

TRACK · FLOATING INDUSTRIAL

Full Paper · WCFS 2026 Proceedings

A Floating High-tech Industrial Cluster for the Saemangeum Area

Utilising the 119 km² of calm enclosed water inside the Saemangeum seawall as a productive asset — a hybrid land–water hybrid land–water development model for the KRW 9 trillion Hyundai Motor Group robotics · AI · hydrogen cluster.

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One of Korea's largest national projects, re-accelerated.

A 39-year national project, re-accelerated by a KRW 9 trillion private investment.

SINCE 1987

39 years

One of Korea's most ambitious national development projects — a large-scale reclamation reclamation initiative on the west coast, shaped by one by one of the world's largest seawall projects.

RECLAMATION PROGRESS · 2025

~40%

Overall reclamation progress reported at approximately 40% — pace constrained by fill-material material shortage, soft-ground foundation cost, and and environmental impact.

HYUNDAI MOTOR GROUP · FEB 2026

₩9 trillion

≈ USD 6 billion

Investment plan for a future-oriented industrial cluster focused on **robotics · AI · hydrogen energy**.

STRATEGIC ALIGNMENT

Robotics · AI · hydrogen are core sectors of Korea's national strategic-technology agenda — Saemangeum is positioned to be positioned to be the physical home of that agenda, but the reclamation delivery model is the bottleneck. This paper reframes the delivery model, not the industrial vision.

A PARADIGM SHIFT · WATER SURFACE AS PRODUCTIVE ASSET

Can the 119 km² of calm
enclosed water inside the seawall
be treated as **productive asset**,
not empty background?

REFRAMING

Instead of asking *how fast can we reclaim more land*, ask: **can floating architecture deliver the same industrial functions — functions — robotics · AI · hydrogen — faster, cheaper, and with less environmental impact than continued reclamation? reclamation?**

A calm, enclosed basin – limited wave exposure.

The seawall converts open sea into a calm, protected inland water basin.

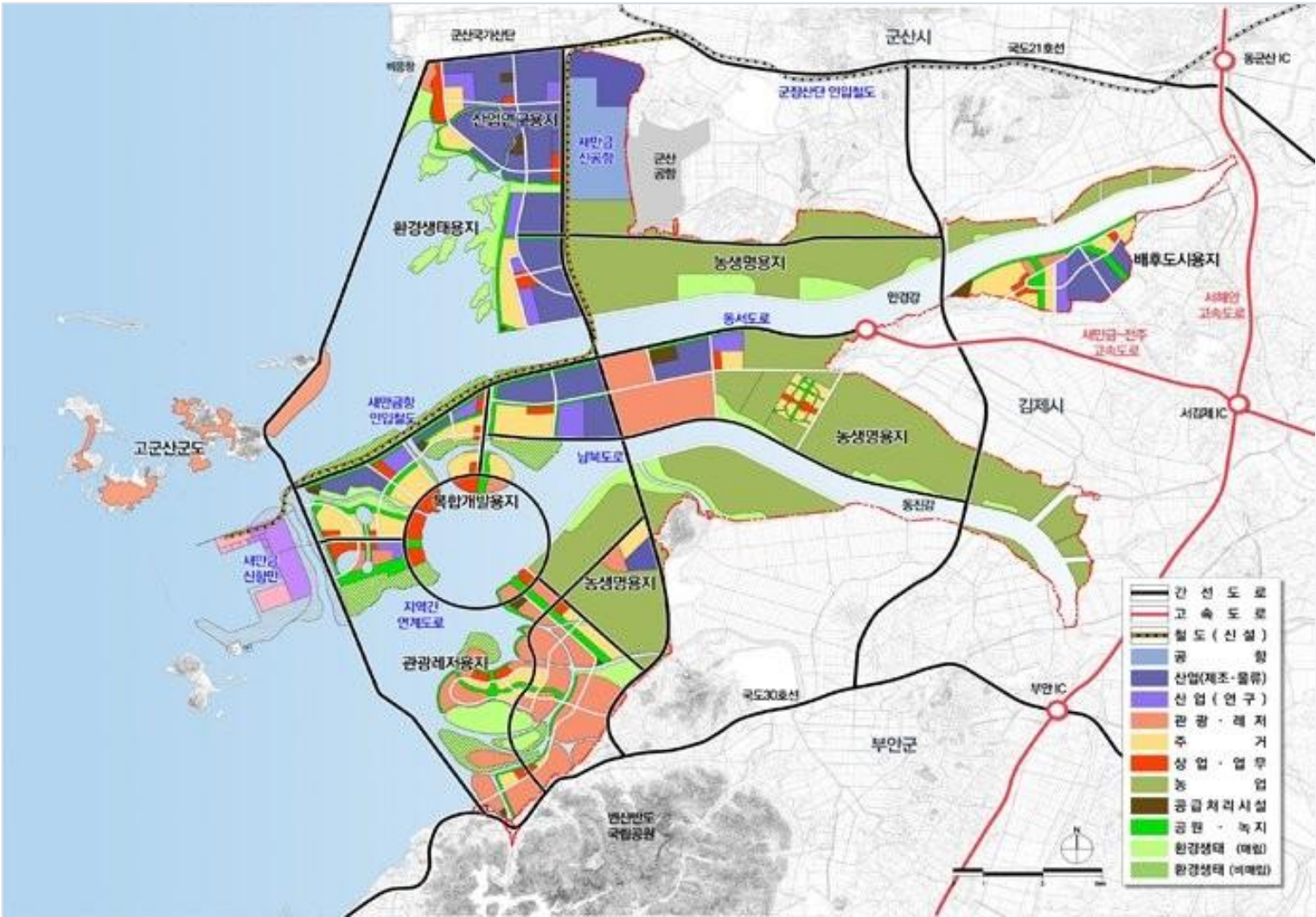


FIG. 1 [5]
Spatial development plan of Saemangeum (2021) — showing land-use zoning and the ~29% water-body share.

409^{km²}

Total project area — one of the largest single national development footprints in Korea.
Korea.

THE DEVELOPABLE WATER

119^{km²}

29%

Enclosed water bodies inside the seawall — central to the spatial structure, not peripheral.

HYDRODYNAMIC FAVOURABILITY

- ◆ Wave exposure — **limited** by the seawall barrier
- ◆ Water body — **enclosed, calm**, non-tidal-dominant
- ◆ Depth & footprint — **large-scale floating structures feasible**

Reclamation alone cannot match the pace of high-tech industry.

Four structural limits of a reclamation-only industrial development model.

01 FILL-MATERIAL SHORTAGE

Sourcing sand and rock at scale is increasingly difficult.

Approx. 40% reclamation progress over ~39 years reflects the cumulative constraint. Continued acceleration compounds the problem.

02 SOFT-GROUND FOUNDATION COST

Reclaimed ground is soft — bearing capacity requires deep piling.

Heavy industrial plants and data centres compound the foundation-engineering burden — a structural cost the reclamation model cannot escape.

03 ENVIRONMENTAL IMPACT

Tidal-flat loss, water-quality risk, ecosystem disruption.

Continuing to reclaim the remaining 60% imposes further ecological costs on the enclosed basin and adjacent tidal-flat systems.

04 CLIMATE · SEA-LEVEL RISE

Fixed ground is rigid against a moving water plane.

Reclaimed land locks in an elevation today; floating structures adapt to water-level change year-on-year — a decisive long-run advantage.

A hybrid development model – not an either/or.

Floating architecture is a complement,
not a replacement —the model is hybrid.

DIMENSION	LAND RECLAMATION (BASELINE)	FLOATING CONSTRUCTION (PROPOSED)
Delivery time	Multi-decade, fill-material dependent	Modular prefabrication in shipyards — years
Foundation cost	Deep piling on soft reclaimed ground	Buoyancy replaces piling
Sea-level adaptation	Fixed elevation — retrofit required	Rises with water level — inherent
Seismic behaviour	Ground-coupled — transmits shaking	Water-isolated — natural damping
Reconfigurability	Permanent land parcel	Modules can be re-moored / relocated
Environmental footprint	Tidal-flat loss	Preserves water surface function

MODEL · Retain reclamation for uses that require ground —heavy foundries, transport nodes. Deploy floating platforms for uses that don't —data centres, R&D, logistics, assembly, housing.

Four precedents – completed, conceptual, proposed, under development.

Four precedents spanning completed, conceptual, proposed, and under-development stages.

FIG. 2 [6]

COMPLETED

Sebitseom

Seoul, Korea
Large floating cultural/commercial complex on the Han River — large-span floating structures and water-level adaptation.



FIG. 3 [1]

CONCEPTUAL

Oceanix Busan

Busan, Korea
UN-Habitat-linked floating city concept — hexagonal buoyant platforms for modular urban infrastructure.

MALDIVES FLOATING CITY [8] · masterplan + residential cluster



FIG. 4 [7] PROPOSED

Oxagon, NEOM Saudi Arabia
Hybrid land–water industrial district.



FIG. 5 [8] UNDER DEV.

Masterplan overall layout
Modular expansion in a calm sheltered lagoon.



FIG. 6 [8] UNDER DEV.

Residential cluster close-up
Modular housing modules within the same project.

Each precedent contributes a distinct lesson.

Each precedent contributes a distinct lesson for the Saemangeum case.

CASE	PROGRAMME	WATER CONDITION	STATUS	RELEVANCE TO SAEMANGEUM
Sebitseom	Cultural / commercial	Urban river	COMPLETED	Large floating structure & water-level adaptation
Oceanix Busan	Floating urban district	Coastal water	CONCEPTUAL	Modular urban infrastructure
Oxagon	Industrial / logistics district	Coastal / port	PROPOSED	Hybrid land–water industrial development
Maldives Floating City	Residential city	Sheltered lagoon	UNDER DEV.	Modular expansion in calm water

SAEMANGEUM'S NICHE · Saemangeum's enclosed 119 km² basin combines Sebitseom's calm-water precedent, Oxagon's industrial ambition, and Maldives' modular expansion—at unprecedented scale.

Six advantages of a floating industrial cluster.

Six advantages that map directly onto Saemangeum's constraints.

01

Land-use efficiency

Uses the 119 km² water surface as a productive asset — reduces dependence on further reclamation and preserves reclaimed land for uses that truly need ground.

02

Water-level adaptability

Structures rise with the water plane — inherent resilience against sea-level rise and long-term water-level level fluctuation, without retrofit.

03

Seismic resilience

Water-isolation attenuates ground shaking — a natural damping mechanism for sensitive equipment (semiconductor tools, precision robotics, HPC racks).

04

Modular prefabrication

Platforms and superstructures built in nearby Gunsan / Jeonbuk shipyards — leveraging Korea's shipbuilding & offshore-engineering base for schedule compression and precision.

05

Renewable-energy integration

Floating PV, offshore wind interconnection, and water-source source heat pumps for data-centre cooling — the basin basin becomes both site and energy resource.

06

Phased scalability

Modules are added as demand justifies — no need to pre-commit reclamation capex for uncertain long-term uptake. Modules can also be relocated between clusters.

Conceptual visualization – land and water integrated.

A hybrid model — land and water infrastructure integrated at cluster scale.



FIG. 7 (Source: Authors)

Conceptual visualization of a floating high-tech industrial complex in Saemangeum — modular platforms grouped by function on the enclosed water surface.

IMPLEMENTATION PRINCIPLES

A. Hybrid zoning

Ground-dependent uses on reclaimed land; ground-independent uses on floating platforms.

B. Modular platforms

Standardised buoyant modules that can be added, added, removed, or re-moored — matching cluster growth.

C. Utility spine

Power, cooling, data, and mooring services carried by dedicated utility corridors between platforms.

D. Local supply chain

Fabrication anchored to Gunsan / Jeonbuk shipyards shipyards — regional economic multiplier.

Which functions go on land, which on floating platforms.

Function-by-function allocation: ground-dependent vs. ground-independent.

RECLAIMED LAND

Ground-dependent functions

Retain the reclamation model where physical ground is genuinely required.

- ◆ **Heavy manufacturing plants** — high point-loads, vibration, ground-anchored process equipment
- ◆ **Hydrogen production & storage** — safety zoning, buffer distances
- ◆ **Transport nodes** — road, rail, deep-water port interfaces
- ◆ **Substations & grid infrastructure** — long-lived civil works
- ◆ **Emergency response & hazardous-material handling**

FLOATING PLATFORMS

Ground-independent functions

Deploy modular buoyant platforms where ground is not intrinsically required.

- ◆ **Data centres** — direct lake-water cooling, heat rejection into the basin
- ◆ **Assembly plants & production modules** — robotics, AI hardware, precision electronics
- ◆ **Logistics facilities** — buffer storage, distribution, water-borne freight
- ◆ **Offices & R&D** — reconfigurable, seismic-isolated by water
- ◆ **Utilities & energy modules** — floating PV, storage, water-source heat pumps

The proposed programme fits the Hyundai Motor Group cluster (robotics · AI · hydrogen): hydrogen belongs on land for safety, robotics assembly and AI compute belong on water for schedule and cooling.

Not a final blueprint – eight questions requiring quantification.

Eight open questions that must be quantified before implementation.

A · ECONOMIC & ENGINEERING

- Q1** **Capital-cost benchmarking.** Floating vs. reclamation on a per-m², per-function basis—including ground including ground improvement, piling and dewatering costs.
- Q2** **Mooring & utility systems.** Selection of mooring types, redundancy, and integrated distribution of power, data, of power, data, water, cooling
- Q3** **Maintenance & long-term operating cost.** Hull inspection cycles, biofouling, coating renewal, dry-dock dry-dock intervals over 30–50 years horizons.
- Q4** **Relocation value.** Quantifying the option value of module re-mooring and phased-expansion benefits.

B · REGULATORY, SAFETY & SOCIAL

- Q5** **Water quality.** Cumulative effect of thermal discharge, activity, and industrial operations on the enclosed the enclosed basin.
- Q6** **Industrial logistics & insurance.** Freight interfaces between land and floating platforms; marine-industrial marine-industrial insurance frameworks.
- Q7** **Fire safety.** Compartmentation, water-borne evacuation, response times—beyond conventional land-conventional land-based codes.
- Q8** **Public acceptance & legal framework.** A Special Architectural District designation may be required to required to enable the hybrid land–water regime.

METHODOLOGICAL POSITION · These eight questions are the research programme, not a caveat —each admits a defined method and interim deliverable.

THREE CLAIMS

Saemangeum's 119 km² of enclosed water
can host the **world's first at-scale**
floating industrial cluster.

01

Model — hybrid, not either/or

Land reclamation continues for functions that need ground; floating platforms take everything else. The reclamation model is not rejected — it is bounded.

02

Fit — Hyundai's programme fits

Robotics · AI · hydrogen decomposes cleanly across land and and floating: hydrogen on land for safety; data centres and and assembly on water for cooling, schedule, and seismic seismic isolation.

03

Leverage — Korea's shipbuilding base

Nearby Gunsan & Jeonbuk shipyards convert an industrial industrial transition risk into a delivery advantage — regional regional economic multiplier plus proven fabrication capacity. capacity.

Numbered per the full paper – Fig. references shown on slides 4, 7, 10.

References

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FIG. 7 ATTRIBUTION · Conceptual visualization by the authors — visualization generated with OpenAI ChatGPT (2026); no external reference.

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