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ARTIFICIAL INTELLIGENCE DATACENTER INTEGRATION

STABILITY RISKS & MITIGATIONS

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Artificial intelligence datacenters may cause broad range of instabilities … especially in weak grids

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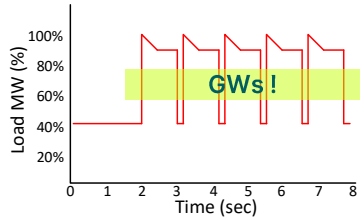
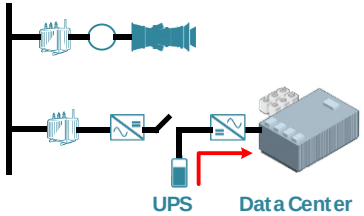
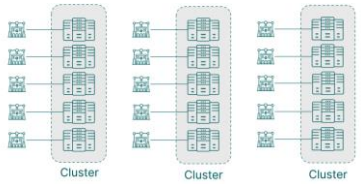
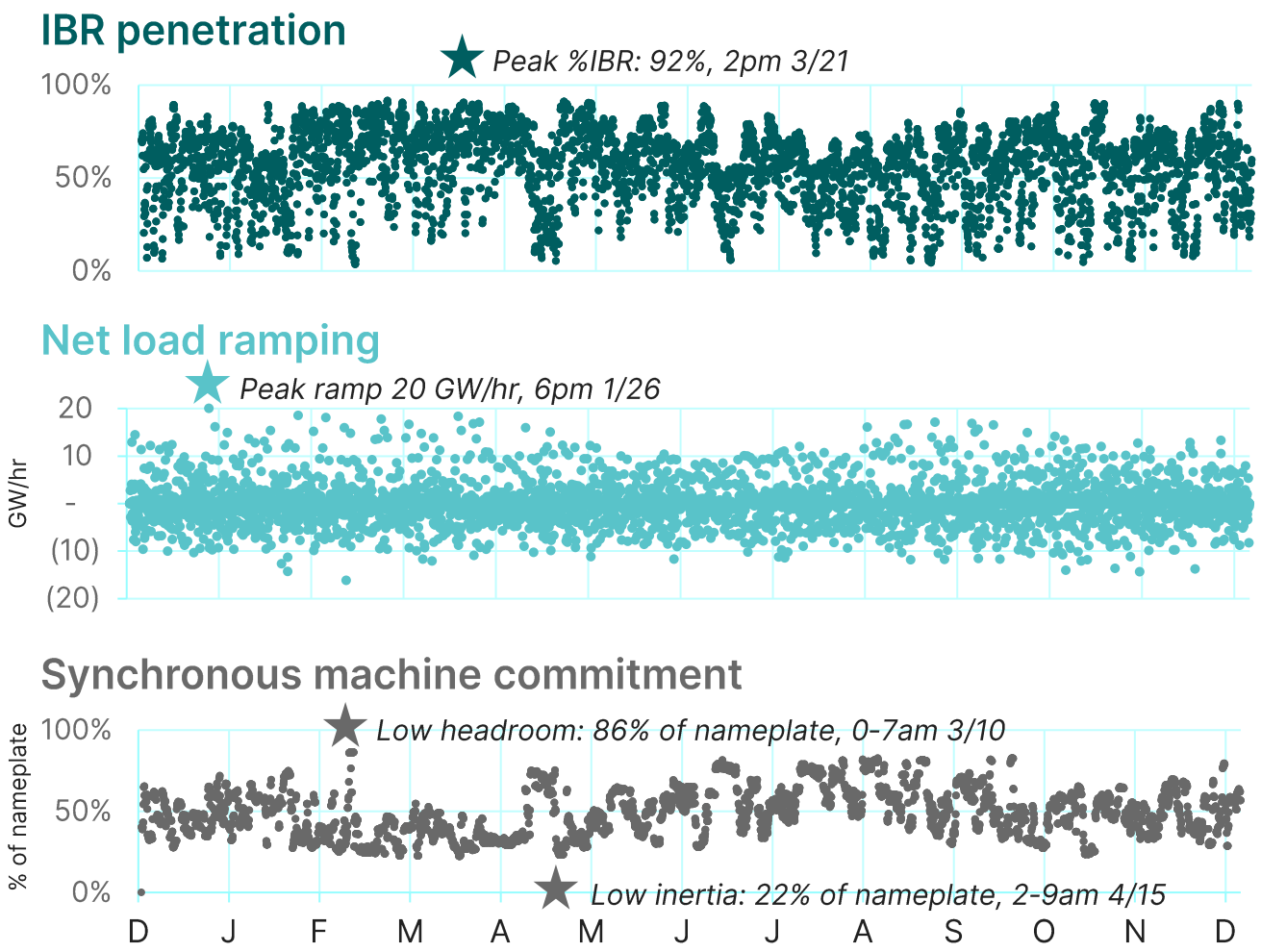
	Voltage instability	Frequency instability	Small signal instabilities	**Example solution:** *Batteries / load banks*
Highly varying repetitive load 	Unstable voltage esp in weak grids	Ramp rates challenge frequency … esp at workload start/stop	High ramp rates → unwanted oscillations & torsional risk	Cycle to counter load ramping
Sensitive UPS operation 	UPS transition challenges voltage esp in weak grids	UPS transition challenges frequency		Absorb shock of DC transition to UPS
Unstable power electronic coordination 	Undamped characteristic → voltage oscillations	Power oscillations lead to frequency excursions	IBR interactions → undamped oscillations & torsional risk	Damp oscillations … act as filter

Given risks, how to serve load with **near zero trips**?

Renewables operation may affect severity of data center stability risks

Example: ERCOT 2040 hourly production cost simulation



Ref: GEV Consulting Services, non-proprietary database

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System conditions with highest stability risk

1. **Workload start/stop coincident with:**
   - High net load ramps
   - Low SM headroom … low renewables
2. **Load cycling coincident with:**
   - High IBR % … weak grid
   - Low inertia
3. **Sensitive UPS transitions coincident with:**
   - High net load ramps
   - Low SM headroom
4. **Unstable power electronic coordination coincident with:**
   - High IBR % … weak grid

Assess collective impact of datacenters & renewables to mitigate risks

Closing thoughts: top recommendations for reliable data center integration

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1. **Interconnection & planning procedures need to be updated** to include data centers which are neither pure loads nor pure generators nor pure storage

2. **Models should be required from data center owners:** power flow & stability models to represent load, generation, & storage controls for each facility

3. **Resource performance requirements** (e.g. ride-thru, frequency response…) need to be defined via system-wide impact assessment across resource types (e.g. renewables, data centers, storage, etc…)

Integrated planning approach required to holistically assess & mitigate risks


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