperscale datacenter load growth



Inverter-Based Resource (IBR) integration



Massive AI infrastructure expansion

CONVERGENCE



GRID STRESSES



Declining Grid Inertia



Elevated Dynamic Loads

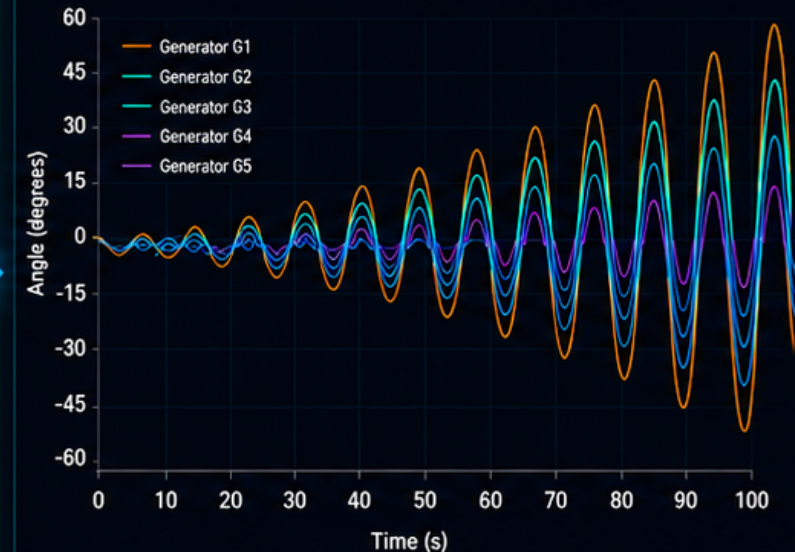


Adverse Control Interactions

OUTCOME

Electromechanical Oscillations – Poorly Damped (Unstable Mode)

Generator Rotor Angle Deviations



Power System Oscillations

DATA CENTERS MAY ALSO IMPACT POWER QUALITY & STABILITY

- Data center loads variations can **drive grid oscillations**, voltage flicker, and torsional interactions with generators.

PLANNING REQUIREMENTS FOR GRID RELIABILITY



INTERCONNECTION
REQUIREMENTS

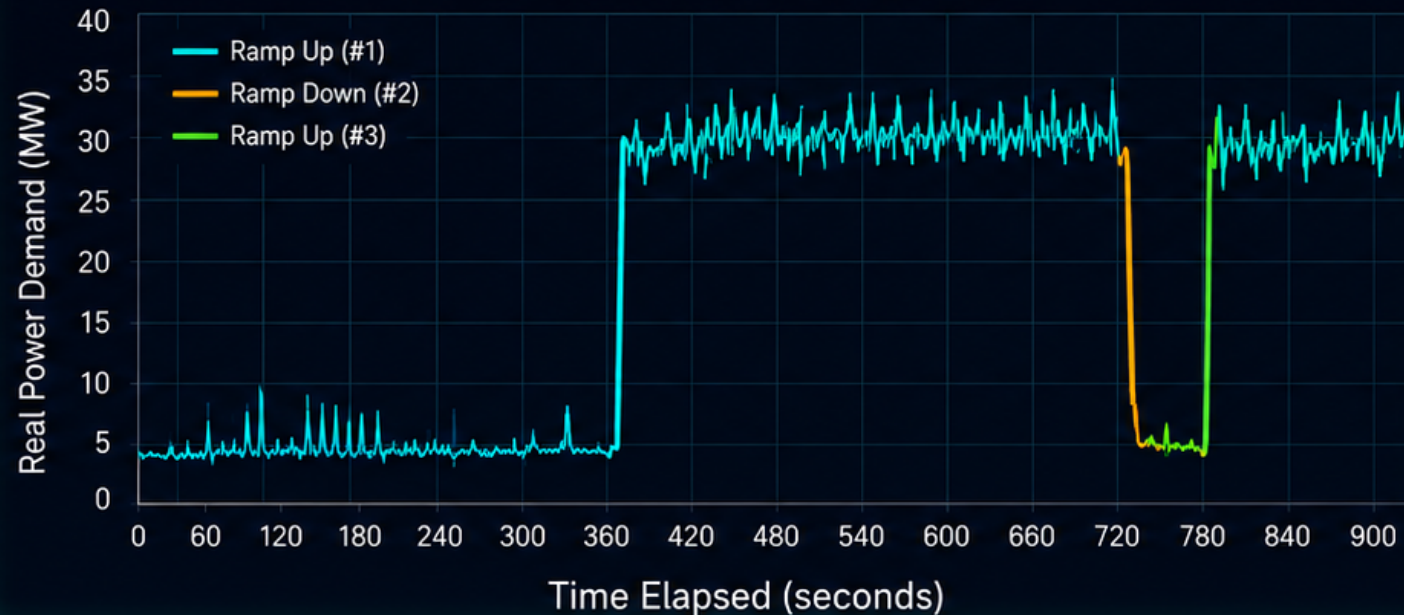


VALIDATED
DATA CENTER MODELS



FACILITY DISTURBANCE
MONITORING

DATA CENTER DEMAND CURVE



Data centers are transitioning to **on-site power** during grid disturbances which may create sudden **large load disconnections**.



NO SINGLE ANSWER

Many critical pathways
to enable an
AFFORDABLE, RELIABLE
energy evolution

OPTIONALITY IS NOT AN OPTION

—
IT IS A REQUIREMENT

Natural Gas Power Generation: Retrofit, Repower, or New

INCREASING COMPLEXITY



DROP-IN BIOFUELS



BLENDED LOW-CARBON FUELS



Source: IERA

CO₂ CAPTURE AND STORAGE



Source: NCCC

100% LOW-CARBON FUELS



FACTORS IMPACTING NATURAL GAS



Upstream Methane Emissions
(Full life cycle)



Public Acceptance, Permitting, Infrastructure



Availability
(Domestic vs. Imports)



Cost
(Supply & Demand, CO₂ tax)

Power *for* AI. AI *for* Power.

A symbiotic relationship. Exponential impact.

POWER FOR AI

Power enables the compute, infrastructure, and scale that **make AI possible**.



Reliable Energy

24/7 power for data centers, chips, and cooling at scale.



Infrastructure Scale

Build, connect, and expand the grids that AI demands.



Fuel for Innovation

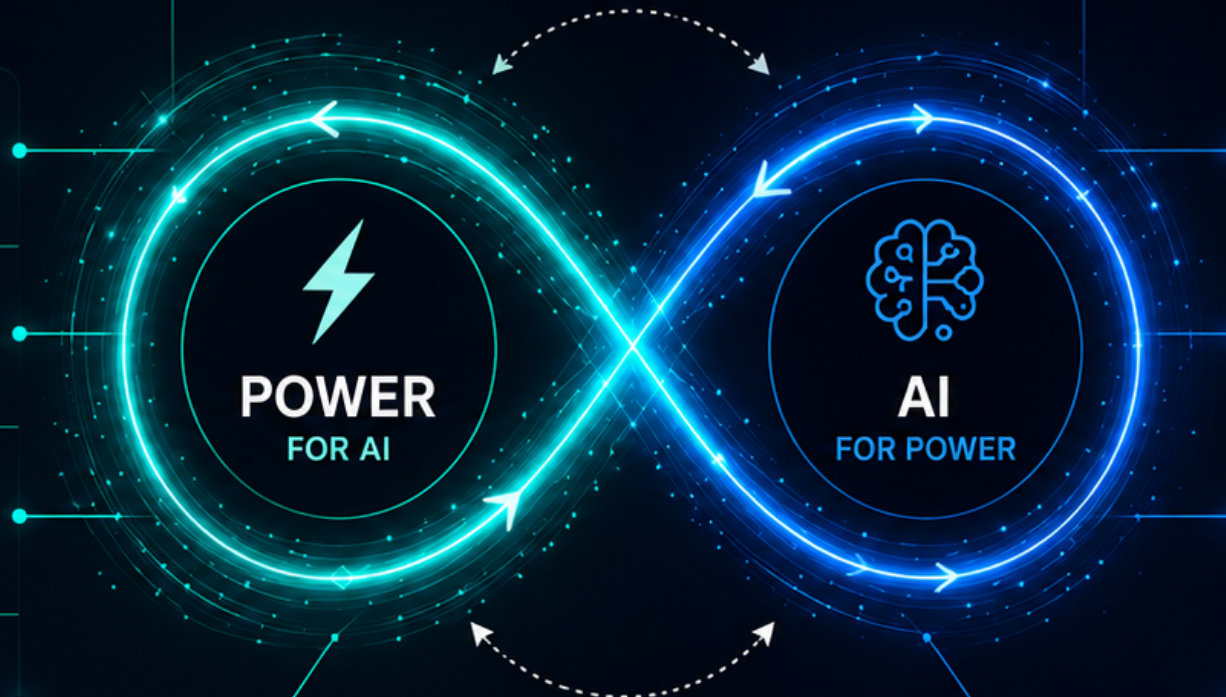
Power unlocks the next wave of breakthroughs in AI.



Compute at Scale

Sustainable, abundant power drives massive computation.

AI pushes the limits of what's possible.



Power makes it possible to push further.

AI FOR POWER

AI transforms how power systems are designed, operated, and **optimized**.



Smarter Operations

AI optimizes generation, storage, and grid operations in real time.



Predictive Insights

Forecast demand, detect issues, and prevent outages.



Resilient Systems

AI strengthens reliability and adapts to extreme events.



Sustainable Future

AI accelerates clean energy integration and efficiency.

STORAGE IS THE ENABLER

THE INDUSTRY IS ALREADY MOVING.

Google

100M+
BATTERY CELLS



Microsoft

PHASING OUT
DIESEL
BY 2030



STORAGE IS MOVING FROM THE MARGINS TO THE CORE.

THERMAL



MECHANICAL



CHEMICAL



NO SINGLE TECHNOLOGY WINS. **OPTIONALITY ACROSS ALL THREE** IS THE REQUIREMENT.

Beyond Resilience

Resilience is no longer about surviving disruption — it's about adapting faster than disruption itself.

THE OLD DEFINITION ROBUSTNESS



Build it strong



Withstand the shock



Return to normal

SUCCESS = SURVIVAL

THE WORLD
CHANGED.
THE DEFINITION
CHANGED.

THE NEW DEFINITION ADAPTABILITY



Learn continuously



Reconfigure in real time



Improve through stress

SUCCESS = EVOLUTION



We don't get to choose a stable world.
**We choose how adaptively
we build for the one we have.**



**THE BUILDERS OF
ADAPTIVE SYSTEMS
ARE ALREADY IN THIS ROOM.**

Engineers don't just create infrastructure.
They create the **capacity to evolve.**



STRONG SYSTEMS
SURVIVE SHOCKS.



ADAPTIVE SYSTEMS
GET **BETTER** BECAUSE OF THEM.

EPRI
TOGETHER...
SHAPING THE FUTURE
OF ENERGY®

