

INFRAVISION 2026 · STUDENT COMPETITION

Subsea Data Infrastructure Ecosystem

A modular, serviceable capsule array off the Normandy coast, France — paired with dedicated offshore wind and a dual-track, audit-ready blue carbon system — engineered to solve the two problems that ended the last generation of subsea data centers.

Theme: Infrastructure as a System

49.7607°N · 0.3739°E — FECAMP, NORMANDY

What This Proposal Actually Claims

Not: “subsea data centers work.” Microsoft already proved that, then shelved the program in 2024.

Instead: this design solves the two specific reasons Microsoft's own team gave for walking away — unserviceable pods and a design built for a pre-AI compute era — and turns ocean dynamics into a second, independently audited revenue stream.

1

Serviceable by design

Modular swappable cartridge pods, retrieved by a resident ROV — directly answers Microsoft's stated “fixed capacity, unserviceable” failure mode.

2

Built for AI-era heat

Single-phase dielectric liquid immersion, not air-cooled nitrogen — the architecture modern GPU-density racks actually need.

3

Two audited carbon tracks

Seagrass (ecosystem co-benefit) and engineered algae-pond burial (durable removal), reported separately — no bundled, unverifiable claim.

The Terrestrial Data Center Ceiling

AI and cloud demand are growing exponentially against three hard terrestrial constraints:

1.125

TYPICAL LAND DC PUE
(LATEST-GENERATION FACILITY)

4.8 L

WATER USED PER KWH OF
LAND DC COOLING

\$11.3M

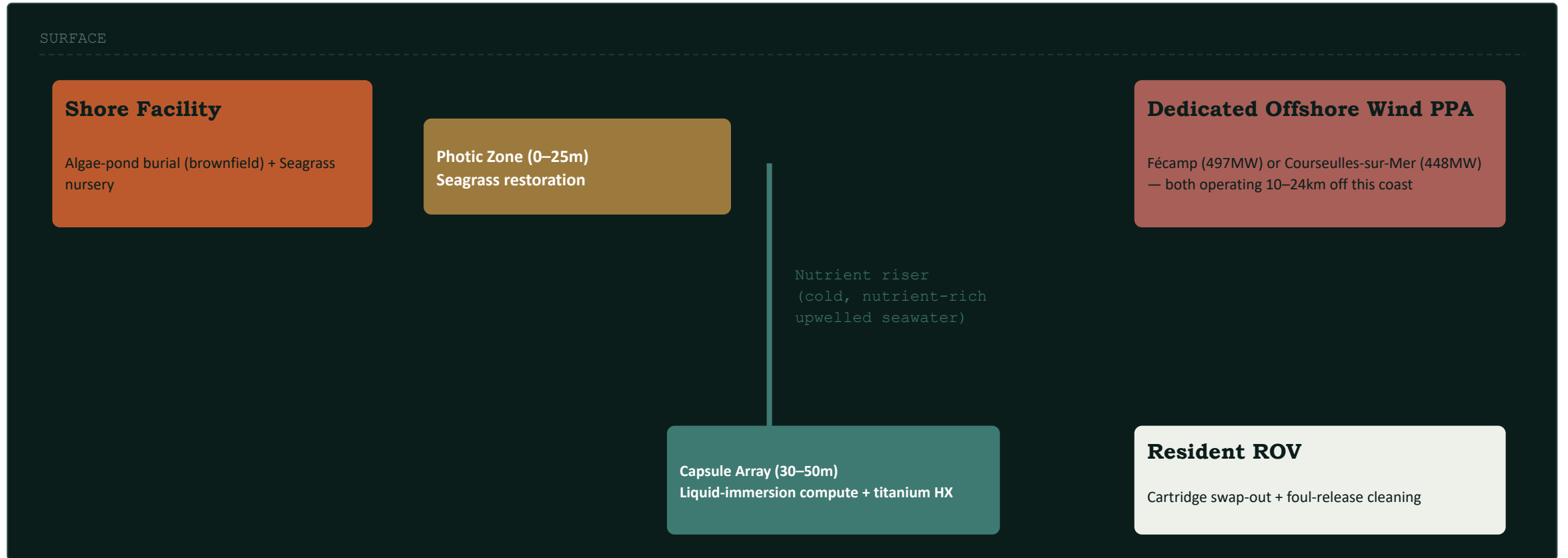
STANDARD LAND DC CAPEX
PER MW (2026 GLOBAL AVG.)

Meanwhile, NVIDIA data-center GPUs sold in a single recent year are projected to consume roughly 14.3 TWh annually — and cooling already accounts for about 40% of total data center power draw. Land-based capacity cannot absorb this curve on power, water, or siting.

Sources: JLL 2026 Global Data Center Outlook (CapEx benchmark); Microsoft Project Natick comparison data (PUE, WUE); Tom's Hardware / NVIDIA GPU shipment analysis, 2026 (GPU power draw, cooling share).

System Definition

Two subsystems, connected by one mechanical link — genuinely integrated, not two systems loosely placed side by side.



Site Selection: Fécamp, Normandy

A named, real site — not a generic coastline. Every number on the following slides is anchored here.

Capsule array

- Sited within Fécamp's offshore wind zone — Normandy's largest offshore wind farm (497MW, 3rd-largest in France), operating 13–24km off this coast
- Fécamp is a working port of 18,000 residents with a 1,000-year maritime history — not an empty stretch of coastline
- Deployed at 30–50m depth, in established offshore-wind-permitted waters, reducing incremental permitting novelty

Shore facility

- Sited on Fécamp's historic Terre-Neuvas quarter — the former cod-fishing and fish-drying industrial waterfront, now under-used since the decline of distant-water fishing
- A real brownfield-adjacent heritage site, not an abstract placeholder — the same authenticity test Gehun Kheda passed for Bhopal
- Walking distance from the working harbor, giving the ROV servicing fleet and port authority a shared, legible base of operations

Sources: EDF Renewables / Enbridge, Fécamp offshore wind farm (497MW, operational); Choose Normandy — Fécamp population and offshore wind status (2026); Fécamp Terre-Neuvas fishing heritage (Travel France Online).

Executive Dashboard

1.07

SUBSEA PUE
(MICROSOFT NATICK RESULT)

0.00

SUBSEA WUE (L/KWH)
VS. 4.8 FOR LAND

13.0 yrs

SIMPLE PAYBACK
(OPEX SAVINGS ONLY, INCL.
CONTINGENCY & INSURANCE)

+\$29.7M

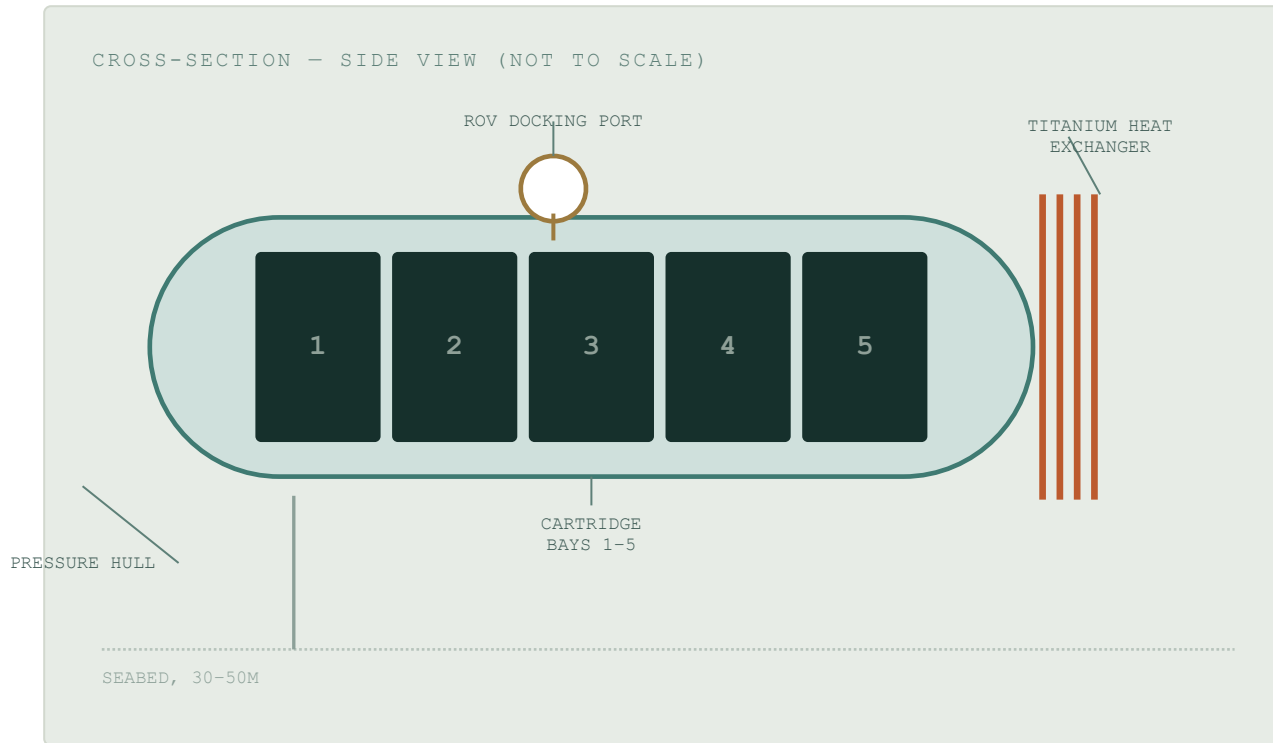
NET VALUE CREATED BY YEAR 15
(BASE CASE, FULLY LOADED)

These are the fiscally conservative numbers: an 8% CapEx contingency and marine insurance are already priced in (Slide 34). The Conservative scenario itself doesn't clear 15 years — see Slide 24 for why that's the expected result under conservative underwriting, not a concealed one.

See Scenario Sensitivity and Cost-Benefit Summary modules for full basis. All figures modeled on a 20MW base-case facility.

Modular Swappable Capsule Design

Microsoft's own reason for retiring Project Natick: pods had fixed capacity and could not be serviced without hauling the entire unit to the surface. This design does the opposite.



1 Cartridge units

Compute racks live in individually retrievable cartridges within the pressure hull — not a single sealed monolith.

2 Resident ROV docking

A permanently stationed ROV swaps cartridges on a scheduled cycle without surfacing the capsule.

3 Standardized interconnect

Cartridges share a common power/data interface, so capacity can be added incrementally as demand grows.

Design response to Microsoft's stated Project Natick retirement rationale (Data Center Dynamics / EmergEdge, 2024–25): fixed-capacity pods requiring full-unit surfacing for repair.

Cooling Architecture: One System, Not Two

REJECTED APPROACH

Dry-nitrogen air cooling

- Servers cooled by circulating inert gas, not liquid
- Cannot be combined with a submerged dielectric-fluid loop — the two are mutually exclusive architectures
- Built for CPU-era power density, not modern GPU racks

PROPOSED ARCHITECTURE

Single-phase dielectric immersion

- Servers fully submerged in circulating dielectric fluid, isolated from seawater by the pressure hull
- Heat transferred to titanium-alloy plate exchangers, then to the ocean
- The architecture modern high-density GPU/AI racks actually require — the same reason land data centers are moving to liquid cooling

Trade-off: liquid immersion is more complex and costly to engineer than air cooling (competitiveness), but it is the only choice that survives the AI compute-density future (performance + resilience).

Hull Protection Without the Toxicity Trade-Off

Copper-based antifouling coatings work by leaching copper ions that are toxic to marine organisms — that is the mechanism, not a side effect. It is regulated in California and Washington State for exactly this reason. Calling it “non-toxic” is not defensible.

The approach here: a silicone-based foul-release coating (non-biocidal)

- Prevents organisms from adhering rather than poisoning them — no leaching, no regulatory exposure
- Requires more frequent mechanical cleaning than a biocidal coating — a real cost, not hidden
- Solved by reusing the resident ROV already deployed for cartridge servicing — one robot, two jobs, on a shared maintenance schedule

Sources: EU Biocidal Products Regulation on copper-based antifouling leach rates; California DPR / Washington State copper antifouling restrictions (ScienceDirect, Chemistry World).

Reliability: The Real Precedent

6 of 855

SUBSEA SERVERS FAILED
(2-YR NATICK DEPLOYMENT)

8 of 135

LAND SERVERS FAILED
(SAME COMPARISON PERIOD)

~8x

LOWER RELATIVE FAILURE RATE
UNDERWATER VS. ON LAND

Why Microsoft still walked away in 2024 — and what's different here

- Stated reason: fixed-capacity, unserviceable pods, and a design not suited to modern AI-scale demand.
- The modular cartridge + resident-ROV design (Slide 7) directly answers the serviceability critique.
- The liquid-immersion architecture (Slide 8) directly answers the AI-density critique.

Sources: ITPro / Tom's Hardware / Data Center Dynamics coverage of Microsoft's 2024 Project Natick retirement; Natick Phase 2 2-year deployment results (natick.research.microsoft.com).

The Real State of the Art

Natick isn't the only precedent. China's Highlander/Shenzhen HiCloud runs a commercial subsea data center today — it was studied closely, and this design departs from it on purpose.

DIMENSION	HIGHLANDER / SHENZHEN HICLOUD	PROPOSED DESIGN (FÉCAMP)
Deployment status	Commercial since 2023 — Hainan (100-module plan) + wind-powered Shanghai facility. Real clients: China Telecom, SenseTime.	Fécamp MVP 2026–28, phased to full array by 2031.
Sovereignty	Chinese state-backed; Highlander + 4 subsidiaries on the US Entity List (2022).	EU-sited, EU-regulated — no export-control exposure for Western tenants.
Cooling architecture	Sealed nitrogen cabin (Natick-derived) + diver-serviced external HVAC.	Single-phase dielectric liquid immersion, built for AI-density GPU racks.
PUE achieved	≤1.15 (Shanghai, 95% wind-powered, initial construction phase).	1.07 modeled — beats Highlander's own best published figure.
Carbon / ESG model	Cites energy & water savings; “carbon neutral” goal stated, no published audited MRV.	Dual-track audited blue carbon; Scope 2-honest net-negative claim (Slide 28).
Servicing philosophy	Over-provisioned redundancy — 25-yr module life, not designed to be opened.	Modular cartridge + resident ROV — designed for iterative upgrade.

This isn't a claim to be first. It's a claim to be the version a European infrastructure fund and a Western ESG-mandated tenant can actually finance, insure, and deploy.

Sources: Data Center Dynamics, SCMP, Data Centre Magazine, Merics (2023–26) — Highlander/Shenzhen HiCloud Hainan & Shanghai UDC coverage; US Commerce Dept. Entity List (2022).

Infrastructure Safety & Certification

Reliability answers “does it keep working.” Safety answers a different question: what happens when something goes wrong, and who signed off that it was planned for.

DIMENSION	SAFETY MEASURE
Structural certification	Pressure hull and mooring system certified to a marine classification society standard (DNV offshore/subsea rules or Bureau Veritas equivalent) before first deployment — not self-certified engineering.
Storm & wave loading	Hull and mooring rated for the site's 100-year storm/wave conditions; 30–50m deployment depth chosen partly for storm and shipping-lane protection.
Cable & trawling protection	Power/data cables buried or armored per standard subsea cable-protection practice, routed through exclusion zones co-designed with fisheries stakeholders (Slide 14).
Containment & emergency response	Dielectric fluid loop designed with secondary containment; capsule breach triggers automatic isolation and a defined emergency response protocol coordinated with the port authority.
Occupational safety	ROV-first servicing minimizes diver bottom-time and pressure exposure; any required diving operations follow IMCA commercial diving safety codes.
Cybersecurity & data protection	Per-cartridge tenant isolation; physical and digital security posture aligned with ANSSI (French cybersecurity agency) and CNIL data-protection requirements.

Scope caveat: this is a framework, not a completed safety case — a naval architecture and marine engineering partner is needed to turn each row into a certified design before Phase 1 construction.

Standards referenced: DNV offshore & subsea classification rules; IMCA (International Marine Contractors Association) diving safety codes; ANSSI & CNIL (French cybersecurity and data protection authorities).

Stakeholder Alignment Map

Power / interest grid across regulatory, commercial, technical, and community stakeholders.

MANAGE CLOSELY

- Host Port Authority
- Hyperscale Compute Tenants
- Blue-Economy VC / Infra Funds

KEEP SATISFIED

- Maritime Spatial Planning Regulator
- National / EU Climate & Energy Policy

KEEP INFORMED

- Conservation & Fisheries Bodies
- Renewable Energy Partner
- ROV / EPC Servicing Partner

MONITOR

- Subsea Cable / Telecom Operators
- Blue Carbon Registry / Auditor
- Coastal Local Communities

Engagement Is a Process, Not a Grid

The power/interest map (previous slide) tells you who. This tells you when and how — across the project's life, not just at planning approval.

Pre-permit	Fécamp port authority & residents	Public exhibition at the Terre-Neuvas waterfront — the same harbor community that lived through the fishing industry's decline gets first sight of what replaces it
Design development	Fisheries & conservation bodies	Co-designed exclusion zones and coating choice reviewed jointly, not presented as a finished decision
Phase 1 construction	ROV/EPC partner & renewable partner	Shared operations base established at the harbor — servicing fleet and offshore wind partner co-located from day one
Operation	Compute tenants & carbon registry	Annual public MRV disclosure — seagrass and algae-pond audits published on the same cycle as facility Scope 2 reporting
Ongoing (standing)	Fécamp Harbor Advisory Council	A permanent body, not a one-off consultation — rotating seats for the port authority, fishers, residents, and the operator, meeting quarterly for the life of the asset

Scenario A: Hyper-Regulatory Carbon Shock

~2030

DRIVER

ESG audit standards tighten sharply; regulators and buyers begin publicly discrediting bundled or unverifiable carbon-offset claims across the industry.

STRESS ON THE PROJECT

A single bundled claim like “kelp equals carbon negative” would be exactly the kind that gets discredited — and would drag the whole project's credibility down with it.

HOW THE DESIGN SURVIVES IT

The carbon accounting here is already split into two independently audited tracks (seagrass, algae-pond), and the “net-negative” claim is scoped to direct Scope 2 emissions against a dedicated renewable PPA — not blue carbon volume against an unrelated baseline. Nothing needs to be restated when scrutiny arrives.

Scenario B: AI Compute-Density Crisis

~2032–33

DRIVER

GPU rack power density continues to roughly triple as AI training/inference demand grows; land grid interconnection queues back up for years in major markets.

STRESS ON THE PROJECT

A dry-nitrogen, air-cooled capsule — the Natick-era design — cannot dissipate modern GPU-rack heat loads. A design frozen in a pre-AI cooling paradigm becomes obsolete on arrival.

HOW THE DESIGN SURVIVES IT

Single-phase dielectric liquid immersion (Slide 8) is the same cooling class land data centers are racing to retrofit for AI racks — this design starts there. Combined with passive ocean heat rejection, capacity scales with tenant demand instead of being capped by air-cooling physics.

Scenario C: Marine Spatial Planning Tightens

~2031

DRIVER

Seabed permitting regimes tighten, and mandatory biodiversity offsets become standard practice for any new marine infrastructure across EU waters.

STRESS ON THE PROJECT

A monolithic, all-at-once deployment (capsule array + two carbon tracks + shore facility, permitted as one package) would face a single, high-stakes permitting decision — and a single point of political and regulatory failure.

HOW THE DESIGN SURVIVES IT

The phased MVP-first roadmap (Module 6) means each phase is independently permissible, with brownfield siting for the algae ponds and a pre-built biodiversity co-benefit story (seagrass restoration) already inside the application, not bolted on afterward.

Key Risks & Adaptation Levers

RISK	ADAPTATION LEVER
Unserviceable pods (Natick's own failure mode)	Modular cartridges + resident ROV
Air-cooling can't handle AI-era heat density	Single-phase dielectric liquid immersion
Copper anti-fouling is toxic by design	Non-biocidal silicone foul-release coating
Net-negative claim fails a Scope 2 audit	Dedicated renewable PPA sized to direct load
Monolithic build = single permitting failure point	Phased MVP-first rollout, brownfield siting
A commercial precedent already exists (Highlander, China) — “first” isn't defensible	Reposition as sovereign, AI-era, audited alternative (Slide 11)

Explicit Trade-Offs (I)

Liquid immersion over air cooling

– Competitiveness: higher engineering complexity & cost

+ Performance & Resilience: only architecture that survives the AI-density future

Non-biocidal coating over copper-nickel

– Competitiveness: more frequent robotic cleaning cost

+ Sustainability & Resilience: avoids a toxicity liability that could block permitting

Explicit Trade-Offs (II)

Phased rollout over full simultaneous deployment

– Competitiveness: slower time-to-full-scale

+ Resilience: each phase independently permissible; no single-point regulatory failure

Dedicated renewable PPA over grid draw

– Competitiveness: real upfront CapEx commitment

+ Sustainability: the only version of “net-negative” that survives a Scope 2 audit

Bold Bet: Refinance via Blue Bond

Sovereign and corporate blue bonds are an established, if still-emerging, instrument for financing ocean-linked infrastructure — a natural fit once the asset has operating data behind it.

Phase 1-2

Build & operate on standard project finance (equity + infrastructure debt)

Post-Phase 2

2–3 years of verified operating data de-risks the asset: real PUE, real reliability, real audited carbon MRV

Phase 3

Refinance a portion of CapEx via a blue bond — lowering cost of capital using the project's own verified blue-carbon and resilience track record as collateral for a better rate

CapEx Comparison — 20MW Base Case

+\$140M

CAPEX PREMIUM: 1.5X MULTIPLIER
+ 8% CONTINGENCY RESERVE

62%

PREMIUM AS A SHARE
OF LAND CAPEX

The multiplier is still the single number to validate with a real marine-engineering EPC quote. The contingency reserve is deliberate, not padding — a novel asset class earns a bigger buffer (Slide 12).

Source: JLL 2026 Global Data Center Outlook (land CapEx benchmark, \$11.3M/MW). Subsea = land × 1.5x modeled multiplier × 1.08 contingency (assumptions).

Annual OpEx Comparison — 20MW Base Case

\$38.47M → \$27.71M

TOTAL ANNUAL OPEX,
LAND VS. SUBSEA (INCL. INSURANCE)

\$10.76M/yr

OPEX SAVINGS
(ENERGY + WATER + MAINTENANCE + INSURANCE)

13.0 yrs

SIMPLE PAYBACK ON OPEX SAVINGS ALONE

Sources: Microsoft Project Natick (PUE, WUE, ~8x reliability → maintenance scaling). Electricity ~France industrial rate; water within France's €2–5/m³ range. Insurance modeled at 0.3%/yr (land) and 0.8%/yr (subsea) of CapEx — assumption pending an underwriter quote.

Scenario Sensitivity: Net Value at Year 15

WHY CONSERVATIVE DOESN'T CLEAR 15 YEARS — ON PURPOSE

With an 8% contingency reserve and marine insurance now priced in, Conservative takes 18.7 years to break even — inside the 20–25-year design life these assets are actually built for (Highlander's own modules are rated 25 years), just outside the 15-year window used here. Showing the harder number matters more than hiding it.

The Number to Lead With

+\$29.7M

net value created by Year 15, base case — OpEx savings plus blue carbon revenue, net of the CapEx premium, contingency, and insurance.

-\$42.1M

CONSERVATIVE

breaks even at yr 18.7

+\$29.7M

BASE

breaks even at yr 12.4

+\$80.0M

OPTIMISTIC

breaks even at yr 8.0

Blue Carbon Track 1: Seagrass Restoration

Ecosystem co-benefit track — lower volume, real biodiversity and coastal-protection value.



Honest caveat, stated up front

Recent geochemical work argues common blue-carbon accounting can overestimate seagrass burial by up to an order of magnitude if it doesn't isolate sediment below the bioturbation layer. This model uses the conservative end of that range and commits to third-party MRV rather than self-reported sequestration — restoration sited away from the capsule's thermal zone, since seagrass (unlike kelp) is thermally sensitive.

Sources: seagrass sediment accumulation literature (Communications Earth & Environment, 2025); blue-carbon voluntary pricing range informed by JBE-certified kelp credits (~\$536/t, Japan, 2021) and generic nature-based credit pricing (Senken 2026).

Blue Carbon Track 2: Engineered Algae-Pond Burial

Durable-removal track — harvested and entombed, not dependent on a living ecosystem surviving disturbance.



Why this fixes the permanence problem

Unlike a living kelp or seagrass meadow, carbon here doesn't re-release if the surface pond is disturbed — biomass is dried and buried, decoupling the claim from ecosystem risk. Sited on brownfield coastal land (former salt pans / disused aquaculture sites), so it doesn't compete with the “escaping land constraints” pitch. Production cost (~\$70/t) is disclosed and modeled against durable-removal market pricing, not asserted as free.

Sources: Brilliant Planet commercial design basis, ~100,000 t CO₂/yr at 1,000 ha (Sustainable Brands, 2023); production cost ~1/10 of DAC (New Atlas, 2022); DAC benchmarked \$450–1,000/t (Senken 2026).

The Net-Negative Claim, Stress-Tested

The math a skeptical judge would run was run twice here — once on an unspecified site, then again on the actual site.

WORST CASE — GENERIC GLOBAL-AVERAGE GRID

~81,500 t

FACILITY EMISSIONS
(435 GCO₂/KWH)

~7%

BLUE-CARBON
COVERAGE

THE ACTUAL SITE — NORMANDY, FRANCE GRID

~3,860 t

FACILITY EMISSIONS
(20.6 GCO₂/KWH)

~155%

BLUE-CARBON
COVERAGE

So the claim is scoped precisely — and still holds up:

On a generic grid, blue carbon alone would cover only ~7% of the facility's footprint — which is why it's never presented as an offset for the whole facility. On the actual site (Normandy, ~21 gCO₂/kWh thanks to France's nuclear-led grid), blue carbon already exceeds direct location-based emissions before any renewable pairing. A dedicated PPA is still committed to, with a Normandy offshore wind partner (Fécamp, 497MW, or Courseulles-sur-Mer, 448MW — both operational/under construction 10–24km off this coast) because hyperscale tenants' ESG mandates typically require market-based Scope 2 accounting (GHG Protocol), not just a favorable grid average.

Sources: RTE Annual Electricity Review 2025 (French grid carbon intensity, 19.6–21.7 gCO₂eq/kWh); IEA Electricity 2026 (global average, 435 gCO₂/kWh); Fécamp & Courseulles-sur-Mer offshore wind farms (EDF Renewables / Enbridge, 2024–25).

System Perspective: Wider Ecosystem Links

■ Energy

The dedicated wind/solar micro-grid can export surplus during low-compute periods — a genuine grid-balancing / demand-response link, not just a captive power source.

■ Mobility & Urban

Near-shore, low-latency placement serves coastal smart-city and port-logistics data needs, giving the port authority a commercial reason to want the project, not just a permitting obligation.

■ Land & Urban Planning

Brownfield algae-pond siting plugs into regional coastal land-regeneration and blue-economy zoning strategy — a live policy priority in France.

■ Circular Economy

Titanium hull salvage at decommissioning closes the materials loop — a recovery pathway a land data center shell doesn't have.

Permanence & MRV Verification Framework

Seagrass	Third-party sediment-core MRV below the bioturbation layer, not self-reported biomass — addresses the overestimation risk directly.	Decades-centuries
Algae-pond burial	Independent audit of burial depth and site integrity (1–4m interment) — a physical, inspectable record, not a modeled projection.	Centuries-millennia
Facility emissions	Metered Scope 2 accounting against the dedicated renewable PPA, reported separately from carbon credit volume.	Real-time / annual

Roadmap — Phase 1: Prove the Fixes at Small Scale

2026–28 · MVP

- First move, before the technical build: a public engagement space opens on the Terre-Neuvas waterfront — the same site as the shore facility, so the community sees the project before the ROV fleet does
- ~5MW modular capsule cluster — single-phase dielectric liquid immersion, non-biocidal foul-release coating
- One carbon track live: brownfield algae-pond burial (fastest to permit, fastest to verified MRV)
- Pilot dedicated renewable pairing with Fécamp's offshore wind farm, sized to Phase 1 load
- Resident ROV servicing model tested and proven before scaling

BUDGET LOGIC

CapEx concentrated in capsule engineering and the ROV servicing system — the two elements that must be de-risked before Phase 2 commits to full scale. The waterfront engagement space is deliberately low-cost: it buys trust before it buys capacity.

Roadmap — Phase 2: Full Array + Second Carbon Track

2028–31 · Scale

- Scale to the full 20MW array (financial model base case)
- Add the seagrass restoration track, sited using Phase 1's verified thermal/MRV data
- Expand ROV servicing fleet to match array size
- Begin compute-tenant contracting on renewable-paired “net-negative” terms

BUDGET LOGIC

CapEx shifts toward array replication (known unit cost from Phase 1) and shore-facility expansion; OpEx savings from Phase 1 begin funding Phase 2 buildout.

Roadmap — Phase 3: Full Operation + Blue Bond Refinance

2031-35 · Commercial

- Full commercial operation across both carbon tracks and full compute capacity
- 2–3 years of verified operating data supports a blue bond refinancing of a portion of CapEx
- Decommissioning and titanium salvage plan finalized as part of the circular-economy commitment

BUDGET LOGIC

Financing cost drops as the blue bond replaces higher-cost early construction debt — the project's own operating track record becomes its collateral.

Budget Logic Summary

CapEx premium (base case)

+\$140M vs. land — 1.5x multiplier + 8% contingency reserve

Contingency & insurance

8% CapEx contingency (subsea only) + marine insurance at 0.8%/yr subsea, 0.3%/yr land — priced in, not assumed away (Slide 12)

Annual OpEx savings

\$10.76M/yr from lower energy, zero water use, ~8x lower maintenance — net of insurance

Annual blue carbon revenue

\$80K (conservative) – \$1.05M (optimistic) — diversification, not the primary payback driver

Fiscal stress-test result

Base case nets +\$29.7M by Year 15; Conservative breaks even at Year 18.7 — inside a realistic 20–25-yr asset life, just outside the 15-yr window used here (Slide 25)

Financing evolution

Standard project finance through Phase 2 → blue bond refinance in Phase 3 once operating data de-risks the asset

Single Impact Indicator

Verified net infrastructure value created per net ton of CO₂e avoided — audited on a Scope 2 (direct emissions) basis.

Why this indicator, specifically

- It can't be gamed by citing carbon-credit volume against an unrelated emissions baseline — the exact trap the “net-negative” claim could otherwise fall into (Slide 28).
- It pairs a resilience metric (IRR / infrastructure value) with an environmental metric (net, audited CO₂e) in a single ratio, rather than presenting them separately where a jury has to trust they connect.
- It's reportable every year of operation — not a one-time modeled projection — so it gets more credible over time, not less.

A Day in Fécamp, 2032

06:40 — Amélie checks the pond readings before the harbor wakes. Her father hauled cod off these docks; she harvests algae biomass a hundred meters from where his boat used to moor.

09:15 — The resident ROV surfaces a service log, not a capsule — a routine cartridge swap, logged and gone before the fishing charters leave for the day.

13:00 — A hyperscale tenant's sustainability officer tours the shore facility. She isn't shown a slide of carbon credits; she's shown the MRV dashboard, updated that morning, audited that quarter.

19:30 — At the waterfront engagement space — the first thing built, three years ago — a town-hall session runs through this quarter's monitoring data. Questions are about jobs and the harbor, not turbines.

A fictional composite, grounded in the real site and the real sequencing in this deck — not a promise, a plausibility check.

Beyond 2035: A Reference Design, Not a One-Off

Fécamp is the demonstrative site — the same role Gehun Kheda played for Bhopal in last year's winning entry. The point was never to stop at one harbor.

2035–40

Second deployment

A second site on France's open Atlantic coast adopts the Fécamp reference design but swaps power source to match local marine conditions: wave energy (Seaturns' full-scale S1 demonstrator, deployed 2026 off the Gironde estuary, targeting certification 2027) replaces offshore wind, since Atlantic swell — not Channel wind — is the stronger resource there. Same capsule, same dual carbon track, different energy partner.

2040+

EU blue-economy network

Verified Scope 2 and MRV data from multiple operating sites builds a shared evidence base, lowering financing cost for each subsequent deployment — the blue bond model (Slide 21) becomes easier to underwrite with a track record, not a projection.

Long-run

The model, not just the site

What replicates is not the capsule alone but the sequence: name a real site, fix the predecessor's real failure, engage the community first, verify claims transparently. Fécamp is the proof of concept for that sequence.

Not a repeat of Microsoft's experiment. A fix for why it ended.

Serviceable

Modular cartridges + resident ROV

AI-ready

Liquid immersion, not air-cooled nitrogen

Auditable

Two carbon tracks, Scope 2-honest “net-negative” claim

Fiscally stress-tested

Base case nets +\$29.7M by Year 15 — with contingency and insurance already priced in

Infrastructure as a System: compute, energy, ecosystem, and community, engineered as one accountable asset.

49.7607°N · 0.3739°E — FECAMP, NORMANDY

Key Assumptions & Sources

ASSUMPTION	VALUE	SOURCE / STATUS
Target site	Normandy coast, France	Near Fécamp (497MW) & Courseulles-sur-Mer (448MW) offshore wind farms
Land DC CapEx	\$11.3M/MW	JLL 2026 Global Data Center Outlook
Subsea CapEx multiplier	1.5x land (1.3–1.8x tested)	ASSUMPTION — no public commercial benchmark; validate with EPC quote
Land / Subsea PUE	1.125 / 1.07	Microsoft Project Natick comparison data
Land / Subsea WUE	4.8 / 0.0 L/kWh	Microsoft Project Natick
Reliability index	~8x (6/855 vs 8/135 failures)	Microsoft Natick 2-yr deployment (ITPro, 2024)
Electricity / water rate	\$0.12/kWh, \$3/m³ (modeled)	Close to actual: France industrial €0.13–0.15/kWh; water €2–5/m³ (Eurostat, 2026)
Seagrass rate / price	5 t/ha/yr, \$30–150/t	Sediment literature (2025) + blue-carbon voluntary pricing (ASSUMPTION range)
Algae-pond rate / price	100 t/ha/yr, \$80–250/t	Brilliant Planet design basis (2023) + durable-removal pricing (Senken 2026)
Grid carbon intensity (actual site)	20.6 gCO2/kWh	RTE Annual Electricity Review 2025 — France, 19.6–21.7 g range
Grid carbon intensity (illustrative worst case)	435 gCO2/kWh	IEA Electricity 2026 — global average

Full Financial Detail

The complete underlying model — short-term vs. long-term position and the blue carbon revenue build — condensed from the full sensitivity workbook.

SHORT TERM — YEAR 5 (BASE CASE)

CapEx premium paid upfront	\$140.1M
Cumulative OpEx savings	\$53.8M
Cumulative blue carbon revenue	\$2.8M
Net position at Year 5	-\$83.5M

A deeply negative Year-5 position is the expected, healthy profile for this asset class — the CapEx premium isn't meant to be recovered this early.

LONG TERM — YEAR 15 (ALL SCENARIOS)

Fully-loaded payback (base)	12.4 yrs
Net value, Conservative	-\$42.1M
Net value, Base	+\$29.7M
Net value, Optimistic	+\$80.0M

Conservative breaks even at Year 18.7 — inside a realistic 20–25-yr asset life, just outside this 15-yr window.

BLUE CARBON REVENUE BUILD

Track	Area	Rate	Credits/yr	Net revenue/yr
Seagrass	200 ha	5 t/ha/yr	1,000 t	\$30K – \$150K
Algae-pond burial	50 ha	100 t/ha/yr	5,000 t	\$50K – \$900K (net of \$350K production cost)