Navigating the Sustainability Transition

Port Development in Saudi Arabia and the UAE

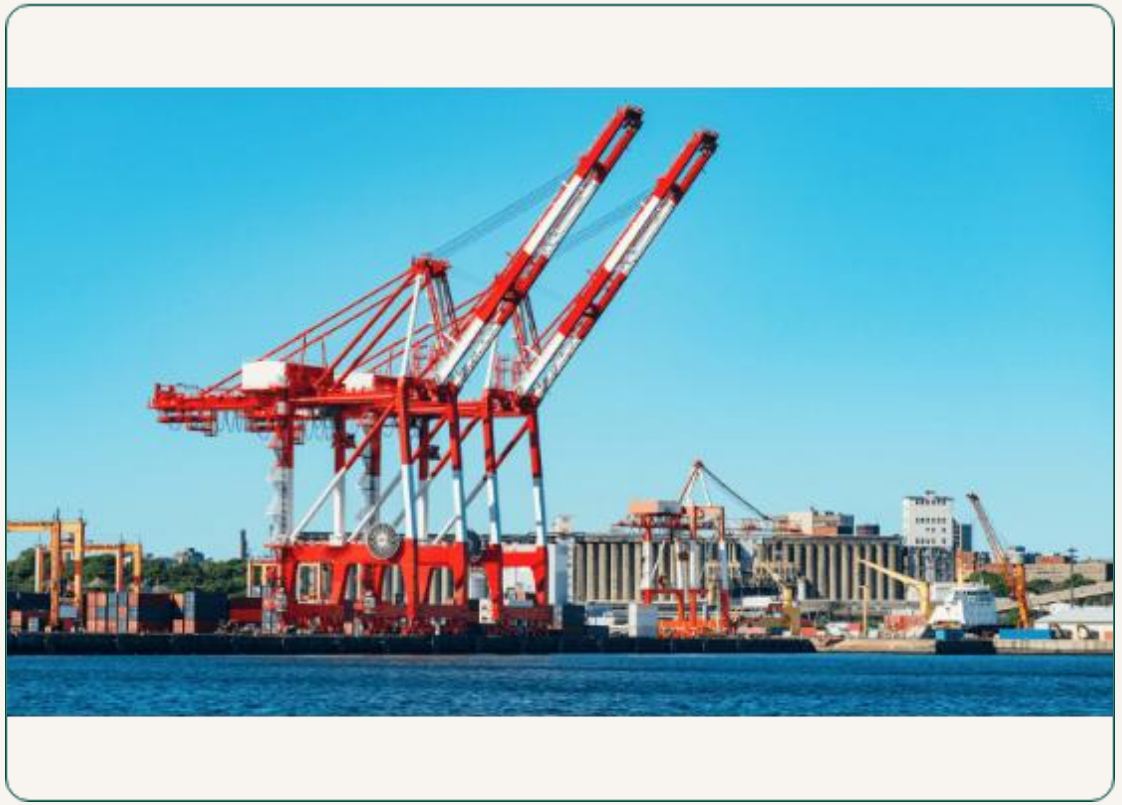
A Conference Presentation

Presented by: Dr. Jane

Date:

The Global Gateway

- Seaports are strategic economic assets, not just infrastructure.
- They handle over **80% of global merchandise trade** by volume.
- Crucial for connecting supply chains, speeding up logistics, and reducing overall trade costs.
- They are key nodes for economic performance and global connectivity.



Gulf Ports: World-Class Efficiency

#1

King Abdullah Port (KSA)

World's most efficient port (World Bank, 2021).

Region of Excellence

The Middle East is recognized globally for its port efficiency and innovation, even amidst pandemic disruptions.

The World Bank's 2021 Top 10 included:

- King Abdullah Port, KSA (#1)
- Salalah, Oman (#2)
- Hamad, Qatar (#3)
- Khalifa Port, UAE (#5)
- Jeddah Islamic Port, KSA (#8)

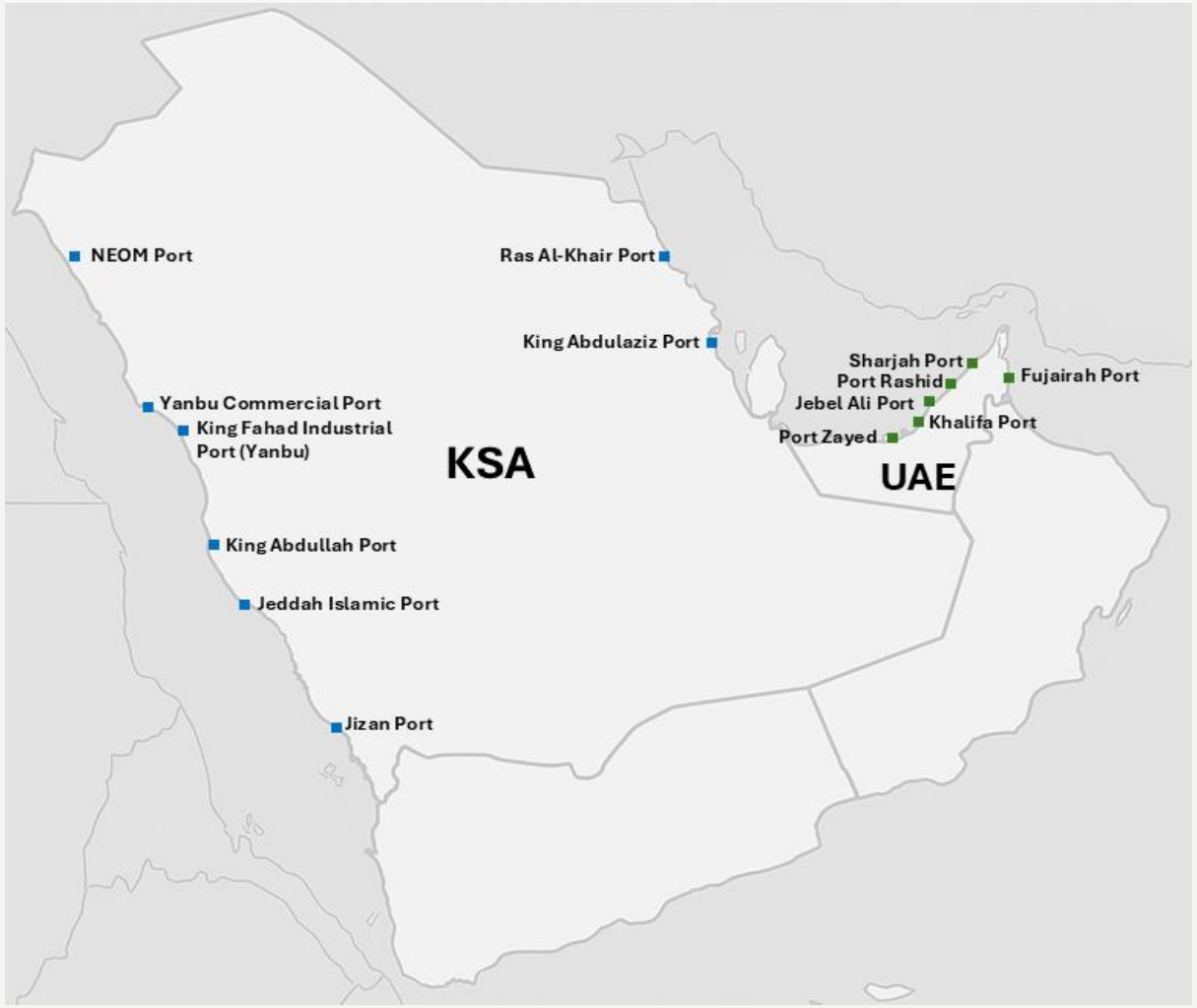
The Sustainability Challenge

- Logistical efficiency is high, but the shift to full sustainability is a complex, multi-domain challenge.
- **Varying Ship Types:** Different standards and fuel requirements create a complex service landscape.
- **New Infrastructure:** Requires investment in shore power (cold ironing) and clean energy generation.
- **Environmental Priority:** Protecting water and air quality is critical due to the region's vulnerable ecosystems.
- **National Governance:** The transition is strongly guided by national visions like Saudi Vision 2030 and UAE Vision 2050.

Geographic Context

This study focuses on ports in Saudi Arabia (KSA) and the United Arab Emirates (UAE).

Interviews were conducted with key stakeholders from major ports across both nations to understand their unique and shared sustainability pathways.



Map of ports in KSA and UAE Source: Authors

Research Questions

This study explores the drivers, challenges, and strategic paths of sustainable port development in Saudi Arabia and the UAE. It addresses two core research questions:

RQ1: What sustainable initiatives are Saudi and UAE ports implementing?

RQ2: What systemic, institutional, or technological barriers hinder the scaling of sustainable practices in Saudi and UAE ports, and what forward-looking strategies could accelerate their adoption and impact?

Literature Review

Global, KSA, and UAE

Context

Global and General Literature Findings

- **Systemic Change:** Effective sustainability depends not only on technology but on how governance, regulation, and investment interact to produce systemic change (Gore, 2022), (Bakar et al., 2023).
- **Institutionalization:** Mature sustainability involves GRI-aligned reporting, AI-enabled operations, and renewable energy integration, often supported by high public-private coordination.
- **Context Dependency:** Global studies reinforce that sustainable port pathways are context-dependent, reflecting distinct institutional and developmental logics (Puig et al., 2014; Alamoush et al., 2021).

Region-Specific Drivers & Barriers

Global Transition Drivers

Europe: Driven by supranational governance and stringent environmental regulations.

East Asia: Driven by centralized policy coordination and state-led technology innovation.

The Gulf's Unique Character

The Gulf’s sustainability transition is defined by national ambition constrained by institutional fragmentation and uneven governance.

Arabian Gulf: Core Barriers

- **Financial Constraints:** Funding limitations and limited access to Public-Private Partnerships (Esmail, 2016; Saydaliev & Chin, 2023).
- **Regulatory Gaps:** Regulatory heterogeneity (e.g., free-zone exemptions) creates enforcement inconsistencies (Lim et al., 2019).
- **Sociopolitical Perception:** Sustainability is often viewed as a state-driven agenda rather than a shared corporate responsibility (Alshabi et al., 2023).

Theoretical Framework

The Multi-Level Perspective

(MLP)

The Multi-Level Perspective (MLP)

This framework helps analyze complex, multi-dimensional transition processes.

- **Landscape (Macro):** Exogenous forces like global climate agreements (IMO 2020) and geopolitical shifts.
- **Regime (Meso):** The dominant institutions, rules, and practices. E.g., national visions (Vision 2030), port authority rules.
- **Niche (Micro):** Innovation spaces where new tech is developed and tested (e.g., AI logistics, solar power, cold ironing).

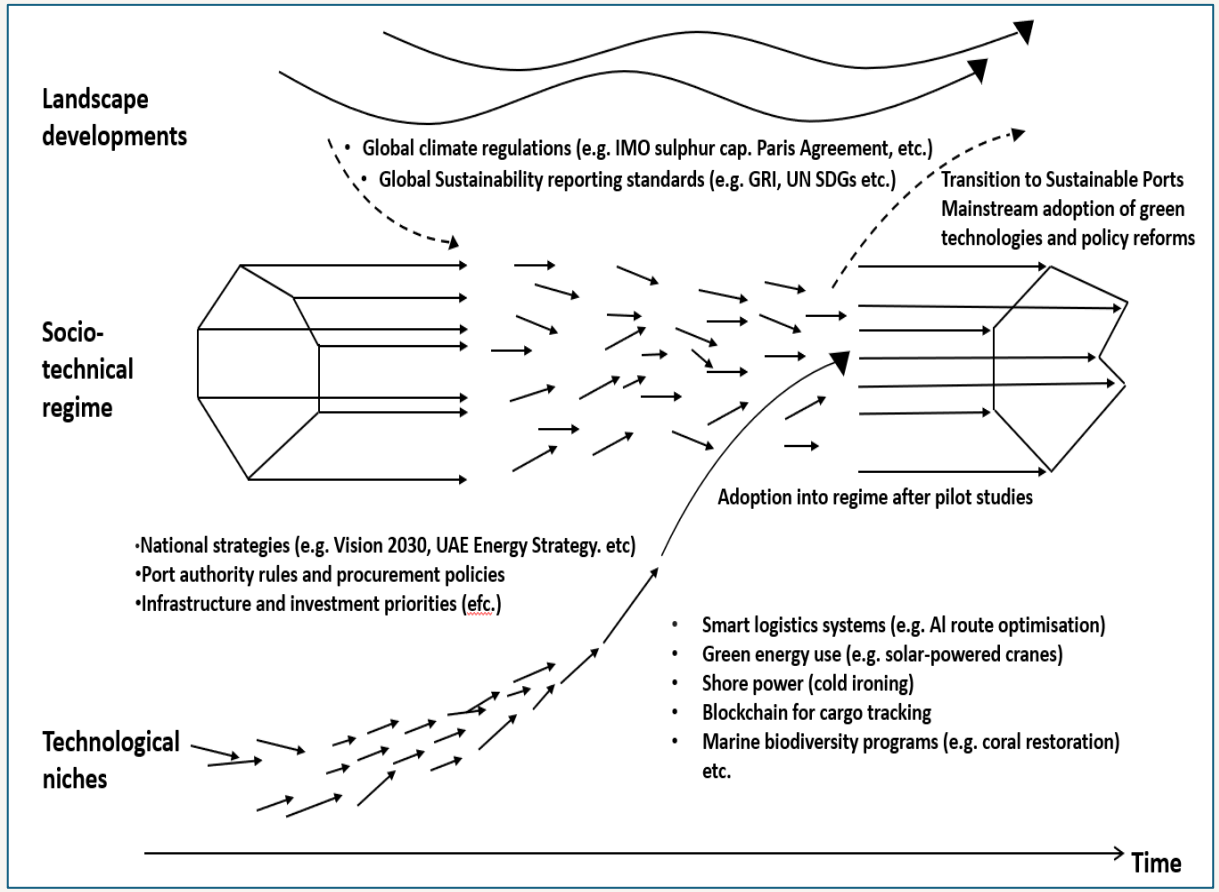


Diagram of the Multi-Level Perspective (MLP) Framework

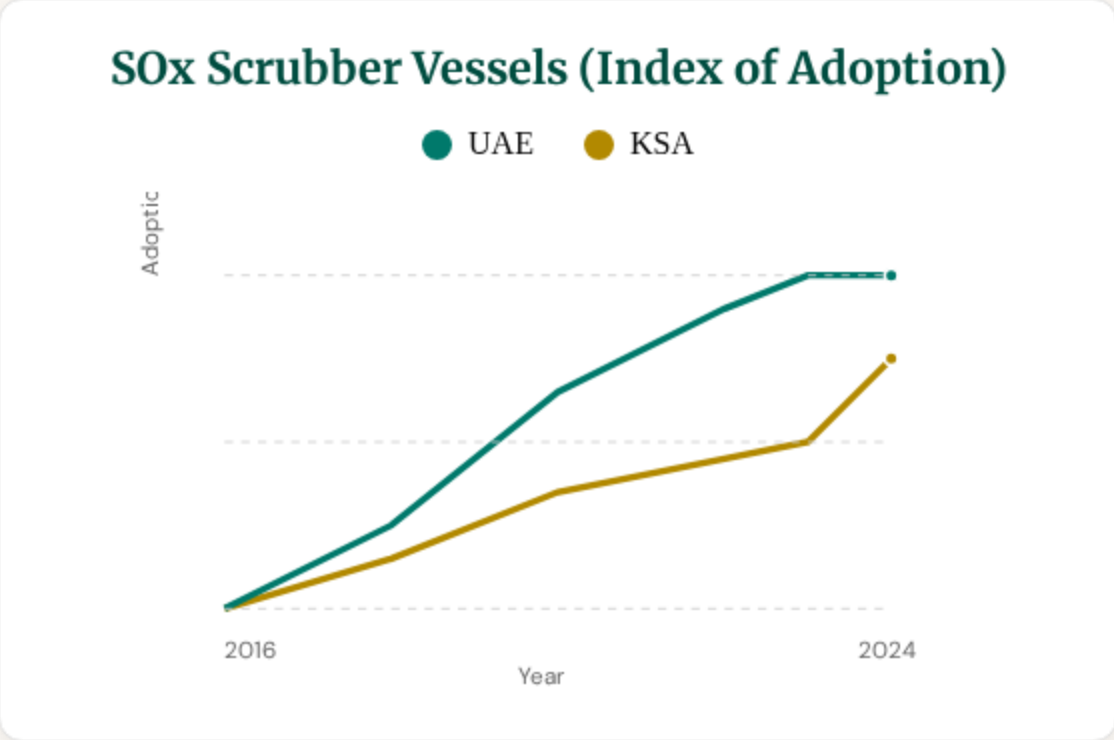
Research Methodology

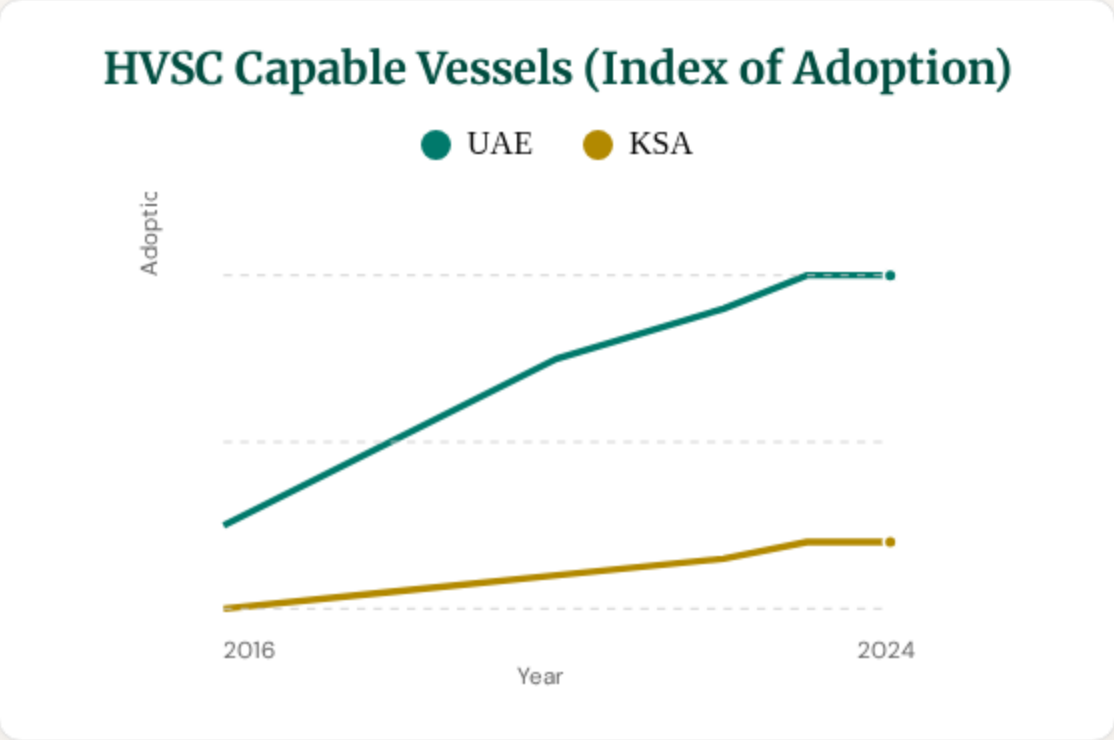
- **Qualitative & Abductive:** Triangulated data from semi-structured interviews and secondary document analysis.
- **26 Semi-Structured Interviews:** Conducted with 15 stakeholders in KSA and 11 in UAE (management, operations, compliance experts).
- **Document Analysis:** Included reports from Clarksons Shipping Intelligence, Mawani (KSA), and Abu Dhabi Ports (UAE).
- **Thematic Analysis:** Data was coded using NVivo 14, with themes mapped to the MLP framework.

Findings: Industry Reporting

Comparative Adoption of Green Shipping Technologies (Clarkson Research, 2024)

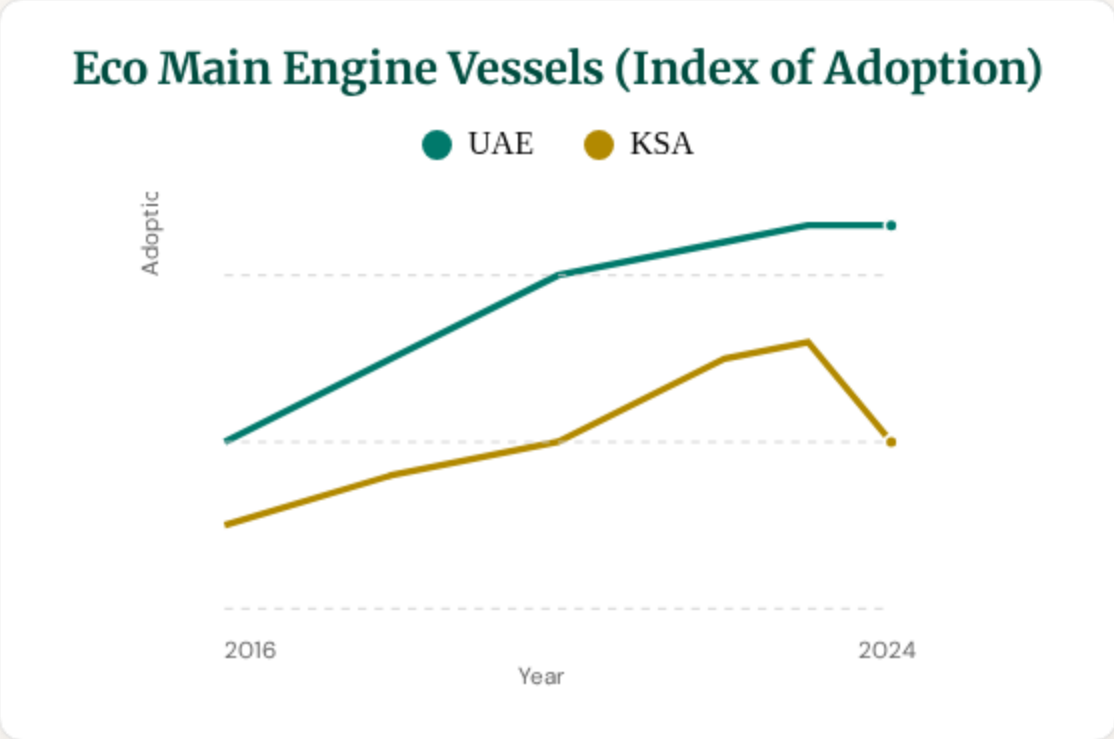
Tech Adoption Trends: Scrubbers & Shore Power [RQ1]

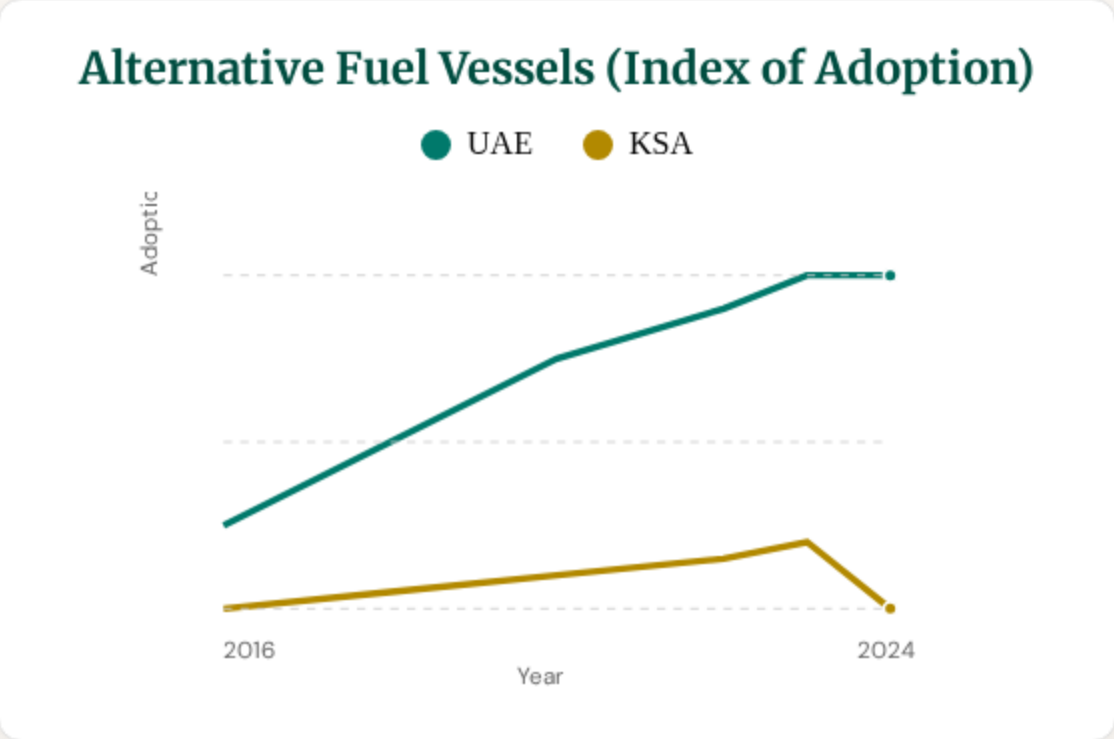




Finding: *The UAE demonstrates significantly steeper and higher adoption for vessels equipped with SOx Scrubbers and High-Voltage Shore Connection (HVSC) capability. The 2024 dip in KSA is attributed to incomplete annual data reporting.*

Tech Adoption Trends: Eco Engines & Alternative Fuels [RQ1]





Finding: *The UAE shows a more proactive and higher-level engagement with the adoption of Eco Main Engine and Alternative Fuel vessels. The 2024 dips reflect incomplete annual data reporting.*

KSA: Themes from Interviews

- **Economic:** Funding is a primary challenge, reliant on state budgets.
  "The financial side is always a challenge..." (Jizan Port)
- **Technological:** Making strides in smart systems (automated cranes) but still see a significant need for AI/Blockchain adoption.
- **Regulatory:** Proactive compliance with national (Mawani) and global (IMO 2020) standards, but limited internal enforcement capacity.
- **Environmental:** Focus on integrating renewable energy (solar) and improving energy-efficient systems.

UAE: Themes from Interviews

- **Economic:** High costs are a challenge, but are being met with Public-Private Partnerships (PPPs) and innovation (e.g., green hydrogen).
- **Technological:** "Heavily investing" in AI-driven logistics, IoT, and blockchain for efficient data management.
- **Regulatory:** Mature compliance (GRI standards), often driven by international customer demand (especially from Europe).
- **Environmental:** Ambitious, visible initiatives like coral reef restoration (Khalifa Port) and electrified port equipment.

MLP Analysis: Niche vs. Regime [RQ1 & RQ2]

Landscape: Both KSA and UAE are strongly driven by National Visions (2030, 2050) and global (IMO 2020) pressures.

Regime (Institutional):

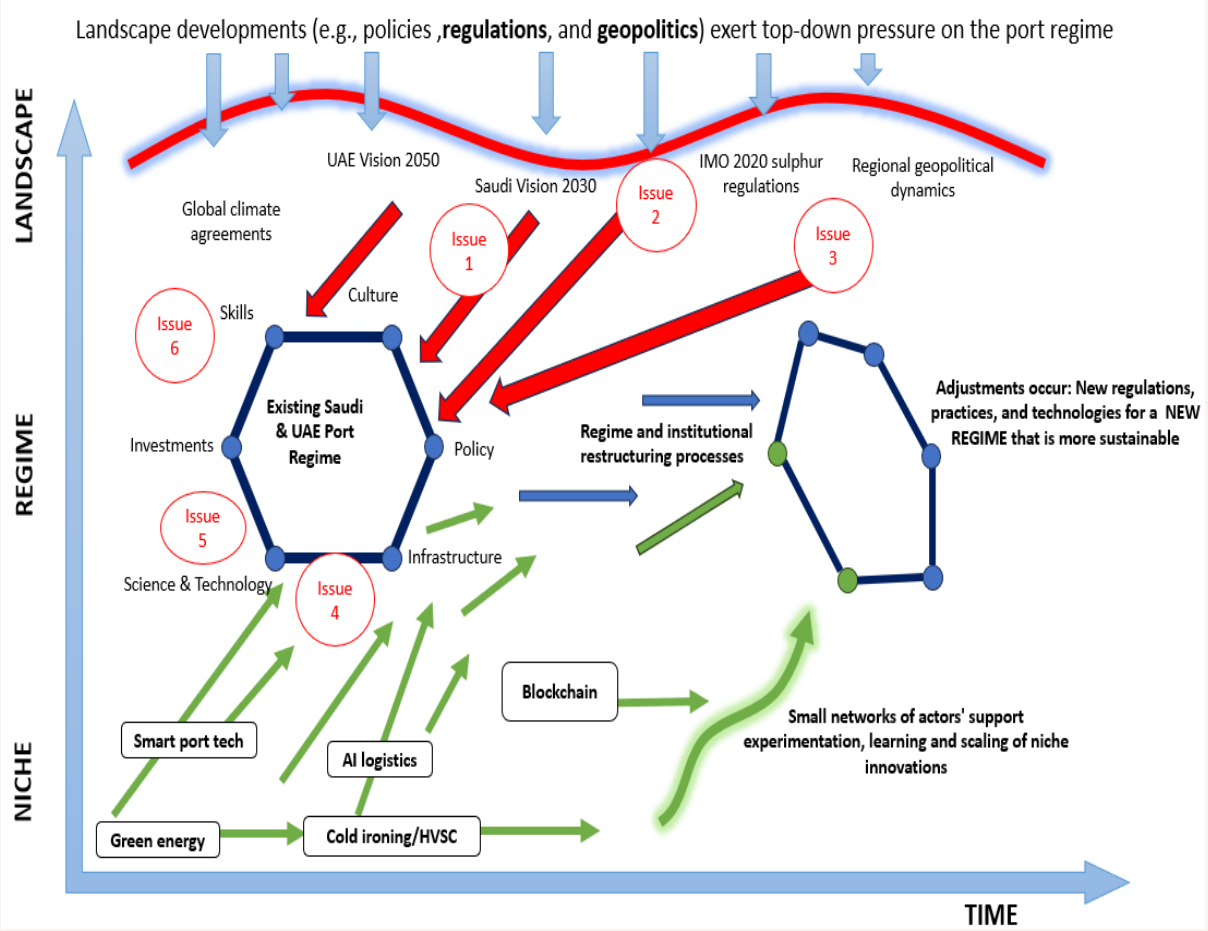
UAE: Maturing. Sustainability is becoming institutionalized (GRI reporting, smart logistics, e-tugs).

KSA: Emergent but uneven. A "policy mix struggle" exists—goals are clear, but funding & follow-through are difficult.

Niche (Technological):

UAE: In"early take-off." Pilots (AI, e-tugs) are nested within supportive regimes and are scaling quickly.

KSA: "Fragile." Pilots are localized (e.g., Jeddah solar) but lack the strong institutional alignment to scale across all ports.



MLP-Informed Analysis of Transitions Source: Authors

Institutional Disparity: Regime Analysis [RQ2]

UAE: Institutional Maturity

- **Integrated Governance:** Centralized policy (DP World/AD Ports Group) linked to international trade demand.
- **Financing:** High Public-Private Partnership (PPP) usage buffers state budgets and drives innovation
- **Reporting:** Mandatory and high-quality sustainability reporting (GRI) across port operators, ensuring accountability.
- **Outcome:** Allows rapid scale of niche innovations into the broader regime (e.g., widespread use of e-tugs).

KSA: Policy Mix Alignment Struggle

- **Fragmented Governance:** Mawani sets top-level policy, but implementation authority is decentralized across many ports.
- **Financing:** Heavy reliance on direct state funding, leading to slower, more cautious deployment cycles.
- **Reporting:** Transparency is improving, but reporting remains less standardized and often voluntary.
- **Outcome:** Niche innovations remain localized (e.g., King Abdullah Port's automation) without systemic propagation.

Niche Innovations: Pilots & Scaling [RQ1 & RQ2]

UAE: Early Take-off Innovations

- **High-Tech Tugboats:** Deployment of electric and unmanned tugs (e-tugs) across Abu Dhabi ports, moving beyond pilot phase.
- **Green Hydrogen:** Aggressive development of green hydrogen facilities to fuel future port machinery.
- **Digitalization:** Heavy investment in blockchain and AI for paperless, optimized logistics that inherently reduce carbon footprint.

KSA: Fragile Niche Innovations

- **Solar Integration:** Successful deployment of solar panels at Jeddah Islamic Port to power administrative buildings (isolated success).
- **Automated Terminal:** King Abdullah Port operates a highly automated, efficient terminal, but this standard is not yet replicated elsewhere.
- **Cold Ironing Policy:** Mawani has set ambitious goals for shore power, but infrastructure deployment is lagging due to high capital investment barriers.

Strategic Path Forward: Policy Recommendations [RQ2]

1. Incentivize PPPs

Shift KSA financing model away from state-only budgets toward Public-Private Partnerships, offering tax breaks or land concessions for green investment.

2. Standardize Compliance

Create a single, enforceable regional standard (e.g., a Gulf Green Ports Charter) that requires all ports to adopt universal GRI reporting metrics and targets.

3. Create Niche Integration Hubs

Establish a dedicated technical fund to help replicate successful niche projects (like KAP's automation or Jeddah's solar) across secondary ports, linking the micro-level to the meso-level.

Actionable strategies derived from the MLP analysis to overcome regime inertia and accelerate the sustainability transition across the Gulf.

Discussion: Barriers to Scaling [RQ2]

Financial Barriers

KSA remains highly reliant on state budgets. UAE uses PPPs more effectively, but high capital cost for green tech is a universal challenge.

Technological Lock-in

"Regime lock-in" from legacy infrastructure. Scaling pilots (like cold ironing) from one flagship port to all ports is difficult and slow.

Cross-Level Disconnects

Top-down pressures (Visions) are not fully connected to bottom-up (Niche) innovations. Pilots remain "islands of green" without systemic integration.

Conclusion & Implications

Contribution

This study shows progress depends on addressing **regime-level constraints** (governance, institutional capacity), not just technology.

Fragmentation, rather than coherence, often defines the sustainability transition in the Gulf.

Implications

Practical: Policymakers must foster stronger governance and cross-sector partnerships to scale successful pilot projects.

Future Research: Longitudinal studies are needed to track these transitions as national visions progress toward their 2030 and 2050 deadlines.

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Thank You

Questions?