# Emerging Solutions for Grid Efficiency

*Practical and emerging approaches to a more efficient electric grid*

*companion to technical paper PR-CH-2608-0001 R 1*

Andre Canelhas · International Rethinking Electricity Forum (IREF), Le Méridien, Paris · 25 August 2026

## The problem: two shocks, one deadlock

The power system was designed as a deterministic machine. The renewable transition made generation, load and power flows vary at once, and gigawatt-scale AI compute now adds a second shock: extreme density, five-nines continuity expectations, and demand arriving in months against connection processes that run in years. Interconnection queues hold far more capacity on paper than the system can deliver at the speed the load requires.

Three rational actors are locked against each other. **Utilities** owe reliability to every consumer and plan in years; **hyperscalers** need firm power in months; **equipment manufacturers** need firm order books before they expand capacity. Each party's precondition is another party's commitment. The binding problem is not technology — it is the allocation of roles, responsibilities and risk.

## What grid efficiency means here

Not classical loss reduction, but the system-level ability to deliver firm, reliable, scalable megawatts to dense, time-critical loads — faster, at lower societal cost, with stronger reliability and sustainability. The working metric is **Speed to Power**; the objective is configurations that improve several criteria simultaneously while residual trade-offs are made explicit and quantitatively managed.

## The engineering toolkit (candidate pathways, each study-gated)

- **Co-location** of generation, storage and load — in either direction: generation at the load, or the load at the resource.
- **Grid-forming inverters and modular storage** — voltage-source behaviour, fast frequency response and defined system-strength contribution, within stated converter limits.
- **Strategic HVDC and FACTS** — controllable ties that can limit disturbance propagation between regions, alongside rebuilt high-capacity AC corridors.
- **Flexible mega-loads as virtual power plants** — contracted flexibility that can support earlier, lower-cost connection.
- **Wide-area, multi-timescale control** — microseconds to market hours operated as one system, on validated, shared models.

## Bridge-to-grid: the delivery pattern

**1 Site for deliverability · 2 Build modular · 3 Bridge power first · 4 Operate as a VPP from day one · 5 Overlay and reinforce the network · 6 Firm progressively.** Where a viable bridging supply, consents and a compliant minimal connection can be secured, first power can be brought forward to months rather than years, with the load in commercial operation while integration matures. Each party underwrites what it is best placed to carry; nothing is quietly socialised onto ordinary consumers.

## The power–compute interface: the load becomes a grid asset

Inside the fence, a native-DC campus architecture built from field-proven equipment — PV, storage and IT load on one DC bus, a bidirectional converter rated only for net exchange, 800 VDC delivered to the rack with conversion beside the GPU — offers an indicative lower power losses from generation and storage to the IT load (HVDC Technologies estimate; boundary and assumptions defined in the paper).

More important than efficiency: the load is shaped at source. Layered storage from rack capacitors to facility batteries, progressive power capping and workload orchestration convert pulsed compute demand into a smooth, bounded power request — attenuating, before it reaches the grid, the oscillatory content that can otherwise excite turbine-generator shaft modes.

Regulators are moving: NERC's 2026 guideline asks large loads to declare cyclical demand frequencies, and EPRI has published screening methods for AI-load torsional interaction. The paper argues for proportionate, generation-referenced performance requirements for converter-interfaced mega-loads.

## Call to action

- **Utilities and system operators:** move from rationing to enabling — readiness-based standards, non-firm and flexible access.
- **Hyperscalers:** bring your own firming; operate as transparent, dispatchable, grid-supporting assets.
- **Manufacturers:** productise and standardise adaptable, grid-forming, rapidly deployable equipment.
- **Policymakers and regulators:** write the shared-risk framework; shield ordinary consumers from socialised costs.
- **All parties:** open standards and shared, high-fidelity models, tested in the loop before energisation.

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*Scope: this note summarises an engineering concept paper, not a feasibility study or design specification; every pathway requires site-specific electrical, protection and commercial studies before adoption. The architectures are open and multi-vendor — nothing is proprietary to, or dependent on, any single supplier, including the author's firm. Full argument, evidence and references: Emerging Solutions for Grid Efficiency, PR-CH-2608-0001 R1, August 2026.*