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From Efficiency to Sustainability

A Decision Maker Brief on the GeSI Sustainable Data Centers Blueprint



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The central question is not whether a data center is becoming more efficient. It is whether the facility fits within the ecological, infrastructural and social systems on which it depends.

Most approaches to data-center sustainability measure incremental improvement: a better PUE (Power Usage Effectiveness) rating, lower water use per unit of computing, reduced reported carbon intensity, or progress against a company's own baseline. These measures are useful for managing operations. They are not, by themselves, evidence of sustainability.

A facility can improve every major efficiency ratio while increasing its total electricity demand, water consumption or pressure on a constrained local system. It can procure renewable electricity on an annual accounting basis and claim "carbon neutrality" while adding load that increases marginal emissions and amplifies critical grid peaks. It can reduce direct water use while shifting burdens into electricity demand, or report strong facility performance while the cumulative effect of a regional cluster exceeds available infrastructure capacity.

The Sustainable Data Centers Blueprint addresses these gaps by grounding assessment in **thresholds and allocations**. A threshold describes the limit, capacity or condition of a relevant system: for example, a regional energy grid, a watershed limit, a carbon pathway or a resilience requirement. An allocation identifies the fair and transparent share of that available resource that may be used by a sector, cluster or facility.

This changes the decision from "Is this facility better than before?" or "Is it better than a peer?" to "Is this facility's total demand compatible with a fair share of the system's safe operating space at the times and places that matter?"

The Blueprint does not replace PUE, WUE, carbon accounting, regulation or engineering standards. It puts them in their proper role. They become evidence used within a wider assessment of actual sustainability, rather than stand-alone proof that sustainability has been achieved.

Efficiency asks how well resources are used. Sustainability asks whether total use fits within limits. The Blueprint brings both questions together.

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01 | WHY THE PREVAILING MODEL FALLS SHORT

INCREMENTAL IMPROVEMENT CAN COEXIST WITH GROWING PRESSURE

Efficiency metrics are ratios. They describe the relationship between inputs and outputs within a defined boundary. They can indicate that cooling overhead has fallen, that less water is used per unit of IT energy, or that the emissions associated with electricity have declined. They cannot establish whether the absolute scale of demand is compatible with the system supplying it.

This distinction becomes decisive as data centers grow larger, cluster geographically and support increasingly power-dense AI workloads. A highly efficient facility may still represent a very large new load. If that load arrives in a constrained grid zone, during system peaks, or in a watershed facing seasonal scarcity, relative efficiency does not resolve the underlying sustainability problem.

CONVENIENT BOUNDARIES CONCEAL SYSTEM IMPACTS

Conventional reporting frequently stops at the facility boundary or the corporate inventory. Yet the most important effects may occur beyond that boundary: generation and network investment needed to serve the load; water consumed indirectly through electricity production; cumulative demand from multiple sites; costs transferred to utilities, ratepayers or public authorities; and the resilience implications of concentrating critical digital infrastructure in a constrained region.

The Blueprint selects boundaries because they are relevant to the impact being assessed, not because they are easy to report. Electricity may need to be considered at the grid-zone or balancing-area level. Water belongs in its watershed or supply system. Thermal impacts depend on local receiving conditions and realistic heat-use opportunities. Social legitimacy depends on the communities and institutions that bear costs, receive benefits and make decisions.

ANNUAL AVERAGES CAN HIDE CRITICAL PERIODS

System compatibility is also temporal. Annual electricity demand can appear manageable while coincident peak demand creates a capacity problem. Average water availability can conceal drought or low-flow constraints. A facility may remain within an annual envelope but exceed a temporary threshold during a heatwave, emergency or infrastructure outage.

Decision-makers therefore need both aggregate results and performance during defined critical intervals. The relevant questions include when demand occurs, how long stress lasts, how frequently it recurs, and what operational response is available.

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02 | THE BLUEPRINT'S APPROACH: THRESHOLDS, ALLOCATIONS AND SYSTEM FIT

The Blueprint provides a disciplined method for connecting infrastructure decisions to the real conditions of a place. It follows four steps.

1. DEFINE THE RELEVANT SYSTEM

Identify the physical and institutional boundary within which the impact must be understood: the relevant grid zone, watershed, water-supply network, planning area, thermal environment or affected community. Different impacts may require different but connected boundaries.

2. SET THE THRESHOLD

Document the ecological limit, infrastructure constraint, transition pathway or operating condition against which performance will be interpreted. Thresholds must include a time basis. They may be annual or cumulative, seasonal, peak-period, or activated temporarily by drought, heat, grid disruption or another stress condition.

Thresholds also differ in adjustability. Ecological-flow or safety constraints may be effectively fixed. Other limits may reflect infrastructure capacity that can be expanded through additional renewable generation, storage, network reinforcement, demand response, water reuse or shared heat infrastructure. Planned investment does not count as additional capacity until it is delivered, available to the relevant system, independently evidenced and appropriately governed.

3. ALLOCATE A FAIR SHARE

A system limit does not automatically determine what portion is available to one sector or facility. Allocation makes that choice explicit. Criteria may include essential service needs, existing commitments, alternatives, utilisation, flexibility, economic and social contribution, resilience requirements, and the rights and needs of other users. Allocation is therefore both an analytical and a governance decision.

4. EXPRESS PERFORMANCE AGAINST THE THRESHOLD AND ALLOCATION

Report whether the facility operates within its allocation, approaches a critical condition or contributes to overshoot. Show the magnitude, timing, duration and recurrence of stress; the uncertainty in the result; and the action that follows. This creates a decision-useful account of system fit rather than another isolated metric.

Conventional improvement lens	Threshold-and-allocation lens
How efficient is the facility?	Is total demand compatible with local system capacity?
Has performance improved against last year or a peer?	Does performance remain within a fair, transparent allocation?
What happens inside the facility boundary?	What happens across the grid, watershed, thermal system and host community?
What is the annual average?	What happens during peaks, droughts, heatwaves and other stress periods?
Does a procurement instrument improve the reported ratio?	Does the action add real capacity, reduce system pressure or shift impacts elsewhere?
Can the project meet minimum requirements?	Under what conditions can the project operate, expand and retain legitimacy?

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03 | WHY THIS MATTERS FOR BUSINESS AND POLICY DECISIONS

BETTER INVESTMENT DECISIONS

Threshold-relative assessment reveals dependencies that can affect asset value and delivery: connection delays, peak-capacity exposure, drought restrictions, infrastructure cost allocation, permitting risk, community opposition and the possibility of stranded or underused capacity. It helps investors and operators distinguish a technically efficient project from one whose business case depends on resource access that may become constrained, costly or contested.

MORE CREDIBLE PERMITTING AND PLANNING

Public authorities need to evaluate cumulative demand, not only individual applications. The Blueprint creates a common evidence base for deciding whether development should proceed, be staged, include operating conditions, fund enabling infrastructure or wait for system capacity. It also clarifies which claims require independent evidence and which decisions require participation by utilities, water authorities, communities and other affected users.

A STRONGER BASIS FOR RESPONSIBLE GROWTH

The framework is not inherently anti-growth. It distinguishes growth that fits within existing capacity, growth that becomes compatible through verified mitigation or additional system investment, and growth that would depend on overshoot or the transfer of costs and risks to others.

Ancillary investment can expand the safe operating space where the relevant threshold is genuinely adjustable. New renewable generation, storage, grid buffering, network reinforcement, demand-response capability, water reuse and shared heat infrastructure may all create system value. But proposed or contracted measures should not be treated as capacity already available. A revised threshold should be recognised only when added capacity is delivered, additional, available to the relevant system and governed so that costs, benefits and risks are fairly distributed.

GREATER TRUST AND A MORE DURABLE SOCIAL LICENCE

Communities and policymakers are increasingly asked to accept long-lived commitments of land, electricity, water and public infrastructure. Trust depends on showing not only that a developer follows rules, but that local limits and competing needs are understood, assumptions are visible, performance can be verified and operating plans will adapt if conditions change.

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04 | A PRACTICAL TEST FOR DECISION-MAKERS

For a proposed facility, expansion or public incentive, leaders should require clear answers to at least the following questions.

SYSTEM AND LIMITS

- What electricity, water, thermal, planning and community systems are materially affected?
- What thresholds or capacity constraints apply, who established them and how will they change under plausible future conditions?
- Which limits are fixed, which vary with external conditions and which can credibly be expanded through investment?

ALLOCATION AND FAIRNESS

- What share of the available resource envelope is being claimed?
- What allocation criteria were used, and how were essential needs, existing users, alternatives, public value and competing investments considered?
- Who bears infrastructure costs, downside risks and opportunity costs, and who receives the benefits?

TIMING AND RESILIENCE

- How does aggregate demand compare with demand during critical peaks, droughts, heatwaves or outages?
- Which loads are critical, which can be shifted or reduced, what triggers action and how long can the response be sustained?
- Does the project remain viable under high-growth, lower-demand, delayed-infrastructure and severe-stress scenarios?

EVIDENCE AND ACCOUNTABILITY

- Which results are measured, estimated or assumed?
- Are promised enabling investments delivered, additional and available to the same system affected by the facility?
- What information will be public, what will be independently verified and what happens if performance exceeds an agreed threshold?

These questions can be applied proportionately. An early-stage screen may identify material constraints and evidence gaps. A higher-stakes decision—such as permitting a large campus, reserving scarce grid capacity or committing public funds—should require a more complete assessment, independent review and enforceable conditions.

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05 | HOW TO USE THE BLUEPRINT NOW

The Blueprint is a practical framework for better decisions, not another certification scheme. Organisations can use its shared questions to examine system fit today, while pilot experience tests and refines the underlying methodology. Any future move towards standardisation remains a separate decision rather than an assumed outcome.

Business leaders and investors should use threshold-relative performance in site screening, due diligence, capital allocation and expansion decisions.

Policymakers and public authorities should assess cumulative effects, make allocation criteria explicit and connect approvals to staged development, verified mitigation and stress-period commitments.

Utilities and system operators should define capacity and stress thresholds and distinguish investments that add real local capability from accounting measures.

Customers and cloud users should incorporate location, timing, criticality and flexibility into workload orchestration and choices.

Across all roles, implementation will evolve as GeSI members and contributing partners conduct focused pilots, support the development of better public methods, meaningful aggregate results and provide controlled verification of sensitive evidence.

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06 | THE DECISION IN FRONT OF US

Data centers are essential infrastructure, and their rapid expansion can support innovation, productivity and resilience. But the scale of planned investment also creates long-lived claims on shared electricity, water, land and public systems. Those claims cannot be judged responsibly through efficiency ratios alone.

The choice is not between growth and sustainability. It is between growth assessed against real system conditions and growth justified mainly through incremental improvements within convenient boundaries.

The Sustainable Data Centers Blueprint offers a more credible basis for action. It retains the operational value of established metrics while adding the questions those metrics cannot answer: What are the limits? What is a fair allocation? When does demand create stress? Can investment expand capacity without transferring harm? What evidence is sufficient? Who participates in the decision? And what happens when conditions change?

For decision-makers, the practical value is clear: thresholds and allocations turn sustainability from a claim about relative improvement into a test of whether infrastructure can operate, grow and create value within the systems that are necessary to sustain it.

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