From Implementation to Assurance

Indonesia’s Maritime Biofuel Pathway within the IMO Decarbonization Framework

Operational Deployment by Pertamina International Shipping
Enabled by Classification Based Safety Governance (Biro Klasifikasi Indonesia)

In collaboration with:

- Ministry of Transportation of the Republic of Indonesia
- Pertamina International Shipping (PIS)
- Biro Klasifikasi Indonesia (BKI)

PERTAMINA INTERNATIONAL SHIPPING

bki

Energizing The Ocean

Biofuel Implementation in Pertamina International Shipping

Navigating Decarbonization in Indonesia's Maritime Sector

The Global Challenge: Decarbonizing Shipping

3% Global Emissions

Shipping accounts for nearly 3% of global CO2 emissions, projected to rise 50% by 2050 without decisive intervention according to IMO 2020 studies

IMO 2050 Target

Ambitious strategy targets a 50% reduction in greenhouse gas emissions by 2050 compared to 2008 baseline levels

Biofuels Solution

Transition to low- and zero-carbon fuels is critical; biofuels represent a key near-term solution for existing fleets

The shipping industry's energy transition requires $1.4–1.9 trillion investment in alternative fuels and infrastructure by 2050

- Source : 2020 study by University Maritime Advisory Services (UMAS) and the Energy Transitions Commission (ETC), commissioned by the Getting to Zero Coalition

Indonesia’s National Biofuel Mandate: Scale, Continuity, and Maritime Readiness

25-Year Policy Continuity (2008–2026)

Indonesia to launch transportation decarbonization roadmap in May

Selasa, 27 Januari 2026 06:34 WIB

Marine Decarbonization Roadmap

Indonesia is finalizing a **comprehensive marine decarbonization roadmap** emphasizing biofuel uptake and sustainable transition pathways.

Progressive Biodiesel Mandates

- **B40 (40% palm-based biodiesel) fully implemented** across sectors in 2025
- **Target expansion to B50 blend** scheduled for 2026 rollout
- Palm oil-based biofuels supported by **strategic export levy adjustments and government subsidies**
- **Maritime Relevance** : B40 mandated for Indonesian-flagged vessels

  95% compliance monitored by national fuel authority (BPH Migas)
- The **Life Cycle Assessment (LCA)** is still under study by the Ministry of Energy and Mineral Resources (MEMR).

These initiatives align with Indonesia's Nationally Determined Contribution (NDC), integrating shipping sector decarbonization with IMO global goals

Sources:
FAO Statistics; USDA Oilseeds Market Report;
Government of Indonesia Biofuel Mandate & National Energy Statistics;
IEA Bioenergy Country Profile (Indonesia);
IMO Resolution MEPC.376(80) – Life Cycle GHG Intensity of Marine Fuels.

Indonesia’s Maritime Biofuel Implementation: Policy, Scale, and Infrastructure Readiness

PIS has translated national biofuel policy into fleet-scale implementation, supported by nationwide bunker and supply readiness.

INDONESIA BIOFUELS DEVELOPMENT PROGRAM

Biodiesel

Expand palm oil–based biodiesel use through B40, while preparing studies and instruments for B50 implementation.

Implemented in Shipping Sector

Bioethanol

Bioethanol mandate remains unimplemented due to limited feedstock and lack of incentives, while Pertamina pilots Pertamax Green 95

Bioavtur

Pertamina produced J2.4 SAF (2.4% bioavtur from RBDPKO), successfully tested in military (2021) and commercial flights (2023).

Green Diesel

Hydrotreated Vegetable Oil

To accelerate the utilization of HVO, the Government has included the Cilacap and Plaju Green Refinery as National Strategic Projects.

Green Gasoline

In 2019, Pertamina successfully produced green gasoline from RBDPKO through co-processing at Plaju Refinery Unit

FLEET-SCALE IMPLEMENTATION

PIS NZE Strategy

A Structured Pathway Toward 2050 Carbon Neutral Shipping

Near-Term Action (2024–2039)

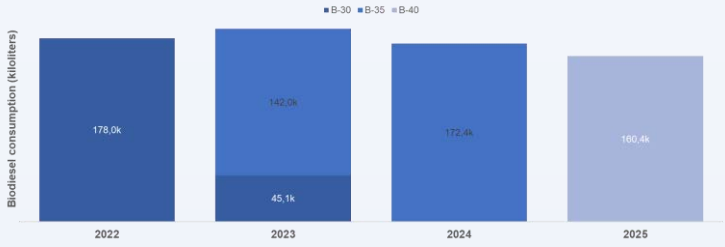
- **Fleet-wide B40 integration**
- Operational & design efficiency measures
- Target: **37% → 67% emission reduction**

Long-Term Transition (2040-2050)

- Multi-fuel readiness (Biofuel, LPG, Ammonia-ready)
- **Net Zero Emission by 2050**

PIS Biodiesel Consumption

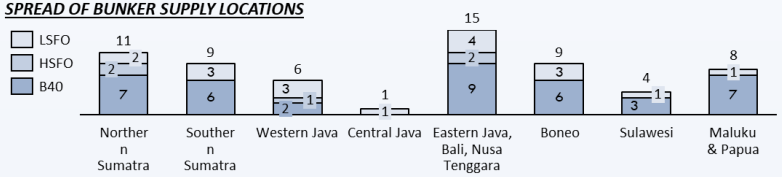
In 2022-2025, PIS has consumed a total of 698 thousand kiloliters (“kL”) of biodiesel, equivalent to **23 billion megajoules** (“MJ”) of energy, which is enough to power over **1 million Indonesian households** for a year.

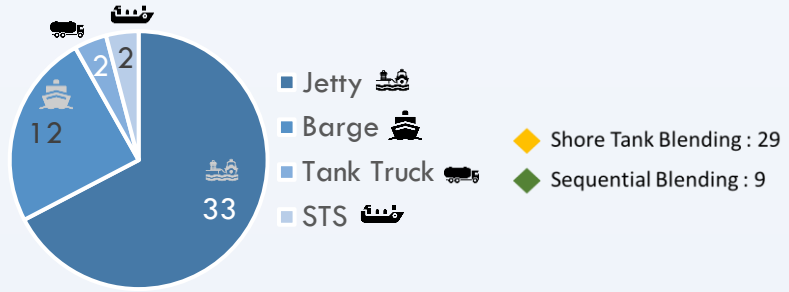


INFRASTRUCTURE & SUPPLY READINESS

38 Bunker Supply Locations provide Biofuel in Indonesia

SPREAD OF BUNKER SUPPLY LOCATIONS



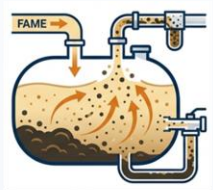


Managing Biofuel Blending Risk in Fleet Operations

FAME is not a drop-in fuel, only disciplined operational control transforms its complexity into safe and stable fleet performance.

Chemical Risk Awareness

FAME is not a drop-in replacement. It requires precise handling.



Solvency

FAME acts as a solvent, lifting accumulated sludge from tanks and lines, which can immediately overwhelm filters.

Water Absorption

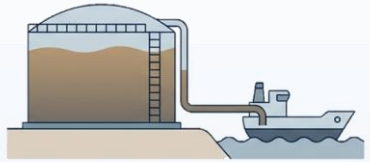
Hygroscopic properties attract water, leading to bacterial growth and corrosion risks in storage.

Stratification

Without perfect homogenization, fuel separates. Engines may pull 100% FAME or 100% Diesel, causing thermal shock.

Blending Approach in Practice

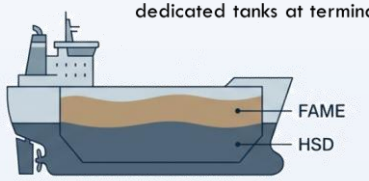
B40 must be blended onshore, requiring upgrades to 35 receiving and 86 other terminals to ensure fuel homogeneity.



Shore Tank Blending

FAME and Diesel (HSD) are pre-mixed in the terminal's storage tank before delivery.

Key benefit : Guaranteed Homogeneity, Assured Quality
The Barrier : Require significant CAPEX for mixing arms and dedicated tanks at terminals.



Sequential Blending

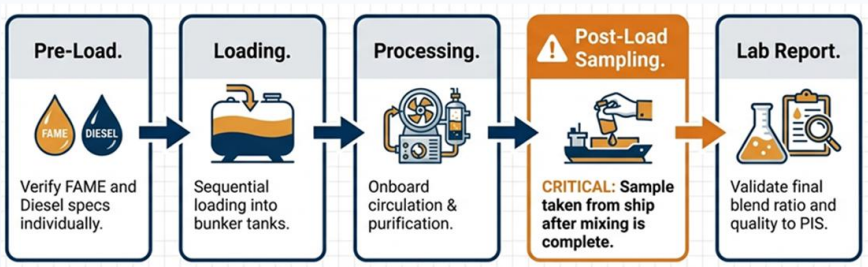
FAME and Diesel are loaded separately into the ship's bunker tanks. Mixing relies on splash turbulence or sea motion.

Permitted only with **strict mitigation.**

Operational Risk Mitigation by PIS

Identifying and mitigating sequential blending risks to protect vessel performance and operational safety

Enhanced Testing & Verification Requirements



Managing Sequential Blending Risks

1. Inter-Tank Transfer
Circulate fuel onboard to force mechanical mixing.

2. Onboard Purification
Aggressive use of separators to remove water and sludge.

3. Hardware Cycle
Accelerated replacement schedule for filters and injectors.

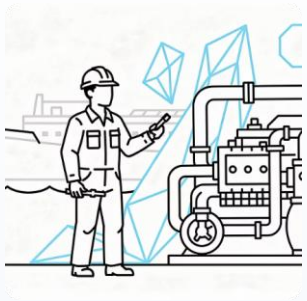
4. Bunker Officer
Verify FAME and B0 specs BEFORE loading,

Risk Mitigation Strategies for Biofuel Use in PIS Fleet

Implementing structured risk mitigation measures to ensure safe, reliable, and scalable biofuel adoption within the PIS fleet

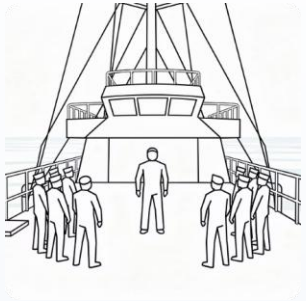
Fuel Quality Assurance

Comprehensive protocols including supplier certification, rigorous batch testing, and systematic onboard fuel sampling to ensure consistent quality standards



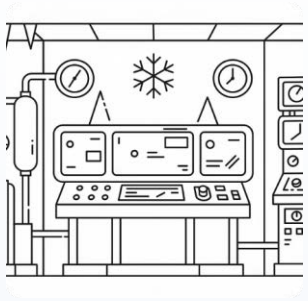
Engine Maintenance

Enhanced filtration systems and scheduled injector inspections specifically adapted to manage unique biofuel properties and prevent operational issues



Crew Training

Specialized training programs focused on biofuel handling, proper storage procedures, and emergency response protocols to mitigate operational risks



Contingency Planning

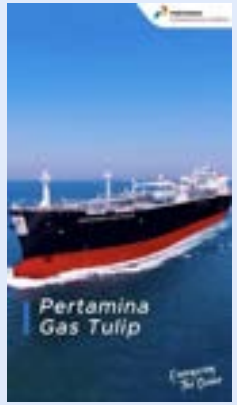
Comprehensive backup strategies including fallback to conventional fuels and flexible blending capabilities to ensure uninterrupted operational continuity

PIS's investment in early-transition fuel LPG-FO dual-fuel vessels

In line with our commitment, PIS has integrated low carbon technology on its newest vessels, proving that PIS is actively contributing to the global effort to reduce carbon emissions by implementing low carbon technology on our fleet of vessels.

Fuel type	Major engine manufacturer technical readiness	No. of PIS' owned vessel readiness (of 111 total)
Residual fuel oil (HFO/LFO)	CAT, HYUNDAI HEAVY INDUSTRIES, YANMAR, MAN, WÄRTSILÄ, Cummins	111
Biodiesel	CAT, HYUNDAI HEAVY INDUSTRIES, YANMAR, MAN, WÄRTSILÄ, Cummins	111
Ethanol/ bioethanol	HYUNDAI HEAVY INDUSTRIES, MAN, WÄRTSILÄ	0
Methanol/ biomethanol	HYUNDAI HEAVY INDUSTRIES, MAN, WÄRTSILÄ	0
LPG	CAT, HYUNDAI HEAVY INDUSTRIES, YANMAR, MAN, WÄRTSILÄ, Cummins	5
LNG	MAN, WÄRTSILÄ	0
Ammonia (Grey/blue/ green)	HYUNDAI HEAVY INDUSTRIES, MAN, WÄRTSILÄ	2 (engine-ready, with tank modification needed for ammonia deployment)

PIS' FO-LPG dual-fuel vessels



PIS' FO-LPG-ammonia triple- fuel vessels

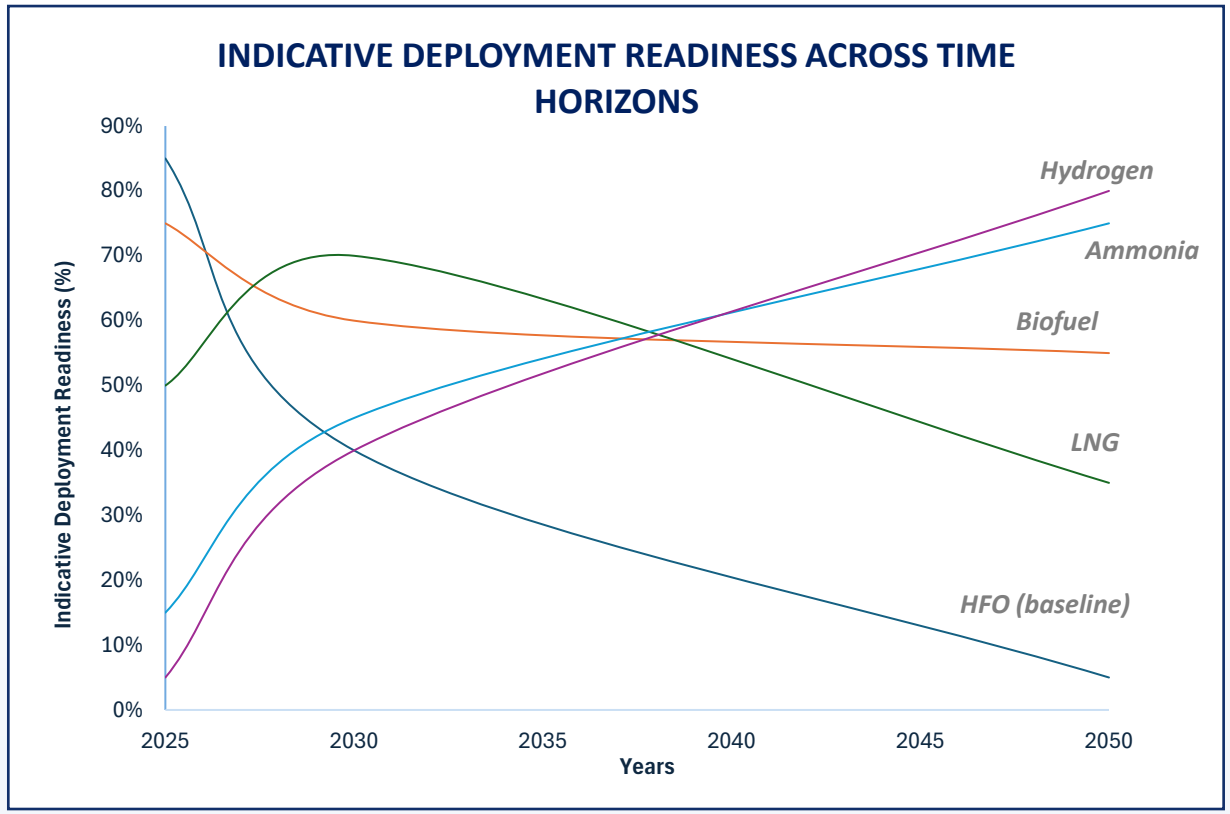
Source: PIS internal documentation

Indonesia’s Maritime Biofuel Pathway
Enabled by Classification

A Safety-Governed Contribution to IMO Decarbonization

Fuel Pathway → Classification → Safe Operation

Decarbonization Requires Multiple Regional Fuel Solutions



Illustrative comparison of relative deployment readiness. Values reflect infrastructure maturity, operational experience, and regulatory readiness, not market share or forecasts.

Sources:
- *IMO Res. **MEPC.376(80)** – Guidelines on Life Cycle GHG Intensity of Marine Fuels*
- *IMO GHG Strategy (Initial & Revised)*
- *CIMAC & ISO 8217:2024 – Marine biofuel compatibility*
- *OECD / IMO GreenVoyage2050 – Fuel readiness & infrastructure pathways*

KEY INSIGHT

IMO 2030 / 2050 Context

- **IMO 2050:** 50% GHG reduction target
- **2030:** critical interim checkpoint for implementation

Why Multiple Fuels Are Needed

- **300+ million tonnes HFO/year**
  → No single fuel solution fits all regions and fleets
- **Infrastructure maturity varies**
  a) LNG: transitional pathway (≈5–7 year infrastructure expansion)
  b) Hydrogen & Ammonia: pilot and early-commercial phase
  c) Biofuel: deployable now as drop-in fuel (2026)
- **National pathways are essential**
  → Diverse regional solutions collectively achieve global targets

Biofuel Deployment Evidence

- **500+ vessels globally operating on B5–B20 blends; Indonesia mandates B40 for all Indonesian-flagged vessels.**
- **MEPC.376(80)** formally recognizes **biofuel within the IMO lifecycle GHG framework**

Enabling Safe Maritime Biofuel Adoption: Readiness, Governance, and Technical Assurance

Biofuel deployment delivers value only when supported by structured lifecycle governance.

OPERATIONAL READINESS

Palm-Based Biofuel: Technical Merit for Maritime Application

Comparative technical characteristics against alternative fuel pathways

PARAMETER	HFO (Baseline)	PALM FAME	UCO BIOFUEL	LNG
Energy Density	~40 MJ/L	35–37 MJ/L	33–35 MJ/L	22–24 MJ/kg
GHG Reduction (Well-to-Wake)	0% (baseline)	60–80%*	70–90%**	15–25%
Supply Availability (2026–2030)	Global, established	56–57 MT/year	<5 MT/year	Infrastructure gap
Engine Retrofit Requirement	None	Minimal	Minimal	Major (≈ USD 10–15 million)

**Certified sustainable palm feedstock (ISPO / RSPO compliant)*
*** Includes avoided methane credit (waste-based pathway)*

Technical Merit

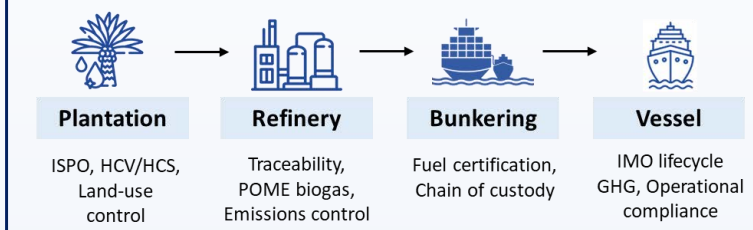
- 60–90% lifecycle GHG reduction (vs HFO)
- Minimal engine retrofit (B5–B50 blends)
- ISO 8217:2024 permits up to 100% FAME (with controls)

Track Record

- 500+ vessels globally operating biofuel blends
- Indonesia mandates B40 fleetwide

LIFECYCLE GOVERNANCE & SUPPLY INTEGRITY

BIOFUEL LIFECYCLE GOVERNANCE ALIGNED WITH IMO FRAMEWORK



- Mandatory ISPO enforcement (PP No. 44/2020 + biennial audits)
- ISPO–RSPO–ISO 8743 traceability chain
- 47% supply under HCV/HCS; POME capture delivering 40–55% GHG reduction (~431,000 tCO_2-eq/year per mill).
- MEPC.376(80) aligned currently under study by Ministry of Minerals and Energy Resources, Indonesia
- 25-year policy continuity

INFRASTRUCTURE & SUPPLY READINESS

RISK GAP

1. **Different Fuel** Physics from Biodiesel (BXX)
2. **Oxidation** Stability & **Water Absorption**
3. **Material** Compatibility
4. **Fuel Quality** Variability

TECHNICAL GOVERNANCE

1. **Standards**: ISO 8217:2024, CIMAC
2. **Control Limits**:
   - Oxidation ≥ 20 h
   - Water < 500 mg/kg
3. **Verification**: Class rules & onboard checks

TRUST & STRATEGIC VALUE

1. **500+ vessels | B40 mandate | no critical incidents**
2. **15+ countries | 25+ MT capacity**
3. **Technology-neutral | multi-fuel pathway**

IMPACT

Onboard Safety & Reliability Risk

ROLE

Risk Transformed Into Controlled Operation

OUTCOME

Safe Adoption With Global Trust

From Standards to Scale: Indonesia's B40 Biofuel Implementation

Indonesia's B40 program links robust fuel quality regulation with proven fleet-scale implementation, providing a credible reference case for IMO's lifecycle-based, technology-neutral decarbonization pathway.

REGULATORY LANDSCAPE

National biodiesel specifications demonstrate readiness to meet international marine fuel quality requirements (MEPC83/INF.29)

Table 1: parameter comparison for biodiesel quality standard

Parameter	Indonesia's National Requirements		ISO 8217:2024	Remarks
	B35	B40		
Water Content (%)	≤ 0,034	≤ 0,032	≤ 0,05	Lower water content reduces corrosion and microbial growth.
Monoglyceride Content (%)	≤ 0,525	≤ 0,5	≤ 0,8	Lower monoglyceride content improves fuel stability.
Oxidation stability (Hours)	11	12	≥ 6	Higher oxidation stability indicates better resistance to degradation over time.
Cold Filter Plugging Point (CFPP) (°C)	15	15	-	Lowest temperature where biodiesel can flow through standard filter in 60 s.
Cloud Point (CP) (°C)	-	-	Max. -16	Temperature where cloud form in biodiesel that affected biodiesel can't flow through even using pumps.

1. Alignment with **IMO GHG Strategy**: lifecycle emissions matter (MEPC framework).
2. **ISO 8217:2024** defines allowable biodiesel parameters for marine fuels.
3. Indonesia's national biodiesel standards (**B35–B40**) are **equal to or stricter than ISO thresholds**, supporting safety and reliability.

B40 DOMESTIC FLEET IMPLEMENTATION

B40 implementation across Indonesia's national fleet shows real-world operational viability.

Indicator	2022	2023	2024 (B40)	Efficiency Change (2024 vs 2022)	Efficiency Change (2024 vs 2023)
Fuel per Voyage (KL/voyage)	346.10	325.72	328.28	**+4–5%**	**~0% to +1%**
Fuel per Day (KL/day)	25.32	24.27	24.50	**+3%**	**~0%**
Fuel per Nautical Mile (L/NM)	116.7	113.3	111.83	**+6–8%**	**+1–2%**

Note: *Aggregated indicators across passenger and pioneer vessels.*

1. **Full-scale deployment** across **83 vessels** with **30+ bunker locations** nationwide for PT. A.
2. **Operational performance improved** (fuel efficiency and consumption indicators).
3. Demonstrates **logistical readiness**, enforcement capability, and operational consistency.

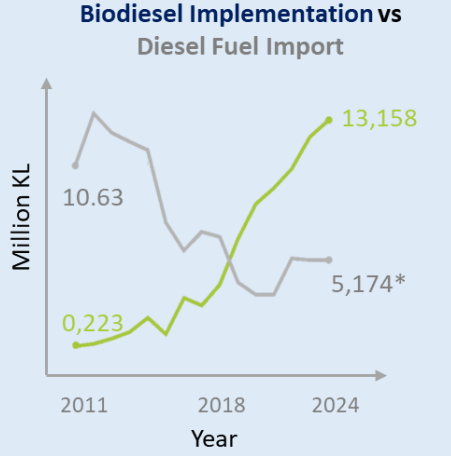
Sources: ISO 8217:2024 | IMO GHG Strategy | National B40 implementation data (Indonesia)

Indonesia's 2026 Biofuel Expansion: Dual Blending Transition and Implementation Considerations

Following B40 implementation, Indonesia plans B50 (PSO) and B35 (NPSO) in 2026.

B50 expansion represents a policy progression that must be supported by technical and infrastructure preparedness.

POLICY EXPANSION & STRATEGIC OBJECTIVE



Expanded biodiesel adoption has significantly reduced Indonesia's reliance on imported diesel fuel.

Dual Blending (B50 PSO – B35 NPSO) represents Indonesia's structured progression toward higher biodiesel blending levels.

Expected outcomes:

1. Strengthen national energy resilience
2. Reduce diesel import dependence
3. Enhance domestic CPO value creation

KEY IMPLEMENTATION CONSIDERATIONS

Scaling blending levels requires parallel infrastructure, technical, and economic readiness.

Infrastructure & Refinery Balance
- 35 terminals ready; 86 require upgrades*
- Refinery configuration & CN balance challenges

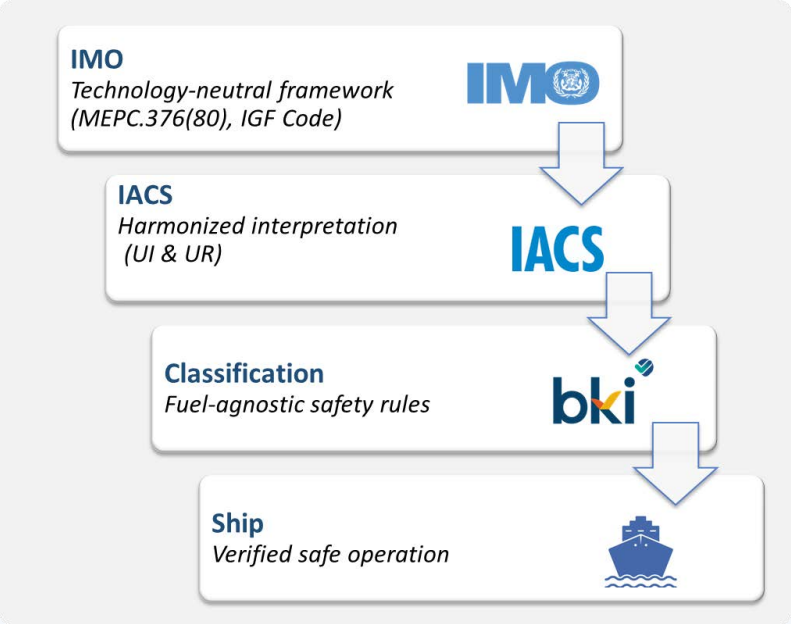
Technical Performance & Fuel Quality
- Higher blend sensitivity (filter life, contaminants)
- Requires strengthened FAME quality control

Market & Feedstock Dynamics
- Subsidy exposure (BPDPKS)
- CPO price volatility & allocation balance

*Upgrading receiving facilities, blending facilities, automation, etc.

BKI: Translating IMO Biofuel Principles into Verifiable Certification

BKI ensures that biofuel adoption is safe, verifiable, and consistent, without fragmenting global standards.



	PRE-CLASSING *(Design Readiness)*	CLASSING *(Initial Assurance)*	POST-CLASSING *(Ongoing Compliance)*
Key Activities	1. Design review 2. ISO / other standards alignment 3. HAZID / HAZOP 4. ISPO supply chain setup	1. Type approval testing 2. Initial survey 3. Crew readiness check 4. Class Certificate issued, E.g,"Biofuel Ready" class notation	1. Fuel system inspections 2. Quarterly fuel sampling (oxidation, water, acid value) 3. Annual class surveys 4. Continuous verification
Duration	(3–6 months)	(2–3 months)	(Annual & continuous)

BKI Class Rules (Pt.1 Vol.III Rules for Machinery Installations) operationalize harmonized IACS requirements, ensuring globally agreed safety standards rather than unilateral national provisions.

Technical and Operational Controls for Safe Biofuel Operations

Biofuel safety is achieved through integrated control of fuel quality, ship systems, and crew operations, applied consistently across all vessels and operating environments

	FUEL *(Quality & Stability Control)*	SYSTEMS *(Hardware & Safety Equivalence)*	PEOPLE *(Competency & Standardized Operations)*
KEY POINTS	1. **Standards:** ISO 8217:2024 parameter compliance 2. **Control thresholds:** ▸ Oxidation ≥ 20 h ▸ Water ≤ 500 mg/kg ▸ Acid value ≤ 0.40 mgKOH/g 3. **Monitoring:** Quarterly sampling; deviation-based escalation	1. **Material compatibility:** Stainless / epoxy coatings; elastomer testing (ASTM D6023) 2. **Engine integration: Fuel filter**; Fuel injector inspection 3. **Redundancy:** Dual-fuel switchover; automated monitoring; sampling ports	1. **Competency:** STCW-aligned Alternative Fuel endorsement (2–3 days) 2. **Operational discipline:** ▸ Pre-bunkering checks (CoC, baseline sampling) ▸ Logbooks & procedures 3. **Deviation response:** ▸ Oxidation <18 h → supply investigation ▸ Water >300 mg/kg → conditioning ▸ Acid >0.40 → supplier audit
PURPOSE	***Prevent degradation, contamination, and instability***	***Ensure safety equivalence to HFO systems***	***Human factors controlled, not assumed***

DESIGNED FOR FLEET-WIDE ADOPTION

1. **All vessel types:** Tanker | Bulk | Container | RoRo | Cargo | Ferry
2. **All operating zones:** Tropical → Cold → Unrestricted
3. **Small vessels (<500 GT):** streamlined rules; core controls only

Retrofit pathway:

- **B40 (2026):** Starting
- **B50 (2027–28):** moderate
- **B100 (2029–30):** full framework

Classification Enables Trust in Biofuel Adoption

Classification does not choose fuels, it enables trust, safety, and scalability

Key Takeaways

Classification as Technical Risk Gatekeeper

- CIMAC-approved engines
- ISO 8217:2024 compliant fuels
- Operationalized under Indonesia's B40 fleetwide application

Classification as Environmental Assurance Provider

- Multi-tier certification & auditability
- Lifecycle GHG traceability & monitoring
- Independently verifies 60–90% lifecycle GHG reduction

Classification as System Integrator

- Integrates fuel, engine, and ship systems
- Provides end-to-end verification (design → operation)
- Ensures consistency across fleets and ship types

Classification as Neutral Trust Anchor (IMO-Aligned)

- IACS-harmonized, fuel-agnostic rules
- Supports IMO objectives without prescribing fuels
- Respects national circumstances & sovereignty

"Decarbonization will succeed not by prescribing identical fuels, but by respecting diverse national pathways that collectively move shipping toward the same global objective."

*Indonesia's maritime biofuel contribution is both **scientifically credible** and **strategically sovereign**. We invite MEPC to recognize this pathway as a proven, ready-to-scale solution for 2026-2030 decarbonization.*

THANK YOU

Indonesia| Maritime Biofuel Expert Presentation | PPR 2026

Energizing The Ocean