A decision with competing architectures

Question

For the same customer workload and service quality, when would floating compute outperform the best feasible land alternative? The investigation challenged the appealing premise that nearby cold water alone creates a business case. It developed a general monograph and a desk comparison of Casco Bay / Portland and Kempenfelt Bay / Barrie. [S1, S2]

Architecture	Potential advantage	Obligations to investigate
Floating water-cooled	Modular construction and limited land footprint	Hull, mooring, marine access, cable landing and removal
Land water-cooled	Water cooling with conventional site access	Land, intake/outfall, environmental permissions
Land air / closed-loop	Established siting and maintenance routes	Power, heat rejection, land and ambient extremes

Equal comparison basis

Use the same IT workload, accepted results, availability, latency requirements and commissioning assumptions. Compare with no build or defer as appropriate. Separate geographically distributed modules are not automatically a low-latency GPU cluster.

Site evidence boundary

The named areas are research selections, not available parcels, approved berths or ranked investments. The source study did not contact utilities, ports, regulators, landowners or customers. Firm power, diverse fiber, actual rights, costs and ecological acceptance remained unknown. That limits the conclusion to screening and a plan for decisive information.

Worked annual economics

Input	Illustrative value
IT load	1 MW
Land-air facility load	1.35 MW
Floating facility load	1.20 MW
Operating hours	8,760 / year
Energy price	100 currency units / MWh
Demand charge	15 currency units / kW-month
Extra floating capital	1,000,000 currency units
Recovery period / rate	10 years / 10%
Extra annual marine operating cost	150,000 currency units

Calculation

Load difference = 0.15 MW = 150 kW. Energy saving = 0.15 x 8,760 x 100 = 131,400 per year. Demand saving = 150 x 15 x 12 = 27,000. Total assumed utility saving = 158,400.
Capital-recovery factor = r(1+r)^n / ((1+r)^n - 1) = 0.1627454. Annual capital premium = 162,745.4. Add 150,000 operating premium to obtain 312,745.4. The annual deficit is 154,345.4 currency units. [S2]

What changes the conclusion

An illustrative land-water load of 1.15 MW would use still less electricity than floating at 1.20 MW. Floating would then need another verified advantage: earlier service, lower usable-site cost or a suitable industrial berth. None is established by this screen. All values are assumptions, not Maine/Ontario tariffs or supplier quotations.

Thermal and temporal constraints

Heat-transfer coefficient fraction	Temperature approach	Heat capacity	IT ceiling
1.00	5 K	1.200 MW	1.000 MW
1.00	3 K	0.720 MW	0.564 MW
0.70	5 K	0.840 MW	0.673 MW
0.70	3 K	0.504 MW	0.367 MW

Show the thermal calculation

With exchanger area 240 m2 and reference coefficient 1,000 W/m2/K, Q = U x A x temperature approach. At 5 K, Q = 1.2 MW. The stress model assumes facility heat = 1.10 x IT load + 0.10 MW. Combined coefficient degradation and warmer intake reduce the modeled IT ceiling to (0.504 - 0.10) / 1.10 = 0.367 MW. These four corners are sensitivities, not event probabilities. [S1, section 13]

Electric reserve cannot replace cooling

With assumed thermal capacitance 50 MJ/K, 5 K headroom and 1.2 MW heat input, zero heat rejection reaches the lumped limit in 50 x 5 / 1.2 = 208 seconds. A battery that supports hours of electrical load does not extend that thermal limit. Real local hot spots and control delays require engineering qualification.

Chronology counterexample

Consider two one-hour slots, a 1 MW compute limit, an empty 1 MWh battery and a deadline after slot two. Supply [2,0] MW serves 2 MWh of work; supply [0,2] serves 1 MWh and leaves 1 MWh stored after the deadline. Total energy is identical. Temporal accessibility changes useful output. Extending the deadline can remove the difference. The example transfers a finite-resource insight without importing geological validation claims.

Site screening and bounded helper evidence

Question	Casco / Portland	Kempenfelt / Barrie
Water evidence	Published shallow harbor monitoring	Depth-dependent lake temperature and oxygen monitoring
Hazards to assess	Storm surge, waves, corrosion and access	Ice, stratification, internal waves and access
Environmental questions	Intake/outfall and marine habitat	Source-water protection and lake ecology
Common missing facts	Firm power, fiber, rights, cost	Firm power, fiber, rights, cost

Why a published temperature is insufficient

A shallow station or monthly mean does not establish extreme temperature at a proposed intake. The source study did not download and quality-control a paired depth-by-time dataset for the two areas. No local P95/P99 cooling capacity or downtime comparison is supported. These are source-study screening observations, not independently refreshed site conditions. [S2]

A resource-account example

The monograph declares a 14,400 kWh job budget: 2,400 consumed + 4,000 reserved + 8,000 available. A requested 9,000 reservation exceeds availability. Counting the reserved 4,000 as available would break the account. Selected local helper execution reported these deliberately constructed violations. This ledger is not a physical battery measurement. [S1, Appendix D]

Unknown histories

The reported helper demonstration retained two compatible supplied histories for a lost acknowledgement and an unknown alternative. Completion of the comparison did not resolve whether the job executed. This shows why replay needs reconciliation. The local patterns were synthetic; no marine scheduler or native enforcement operated.

Review changes the investment question

A stronger denominator

The R2 monograph moves from facility electricity alone to accepted work. Its screening denominator is W = 8,760 x availability x utilization x accepted-output fraction. That product assumes separable factors. Correlated outages, deadlines and checkpoint losses need chronological simulation. A more favorable cooling ratio can coexist with worse cost per delivered result. [S1, section 15]

Execution disclosure reconciled

The source discusses no research-extension/native execution while later reporting selected local mathematical-helper calls. This document distinguishes those components explicitly: selected local advisory calculations are source-reported; no full-system runtime, native review service, marine controller or independent engineering review is claimed.

The next commitment

Obtain an actual site and binding utility/fiber information; specify the workload and service contract; acquire marine, cooling and ecological SME input; and price both water-cooled architectures against the credible land baseline. The present study is broad screening. Actual site information enables deeper engineering rather than simply more candidate locations.

Sources and reproduction

[S1] Compute_at_Sea_HSDLG_V2_Monograph_R2, sections 12-16 and Appendix D.
[S2] Compute_at_Sea_Casco_Kempenfelt_Feasibility_R1, sections on architectures, thermal screening and economics. Both supplied project documents, dated November 2026.
The economic and thermal arithmetic in this public document was recalculated from declared inputs. Existing helper executions were not rerun. Public source navigation in S2 includes NOAA Portland station 8418150 / CASM1 and Ontario Lake Simcoe monitoring. No site engineering suitability finding follows from those references.

Diligence

Detailed assumptions, calculation records, standards and selected execution evidence are available for scoped review under an appropriate NDA or contract.

Additional technical documentation, standards, test records and implementation details are available for scoped diligence under an appropriate NDA or contract.