Battery-Backed AI

The Investment Case for Storage beside Gulf Data Centres

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Abstract

Artificial-intelligence data centres combine concentrated electricity demand with strict continuity requirements. Battery energy storage can respond in milliseconds, support ride-through, bridge generator start, manage demand peaks, shift renewable energy and provide grid services. The same physical asset cannot be assumed to deliver every service simultaneously. Its commercial value depends on a controlled allocation of power, energy, state of charge, cycling capacity and operating authority.

This paper develops an investment and financing framework for battery storage beside Gulf data centres. It distinguishes uninterruptible-power batteries, rack and low-voltage direct-current storage, facility-scale resilience systems and grid-interactive battery plants. It maps the path from use case and electrical architecture through sizing, dispatch, measurement, safety, contracting, degradation, revenue stacking and terminal value.

The evidence base includes International Energy Agency reporting on global battery deployment and power-system flexibility; United States Department of Energy materials on data-centre electrical models, storage performance and valuation; Australian Energy Market Operator evidence on battery dispatch and changing market spreads; California ISO operating evidence; Singapore Energy Market Authority storage policy; Great Britain safety guidance; and official Abu Dhabi and Dubai policy and project materials.

Six figures present the service hierarchy, state-of-charge allocation, architecture choices, cash-flow stack, degradation path and implementation dashboard. Six tables provide a use-case register, sizing file, international comparison, hypothetical project case, stress matrix and 120-day execution plan. Every capacity, price, cost, cycle, probability, date, loss estimate and financial result in the worked example is a hypothetical management assumption created solely to demonstrate the method.

Battery chemistry, electrical design, protection, fire and life safety, cooling, controls, grid connection, licensing, metering, cybersecurity, warranties, insurance, customer contracts, financing, tax, accounting and legal treatment require qualified professional review. This paper provides general information for professional audiences and does not provide engineering, safety, legal, regulatory, tax, accounting, valuation, credit or investment advice.

JEL Classification: G31, G32, L94, L86, O33, Q41, Q42, Q48

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1. Begin with the protected service

A data centre is built to deliver digital service. Storage creates value only when it supports that purpose or earns incremental cash without weakening it. The investment case should begin with the protected load, acceptable interruption, recovery objective and financial consequence of failure.

Uninterruptible power supplies maintain continuity during input-power failure.[4] Their batteries typically bridge short events and generator start. Facility-scale battery energy storage can provide longer-duration support, demand management and grid service. Rack-level batteries can protect individual computing systems. These architectures have different electrical boundaries, response characteristics, failure modes and operating authorities.

The International Energy Agency reported that battery-based UPS additions, primarily in data centres, rose to 45 GW in 2025. The IEA also noted that these systems generally provide short-duration backup rather than the longer energy service associated with utility-scale storage.[2] Capacity figures do not establish the usable energy, warranty or dispatch rights of a particular system.

The committee should define the primary obligation before considering revenue stacking. A resilience system may need to hold enough state of charge for a grid event, generator failure, switching problem or extended restoration. Selling that reserve can increase revenue while reducing the protection purchased by the original capital expenditure.

Figure 1. Battery service hierarchy beside a data centre

Author framework. The protected digital service governs every secondary use.

2. Define power, energy and time separately

Battery power is measured in megawatts. Energy is measured in megawatt-hours. Duration is usable energy divided by delivered power after losses, operating limits and reserves. A 40 MW battery with 80 MWh nameplate energy is described as a two-hour system at full power before adjustment. It may deliver less after state-of-charge limits, degradation, temperature, auxiliary load and conversion losses.

Data-centre duties span milliseconds to hours. Power quality and ride-through require fast response. Generator bridge may require minutes. Peak management can require several hours. Renewable shifting may require four to eight hours. Extended outage resilience can exceed an economic lithium-ion design and may need generators, alternative fuels, multiple grid feeds or longer-duration technologies.

Sizing should use a time-domain load profile. It should model the protected load, step response, inrush, generator sequence, cooling, auxiliary consumption, battery management, inverter capability, grid condition and restoration. Average annual demand is an inadequate design basis for a critical event.

The IEA describes batteries as well suited to one to eight hours of short-term flexibility and fast grid response.[3] This range is system context rather than a rule for a particular data centre. The facility needs its own duty-cycle and loss model.

Table 1. Data-centre storage use-case register

Use case	Required response	Energy duration	Primary evidence	Principal conflict
Power quality	sub-second	seconds to minutes	electrical study and inverter test	protection and converter limits
UPS ride-through	immediate	minutes	protected-load and transfer test	reserve cannot support discretionary cycling
Generator bridge	immediate	start and stabilisation period	generator sequence and failure test	fuel, maintenance and start uncertainty
Peak reduction	scheduled or automated	one to several hours	interval load and tariff data	recharge can create a second peak
Renewable shifting	scheduled	several hours	solar or supply profile and metering	energy may be unavailable for resilience
Connection support	contractual	defined constraint window	utility agreement and network study	service may require location-specific performance
Grid balancing	seconds to minutes	product-specific	market eligibility and dispatch test	frequent cycling and revenue volatility
Emergency system support	event-driven	system-specific	dispatch rights and operating reserve	customer continuity and low state of charge

Each use requires current engineering, contract, warranty, regulatory and operating evidence.

3. Distinguish UPS from grid-interactive storage

UPS architecture prioritises uninterrupted delivery to critical information-technology equipment. Batteries may sit in a double-conversion system, low-voltage DC bus or rack-level battery backup unit. Their controls, warranties and protection reflect continuity duty.

A United States Department of Energy sponsored 2025 data-centre modelling report observes that UPS batteries may be sized for tens of minutes and can wear quickly when used for continuous load smoothing. It also notes that a UPS rectifier may need to disconnect during a grid disturbance to protect the information-technology load, which can limit the ability to provide grid ride-through.[5]

These constraints should be tested before assigning revenue to existing batteries. The owner needs confirmation from the UPS and battery suppliers, independent electrical engineers, insurers and customers. The test should cover response, transfer, protection, cycling, heat, warranty, maintenance and end-of-life implications.

A separate grid-interactive battery can preserve the UPS reserve and provide longer service. It adds land, interconnection, protection, fire separation, controls and capital. A shared system may reduce duplication, though it concentrates functions and requires stricter reserve governance.

4. Choose the electrical architecture

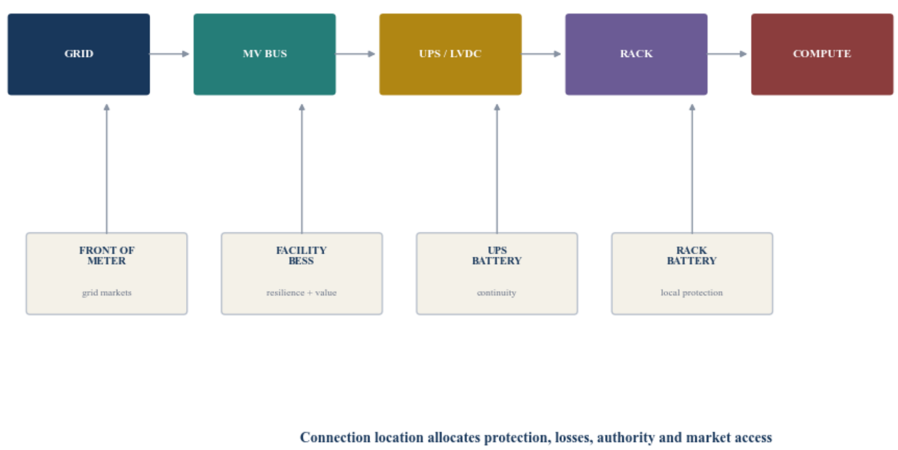
Storage can connect at the rack, low-voltage DC bus, UPS output, low-voltage AC bus, medium-voltage facility bus or grid connection. Location changes which loads it protects, which losses it experiences and which services it can measure.

Rack storage can respond close to the computing load and reduce central distribution requirements. It increases the number of battery systems, maintenance points and fire locations. Central storage can consolidate controls and energy while depending on common switchgear and distribution paths.

Behind-the-meter storage can reduce facility withdrawal and support customer resilience. Front-of-meter storage may access grid markets more directly and remain electrically separate from the data-centre load. A co-located project can contain both, with distinct meters and operating rights.

The architecture should be evaluated against single points of failure. A battery connected downstream of a failed switchboard cannot protect an upstream loss. A shared inverter or controller can affect several services. Protection coordination and fault contribution require specialist study.

Figure 2. Storage architecture choices and service reach



Author framework. The connection point determines protected load, control and settlement boundary.

5. Reserve state of charge explicitly

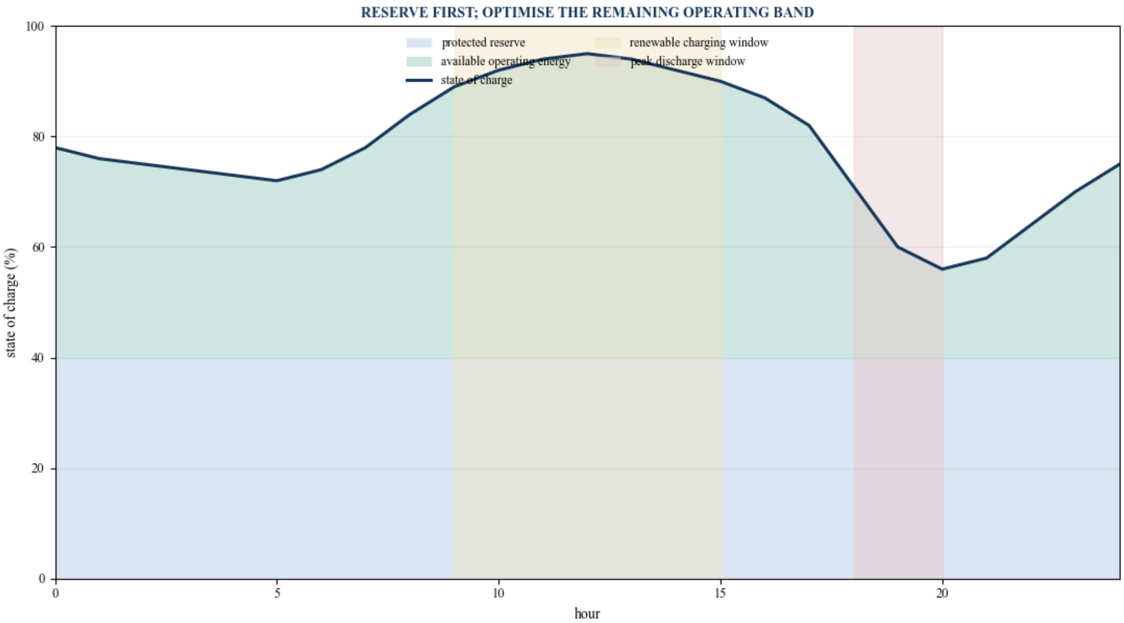
State of charge is the battery's current energy position. A resilience reserve specifies the minimum energy held for protected service. An operating band limits charging and discharge to preserve life, safety and readiness.

The dispatch controller should allocate energy among protected reserve, committed grid service, expected peak management and discretionary optimisation. These allocations should change with grid condition, generator status, maintenance, customer criticality, weather and battery health.

A simple rule can hold a fixed reserve. A dynamic rule can increase reserve during grid stress or generator maintenance. Dynamic optimisation can improve economics while adding model and governance risk. The committee should approve the rule, override rights and minimum floor.

Recharge deserves the same attention as discharge. The facility needs a maximum recharge rate, permissible windows and plan for consecutive events. Recharging after a system peak can create cost or constraint. Slow recharge can leave the battery unprepared for the next outage.

Figure 3. State-of-charge allocation through an operating day



Author framework. Values are illustrative and do not represent an actual battery or dispatch plan.

6. Model Gulf heat and cooling

Battery performance and life depend on temperature. High ambient conditions increase cooling energy and can reduce available power or accelerate degradation when thermal management is inadequate. Data-centre electricity demand can also rise with cooling load during hot periods, making battery need and battery stress correlated.

The design should use site-specific ambient profiles, enclosure heat gain, HVAC redundancy, dust, humidity, salt, ventilation and fire strategy. It should model auxiliary power during charge, discharge, standby and emergency operation.

Singapore's Energy Market Authority used early utility-scale storage projects to gather performance evidence in a hot and humid environment.[11] Gulf projects require their own climatic and site tests. Supplier ratings should be reconciled to the project's maximum design conditions and degradation warranty.

The financial model should reduce net deliverable energy by cooling and conversion losses. It should include cooling capital, maintenance and replacement. Resilience calculations should assume auxiliary systems remain powered during the event.

7. Build the complete sizing file

The sizing file should reconcile nameplate power and energy to beginning-of-life and end-of-life usable service. It should include state-of-charge range, depth of discharge, round-trip efficiency, inverter capability, cell and system degradation, auxiliary load, availability, outages and temperature derating.

Power capability can degrade differently from energy. A system may retain enough energy while failing a high-power response. Inverter and transformer limits can cap delivery. Grid and facility voltage conditions can change performance.

The file should run event sequences rather than isolated events. A grid-service dispatch followed by an outage is more demanding than either alone. A morning event, incomplete recharge and evening peak should be tested. Generator failure should be layered onto a low-state-of-charge case.

Table 2. Battery sizing and diligence file

Field	Required evidence	Model treatment	Decision test
Nameplate power and energy	supplier data and tested configuration	separate MW and MWh	does the selected configuration match the duty?
Usable operating range	warranty and control settings	minimum and maximum state of charge	is protected reserve enforceable?
Efficiency	tested charge, discharge and auxiliary data	interval losses by operating mode	does net energy reach the load or meter?
Degradation	warranted curves and duty cycle	calendar and cycling loss	is end-of-life service still adequate?
Temperature	site weather and thermal design	power, energy and auxiliary derating	does peak heat coincide with system need?
Availability	maintenance and component architecture	planned and forced outage cases	is redundancy sufficient for the obligation?
Recharge	grid capacity, tariff and operating rule	rate, window and consecutive events	can reserve be restored before the next need?
Protection	electrical studies and tests	trip and isolation sequence	does storage remain available through credible faults?
Safety	hazard studies and emergency plan	capital, spacing and operating restrictions	are risks managed through the lifecycle?
Replacement	module, inverter and control plan	timing, cost and outage	is lifecycle capital funded?
Terminal value	residual health and removal obligations	reuse, recycle or disposal case	is residual value supported by evidence?

Design inputs require current supplier, engineer, operator, insurer and regulatory evidence.

8. Separate resilience value from avoided loss

Resilience value is difficult to price because severe events are infrequent and their consequence can be large. The model should estimate the frequency, duration and cause of service interruptions; the probability storage performs; and the losses avoided.

Avoided loss can include customer credits, lost revenue, damaged equipment, data recovery, operational restoration and reputational consequences. These values require evidence and should not be treated as certain cash. Insurance terms, customer liability caps, redundant grid supply and generators affect the exposure.

The base case should value storage against the complete existing resilience chain. If generators already provide reliable extended backup, battery value may lie in bridge reliability, fuel reduction or power quality. If grid connection is weak, longer energy duration may carry greater value.

Resilience value should be reported as a scenario range separate from contracted revenue. A lender should not size debt to an avoided-loss estimate unless the cash mechanism is clear.

9. Identify contracted and merchant cash

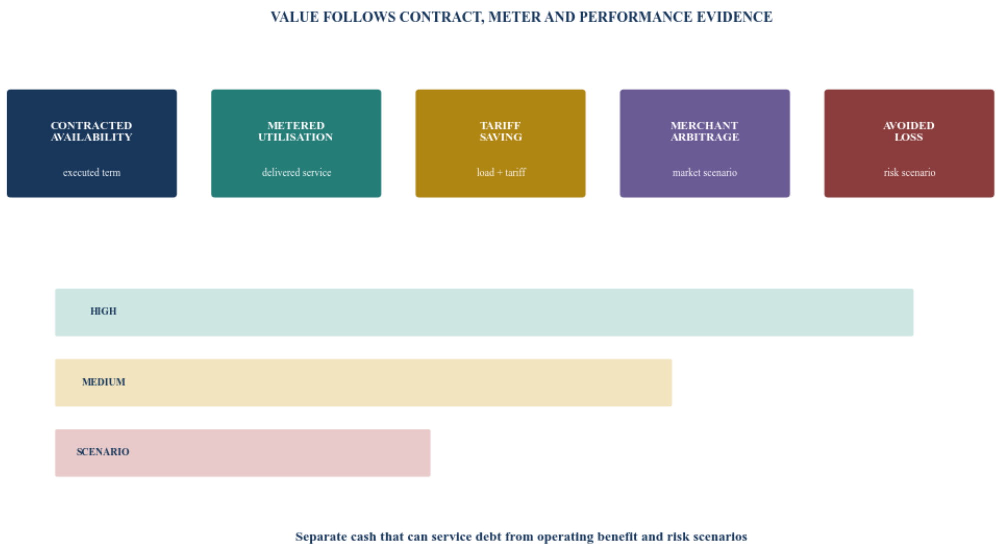
Storage can earn or save cash through capacity, availability, balancing, demand response, energy arbitrage, peak reduction, connection support, tariff management and renewable shifting. Each stream has different counterparty, term, dispatch, measurement and credit quality.

Contracted revenue should be supported by an executed agreement, eligibility, metering, operating history, payment formula and termination rights. Merchant revenue depends on future prices, volatility, competition, regulation and dispatch. Avoided tariff cost depends on the current tariff and facility load.

Australia demonstrates both opportunity and volatility. AEMO reported a new National Electricity Market battery discharge record of 3,556 MW in the first quarter of 2026 and estimated quarterly grid-scale battery revenue of AUD 96.9 million. In the third quarter of 2025, AEMO reported falling battery price spreads alongside capacity growth, which reduced arbitrage earnings despite higher discharge.[8][9]

These observations show why a single historical revenue period is not an underwriting case. Gulf models should separate each stream and stress lower prices, more capacity, dispatch restrictions and market-rule change.

Figure 4. Storage cash-flow stack and evidence quality



Author framework. Revenue receives value according to contract and operating evidence.

10. Prevent revenue double counting

A battery has finite power, energy and cycling capability. Capacity committed to one service may be unavailable for another. The model should co-optimise services by interval and preserve the protected reserve.

Revenue stacking should use compatible products. A battery cannot receive full capacity value from two buyers who may dispatch simultaneously unless rules permit and physical headroom covers both. Tariff savings and market revenue can also refer to the same discharge.

The operator needs a dispatch hierarchy, nomination process and conflict rule. Settlement data should allocate charge, discharge and losses to each service. Contracts should disclose other obligations and address priority.

The investment case should include an unstacked base case, an approved stacked case and a downside case in which secondary revenue disappears. Capital should remain supportable under the approved downside.

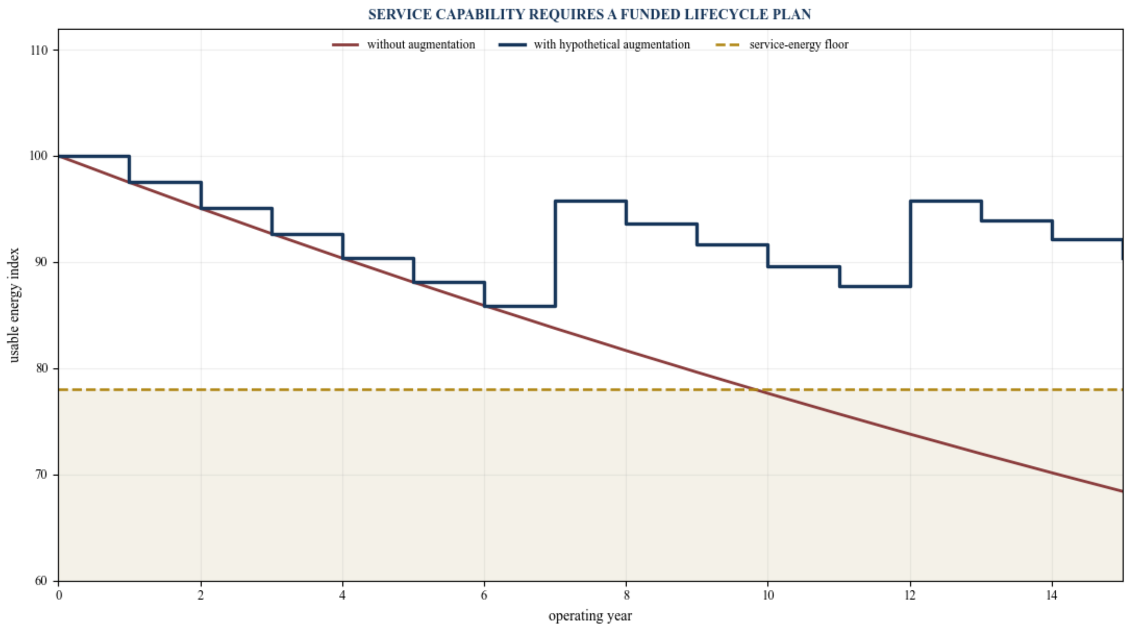
11. Price degradation as a delivered-service cost

Battery capacity declines with calendar time, temperature, state of charge, depth of discharge, cycle count and power. Warranty language may limit annual throughput, average state of charge, temperature and operating modes.

Degradation should be modelled from the proposed dispatch, not a generic annual percentage. The model should calculate equivalent full cycles, energy throughput, calendar loss, augmentation and replacement. It should include downtime and commissioning.

A high-value fast-response service may use little energy while demanding readiness and power. Arbitrage can use more energy and cycles. Resilience reserve can maintain a high state of charge that affects ageing. The optimal stack therefore depends on both revenue and degradation.

Figure 5. Hypothetical usable-energy and augmentation path



Every value is a hypothetical management assumption for method demonstration.

12. Underwrite safety as a lifecycle obligation

Battery safety extends from cell selection and factory quality through transport, installation, operation, maintenance, incident response, augmentation and decommissioning. The design should address thermal runaway, fire propagation, explosion, toxic or flammable gases, electrical hazards, water and environmental effects.

Great Britain's Health and Safety Executive states that designers, installers and operators carry lifecycle responsibilities under applicable health and safety law.[12] United Kingdom government guidance maps standards across grid-scale storage deployment.[13] These sources apply in Great Britain, though the control topics are useful diligence prompts elsewhere.

Gulf projects require current local approvals, civil defence engagement, environmental review, insurer input and applicable standards. Site separation from data halls, air intakes, critical switchgear, fuel systems and public boundaries requires specialist consequence analysis.

The financial model should include detection, suppression, ventilation, water, access, monitoring, training, spares, inspections, emergency exercises and decommissioning. Safety capital should not be treated as optional contingency.

13. Govern cyber and control systems

The energy-management system receives price, grid and facility signals and issues commands to batteries, inverters, switchgear and auxiliary systems. It can affect critical power.

Control architecture should segment networks, authenticate users and devices, restrict commands, log activity, manage software change and preserve safe local operation when communication fails. External aggregators should receive only the access needed for the contracted service.

The operator should define manual override, loss-of-communication behaviour, invalid signal rejection and restoration. Cyber incidents should trigger coordinated energy and data-centre response.

Source code, algorithms, cloud dependencies, licences and vendor support belong in diligence. A battery with unavailable controls can lose market and resilience value even when cells remain healthy.

14. Compare international operating evidence

The IEA reported 108 GW of new battery storage capacity worldwide in 2025, with deployment led by China and followed by the United States and Europe.[2] Global scale supports supply-chain learning while project performance remains specific to design and duty.

Australia provides transparent dispatch and revenue evidence through AEMO. California ISO reported that 4,260 MW of battery storage helped meet 2025 summer peak demand.[10] Singapore has used policy and pilots to develop storage in a dense, hot and humid system.[11] Great Britain provides mature safety and planning evidence.[12][13]

Gulf evidence includes Abu Dhabi's 108 MW distributed virtual battery plant opened in 2019, Dubai's planned 1,400 MW six-hour battery system within the seventh phase of the Mohammed bin Rashid Al Maktoum Solar Park, and Abu Dhabi's 2026 solar self-supply policy incorporating battery storage.[14][15][16]

These are different projects and institutional settings. Their value lies in the questions they surface: climate, service duration, control, dispatch, safety, licensing, contracting and system integration.

Table 3. Selected international storage evidence and Gulf decision lessons

Market	Official evidence	Demonstrated issue	Gulf decision lesson
Global	IEA deployment and flexibility analysis	rapid scale, shorter and longer duration, UPS growth	separate global cost context from project deliverability
Australia	AEMO dispatch and revenue reporting	record discharge and changing arbitrage spreads	stress merchant revenue and measure state-of-charge behaviour
California	CAISO peak-support evidence	large battery fleet supporting summer peak	test coincident availability during high-load conditions
Singapore	EMA policy and hot-humid pilots	dense-system integration and climate evidence	validate thermal design and land-efficient architecture locally
Great Britain	HSE and government safety guidance	lifecycle duties, planning and emergency response	fund safety, approvals and decommissioning from inception
Abu Dhabi	virtual battery plant and self-supply policy	distributed control, storage policy and licensing	confirm current eligibility, dispatch and settlement rights
Dubai	planned six-hour solar-park storage	large-scale renewable shifting and dispatchability	compare facility storage with system-scale procurement alternatives

Each source applies within its stated market and institutional purpose; project decisions require current local evidence.

15. Select the investment perimeter

The project can own storage within the data-centre company, a separate energy subsidiary, a utility arrangement or a third-party service contract. Ownership affects capital, control, tax, accounting, licences, insurance, grid rights and lender security.

Data-centre ownership maximises control and integration. It concentrates technology and operating risk. Third-party ownership can transfer capital and performance obligations while creating dependency and contract complexity. A utility-owned system can support network needs while offering less customer control.

The investment perimeter should include cells, modules, racks or containers, inverters, transformers, switchgear, cabling, controls, HVAC, fire systems, civil works, grid studies, metering, spares, commissioning and lifecycle capital. Interconnection and data-centre interface costs can be material.

The committee should compare build, lease, storage-as-a-service and utility tariff options on one delivered-service basis.

16. Finance against controllable cash

Lenders need evidence of construction completion, performance, warranties, insurance, operating capability, revenue, operating cost and replacement funding. Technology and market risk should be allocated to parties able to manage it.

Debt sizing should distinguish contracted availability and service revenue from merchant arbitrage, tariff savings and avoided loss. Contract tenor should cover debt service. Termination, change in law and performance deductions require downside modelling.

Security should cover project assets, accounts, material contracts and insurance subject to applicable law. Direct agreements can provide notice and cure. The lender should understand whether the battery can operate separately from the data centre and whether removal is technically and legally practical.

Replacement and augmentation reserves can protect end-of-life service. Cash sweeps can respond to underperformance. Distribution tests should include state of health, reserve compliance and contracted availability.

17. Test a hypothetical Gulf project

Consider a hypothetical 40 MW, 120 MWh facility-scale battery beside a 100 MW data-centre campus. Management assumes a protected reserve of 48 MWh, leaving a controlled operating band for peak management, renewable shifting and a contracted flexibility product.

Management assumes a hypothetical installed cost, operating cost, efficiency, degradation curve, augmentation plan, tariff saving and service revenue. Every input is illustrative. It does not represent a quotation, market price, project or forecast.

The model calculates annual delivered energy, gross cash benefit, operating cost, degradation and augmentation. It reports resilience scenarios separately. Debt sizing uses only the portion of cash supported by an assumed executed contract in the demonstration.

Table 4. Hypothetical battery-backed data-centre case

Item	Hypothetical assumption	Treatment	Principal caveat
Battery	40 MW / 120 MWh nameplate	facility-scale AC system	final design and losses unverified
Protected reserve	48 MWh	unavailable for routine optimisation	reserve depends on protected-load study
Operating band	60 MWh at beginning of life	allocated among approved services	state of charge and degradation reduce availability
Installed capital	USD 31.0m	upfront project cost	quotation, scope and duties unverified
Annual fixed cost	USD 0.95m	operations, controls, safety and insurance	excludes exceptional repair
Contracted service cash	USD 2.10m annually	availability and delivery case	counterparty and terms hypothetical
Tariff and energy benefit	USD 1.35m annually	interval load and price case	depends on tariff and dispatch
Merchant cash	USD 0.55m base case	scenario value only	price and competition exposure
Augmentation	USD 4.8m in years 7 and 12	maintains service floor	technology and timing unverified
Avoided-loss value	reported separately	resilience scenario	no certain cash receipt

Every value is a hypothetical management assumption for method demonstration; USD-equivalent amounts do not represent current market prices.

18. Stress the project

The investment case should test higher temperature, lower efficiency, faster degradation, low price spreads, service termination, delayed connection, lower load, battery outage, failed augmentation and safety-related shutdown.

Correlation matters. Extreme heat can raise campus demand, increase battery cooling load and reduce power at the same time. A grid event can arrive after an earlier commercial dispatch. A market downturn can reduce revenue while replacement costs remain.

The base project should remain financeable when merchant cash falls materially. Resilience reserve should survive every approved operating case. A scenario that requires using protected reserve to meet financial covenants indicates an inconsistent structure.

Table 5. Hypothetical battery investment stress matrix

Case	Contracted cash	Tariff and merchant cash	End-of-life usable service	Capital consequence	Decision implication
Base	USD 2.10m	USD 1.90m	maintained by augmentation	USD 4.8m at years 7 and 12	proceed only after full evidence
Low market spread	USD 2.10m	USD 0.85m	unchanged	unchanged	debt should exclude merchant upside
Faster degradation	USD 2.10m	USD 1.72m	falls below floor in year 6	earlier USD 5.6m augmentation	reprice warranty and lifecycle reserve
High heat	USD 1.86m	USD 1.40m	reduced seasonal power and energy	added cooling and derating	resize and test worst-day performance
Contract termination	USD 0	USD 1.55m	technically available	stranded controls and service cost	base project must survive lost contract
Safety shutdown	USD 0 during outage	USD 0 during outage	unavailable	remediation and lost service	confirm separation, insurance and liquidity
Consecutive grid events	limited by reserve	reduced optimisation	reserve becomes binding	no new capital	protect minimum state of charge

Every value is a hypothetical management assumption and demonstrates sensitivity rather than a forecast.

19. Establish the governance dashboard

The board should receive physical, commercial and risk measures. Physical measures include state of charge, state of health, usable energy, power capability, efficiency, temperature, availability, faults and protected reserve.

Commercial measures include contracted availability, dispatch, delivered energy, tariff saving, market revenue, deductions, operating cost and settled cash. Risk measures include reserve breaches, warranty headroom, safety alarms, cyber events, insurance conditions and replacement funding.

Reported cash should reconcile to metered operation. The dashboard should distinguish accrued, invoiced, settled and disputed amounts. Market optimisation results should be compared with the approved downside.

Change control should cover software, dispatch algorithms, service stacking, operating limits, battery modules, suppliers and safety design. Any change that affects protected service should require data-centre operational approval.

20. Implement through gated delivery

The first month establishes governance, load evidence, use cases and the current regulatory route. The second month completes architecture, sizing, safety and market design. The third month runs procurement, financing, contract and interface work. The fourth month completes technical and commercial diligence and reaches a controlled investment decision.

Figure 6. Battery-backed data-centre implementation dashboard

Author framework. Each gate requires current technical, commercial and regulatory evidence.

Table 6. 120-day execution plan

Days	Workstream	Required output	Gate
0 to 10	governance	executive owner, technical leads and controlled data room	authority and scope approved
11 to 20	protected service	critical loads, continuity sequence and loss scenarios	primary duty confirmed
21 to 30	use-case register	resilience, facility, energy and grid products	compatible services identified
31 to 40	architecture	electrical boundary, redundancy and control path	protection concept accepted
41 to 50	sizing	power, energy, losses, reserve and event sequence	beginning and end-of-life service passes
51 to 60	safety and regulation	hazard strategy, approvals, licensing and insurance	route and lifecycle duties confirmed
61 to 70	procurement	comparable supplier and integrator proposals	complete delivered scope reconciled
71 to 80	commercial	service contracts, tariff and merchant cases	cash classified by evidence quality
81 to 90	finance	debt case, security, reserves and covenants	downside supports capital structure
91 to 100	technical diligence	warranty, controls, tests and performance security	deliverability and remedies approved
101 to 110	stress and interfaces	heat, outage, degradation, safety and data-centre conflicts	protected reserve survives all cases
111 to 120	investment decision	authorised budget, contracts, conditions and dashboard	committee approves, revises or declines

Timing is an author framework and should be adapted to project, approval and procurement requirements.

21. Set the investment decision

The committee should approve the protected service, minimum reserve, architecture, nameplate and usable capacity, approved services, dispatch hierarchy, capital budget, lifecycle reserve, contracted revenue and merchant limit.

Conditions should cover regulatory approvals, grid connection, customer and lender consent, final engineering, safety plan, insurance, supplier contract, performance security, control testing and financial close.

The approval should state which value sources support capital. Contracted cash can support debt according to its terms and counterparty. Tariff saving can support equity when the load and tariff evidence is stable. Merchant revenue and avoided loss should remain scenarios unless stronger evidence exists.

The project should decline or resize when the protected reserve is unclear, safety route is unresolved, supplier warranties conflict with dispatch, revenue depends on double counting or lifecycle capital is unfunded.

22. Limitations and conclusion

Battery technology, prices, supply chains, market rules, tariffs, grid needs, safety requirements, insurance, data-centre loads and customer contracts can change. Investment decisions require current evidence from regulators, utilities, system operators, equipment suppliers, independent engineers, fire and safety specialists, insurers, customers, lenders and qualified advisers.

IEA materials provide global and comparative analysis.[1][2][3] DOE and California ISO materials apply within their stated United States purposes.[4][5][6][7][10] AEMO materials describe Australian market outcomes.[8][9] Singapore, Great Britain, Abu Dhabi and Dubai sources apply within their respective institutional settings.[11][12][13][14][15][16]

Every capacity, cost, price, rate, duration, cycle, probability, date, degradation value and financial result in the worked example is a hypothetical management assumption. No data-centre project, battery quotation, tariff, contract, market price or realised performance is claimed.

Storage beside a Gulf data centre can create significant resilience and operating value when the protected service governs design and dispatch. The battery should be sized to net deliverable performance, reserved explicitly, tested under Gulf conditions and supported by a funded lifecycle plan.

The investment case becomes financeable when contracted cash is distinguished from market exposure, merchant upside remains stressed, safety and cyber duties are complete, and every secondary service respects the facility's primary digital obligation.

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