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Making Singapore's Digital Infrastructure Future-Ready

A Progressive Framework for Data Centre Energy Efficiency under Singapore's Draft Digital Infrastructure Bill 2026

FOR GOVERNMENT CONSIDERATION

Submitted to the Government of Singapore
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Abstract

Singapore's draft Digital Infrastructure Bill 2026 represents an important step in the regulation of data centres as critical economic infrastructure with significant energy and environmental consequences. The Bill expressly contemplates facility-level energy-efficiency requirements, equipment-level energy-efficiency requirements, water-efficiency requirements, regular compliance reporting, codes of practice, audits, remedial directions and financial penalties.

This white paper supports the objective of improving data-centre sustainability but argues that the regulatory framework should remain sufficiently progressive to recognise a fundamental distinction:

> ***Efficient infrastructure is not necessarily efficient computation.***

Traditional data-centre efficiency measures appropriately examine how efficiently electricity is supplied to information technology equipment and how much additional energy is consumed by cooling, power distribution and other supporting infrastructure. These measures remain essential. However, the rapid growth of artificial intelligence raises a further question:

> ***How much computation was necessary to achieve the intended digital outcome?***

A data centre may become increasingly efficient at delivering electricity to servers while those servers perform unnecessary, duplicative, poorly targeted or avoidable computation. Conversely, a new computing architecture may achieve an equivalent or superior useful outcome using substantially fewer computational resources.

The draft Bill already creates a basis for broader thinking by distinguishing facility-level energy efficiency from equipment-level energy efficiency. This paper proposes that Singapore progressively develop a three-layer framework:

Energy and Infrastructure Efficiency + **IT Equipment Efficiency** + **Computational Outcome Efficiency**

The proposed approach is technologically neutral. Government should not determine which particular hardware, algorithm, energy architecture or computing model must be used. Instead, the regulatory framework should allow operators and innovators to demonstrate, through measurable and auditable evidence, that a required outcome can be achieved with fewer resources while preserving security, resilience and reliability.

The central policy proposition is:

> **The law should regulate required outcomes while leaving engineering free to discover better methods of achieving them.**

This paper therefore recommends, among other measures, an outcome-based alternative compliance pathway, recognition of system-level efficiency improvements, real-world operational measurement, an innovation sandbox, and the progressive development of metrics that relate resource consumption to useful computational outcomes.

The objective should ultimately be:

$$\frac{\textbf{Maximum Useful Digital Outcome}}{\textbf{Minimum Necessary Resource Consumption}}$$

Executive Summary

Singapore faces a structural challenge shared by advanced digital economies but intensified by its physical and resource constraints.

The country seeks to remain a leading global digital and artificial-intelligence hub while managing limited land, energy and water resources. Data centres are indispensable to the first objective and materially affect the second.

The draft Digital Infrastructure Bill responds by establishing a licensing and compliance framework for data-centre operators. Section 33 expressly contemplates prescribed minimum facility-level energy-efficiency requirements, equipment-level energy-efficiency requirements for information technology equipment, and minimum facility-level water-efficiency requirements. Sections 34 and 35 provide for regular reporting, possible audits and codes of practice relating to energy and water efficiency.

This is an important regulatory development.

It also creates an opportunity.

The International Energy Agency reported in April 2026 that global data-centre electricity consumption rose by **17% in 2025**, while electricity use by AI-focused data centres grew even faster. Although energy consumed per AI task is improving rapidly, increasing adoption and more energy-intensive applications, including AI agents, continue to drive aggregate demand upward.

Singapore has already begun addressing both sides of data-centre efficiency. Its Green Data Centre Roadmap includes facility efficiency and compute or IT-equipment efficiency, while the Singapore Standard on Energy Efficiency of Data Centre IT Equipment, **SS 715:2025**, is intended to support reductions in IT-equipment energy consumption.

The next progressive step is to recognise that three different questions are involved:

First: How efficiently is energy delivered to the computing equipment?

This concerns the facility: power distribution, conversion, cooling and supporting infrastructure.

Second: How efficiently does the computing equipment operate?

This concerns servers and other IT equipment.

Third: How much computation is actually required to achieve the intended outcome?

This concerns the relationship between resource consumption and useful computational work.

These questions are related but not identical.

A facility may improve its Power Usage Effectiveness while the computational workload itself continues to expand. PUE measures the relationship between total facility energy and IT-equipment energy; it does not, by itself, determine whether the IT workload is producing the required outcome with the minimum necessary computation.

The central proposition of this white paper is therefore:

> **Singapore should preserve established facility and equipment metrics while progressively creating a regulatory pathway for outcome-based efficiency.**

Such a pathway would not require government to decide whether one algorithm, AI model or power architecture is superior to another. It would instead permit innovators to demonstrate:

Efficiently Powering More Computation	≠	**Computing More Efficiently**

The proposed regulatory architecture is:

Equivalent or Superior Defined Outcome	+	**Lower Verified Resource Consumption**

This approach could make Singapore's legislation more progressive in three respects.

First, it would avoid unintentionally freezing present-day engineering methods into future compliance standards.

Second, it would create incentives for innovation across the entire energy-to-computation chain rather than only within individual components.

Third, it would recognise a fundamental principle of sustainability:

> **A unit of energy avoided through unnecessary computation is as relevant to resource conservation as a unit of energy saved through more efficient infrastructure.**

BASELINE → **MEASURE** → **INNOVATE** → **VERIFY** → **REPORT**

PART I — THE LEGAL AND REGULATORY LAYER

1. The Draft Bill Creates a New Energy-Compliance Architecture

The draft Digital Infrastructure Bill establishes a dedicated licensing regime for data-centre operators. Its structure places environmental sustainability within the continuing obligations of operating regulated data-centre infrastructure rather than treating sustainability solely as a voluntary objective.

Section 33 is particularly significant. It requires a licensee, subject to requirements to be prescribed, to ensure:

1. compliance with minimum facility-level energy-efficiency requirements;
2. compliance by installed information technology equipment with equipment-level energy-efficiency requirements; and
3. compliance with minimum facility-level water-efficiency requirements.

The legislation therefore recognises at least two distinct energy-efficiency domains:

Facility-Level	&	Equipment-Level
PUE, cooling, distribution		SS 715:2025, IT efficiency

> *This distinction is important.*

A data centre is not merely a building that consumes electricity. Nor is it merely a collection of computers. It is a system in which energy is sourced, converted, distributed and ultimately consumed to perform computation.

> **The Bill therefore creates the beginnings of an energy-to-computation regulatory chain.**

2. Compliance Is Intended to Be Continuing and Evidential

The proposed regime does not appear to treat energy efficiency as a one-time design requirement.

Section 34 requires periodic reports concerning compliance with the relevant Part of the legislation, regulations, licence conditions and applicable codes of practice. The Authority may require such a report to be audited and accompanied by an auditor's report. Section 35 permits the Authority to issue or approve codes of practice relating to measures for ensuring energy and water efficiency.

The resulting regulatory structure can be represented as:

REQUIREMENT → **OPERATION** → **MEASUREMENT** → **REPORTING** → **AUDIT** → **REMEDIATION**

This is important because it creates an opportunity for evidence-based innovation.

If compliance is measured and audited, the framework need not rely solely on prescribed technologies. It can potentially recognise actual performance.

The question is therefore whether the regulatory framework should provide only:

> *a prescribed pathway to compliance*

or also:

> *a verified outcome-based pathway to equivalent or superior compliance.*

This white paper recommends both.

3. The Risk of Technology Lock-In

Codes of practice are necessary. They provide operators with certainty and allow regulators to establish minimum standards.

However, detailed technical requirements can create an unintended problem if compliance becomes inseparable from the use of particular architectures or methods.

A regulatory framework developed around current technology may inadvertently establish:

Current Best Practice → **Regulatory Requirement** → **Market Standard** → **Barrier to Alternative Architecture**

The result can be paradoxical.

A new technology may produce a better environmental outcome but face difficulty because it does not operate according to the method assumed by the existing compliance framework.

This risk is especially relevant in rapidly developing fields such as:

- artificial intelligence;

- computing architectures;
- advanced cooling;
- power electronics;
- energy storage;
- renewable-energy integration; and
- dynamic workload management.

The legislation should therefore distinguish between:

Prescriptive compliance

Use an approved method or meet a prescribed technical specification.

and:

Performance-based compliance

Demonstrate, through accepted measurement and verification, that the required or superior outcome has been achieved.

Both have legitimate roles.

The progressive principle should be:

> **A code of practice should establish a reliable path to compliance without becoming the only technically permissible path to the regulatory objective.**

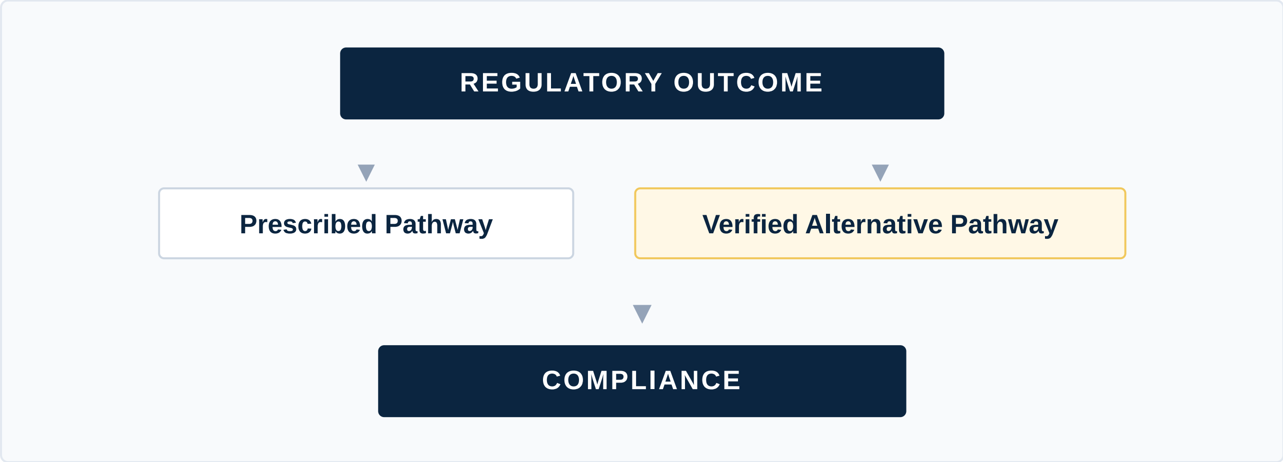
4. The Case for an Alternative Compliance Pathway

This white paper recommends that the Bill, regulations or codes of practice expressly permit an Alternative Performance-Based Compliance Pathway.

Under such a pathway, an operator or technology provider could demonstrate that an alternative system achieves:

1. the required level of energy efficiency or better;
2. equivalent or better security;
3. equivalent or better operational resilience;
4. equivalent or better reliability; and
5. independently verifiable performance.

The architecture would be:



This would make the regulatory framework technology-neutral in practice, not merely in principle.

PART II — THE SCIENTIFIC AND ENGINEERING LAYER

5. The Energy-to-Computation Chain

Data-centre energy consumption should be understood as a system.

A simplified chain is:

Energy Source → **Power Infrastructure** → **Cooling and Support** → **IT Equipment** → **Computation** → **Useful Digital Outcome**

Efficiency can be lost or improved at every stage.

The regulatory challenge is that no single metric necessarily captures the entire chain.

For example, PUE is commonly expressed as:

$$\text{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$

This is valuable for assessing facility overhead. A PUE approaching 1 indicates that a greater proportion of facility energy is reaching IT equipment rather than being consumed by supporting infrastructure.

But consider two hypothetical systems:

System A	**100 units** of IT energy → Required outcome
System B	**20 units** of IT energy → Same required outcome

If both facilities have the same PUE, PUE alone does not distinguish the computational efficiency of the two workloads.

This is not a criticism of PUE. It is a recognition of its purpose.

A metric should not be criticised for failing to measure something it was not designed to measure.

The policy implication is that facility metrics should be complemented, not discarded.

6. The Missing Endpoint: Useful Computational Outcome

The conventional measurement chain may stop at:

Energy → **IT Equipment**

But the economic and social purpose of a data centre lies beyond the equipment.

The equipment exists to produce:

- information;
- inference;
- storage;
- communication;
- simulation;
- transactions;
- scientific results;
- digital services; or
- other computational outcomes.

The complete chain is therefore:

Energy → **Infrastructure** → **Equipment** → **Computation** → **Outcome**

A progressive efficiency framework should ultimately be capable of asking:

> ***What useful outcome was produced for the resources consumed?***

This paper refers to that concept as Computational Outcome Efficiency.

It can be expressed conceptually as:

$$\text{Computational Outcome Efficiency} = \frac{\text{Defined Useful Computational Outcome}}{\text{Resources Consumed}}$$

This is not proposed as a single universal numerical metric.

Different workloads have different purposes. A medical model, database query, scientific simulation and language model cannot necessarily be compared through one common output unit.

The concept should therefore initially be applied through like-for-like or mission-equivalent comparison.

The appropriate question is:

> ***Can the same defined task or required service level be achieved with fewer resources?***

7. The Rise of AI Makes the Question Urgent

The energy demand associated with data centres is increasing rapidly. The International Energy Agency projects major growth in global data-centre electricity demand, with AI being an important driver. Its 2025 analysis projected global data-centre electricity consumption reaching around **945 TWh by 2030**, while its 2026 update reported continued rapid growth and noted that aggregate demand can rise even while energy consumed per AI task falls.

This reveals a fundamental distinction between:

Efficiency per Task and **Total System Consumption**

An individual AI operation may become more efficient while the number, complexity and autonomy of AI operations increase faster.

Therefore, sustainability cannot rely solely on improving the efficiency of each unit of hardware.

It must also consider:

- workload utilisation;
- computational redundancy;
- unnecessary processing;
- task scheduling;
- model and architecture efficiency;
- reuse of prior computation where appropriate;
- whether a task remains necessary; and
- whether a smaller computational pathway can achieve the required outcome.

This is consistent with broader international analysis identifying not only infrastructure efficiency but also server efficiency, utilisation and shutdown of underused equipment as material data-centre energy-efficiency opportunities.

8. The First Principle: Do Not Consume What Is Not Required

Most energy-efficiency strategies ask:

> *How can this operation consume less energy?*

A deeper question is:

> *Is the operation itself necessary in its present form?*

This produces two complementary approaches.

Approach A	**Improve the efficiency of the operation** · 100 units of work → Use less energy per unit
Approach B	**Reduce unnecessary work** · 100 units of proposed work → 20 units actually required

The two approaches should not compete.

They multiply.

Less Energy per Operation × **Fewer Necessary Operations** → **Lower Total Resource Demand**

This gives rise to a central principle:

> **The greenest computation may be the computation that was not necessary to perform.**

This proposition should not be interpreted as an argument against computing or AI. It is an argument for purposeful computing.

9. Static Efficiency and Dynamic Reality

Data centres operate in changing conditions.

Variables include:

- workload demand;

- server utilisation;
- energy availability;
- grid conditions;
- renewable generation;
- storage state;
- ambient temperature;
- cooling demand; and
- urgency of computation.

A system that is optimal at one moment may not be optimal at another.

Accordingly:

Efficiency ≠ Single Peak Measurement

A more complete understanding includes:

Performance Across Time and Operating Conditions

Standardised test conditions remain indispensable because they permit comparison.

However, operational compliance should also be capable of recognising measured real-world performance.

The regulatory framework should therefore support both:

Standardised Benchmarking + **Operational Measurement**

This principle is already compatible with a regulatory regime built around continuing reporting and audits.

10. System-Level Efficiency

Efficiency improvements can propagate through the data-centre system.

For example:

Reduced Electrical Loss → **Reduced Heat** → **Reduced Cooling Demand** → **Further Energy Reduction**

Similarly:

Avoided Computation → **Reduced IT Energy** → **Reduced Heat** → **Reduced Cooling Demand**

A component-level metric may fail to recognise the full system effect.

This white paper therefore proposes that, where causation can be measured and verified, the compliance framework should permit system-level efficiency accounting.

The governing principle should be:

> **Measure the verified net resource consequence of the innovation across the relevant system boundary.**

The system boundary must be defined transparently to prevent double counting.

PART III — THE INNOVATION LAYER

11. Why Technology Neutrality Matters

The purpose of this section is not to propose that Government adopt any particular proprietary technology.

It is to demonstrate the range of innovations that a progressive regulatory framework should be capable of evaluating.

The innovation landscape can be divided into three broad domains:

SUPPLY → **DELIVERY** → **COMPUTATION**

Innovation may improve:

1. how energy is sourced;
2. how energy is converted, stored and delivered; or
3. how much computation is required.

A regulatory framework focused only on one layer may fail to recognise improvements elsewhere.

12. Innovation Domain One: Renewable-Energy Utilisation

The first domain concerns the relationship between variable renewable resources and usable electrical output.

New architectures may seek to improve:

- utilisation of available renewable energy;
- operation under variable environmental conditions;
- direct energy admission;
- reduced conversion stages;
- dynamic matching of available energy and load; and
- integration with storage.

The author's **Solar Driver™** work is one example of an experimental architecture directed at real-time alignment between available solar conditions and delivered output. The underlying proposition is that energy performance should be evaluated across time and actual operating conditions rather than solely through a peak operating point. The author's own materials describe Irradiance-Output Correlation as a proposed method for examining the relationship between available irradiance and output over time.

At present, these concepts should be treated as innovation candidates requiring independent, application-specific validation before any claim of data-centre compliance or performance improvement is made.

The policy relevance is broader than the particular technology:

> **If a new architecture demonstrably obtains more useful renewable energy from the same available resource, the regulatory framework should be capable of recognising that verified improvement even if the architecture differs from established methods.**

13. Innovation Domain Two: Power Conversion, Storage and Continuity

Data centres require both efficiency and continuity.

The engineering objective is therefore not simply:

Minimum Energy Consumption

but:

Efficiency + Reliability + Continuity

Alternative power architectures may seek to reduce:

- conversion stages;
- switching losses;
- resistive losses;
- unnecessary intermediate processing;
- storage and discharge losses; and
- duplicated infrastructure.

The author's broader energy work includes proposed architectures involving energy admission, storage, switching and power-flow management. These technologies have not been established by the draft Bill as compliance mechanisms and would require appropriate engineering validation for data-centre use.

Their relevance to policy is again methodological:

> **The regulatory system should recognise measured net performance rather than assume that the existing number of conversion or control stages is inherently necessary.**

An alternative architecture that safely and reliably achieves the required electrical outcome with lower verified total loss should be capable of entering an approved test and compliance pathway.

14. Innovation Domain Three: Mission-First and Low-Compute Architectures

The third domain may become increasingly important as AI-related demand grows.

Conventional computational systems frequently receive a request and process information to determine an output.

An alternative approach may begin by defining the required mission or outcome and reducing the computational search space before expensive processing occurs.

Conceptually:

Large Possible Information Space → **Mission Filter** → **Smaller Relevant Space** → **Computation**

If such an architecture can produce an equivalent or superior defined outcome with less compute, then:

Compute Avoided → Energy Avoided

The author's work in **Mission-First computing** and **Relational Code™** explores this broader proposition. A related patent document describes adaptive computational pathways and the reduction of computational redundancy as intended objectives of a relational computing framework.

These are proposed architectures rather than established regulatory metrics.

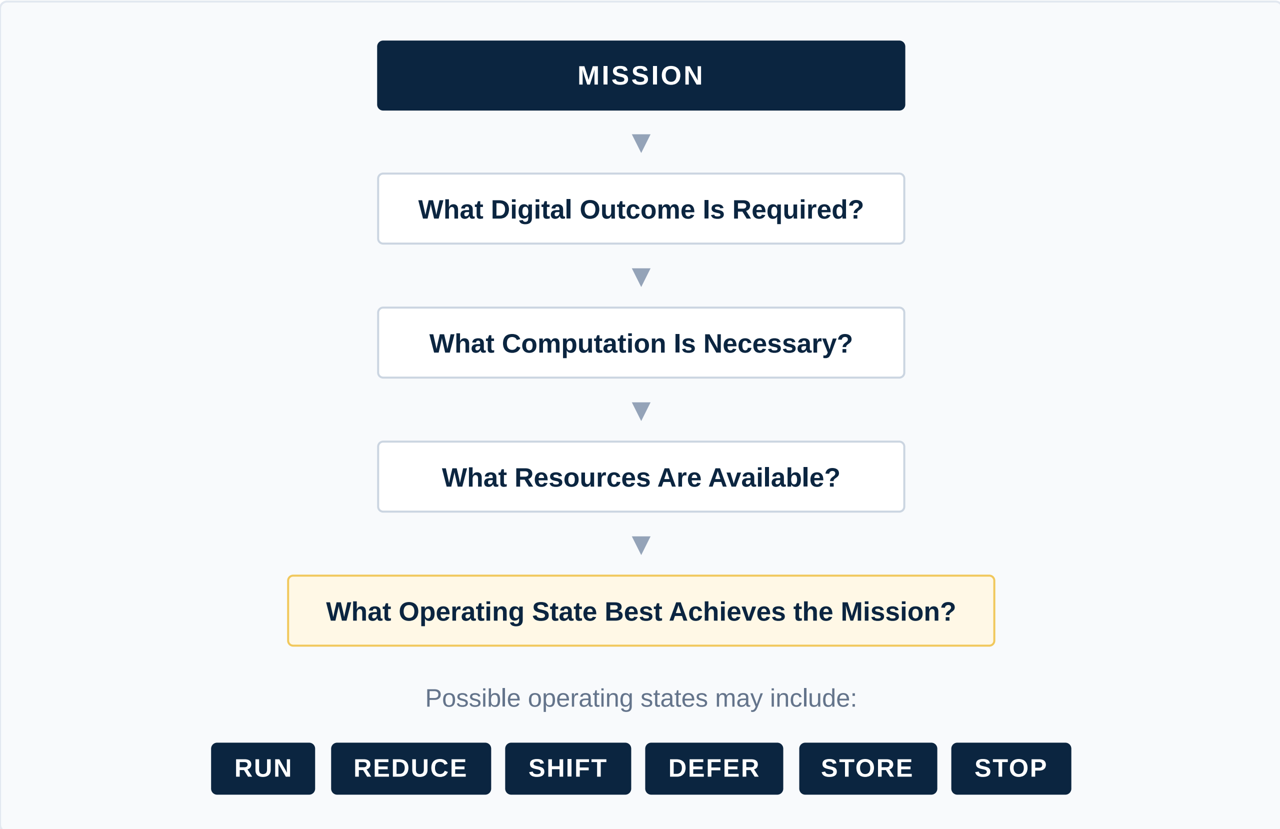
The policy point is nevertheless significant:

> **A progressive data-centre energy framework should not treat computational demand as an untouchable external fact.**

Where the same required digital outcome can be achieved with less computation, the resulting energy reduction is a legitimate form of efficiency.

15. A Proposed Resource-Intelligent Computing Framework

The three innovation domains can be brought together in a common architecture:



This paper refers to the general concept as **Resource-Intelligent Computing**.

It is not a proposal that every data centre must use one particular control system.

It is a regulatory principle:

> **The relationship between required outcome, computational demand and available resources should itself be capable of optimisation.**

PART IV — PROPOSED POLICY AND LEGISLATIVE FRAMEWORK

16. Recommendation 1: Preserve the Bill's Two Existing Efficiency Layers

The distinction in section 33 between:

- facility-level energy efficiency; and
- equipment-level energy efficiency

should be preserved.

This is a strong foundation.

The two categories recognise that an efficient building cannot compensate indefinitely for inefficient IT equipment, and efficient IT equipment does not eliminate facility overhead.

17. Recommendation 2: Enable Future Recognition of Computational Outcome Efficiency

The legislation or its subsidiary framework should be drafted broadly enough to permit future recognition of:

> **verified reductions in the computational resources required to achieve a defined or equivalent digital outcome.**

This need not immediately become a mandatory universal metric.

The concept could initially be developed through:

- voluntary reporting;
- regulatory sandboxes;
- pilot programmes;
- sector-specific benchmarks;
- procurement incentives; or
- alternative compliance pathways.

The objective is to prevent the legislation from assuming that all IT energy delivered to equipment represents equally necessary or efficient computation.

18. Recommendation 3: Create an Alternative Performance-Based Compliance Pathway

The Authority should be empowered expressly, whether through the Act, regulations or codes of practice, to recognise an alternative method where an operator demonstrates:

Equal or Better Required Outcome + **Equal or Better Resilience** + **Lower Verified Resource Consumption**

This would encourage innovation while preserving regulatory safeguards.

The burden of proof should rest on the party seeking recognition of the alternative pathway.

Evidence should be:

- measurable;
- reproducible;
- auditable;
- based on an agreed system boundary;
- independently verified where appropriate; and
- compared against a valid baseline.

19. Recommendation 4: Recognise Operational Performance Alongside Standardised Ratings

Standardised tests are essential for comparability.

Actual operating conditions are essential for reality.

The weight given to each can depend on the relevant technology and compliance requirement.

The regulatory framework should therefore permit:

Standardised Performance + Measured Operational Performance

This would allow regulators to identify technologies that perform well in real-world tropical, variable-load or AI-intensive environments while retaining standardised benchmarks.

20. Recommendation 5: Permit System-Level Efficiency Accounting

Where an innovation produces verified effects across multiple layers, the framework should permit those effects to be recognised.

The total verified saving may be greater than the saving measured at one component.

For example:

Less Computation → **Less IT Energy** → **Less Heat** → **Less Cooling**

Safeguards should include:

- defined measurement boundaries;
- prevention of double counting;
- baseline consistency;
- treatment of rebound effects;
- treatment of reliability changes; and
- independent verification where material.

21. Recommendation 6: Establish a Data Centre Energy Innovation Sandbox

Singapore should consider a dedicated sandbox for technologies that may improve data-centre sustainability but do not fit neatly within established architectures.

Potential areas could include:

- alternative power-conversion architectures;
- advanced energy storage;
- renewable-energy integration;
- dynamic energy admission;
- workload shifting;
- low-compute AI;
- mission-based computing;
- advanced cooling;
- waste-heat utilisation; and
- integrated energy-compute optimisation.

A sandbox could allow:

CONTROLLED TEST → **MEASUREMENT** → **INDEPENDENT VALIDATION** → **REGULATORY LEARNING**

This would allow the regulator to learn alongside industry rather than waiting for innovation to become conventional before recognising it.

22. Recommendation 7: Reward Continuous Improvement

Minimum thresholds are necessary, but they can create a compliance ceiling if the regulatory incentive ends once the threshold is reached.

Singapore should consider mechanisms that recognise:

- year-on-year verified improvement;
- performance beyond minimum standards;
- demonstrated reductions in resource intensity;
- successful deployment of validated new technologies; and
- transparent sharing of non-proprietary performance data.

The objective should be:

Minimum Compliance → Continuous Improvement

23. Recommendation 8: Require Evidence Proportionate to the Claim

A progressive framework should be open to innovation but rigorous about evidence.

The more significant the claimed benefit, the stronger the required validation should be.

A possible hierarchy is:

Level 1 — Laboratory evidence
Controlled proof of technical function.

Level 2 — Pilot evidence
Performance in a limited operational environment.

Level 3 — Independent field validation
Third-party verification under real operating conditions.

Level 4 — Compliance recognition

Acceptance for a defined regulatory purpose.

Level 5 — Scaled deployment evidence

Longitudinal performance across multiple sites or operating conditions.

This creates a fair principle:

> **Innovation should not be rejected because it is new, and it should not be accepted merely because it is new.**

Evidence is the bridge.

PART V — PROPOSED AMENDMENT AND IMPLEMENTATION MATRIX

AREA	PRESENT DIRECTION OF DRAFT BILL	PROPOSED PROGRESSIVE DEVELOPMENT
Facility efficiency	Minimum facility-level requirements may be prescribed	Preserve and strengthen
IT equipment efficiency	Equipment-level requirements may be prescribed	Preserve; allow workload and system-level innovation
Computational efficiency	Not expressly identified in the reviewed section 33 text	Enable future recognition of outcome-equivalent compute reduction
Compliance method	Requirements and codes may prescribe measures	Add or clarify alternative performance-based pathway
Measurement	Periodic reporting and possible audit	Include operational evidence where appropriate
Innovation	Codes can evolve	Establish formal energy-innovation sandbox
System effects	Not expressly addressed in section 33	Permit verified system-level accounting
Continuous improvement	Minimum requirements contemplated	Create incentives or recognition beyond minimum compliance
Evidence	Reporting and audit contemplated	Develop tiered validation pathway for novel technologies

The purpose of this matrix is not to require every proposal to appear in primary legislation.

Some matters may be more appropriately implemented through:

- regulations;
- codes of practice;
- regulatory guidance;
- licence conditions;
- sandbox programmes; or

- voluntary standards.

> **The principal legislative objective should be to ensure that the primary framework does not prevent future recognition of superior methods.**

PART VI — PROPOSED DRAFTING PRINCIPLES

24. Possible Principle for Section 33 or Subsidiary Legislation

Without attempting to replace Parliamentary Counsel's drafting, the following policy language illustrates the intended direction:

> **In prescribing energy-efficiency requirements, the Authority may recognise measures that improve the efficiency of the data-centre facility, information technology equipment, or the use of computational resources, including verified methods that achieve a defined or equivalent digital outcome with reduced energy or other prescribed resource consumption.**

A further provision or code could provide:

> **The Authority may approve an alternative method of compliance where the licensee demonstrates, in the form and manner required by the Authority, that the alternative method achieves an outcome equivalent or superior to the applicable prescribed requirement without materially reducing security, resilience or reliability.**

The precise legal drafting would require governmental review.

The policy objective is clear:

> **Prescribe the Standard · Without Freezing the Method**

PART VII — WHY THIS MATTERS FOR SINGAPORE

25. Singapore's Constraint Can Become an Innovation Advantage

Singapore cannot compete indefinitely through unlimited land, unlimited water or unlimited domestic energy resources.

Its comparative advantage lies elsewhere:

Intelligence + **Engineering** + **Governance**

The draft Bill creates an opportunity to combine all three.

The policy choice is not simply between:

More Data Centres

and:

More Sustainability

A third path exists:

More Useful Digital Value from Each Unit of Resource

Singapore's Green Data Centre Roadmap already seeks sustainable growth and includes work on both facility and IT-equipment efficiency.

The draft Bill can provide the legislative architecture for the next stage.

Singapore could become a global testbed for:

Resource-Intelligent Computing

— computing in which energy, infrastructure and computational demand are treated as one connected optimisation problem.

Conclusion

The draft Digital Infrastructure Bill 2026 represents an important transition in Singapore's approach to digital infrastructure.

Data-centre energy and water efficiency are no longer merely matters of voluntary good practice. The Bill contemplates continuing legal obligations, reporting, codes of practice, audits and enforcement.

That creates both responsibility and opportunity.

The first generation of data-centre sustainability asks:

> ***How efficiently can energy be delivered to the computer?***

The next generation must also ask:

> ***How efficiently can the computer achieve the outcome for which the energy was consumed?***

These questions should not replace one another.

They form a chain:

Efficient Energy → **Efficient Infrastructure** → **Efficient Equipment** → **Efficient Computation** → **Useful Outcome**

A progressive regulatory framework should therefore preserve established standards while remaining open to architectures that improve performance elsewhere in the chain.

The proposed approach is not to regulate particular algorithms or technologies.

It is to establish a simple principle:

> **If an innovator can achieve the required outcome with fewer resources, without compromising security, resilience or reliability, the regulatory framework should provide a credible pathway for that improvement to be measured, verified and recognised.**

This requires:

- strong minimum standards;
- technology neutrality;
- performance-based alternative compliance;
- operational measurement;
- system-level accounting;
- independent verification;
- regulatory experimentation; and
- continuous improvement.

The resulting regulatory philosophy can be expressed simply:

BASELINE → **MEASURE** → **INNOVATE** → **VERIFY** → **IMPROVE**

Singapore's resource constraints make this question urgent.

Its technological and regulatory capabilities make leadership possible.

The objective should not be merely to build data centres that consume energy more efficiently.

It should be to build a digital economy that produces:

$$\frac{\textbf{Maximum Useful Digital Outcome}}{\textbf{Minimum Necessary Resource Consumption}}$$

The greenest computation may ultimately be the computation that was never necessary to perform.

CLOSING PROPOSITION

The greenest computation may ultimately be the computation that was never necessary to perform.

A progressive regulatory framework should preserve strong minimum standards while remaining open to architectures that reduce total resource consumption elsewhere in the energy-to-computation chain. Regulate the outcome; liberate the engineering.

01
Strong minimum standards

02
Technology neutrality

03
Performance-based alternative compliance

04
Operational measurement

05
System-level accounting

06
Independent verification

07
Regulatory experimentation

08
Continuous improvement

> *A balanced regulatory approach can drive efficiency, foster innovation, and ensure Singapore remains a global leader in sustainable digital infrastructure.*

ABOUT THE AUTHOR

Inventor of Relational Code™	Creator of Judicial Intelligence AI™	Inventor of Solar Driver™, Battery Driver™ & Flow Driver™	32 patents across AI, energy and information systems

- Kannappan Chettiar is the Founder of SUNAMY.AI, where he researches next-generation computing architectures that combine artificial intelligence, governance and mission-first reasoning.
- His work spans artificial intelligence, information systems and energy engineering, with a focus on reducing computational waste, improving decision quality and developing more resource-efficient digital infrastructure.
- He is the inventor of Relational Code™ and the creator of Judicial Intelligence AI™, frameworks designed to improve alignment between purpose, computation, justification and execution.
- He is also the inventor of Solar Driver™, Battery Driver™ and Flow Driver™, with a portfolio of 32 patents across artificial intelligence, energy and information systems.
- This policy paper is submitted in his personal capacity to contribute technical and policy perspectives for consideration during the consultation process on Singapore's Draft Digital Infrastructure Bill 2026.

RESEARCH FOCUS

Outcome-aligned artificial intelligence, mission-first computing, information governance, decision intelligence, and resource-efficient digital infrastructure.

INNOVATION PORTFOLIO

Relational Code™, Judicial Intelligence AI™, Solar Driver™, Battery Driver™ and Flow Driver™ within a broader portfolio of 32 inventions.

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SUBMISSION

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