

Ethanol as a Marine Fuel: A Scalable Pathway for Shipping's Decarbonisation

Ethanol and Methanol — complementary solutions for immediate and scalable impact

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CMA CGM IRON — methanol dual-fuel; first deep-sea containership bunkered with bioethanol in Brazil (Santos, Jul 2026)



01 The Decarbonisation Challenge

Where we are and
what's needed



02 The Alcohol Opportunity

Methanol and ethanol
— complementary
solutions



03 India's Ethanol Advantage

Production, resources
and policy support



04 India's Shipbuilding Momentum

A national opportunity
for alternative fuels



05 From Trials to Deployment

Blending, engines,
bunkering and standards



06 Key Takeaways and Next Steps

What India and the global
community can do now

Build the ecosystem, not the molecule

India can connect its biofuel scale, shipbuilding push and port infrastructure into one marine-fuel strategy.



20%

India's nationwide petrol ethanol blend, 2025–26



~20 bn L/yr

Ethanol production capacity reported in 2026



Feedstock & distilleries



Shipyards



Ports & liquid bulk



₹69,725 cr (≈ US\$7.2 bn)

Approved shipbuilding & maritime reform package



500 KTPA

Kandla target for RFNBO e-methanol by 2028–29

The opportunity is not ethanol versus methanol.

It is vessels, ports and standards able to use the lowest-CI liquid available at the right place and time.

The adoption curve is compressing

From engine tests to repeated commercial bunkering in under a year.



112–120

methanol-capable vessels in operation — engines that can also run on ethanol

+400

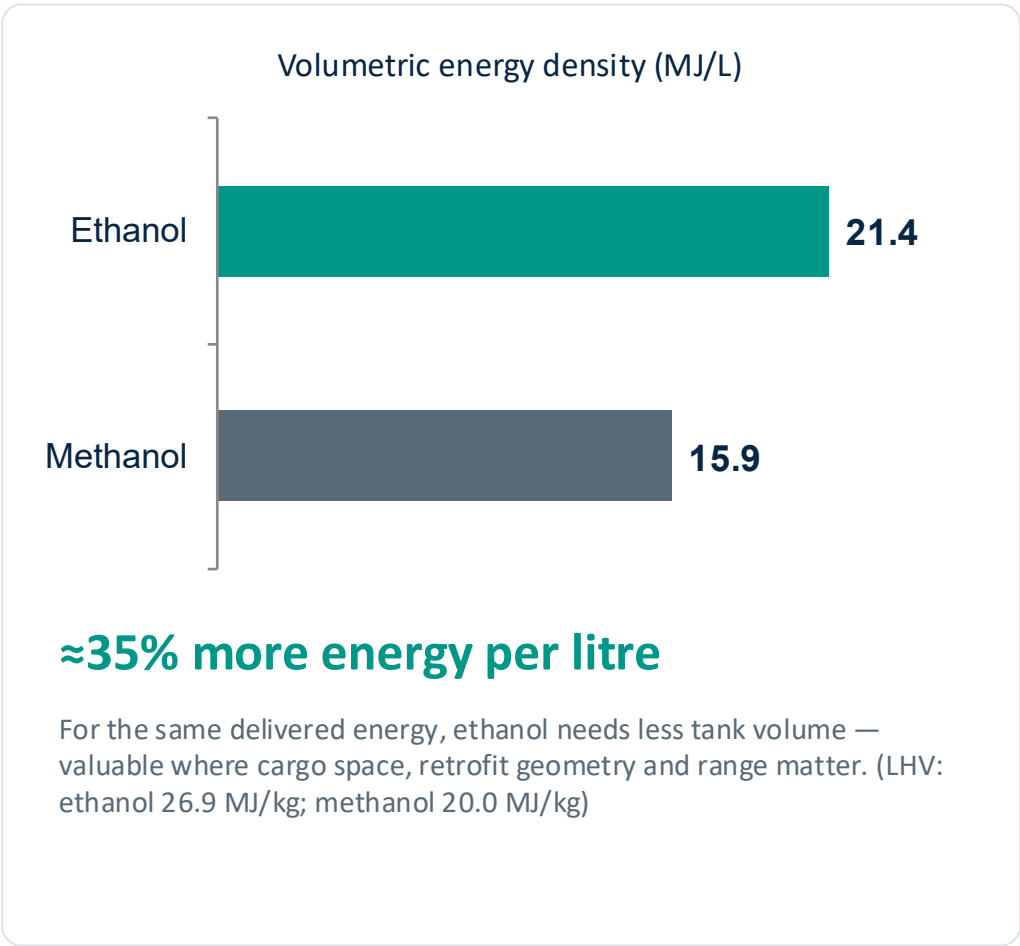
additional non-fossil-ready vessels expected in coming years

200

CMA CGM low-carbon-energy-capable ships targeted by 2031

Methanol opened the door — ethanol can widen it

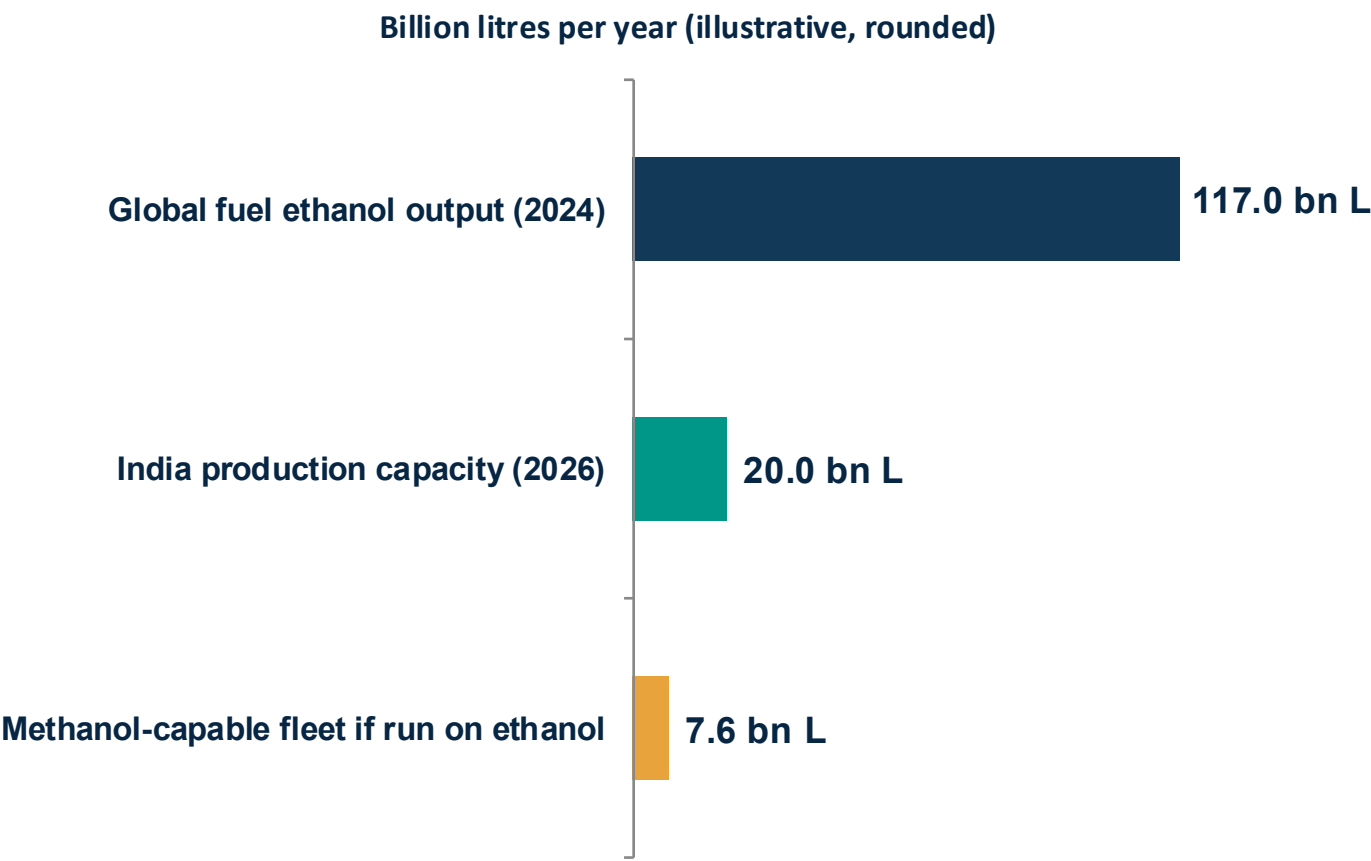
Same family of ambient liquids and engines; different supply economics and physical properties.



	METHANOL	ETHANOL
Engines	Rapid adoption of dual-fuel engines	Runs in methanol DF engines; Everllence LGIM certified, WinGD X-DF-M/E ordered
Supply	Growing bio- and e-methanol projects	Largest existing biofuel pool: ~31 bn gal produced globally (2024)
Handling	Established bunkering network; toxic	Not classified as toxic; same ambient-liquid handling family
Standards	IMO interim guidelines + ISO spec in place	ISO/TC 28 WG18 marine spec underway; CCC 12 amendments tabled

The near-term demand pool already exists

The methanol-capable fleet in service could itself absorb a meaningful share of today's ethanol output.



~6 Mt/yr

≈ 2 bn gal of ethanol if the 112–120 methanol-capable vessels ran full-time on ethanol (NLR)

≈ 6.5%

of 2024 global fuel ethanol output (31 bn gal) — a demand pool, not a supply crunch

≈ 38%

of India's reported 2026 production capacity — a sense of scale for a domestic marine outlet

Conversions: 1 US gal = 3.785 L. Shares derived by MEMA from NLR (Sep 2026) and PIB figures; illustrative only.

NEWBUILD ORDER BOOK — methanol-fuelled



committed: 168 methanol-fuelled in fleet (0.1%) + 279 on order (3.1%)

1,385

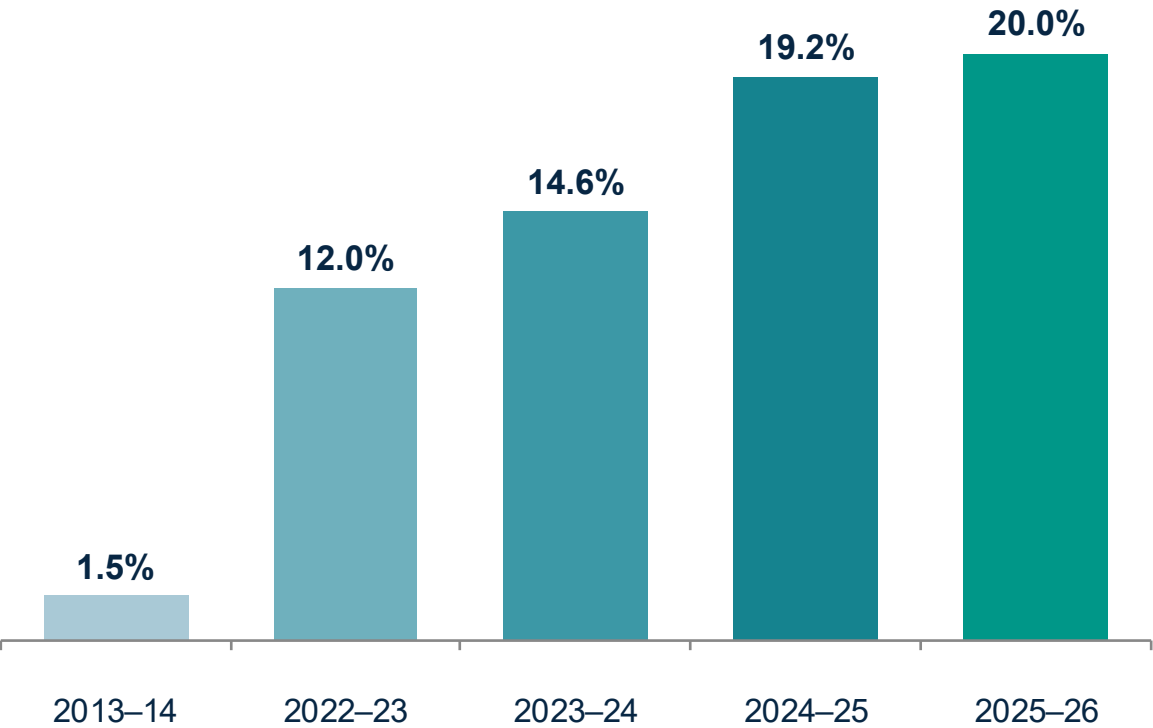
convertible: 544 methanol-ready in fleet (0.5%) + 841 on order (9.3%)

3× more ships are built ready to convert than are committed. Methanol DF orders fell 149 → 61 → 4 (2024 → 2025 → H1 2026), and in H1 2026 owners placed 85 methanol-ready orders against just 4 dual-fuel. Owners bought the option — ethanol is how it gets exercised: same ambient-liquid tank and piping spec, available in volume today.

From 1.5% to 20% blending — the infrastructure is built

India's road-fuel programme created production, logistics, quality control and commercial discipline.

Ethanol blending in petrol — national average (%)



38 → >1,200 cr L
(0.38 → >12 bn litres)
Ethanol procurement, 2013–14
→ 2025–26 (projected)

421 → ~2,000 cr L
(4.2 → ~20 bn litres)
Production capacity, 2014 →
2026

A BROADENING FEEDSTOCK POOL



Compare on delivered energy + verified lifecycle CI + sustainability — not generation labels.

Kandla has already demonstrated the platform approach

Use existing liquid-bulk capability, validate procedures, then scale — the same playbook works for ethanol.



2 Apr 2026

Shore-to-ship methanol bunkering trial at Deendayal Port (Kandla)



PRL 6

DNV-assessed IAPH Port Readiness Level



~500 KTPA

RFNBO-compliant e-methanol targeted by 2028–29

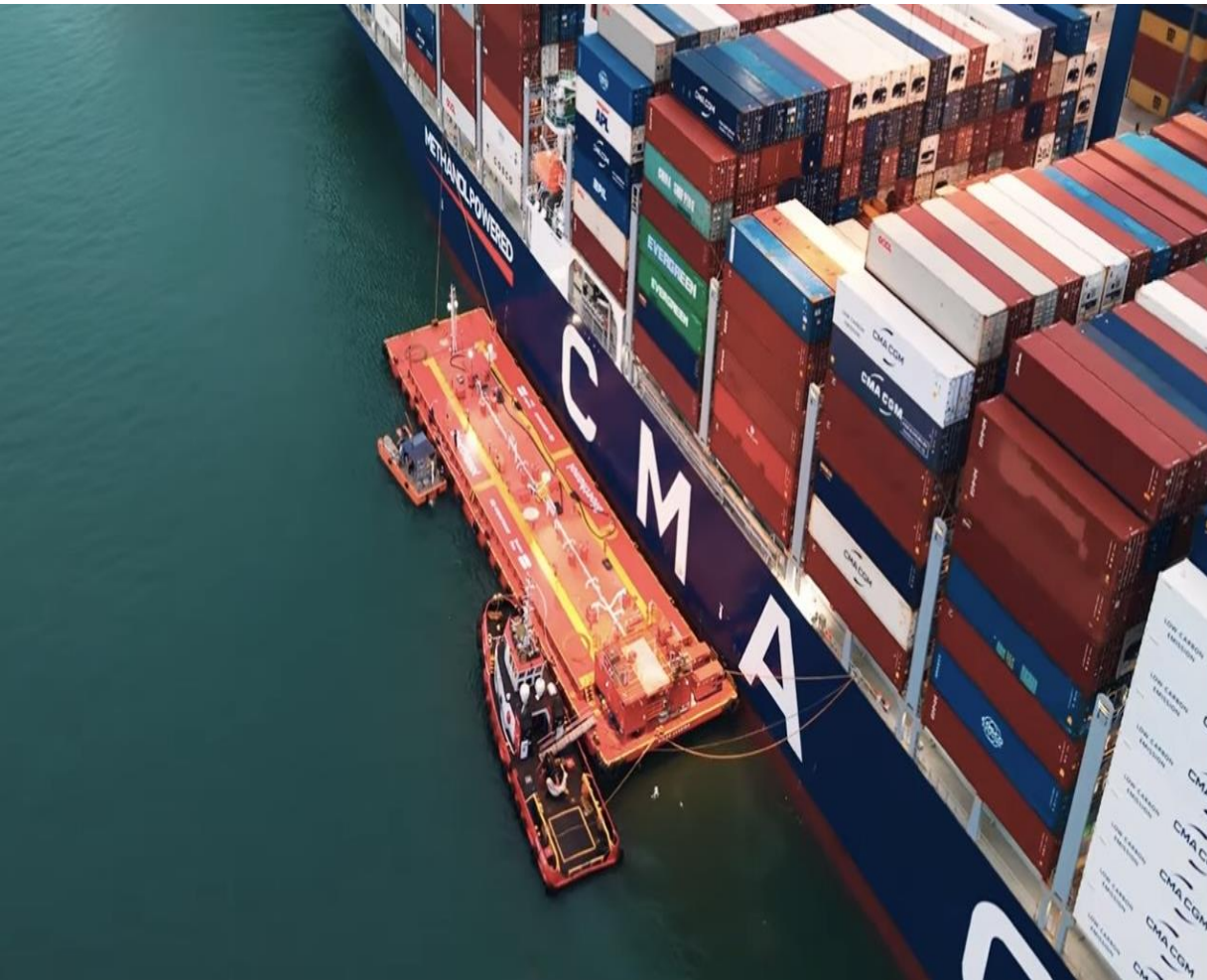
Partners

Deendayal Port Authority · Stolt Tankers · J M Baxi · Aegis Vopak · IndianOil

Why it matters for ethanol

The institutional learning — procedures, training, safety case — cuts the time needed to introduce ethanol safely.

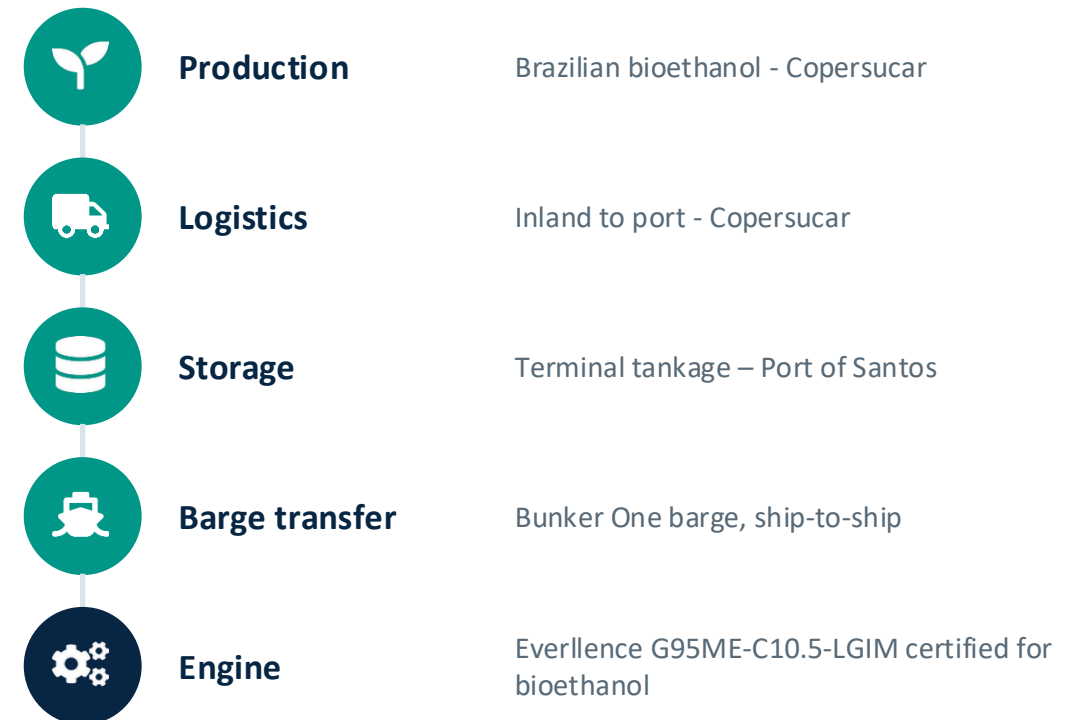
Brazil experience



Bunker One barge alongside CMA CGM IRON (13,000 TEU, methanol dual-fuel) · Santos, July 2026 · Photo: CMA CGM / Bunker One

Santos: ethanol moved from discussion to deep-sea bunkering

The precedent is not only the molecule — it is the full bunkering chain.



India has comparable ingredients: **production scale, ports, liquid-bulk logistics and maritime industrial policy.**

Ethanol is increasingly visible inside the IMO framework

For an IMO audience, credibility comes from measured pathways and conservative claims.

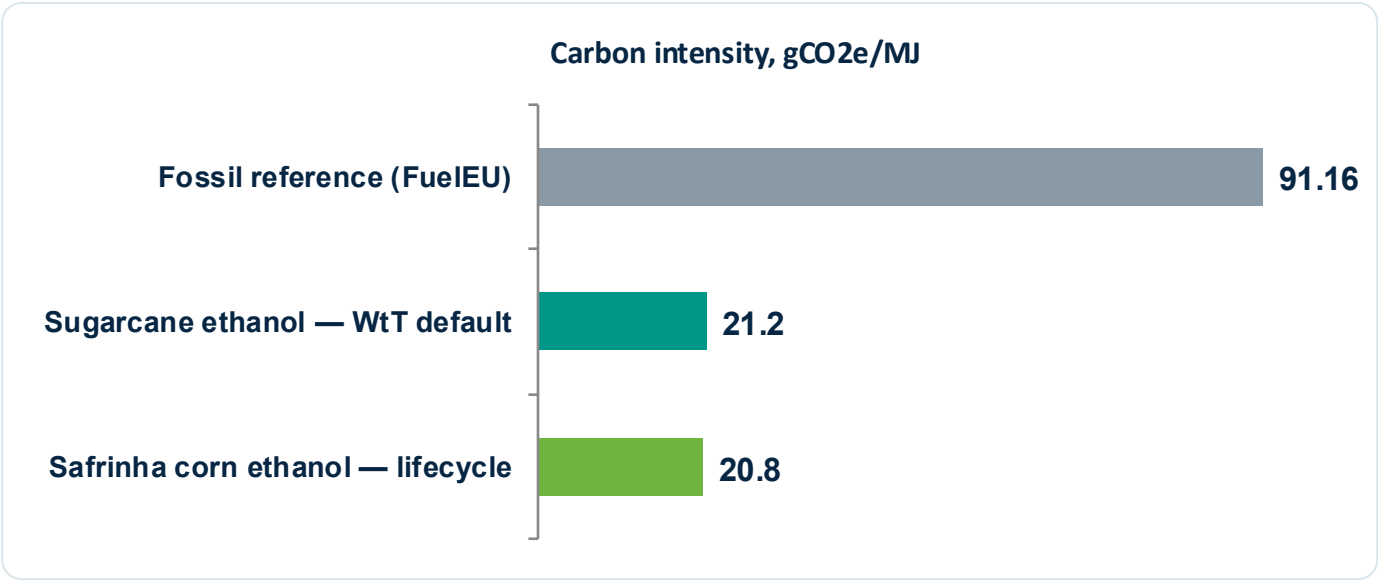
**LCA framework**
MEPC.391(81) — 2024 IMO LCA Guidelines

**Pathways**
Brazil intermediate-crop corn: EtOH_b_FR_intcom_r_CHP (MEPC 84)
Brazil sugarcane: EtOH_v_sc_FR_r (to MEPC 85)

**Safety**
CCC 12/INF.15 + CCC 12/3/6 — ethanol vs methanol, MSC.1/Circ.1621 amendments

**Certification**
Draft SFCS Guidelines — MEMA backs mass-balance chain of custody

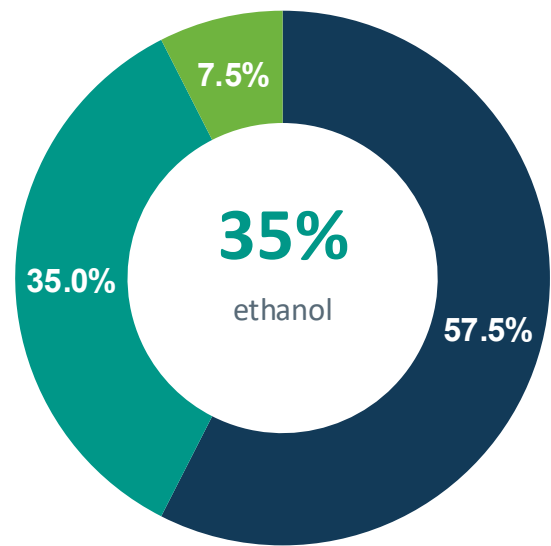
**Fuel spec**
ISO/TC 28/SC 4/WG 18 marine ethanol specification



~77% lower
than the fossil reference on these values — but the tank-to-wake side (CH₄, N₂O) still needs measurement on real ethanol engines.
India can contribute pathways and TtW data rather than wait for standards set elsewhere.

A practical blend pathway for the existing fleet

MEMA / DUT programme: MGO + ethanol + FAME — an incremental route while dedicated alcohol fleets scale.



■ MGO ■ Ethanol ■ FAME

FAME evaluated as co-solvent / stabiliser — not just another renewable component.



Stable

Exceptional blend stability in the current test programme



~6% water

Tolerated without observed brake-thermal-efficiency loss



2 labs

DUT (Delft) + parallel validation at MESD / NTU Singapore

TWO ROUTES TO THE INJECTOR

Pre-blended, stabilised

MGO / ethanol / FAME blended ahead of bunkering; FAME guards against phase separation.

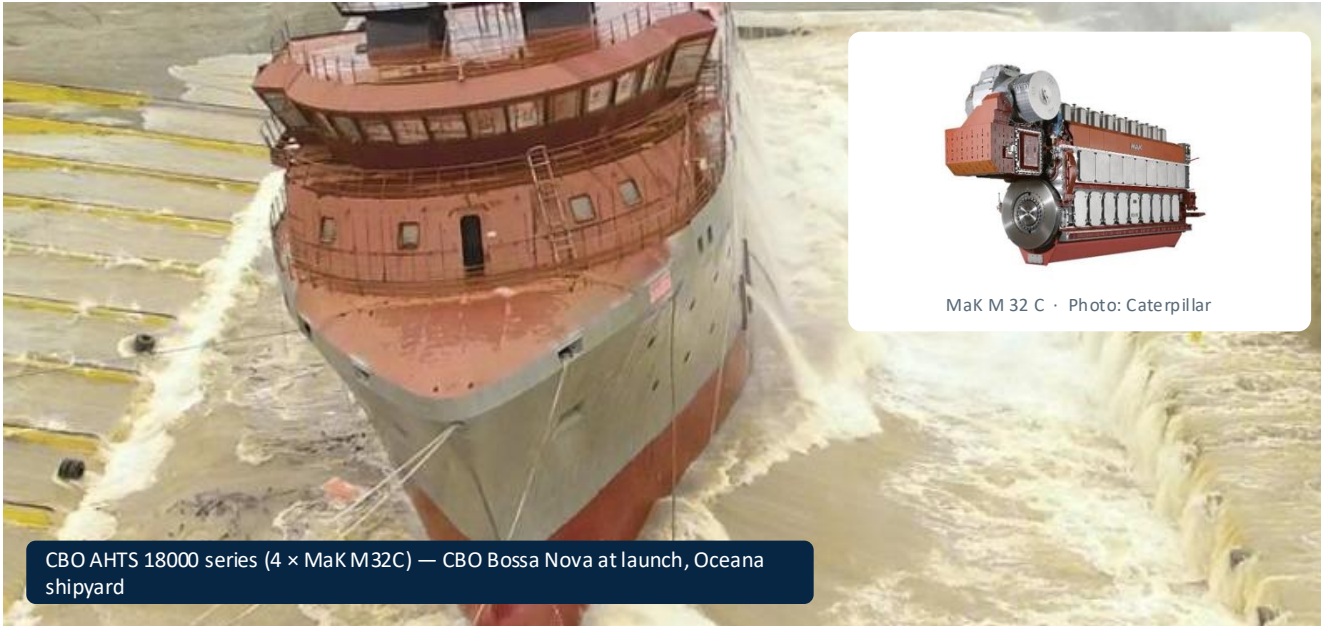
Blend at point of injection

Caterpillar unit blends 35% ethanol into MGO for immediate injection; testing since Sep 2026, results to CBO for an offshore vessel in Brazil.

Denaturants: Singapore approves 14 formulae; testing also covers 2%-gasoline-denatured ethanol to unlock US supply — the key to MPA extending TR 129 to ethanol.

CBO + Sotreq / Caterpillar MaK — taking ethanol blending onboard

CBO is moving ethanol from testing toward commercial offshore operation, working with Sotreq and Caterpillar/MaK on a retrofit of an existing MaK M32C installation.



CBO AHTS 18000 series (4 × MaK M32C) — CBO Bossa Nova at launch, Oceana shipyard



WHY IT MATTERS Existing engine + retrofit kit + existing liquid-fuel infrastructure = a potentially scalable route to immediate renewable-fuel substitution.

Directly relevant to other MaK-powered offshore, workboat and commercial fleets — ethanol can enter shipping through retrofit as well as newbuild dual-fuel engines.

THE TECHNOLOGY

- A retrofit, not a new engine — Caterpillar/MaK Dual Blend / Fuel Blending Solution.
- Designed for existing MaK M20–VM43 engine families.
- Up to ~35% ethanol or methanol blended with MDO/MGO or biofuel equivalents.
- Dedicated fuel supply, metering/blending and control hardware integrated with the existing engine.
- DNV Approval in Principle obtained after test-facility validation.

THE CBO PROJECT

- An existing MaK M32C-powered offshore vessel selected for Brazil's first application.
- One engine converted initially — remaining engines provide conventional redundancy.
- Sotreq expects to deliver Brazil's first Dual Blend Kit during 2026.
- Installation, commissioning and field validation lead toward planned commercial operation.
- Displaces part of the vessel's diesel with renewable ethanol — without replacing the engine.

Seven workstreams building the evidence base

A shared programme Indian institutes, OEMs, ports and fuel suppliers can plug into.



01

Fuel blending

MGO / ethanol / FAME stability,
water tolerance, blend envelope



02

Denaturants

Marine-compatible denaturant
position; Singapore list; 2% gasoline



03

4-stroke testing

Engine validation on blends and neat
ethanol



04

2-stroke / TtW

Tank-to-wake emissions from real
ethanol engines for IMO



05

Bunkering scale-up

Barge / STS procedures; SIBCON
Ethanol Bunkering Roundtable



06

OPS demonstrator

Containerised 2 × 400 kW spark-
ignition shore power on E100



07

Standards & guidance

ISO WG18, TR 129, IMO / CCC and
competency framework

OPS status

Unit recalibrated to ethanol, stable
idle achieved.

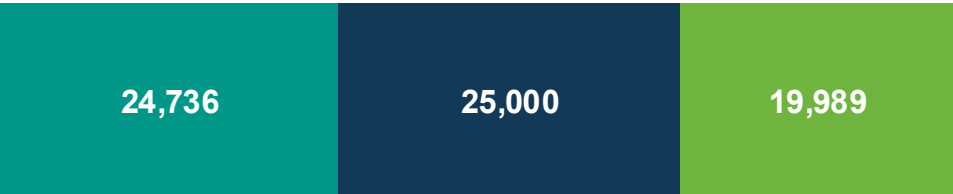
Next gate: 25% load.

*A port-side use for ethanol that needs
no ship at all.*

India's shipbuilding expansion is a fuel-design opportunity

The best time to create fuel optionality is before the steel is cut.

₹69,725 cr package (≈ US\$7.2 bn) — values in ₹ crore



- Shipbuilding Financial Assistance Scheme (≈ US\$2.6 bn)
- Maritime Development Fund (≈ US\$2.6 bn)
- Shipbuilding Development Scheme (≈ US\$2.1 bn)



5 clusters

Greenfield clusters with in-principle approval (Aug 2026): Gujarat, Maharashtra, Andhra Pradesh, Odisha, Tamil Nadu — ₹9,930 cr (≈ US\$1.0 bn) central support

DESIGN ALCOHOL-READINESS IN FROM DAY ONE

-  Tank arrangement & materials
-  Ventilation & vapour management
-  Gas / leak detection
-  Fire-fighting (alcohol-resistant foam)
-  Fuel supply system & engine choice
-  Crew competency & procedures

Domestic newbuilds: a controlled setting for yards, class, OEMs, ports and fuel suppliers to learn together.

Start where India can learn quickly and control the variables

Not every first application needs to be a 15,000-TEU containership.

Most control · fastest learning

Largest volumes · international impact

Start where fuel demand, vessel operation and bunkering can be measured repeatedly — then scale.



PORT / HARBOUR

Tugs, workboats, auxiliary engines,
ethanol shore power (OPS)



COASTAL

Short-sea and domestic trades on
fixed routes



OFFSHORE

OSVs and service vessels with
predictable bunkering



DEEP SEA

Alcohol-ready newbuilds on
international green corridors

The port challenge is operational — and solvable

Santos and Kandla show the sequence. Competency is what makes it repeatable.



Fuel spec & Bunker Delivery Note



Storage compatibility & segregation



Transfer rate, hoses, ESD, vapour



SIMOPS, exclusion zones, emergency response

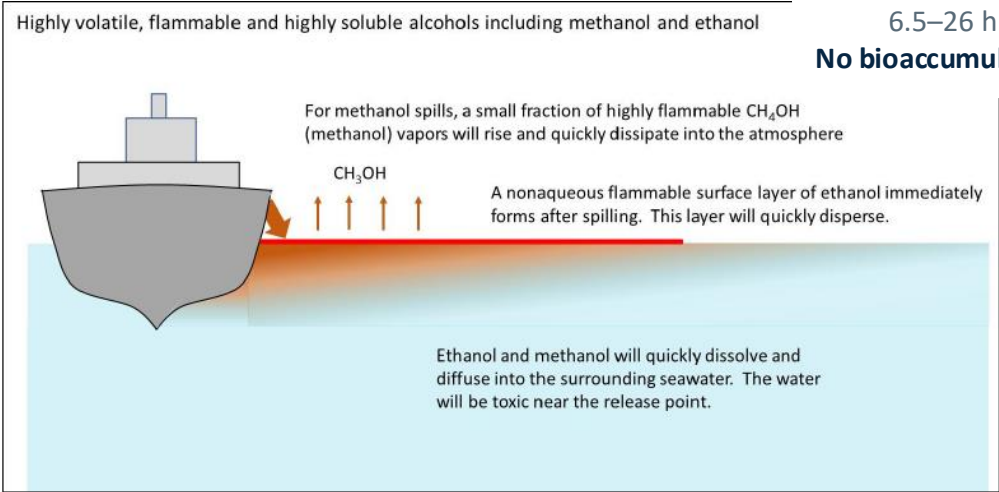


Crew & bunker-operator training



MRV, chain of custody, lifecycle CI

SPILL PROFILE vs FUEL OIL



Vapour and ignition risk remain during a release — not a "no-risk" fuel. Source: NLR (Sep 2026).

Dissolves rapidly
Fully water-soluble
Biodegrades fast
Half-life in water
6.5–26 h
No bioaccumulation

MEMA Alcohol Fuel Competency Framework

MEMA defines the competencies the industry needs; qualified training providers show how they are delivered.

Ship crews

Bunker operators

Terminal staff

Port authorities

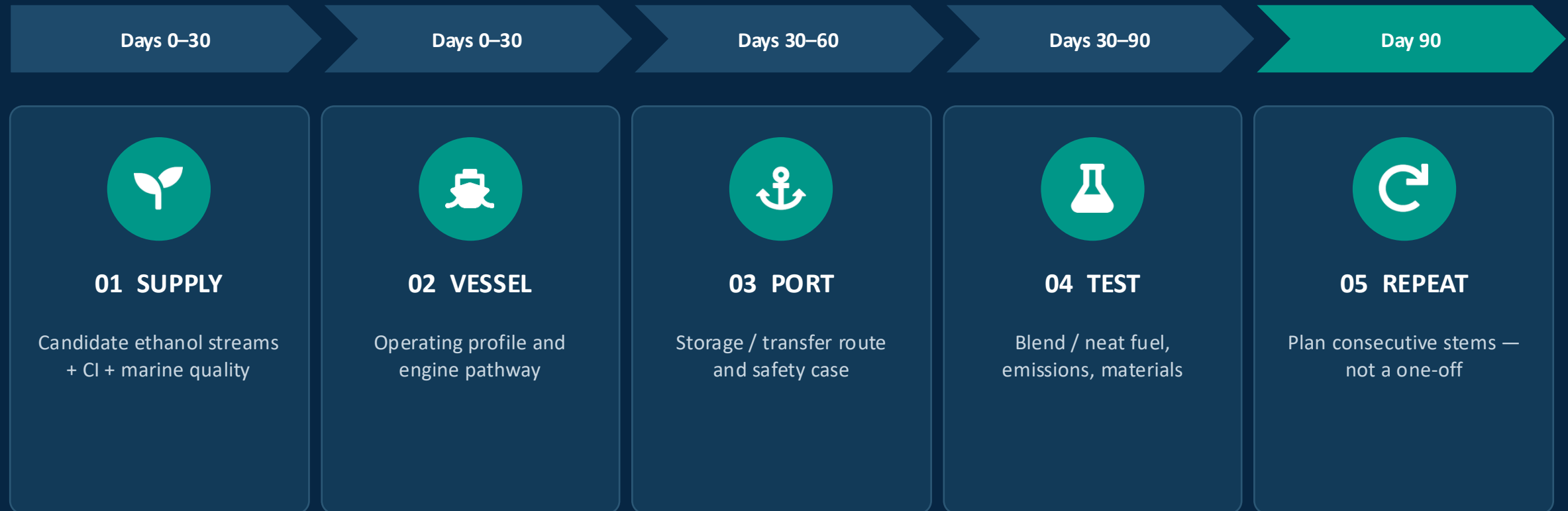
Emergency services

Surveyors / inspectors

Regulators

Move from interest to an Indian demonstration pathway

A small programme can answer the questions that matter before committing to scale.



Output at day 90: a costed, repeatable Indian pilot — supply, vessel, port and test plan agreed.

Don't sacrifice good in pursuit of perfect — start building the ecosystem now

1

Complementary platforms

Treat methanol and ethanol as one ambient-liquid family — design ships and ports for both.

2

Use India's ethanol scale

Create a marine demand option alongside E20 — with verified lifecycle CI travelling with the fuel.

3

Build optionality now

Write alcohol-readiness into the shipbuilding programme before the steel is cut.

PROPOSED NEXT STEPS

- Nominate 1–2 ports and 1–2 vessel classes for a 90-day scoping
- Join MEMA working groups — Technical, Policy, Safe Handling & Bunkering, Fuels & Logistics
- Share Indian pathway, fuel-quality and engine data for IMO / GESAMP and ISO
- **Register interest with GBA**

Thank you · Chris Chatterton · Founder & Chairman, MEMA · Managing Director, Maritime, GCGF