INFOGRAPHIC

AI DATACENTERS

MEETING THE CHALLENGES OF DENSITY, HEAT, AND RELIABILITY IN THE AGE OF ARTIFICIAL INTELLIGENCE

2X
GROWTH RATE

POWERING THE FUTURE IS TAXING THE GRID

UNPRECEDENTED AI DEMAND IS STRAINING THE GRID AND CHALLENGING THE LIMITS OF TODAY'S INFRASTRUCTURE

AI datacenters are the thrust of the digital revolution, powering generative AI, real-time analytics, and data processing. But they come at a cost: by 2030, AI datacenters will add an estimated 50 GW of new load to the U.S. grid – more than double the historical growth rate.

The scale and speed of this transformation is straining the nation's power infrastructure, with reliability now a top concern for operators, regulators, and national security leaders. The Department of Energy warns: without decisive modernization, the risk of large-scale power outages could rise by 100x, putting generative AI and economic security at risk.

PRESSURE POINT	AI DATACENTER CHALLENGE
Datacenter load rising 50GW by 2030	Individual rack loads now reach 10 kW to over 100 kW, pushing BOPP capacitors to overheat or fail during peaks, causing instability and outages.
Grid instability & voltage fluctuations	Mixed power sources create surges, sags, and phase shifts that BOPP capacitors struggle to regulate, exposing AI hardware to power disruptions.
Space & scalability constraints	Oversized BOPP banks don't fit in tight, modular data center designs, slowing deployment and blocking flexible layouts.
Thermal stress in high-power environments	AI workloads generate intense heat and force costly oversizing, active cooling, and frequent replacements to prevent failure, raising capital and operating costs.
High-frequency ripple & fast duty cycles	Rapid switching shortens the lifespan of BOPP capacitors, reducing reliability, especially during peak power events.
Short service life & high O&M costs	Frequent maintenance and replacement in always-on data centers drive up costs and increase the risk of downtime.

Meeting these demands requires next-generation grid components that are compact, resilient, and engineered for continuous, high-performance operation.

CAPACITORS KEEP AI ONLINE

AI DATACENTERS DEPEND ON CAPACITORS TO DELIVER VOLTAGE REGULATION, REACTIVE POWER, AND HARMONIC FILTERING FOR 24/7 WORKLOADS.

AI datacenters depend on capacitors. They keep the power flowing smoothly, absorb sudden spikes, and protect mission-critical AI hardware from voltage fluctuations and grid instability. As AI workloads push power systems to new extremes, the quality and reliability of capacitor banks greatly influence datacenter uptime, performance, and operational costs.

FUNCTION	BENEFIT IN AI DATACENTERS
Voltage Stabilization & Surge Protection	Maintains steady voltage and shields critical equipment from sudden spikes, ensuring power quality and safety
Energy Storage & Reactive Power Support	Absorbs peak loads, releases energy on demand, and maintains stable power factor for efficient AI operations
Harmonic Filtering	Suppresses electrical noise and harmonics generated by fast-switching AI hardware, protecting servers and equipment
System Scalability	Enables modular, flexible capacitor banks that grow with datacenter capacity and evolving workloads
Reliability & Endurance	Ensures uptime by surviving relentless thermal cycling, rapid switching, and high-frequency electrical stress

Maintaining reliability under extreme electrical and thermal stress from 24/7 AI workloads is a critical performance requirement. Capacitor banks must survive increasing temperatures, faster switching, and more frequent power surges to support the growth of AI.

BOPP-BASED
LIMITATIONS
UNDERCUT UPTIME

THE BOPP BOTTLENECK

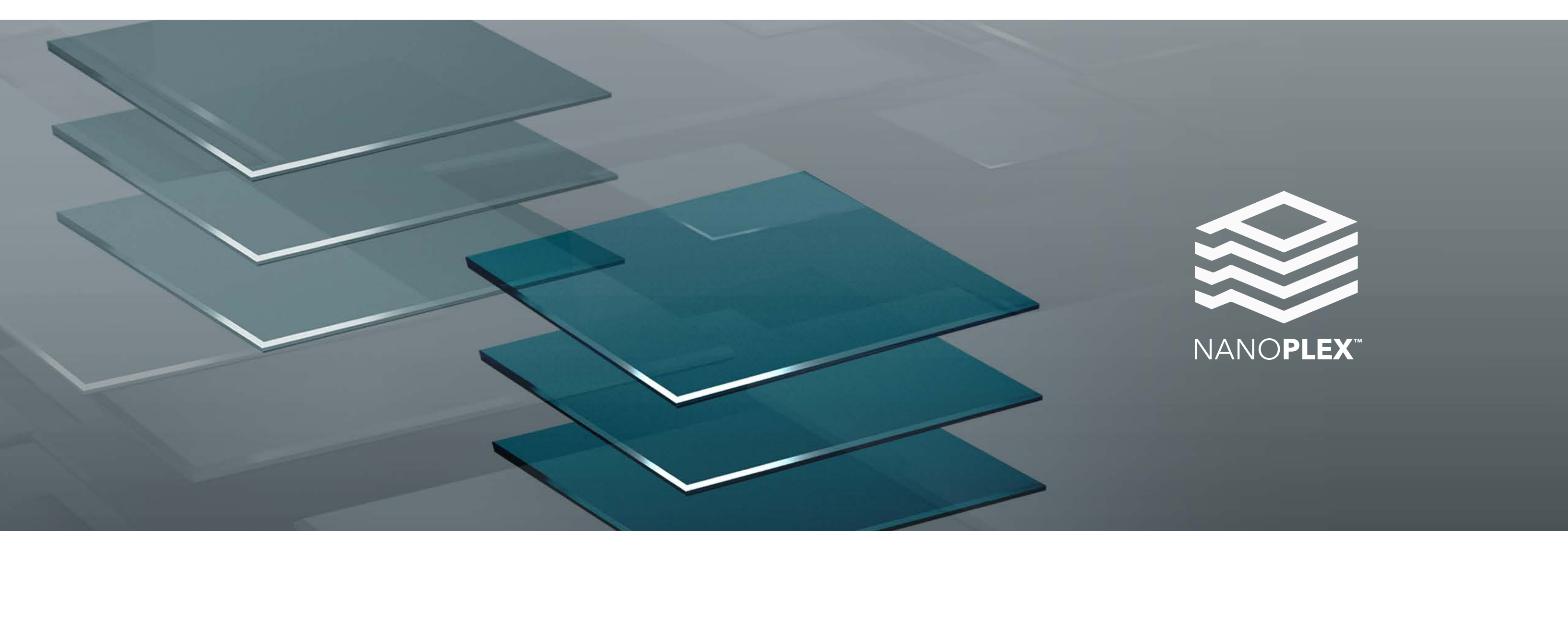
BOPP LIMITATIONS UNDERCUT UPTIME, EFFICIENCY, AND DATACENTER SCALABILITY

BOPP-film capacitors derate under heat, requiring frequent maintenance, planned downtime, and expensive oversizing that takes up space.

For operators under pressure to scale, meet demand, control costs, and guarantee uptime, BOPP is no longer a sustainable option. It is a bottleneck that limits growth, drains resources, and erodes the resilience that next-gen datacenters require.

AI DATACENTER CHALLENGE	WHY BOPP FAILS
Extreme rack-level power & thermal loads	BOPP derates or fails above 85°C, risking overheating, outages, and forced oversizing/cooling
Tight, modular layouts & limited space	BOPP banks are bulky, consuming floor space, blocking scaling, and limiting flexible deployment
24/7 operation, rapid switching & cycling	BOPP ages quickly, requiring frequent maintenance and driving up costs
Unstable power sources & voltage events	BOPP struggles to stabilize voltage under rapid surges, sags, or phase shifts, exposes AI hardware to risk
Need for rapid deployment & modernization	BOPP is incompatible with new modular, high-density designs, slowing expansion and modernization

AI datacenters demand advanced capacitors built to withstand relentless heat, nonstop cycling, and rapid load fluctuations without loss of stability or uptime.



OPERATATES UP TO
5X
LONGER

THE PEAK NANOPLEX™ ADVANTAGE

WHERE BOPP CAN'T KEEP UP, NANOPLEX DELIVERS

NanoPlex is a fundamentally new dielectric film platform, engineered to outperform conventional BOPP in every critical measure. Purpose-built for the demands of next-generation power systems, NanoPlex films unlock higher temperature operation, greater energy density, longer service life, and lower energy losses. With plug-and-play compatibility, U.S. based manufacturing, and an allied-secured supply-chain, NanoPlex empowers capacitor OEMs and grid operators to modernize.

ADVANTAGE OF NANOPLEX CAPACITORS VS. BOPP CAPACITORS

FEATURE	NANOPLEX	BOPP
Max Operating Temp	Operates reliably up to **135 °C without derating**	Up to 85 °C; derating required in high-heat conditions
Thermal Stability	**No film shrinkage** or degradation **at 135 °C**	Shrinks/degrades under elevated temperatures
Operational Lifespan	**Up to 5x longer life** under continuous thermal & load stress	Shorter lifespan under substation duty cycles
Dissipation Factor	**50% lower energy losses;** reduced self-heating	Higher losses, more heat generation
Energy Density	Up to **4x energy storage** per unit volume	Lower density; requires more space for desired capacitance
Size & Weight	**50% smaller, 30% lighter** – ideal for tight spaces & retrofits	Bulky form factors limit installation options in compact datacenters
Design Compatibility	**Plug-and-play with existing designs & equipment,** including metallization & winding	Incompatible with modern datacenter upgrade paths
Manufacturing	**100% U.S. engineered and manufactured**	80% of BOPP film sourced overseas, 70% from China
Supply Chain	**100% allied-sourced and geopolitically insulated**	Subject to geopolitical risk and sourcing delays

70%
OF GRID
IS 25 YEARS OLD

ENGINEERED TO OUTPERFORM

NANOPLEX IS PURPOSE-BUILT FOR THE HEAT, PACE, AND DENSITY OF MODERN AI INFRASTRUCTURE

Engineered for the relentless stress of today's high-density, always-on environments, NanoPlex enables AI datacenters to maximize uptime, minimize cooling and maintenance costs, and confidently scale as workloads intensify.

Handles Extreme Heat
135°C continuous no derate operation eliminates costly oversizing and cooling

Saves Space
4x energy density and 50% smaller, 30% lighter designs support modular, space-constrained datacenters

Minimizes Downtime
5x service life under nonstop, rapid cycling, minimizes downtime & operating costs

Protects & Stabilizes
50% lower dissipation reduces loss and keeps voltage stable, protecting sensitive hardware from surges

Effortless Upgrade
Drop-in compatible with existing capacitor designs for a no-retooling path to higher performance

Cleans Power
Low-ESR smooths out ripple, harmonics, and phase shifts from power sources to deliver clean, stable power

NanoPlex film powers the next generation of AI datacenters where rack density is soaring, temperatures run high, and performance and reliability can never be compromised.

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