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The Arabian Energy Corridor: A Geopolitical and Economic Framework for Energy Security and Supply Resilience

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Abstract

This study proposes the concept of the **Arabian Energy Corridor (AEC)** as a strategic energy infrastructure framework designed to enhance the resilience, efficiency, and geopolitical stability of hydrocarbon exports from the Arabian Peninsula. The corridor is conceptualized as a phased, multi-state energy network anchored by a primary crude oil pipeline linking **Abqaiq** to the deep-water export hub at **Duqm**. By providing a direct outlet to the Arabian Sea, the proposed corridor would reduce dependence on the **Strait of Hormuz**, through which a substantial share of global oil trade currently passes. The study develops a two-stage economic model for the corridor. In the first stage, a standalone Abqaiq–Duqm pipeline is evaluated as a Saudi-controlled export bypass with an estimated capacity of approximately 1.5 million barrels per day. In the second stage, the corridor expands into a regional energy platform through the integration of additional crude and gas flows from neighboring Gulf producers, including the United Arab Emirates and Qatar, thereby transforming the system from a single-asset pipeline into a multi-stream energy logistics corridor.

Using benchmark comparisons from existing Gulf infrastructure projects, publicly available energy trade statistics, and corridor-level throughput modeling, the study evaluates the capital requirements, transport economics, and strategic value of the proposed network. The analysis demonstrates that while the standalone pipeline is economically justified primarily as export-security infrastructure, the fully integrated Arabian Energy Corridor generates stronger economic viability through scale effects, diversified revenue streams, and hub-based logistics operations centered on Duqm. These functions include crude storage, blending, export timing optimization, and downstream integration with refining and petrochemical facilities. The corridor also aligns with the structural shift in global oil demand toward Asian markets—particularly **China**, **India**, **Pakistan** and **Japan**—which increasingly dominate the destination of Gulf hydrocarbon exports.

The findings suggest that the Arabian Energy Corridor represents not merely a transportation project but a broader regional energy architecture capable of enhancing supply-chain security, supporting market diversification, and strengthening the Gulf's long-term export resilience in an evolving global energy landscape. By combining strategic infrastructure development with regional cooperation and international investment participation, the proposed corridor offers a viable framework for reducing chokepoint risk

while positioning Duqm as a major future energy logistics hub connecting Middle Eastern producers with Asian energy markets.

Keywords: Arabian Energy Corridor; Abqaiq–Duqm Pipeline; Strait of Hormuz Bypass; Energy Security; Gulf Energy Infrastructure; Export Route Diversification; Asian Energy Markets; Regional Energy Integration.

Executive Summary

Background and Context

The global energy system remains heavily dependent on a limited number of strategic maritime chokepoints, with the Strait of Hormuz serving as the most critical route for oil and gas exports from the Gulf region. A substantial share of global energy flows passes through this narrow passage, exposing markets to geopolitical disruptions, supply uncertainty, and price volatility. Recent regional conflicts have demonstrated that even perceived risks in the Strait can significantly disrupt shipping operations and global energy stability.

Objective of the Study

This study aims to evaluate the feasibility and strategic relevance of the **Arabian Energy Corridor (AEC)** as an alternative energy transport system. It seeks to develop an integrated framework combining economic viability and geopolitical risk mitigation, while proposing a scalable infrastructure model for long-term energy security. ***"Not just infrastructure, but a new Gulf energy export doctrine"***

Methodological Approach

The study adopts a scenario-based analytical framework, comparing two configurations: a standalone crude pipeline and a fully integrated multi-stream corridor. The analysis combines economic modeling with geopolitical assessment to evaluate both financial feasibility and strategic necessity.

Key Findings

The findings indicate that a standalone crude pipeline, while strategically valuable, has limited commercial viability when assessed solely on transport efficiency. However, when expanded into a full corridor integrating crude and gas flows from Saudi Arabia, the UAE, and Qatar, the project becomes significantly more viable. Economies of scale, increased throughput, and diversified revenue streams—such as transport, storage, and export services—substantially improve financial performance.

A key contribution of the study is the introduction of the **Energy Security Premium**, which captures the economic value of reducing disruption risks in global energy supply chains. This highlights the limitations of traditional cost-based infrastructure evaluation models.

Strategic Implications

The study further proposes a **demand-side participation model**, encouraging major Asian energy-importing economies—including China, India, Japan, and Pakistan—to co-invest in corridor infrastructure. This approach aligns investment with long-term demand, enhances financial viability, and reduces geopolitical tensions by transforming the corridor into a shared economic asset. The AEC is

positioned as a Saudi-led, GCC-anchored initiative, emphasizing economic cooperation while avoiding militarization.

Conclusion

The Arabian Energy Corridor represents a strategic shift from reliance on vulnerable maritime routes toward infrastructure-based energy security. By integrating economic efficiency with geopolitical resilience, the corridor emerges not merely as a transport project but as a multi-dimensional energy platform with regional and global significance.

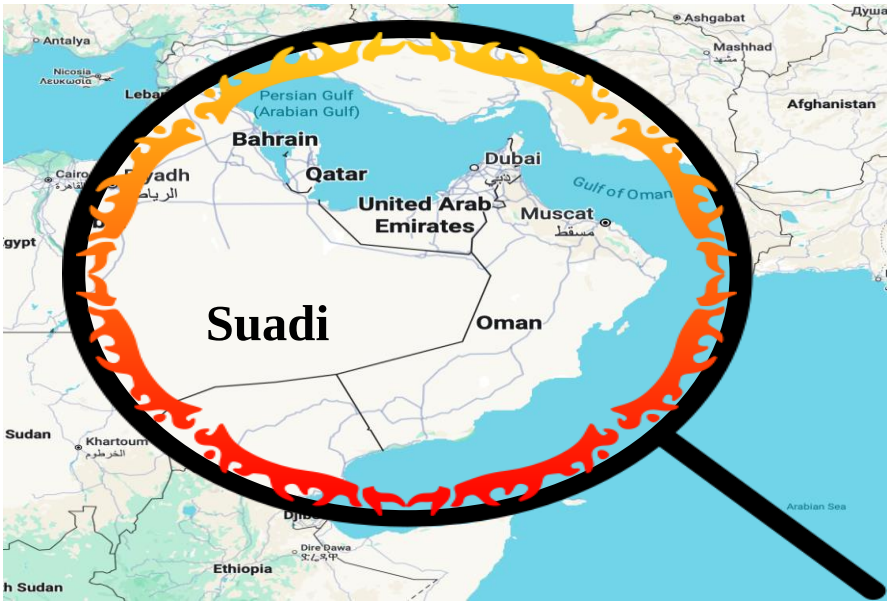
1. Introduction

1.1 Background and Context

The global energy system remains critically dependent on a limited number of strategic maritime chokepoints, among which the Strait of Hormuz holds unparalleled importance. Approximately one-fifth of global oil consumption and a substantial proportion of liquefied natural gas (LNG) exports pass through this narrow waterway, making it one of the most vital arteries of the global energy supply chain (U.S. Energy Information Administration [EIA], 2024). The concentration of such a significant volume of energy flows within a geographically constrained passage creates a structural vulnerability, exposing global markets to disruptions arising from geopolitical tensions, military confrontations, and regional instability.

In recent years, this vulnerability has become increasingly pronounced. Escalating tensions in the Middle East, particularly involving Iran and its regional counterparts, have demonstrated that even the perception of risk in the Strait of Hormuz can have immediate and significant consequences. Disruptions in shipping, increased insurance premiums, and volatility in global oil prices are often triggered not only by physical blockades but also by uncertainty and perceived threats to maritime security (International Energy Agency [IEA], 2023). This evolving risk environment highlights the fragility of existing energy transportation systems and underscores the need for more resilient infrastructure solutions.

Geopolitical Risk Exposure in the Arabian Peninsula



1.2 Problem Statement

Despite the strategic importance of the Strait of Hormuz, prevailing approaches to energy security in the region have largely relied on **military-based frameworks**, including naval patrols, defense alliances, and external security guarantees. While these measures may provide short-term stabilization, they do not address the underlying structural issue: the excessive concentration of energy transit routes within a single maritime corridor. As a result, the global energy system remains exposed to systemic risks that cannot be fully mitigated through military means alone.

Furthermore, reliance on external security providers introduces additional uncertainties. The effectiveness and reliability of such arrangements have been increasingly questioned in light of recent geopolitical developments, which have exposed limitations in the ability of external actors to ensure uninterrupted energy flows under conditions of escalating conflict. This situation has created a strategic dilemma for Gulf Cooperation Council (GCC) countries, whose economies remain heavily dependent on hydrocarbon exports and whose infrastructure is significantly exposed to maritime chokepoints.

1.3 Research Gap

Existing academic and policy literature on energy security and infrastructure development has predominantly focused on either geopolitical dynamics or economic feasibility in isolation. Studies on maritime chokepoints emphasize security risks and strategic vulnerabilities (EIA, 2024), while research on pipeline infrastructure primarily examines cost efficiency, transportation economics, and engineering feasibility (BP, 2023). However, there is a limited body of work that integrates these perspectives into a unified analytical framework capable of addressing both geopolitical risk and economic viability simultaneously.

Moreover, traditional infrastructure evaluation models tend to prioritize transport efficiency and cost minimization, often overlooking the broader economic implications of supply disruption and systemic risk. This gap is particularly significant in the context of the Gulf region, where geopolitical instability and energy market interdependence necessitate a more comprehensive approach to infrastructure planning.

1.4 Research Objectives and Contributions

In response to these gaps, this study aims to develop an integrated framework for evaluating the **Arabian Energy Corridor (AEC)** as a strategic and economic solution to the vulnerabilities associated with the Strait of Hormuz. The primary objectives of the study are as follows:

- To assess the feasibility of a land-based energy corridor connecting Saudi Arabia to the Arabian Sea via Oman
- To evaluate the economic viability of both standalone and integrated corridor models
- To analyze the geopolitical implications of reducing dependence on maritime chokepoints
- To propose a demand-side investment framework involving major energy-importing economies

A key contribution of this research is the introduction of the concept of the **Energy Security Premium**, which captures the economic value of mitigating geopolitical risk in energy supply chains. By incorporating risk considerations into economic evaluation, this concept extends beyond traditional cost-based models and provides a more realistic assessment of infrastructure value. Additionally, the study advances the concept of a **multi-stream energy corridor**, integrating crude oil and natural gas flows from multiple Gulf producers. This approach enhances economies of scale, diversifies revenue streams, and improves overall project viability. The research also proposes a **demand-side participation model**,

encouraging major Asian energy-importing countries—such as China, India, Japan, and Pakistan—to co-invest in infrastructure that directly secures their energy supply.

1.5 Conceptual Framework: The Arabian Energy Corridor

The Arabian Energy Corridor is conceptualized as a strategic overland infrastructure system connecting Saudi Arabia's eastern oil processing hub at Abqaiq to Duqm Port in Oman. By bypassing the Strait of Hormuz, the corridor provides direct access to the Arabian Sea, enabling more secure and flexible energy export routes.

Unlike traditional pipeline projects, the AEC is designed as a **multi-dimensional energy platform**. It integrates multiple energy streams, including crude oil and natural gas, while leveraging Duqm as a regional hub for storage, refining, blending, and re-export. This transformation from a single-purpose pipeline to a multi-user infrastructure system represents a fundamental shift in how energy transport projects are conceptualized and evaluated.

The corridor is positioned as a **Saudi-led, GCC-anchored initiative**, with selective participation from Asian energy-importing economies. This structure ensures regional ownership while promoting international collaboration based on economic interests rather than geopolitical alignment. By emphasizing infrastructure-based resilience over military solutions, the AEC offers a pragmatic approach to addressing long-term energy security challenges.

2. Literature Review

2.1 Global Energy Transportation and Strategic Chokepoints

The global oil trade relies heavily on a limited number of maritime chokepoints that serve as critical gateways for energy transportation. Among these, the **Strait of Hormuz** is widely regarded as the most important for global oil supply. According to the U.S. Energy Information Administration (EIA, 2024), approximately one-fifth of the world's petroleum liquids consumption passes through the Strait of Hormuz each day. This high concentration of energy flows within a narrow maritime corridor creates a significant vulnerability for global energy markets.

The strategic significance of maritime chokepoints has been extensively examined in the literature on energy security and geopolitics. Scholars argue that chokepoints not only represent logistical bottlenecks but also geopolitical pressure points where regional conflicts or political instability can disrupt global energy supply chains (Yergin, 2020). As a result, both producing and consuming countries have increasingly sought to diversify transportation routes to mitigate risks associated with chokepoint dependence.

Energy-importing countries, particularly those in Asia, have shown growing concern regarding the security of maritime energy routes. Studies have highlighted that countries such as **China**, **Pakistan, India**, and **Japan** rely heavily on uninterrupted energy shipments from the Middle East, making them particularly vulnerable to disruptions in Gulf shipping lanes (International Energy Agency [IEA], 2023). Consequently, the diversification of energy transport infrastructure has become a central policy concern in global energy governance.

2.2 Pipeline Infrastructure as an Energy Security Strategy

Pipeline infrastructure has long been considered a critical tool for reducing reliance on maritime chokepoints and enhancing the resilience of energy supply systems. Pipelines provide stable and continuous transportation of hydrocarbons while reducing exposure to maritime risks such as piracy, naval conflict, and shipping disruptions (Stevens, 2016). For this reason, many oil-producing regions have developed pipeline corridors to complement maritime export routes.

In the Gulf region, one of the most significant examples of such infrastructure is the Saudi East–West pipeline, which transports crude oil from eastern Saudi oil fields to the Red Sea export terminal at **Yanbu**. This pipeline allows Saudi Arabia to bypass the Strait of Hormuz for a portion of its exports and provides strategic redundancy in the kingdom's export infrastructure (EIA, 2024).

Similarly, the United Arab Emirates developed the Abu Dhabi Crude Oil Pipeline, connecting the onshore oil processing hub at **Habshan** to the export terminal at **Fujairah**. The pipeline enables a significant share of UAE oil exports to bypass the Strait of Hormuz entirely and has strengthened the country's ability to maintain exports during potential regional disruptions (Stevens, 2016).

Despite these developments, existing bypass pipelines provide only partial diversification of export routes. A large proportion of Gulf oil exports continues to rely on maritime transport through the Strait of Hormuz, highlighting the need for additional infrastructure solutions capable of enhancing regional export resilience.

Table 1: Comparative Pipeline Infrastructure in the Gulf Region

Project	Country	Capacity	Route	Purpose
East–West Pipeline	Saudi Arabia	~5 mb/d	Abqaiq → Yanbu	Red Sea bypass
ADCOP	UAE	~1.5 mb/d	Abu Dhabi → Fujairah	Hormuz bypass
Proposed AEC	Saudi + GCC	~2.5 mb/d + gas	Abqaiq → Duqm	Full corridor bypass

Source: Author's compilation based on EIA (2024), IEA (2023), and industry data

2.3 Shifting Geography of Global Oil Demand

The geography of global energy demand has changed significantly over the past two decades. While Western economies historically dominated global oil consumption, rapid economic growth in Asia has shifted the center of global energy demand eastward. According to the International Energy Agency (2023), Asia now accounts for the majority of global oil demand growth, with China and India emerging as the largest incremental consumers of crude oil.

This shift has important implications for the design and orientation of energy transport infrastructure. Traditional export routes from the Gulf, particularly those oriented toward the Mediterranean and European markets, no longer reflect the primary direction of energy trade flows. Instead, Gulf oil exports are increasingly directed toward Asian markets via the Indian Ocean. Researchers have noted that the growing dependence of Asian economies on Gulf hydrocarbons has increased the importance of secure maritime access to the Indian Ocean basin (Fattouh & Sen, 2018). Consequently, infrastructure projects that provide direct access to Asian shipping lanes are likely to play a critical role in shaping future energy logistics networks.

2.4 Emerging Energy Hubs and Regional Infrastructure Integration

In addition to pipeline diversification, the concept of regional energy hubs has gained increasing attention in energy policy discussions. Energy hubs serve as integrated platforms combining storage, refining, logistics, and trading activities, allowing producers and traders to optimize supply chains and respond more flexibly to market conditions (Stevens, 2016).

The development of energy hubs often occurs in strategic geographic locations where infrastructure, shipping routes, and industrial capacity intersect. One emerging example is the port of **Duqm**, which has been developed as part of Oman's long-term economic diversification strategy. Duqm hosts a major refinery complex, large-scale crude storage facilities, and an expanding industrial zone designed to support downstream energy industries (Oxford Business Group, 2022).

The strategic location of Duqm on the Arabian Sea offers a significant logistical advantage. Unlike many Gulf export terminals, Duqm provides direct access to the Indian Ocean without requiring ships to pass through the Strait of Hormuz. This geographic position has led analysts to view Duqm as a potential future energy logistics hub capable of supporting regional export diversification (Fattouh & Sen, 2018).

2.5 Research Gap

While the literature extensively examines energy chokepoints, pipeline diversification strategies, and the emergence of regional energy hubs, relatively limited research has explored the possibility of an integrated energy corridor linking major Gulf hydrocarbon production centers directly to the Arabian Sea. Existing studies tend to analyze individual infrastructure projects—such as bypass pipelines or export terminals—rather than examining the potential for a multi-country energy transport corridor that combines pipeline infrastructure with hub-based logistics.

The concept of an **Arabian Energy Corridor**, anchored by a pipeline connecting **Abqaiq** to **Duqm**, represents a novel approach to addressing this gap. By integrating pipeline transportation, export diversification, and energy hub development into a single regional infrastructure framework, the proposed corridor offers a new perspective on how Gulf energy exporters could enhance supply-chain resilience while aligning infrastructure with the evolving geography of global energy demand.

3. Research Methodology

3.1 Research Design

This study adopts a **mixed-methods research design**, integrating qualitative geopolitical analysis with quantitative economic and infrastructure modeling to evaluate the feasibility and strategic significance of the proposed Arabian Energy Corridor (AEC). Mixed-methods approaches are particularly suitable for complex policy-oriented studies, as they allow for the integration of multiple analytical perspectives within a single framework (Creswell & Creswell, 2018).

The research is exploratory and policy-oriented in nature, given that the AEC represents a conceptual infrastructure framework rather than an existing operational project. Exploratory research is appropriate in contexts where limited prior empirical studies exist and where the objective is to develop new conceptual and analytical insights (Yin, 2018).

Accordingly, the methodology combines **comparative infrastructure analysis**, **scenario-based economic modeling**, and **strategic geopolitical assessment** to evaluate whether a land-based energy corridor connecting Abqaiq to Duqm can enhance export diversification and regional energy security.
The research is structured in two analytical phases:

1. **Phase I:** Evaluation of a standalone crude oil pipeline connecting Abqaiq to Duqm
2. **Phase II:** Expansion into a broader Arabian Energy Corridor integrating crude and gas flows from multiple Gulf producers

This two-stage framework enables a comparative assessment between a single-user infrastructure model and a multi-stream regional energy system, providing a more comprehensive evaluation of both economic viability and strategic relevance.

3.2 Data Sources

The study primarily relies on **secondary data sources**, including international energy databases, government publications, and academic literature related to energy security, infrastructure development, and maritime chokepoints.
Key data sources include:

- U.S. Energy Information Administration (EIA)
- International Energy Agency (IEA)
- Industry reports and policy research institutions
- Infrastructure case studies from the Gulf region

These sources provide reliable and widely accepted data on:

- Global oil and gas transportation flows
- Maritime chokepoint dependencies (e.g., Strait of Hormuz)
- Existing pipeline capacities and bypass infrastructure
- Regional export patterns and demand trends

Additional empirical grounding is provided through comparative analysis of existing infrastructure projects, including:

- The Saudi East–West Pipeline (Abqaiq–Yanbu)
- The Abu Dhabi Crude Oil Pipeline (ADCOP) to Fujairah

These case studies serve as **benchmark references** for estimating capital costs, pipeline capacities, operational efficiencies, and strategic objectives, thereby enhancing the robustness of the modeling framework.

3.3 Analytical Framework

The analytical framework integrates three complementary methodological approaches to provide a comprehensive evaluation of the proposed corridor.

3.3.1 Comparative Infrastructure Analysis

A comparative analytical approach is employed to examine existing pipeline systems designed to bypass maritime chokepoints. By analyzing infrastructure projects within the Gulf region, the study identifies key parameters such as:

- Pipeline capacity
- Construction costs

- Transport efficiency
- Strategic objectives

This comparative analysis provides empirical benchmarks that inform the estimation of cost structures, technical feasibility, and operational assumptions for the proposed corridor.

3.3.2 Scenario-Based Economic Modeling

The economic evaluation is conducted using a **scenario-based modeling approach**, which allows for the analysis of multiple potential configurations under varying assumptions. Scenario analysis is widely used in infrastructure and policy research to address uncertainty and evaluate alternative development pathways (IEA, 2023).

Two primary scenarios are developed:

- **Scenario A:** Standalone Abqaiq–Duqm crude pipeline
- **Scenario B:** Integrated Arabian Energy Corridor incorporating multi-country hydrocarbon flows and hub-based logistics functions

For each scenario, the model evaluates:

- Capital investment requirements (CAPEX)
- Throughput volumes
- Utilization rates
- Unit cost efficiencies

This approach enables a dynamic comparison between a single-purpose infrastructure model and a multi-stream energy platform, highlighting the economic implications of scale and integration.

3.3.3 Strategic Energy Security Assessment

In addition to economic modeling, the study incorporates a **strategic energy security assessment**, focusing on the role of infrastructure diversification in reducing systemic risk.

This component evaluates:

- Dependence on maritime chokepoints
- Exposure to geopolitical disruptions
- Alignment with global energy demand patterns

Particular attention is given to the increasing shift of energy demand toward Asian markets—especially China, India, and Japan—which reinforces the strategic importance of secure and diversified export routes (EIA, 2024).

This integrated approach ensures that the corridor is evaluated not only in terms of economic feasibility but also in terms of its contribution to long-term energy system resilience.

3.4 Assumptions and Modeling Parameters

Given that the Arabian Energy Corridor is a conceptual proposal, the analysis is based on a set of **modeled assumptions derived from empirical benchmarks**.

Key parameters include:

- Pipeline capacity estimates based on comparable projects
- Capital cost ranges derived from regional infrastructure benchmarks
- Operational lifespan assumptions (typically 20–30 years)
- Utilization rates under different demand scenarios

These assumptions are grounded in observed industry standards and comparable infrastructure systems, enabling the construction of a realistic yet flexible economic model.
The use of scenario-based assumptions allows the study to address uncertainty while maintaining analytical rigor.

3.5 Limitations of the Study

This study is subject to several methodological limitations.
First, the proposed corridor is not yet an officially announced or engineered project. As a result, detailed route planning, engineering specifications, and precise cost estimates are unavailable. The analysis therefore relies on **benchmarking and scenario modeling** rather than project-specific engineering data.
Second, the study focuses primarily on **economic and strategic dimensions**, while environmental impact assessments, regulatory frameworks, and political negotiations are beyond its scope. These factors may significantly influence real-world implementation.
Third, uncertainties related to geopolitical developments and energy market dynamics may affect long-term projections.
Despite these limitations, the methodological framework provides a **robust and structured approach** for evaluating the strategic rationale and economic potential of the Arabian Energy Corridor.

3.6 Methodological Contribution

This study contributes methodologically by integrating **geopolitical risk analysis with economic modeling** within a unified analytical framework. By combining infrastructure benchmarking, scenario-based evaluation, and strategic assessment, the research offers a comprehensive approach to evaluating large-scale energy infrastructure in geopolitically sensitive regions.

4. Geopolitical and Strategic Context

4.1 Strait of Hormuz as a Structural Energy Chokepoint

The Strait of Hormuz represents one of the most critical maritime chokepoints in the global energy system, facilitating the transit of approximately 20% of global petroleum liquids consumption and a significant share of liquefied natural gas (LNG) exports (U.S. Energy Information Administration [EIA], 2024). This concentration of energy flows within a narrow and geopolitically sensitive corridor creates a structural vulnerability that exposes global markets to disruptions arising from regional instability, military tensions, and strategic competition.
Unlike other transportation routes, the Strait of Hormuz lacks viable large-scale alternatives capable of absorbing sudden disruptions. Although limited bypass infrastructure exists within the Gulf region—such as the Saudi East–West pipeline and the UAE's Abu Dhabi Crude Oil Pipeline (ADCOP)—their combined capacity remains insufficient relative to total export volumes. As a result, a substantial proportion of Gulf energy exports remains dependent on this single maritime passage, reinforcing systemic exposure to geopolitical risk.

Table 2: Strategic Importance of the Strait of Hormuz

Indicator	Value	Source
Share of global oil transit	20% of global consumption	EIA (2024)
LNG transit share	25–30% of global LNG trade	IEA (2023)
Key exporting countries	Saudi Arabia, UAE, Kuwait, Iraq, Qatar	EIA (2024)
Daily oil flow	20–21 million barrels/day	EIA (2024)
Strategic risk level	Very High (chokepoint dependency)	Author analysis

Source: Author's compilation based on EIA (2024), IEA (2023), and industry data

4.2 Evolving Regional Power Dynamics and Iran's Deterrence Capability

The geopolitical environment surrounding the Strait of Hormuz is shaped by complex regional power dynamics, with Iran playing a central role. Over the past decade, Iran has developed and demonstrated credible deterrence capabilities, including asymmetric maritime strategies, missile systems, and the capacity to disrupt shipping lanes. These capabilities have altered the strategic balance in the region, making the prospect of disruption more plausible even in the absence of full-scale conflict.

Recent geopolitical developments have further reinforced this reality. Episodes of escalation involving Iran and external actors have demonstrated that energy infrastructure and shipping routes are increasingly vulnerable not only to direct attacks but also to indirect disruptions caused by heightened threat perceptions. In this context, the concept of deterrence extends beyond military confrontation to include the ability to influence market behavior, shipping decisions, and insurance dynamics.

Importantly, these developments indicate that modern energy disruption does not require a complete blockade of the Strait. Instead, **perceived risk alone** can significantly affect energy flows, as shipping companies adjust routes, insurers increase premiums, and market participants respond to uncertainty.

4.3 Limitations of External Security Frameworks

Historically, the security of energy transit routes in the Gulf has been supported by external military presence, particularly that of the United States. Naval patrols, strategic alliances, and defense commitments have been central to maintaining the stability of maritime routes. However, recent developments have raised questions regarding the effectiveness and sustainability of this security architecture.

The increasing complexity of regional conflicts, combined with shifting geopolitical priorities, has exposed limitations in the ability of external actors to guarantee uninterrupted energy flows under all conditions. Moreover, reliance on military-based solutions introduces its own risks, including the potential for escalation, miscalculation, and the militarization of energy infrastructure. From a strategic perspective, this reliance creates a structural imbalance in which energy security is dependent on external intervention rather than internal resilience. This has prompted a growing recognition among Gulf states of the need to develop **infrastructure-based solutions** that reduce dependency on external security guarantees.

STRAIT OF HORMUZ

4.4 Strategic Vulnerability of GCC Energy Exports

The economies of Gulf Cooperation Council (GCC) countries remain heavily dependent on hydrocarbon exports, making energy infrastructure a critical component of national economic stability. However, the geographic concentration of export facilities and reliance on maritime routes through the Strait of Hormuz create a significant **single-point-of-failure risk**.

Saudi Arabia, as the region's largest oil exporter, and Qatar, as a leading LNG supplier, are particularly exposed to this vulnerability. A disruption in the Strait would not only affect export volumes but could also have cascading effects on government revenues, fiscal stability, and broader economic performance. Furthermore, global energy demand patterns have increasingly shifted toward Asia, with countries such as China, India, and Japan accounting for a substantial share of Gulf energy imports (EIA, 2024). This shift amplifies the strategic importance of maintaining reliable export routes and highlights the need for infrastructure that can support long-term supply commitments to these markets.

4.5 Rationale for a Land-Based Energy Corridor

In response to these vulnerabilities, the development of a land-based energy corridor emerges as a strategically viable solution. Unlike maritime routes, overland infrastructure is less susceptible to disruption from naval conflict and provides greater control over energy flows.

The proposed Arabian Energy Corridor (AEC), connecting Abqaiq to Duqm, offers a direct bypass of the Strait of Hormuz, enabling Gulf energy exports to access the Arabian Sea without passing through high-risk maritime zones. This approach represents a shift from reactive security measures to **proactive infrastructure-based resilience**, addressing the root cause of vulnerability rather than its symptoms.

Importantly, the AEC is conceptualized as an **economic infrastructure project rather than a military initiative**, reducing the likelihood of geopolitical escalation. By focusing on economic cooperation and supply chain stability, the corridor aligns with broader regional and global interests in maintaining secure and reliable energy markets.

PROPOSED AEC – PART 1

4.6 Demand-Side Participation and Strategic Neutrality

A distinguishing feature of the AEC framework is the proposed inclusion of major Asian energy-importing economies—such as China, India, Japan, and Pakistan—as co-investors in corridor infrastructure. This approach represents a shift toward a **demand-side participation model**, in which consuming nations actively contribute to securing their energy supply chains.

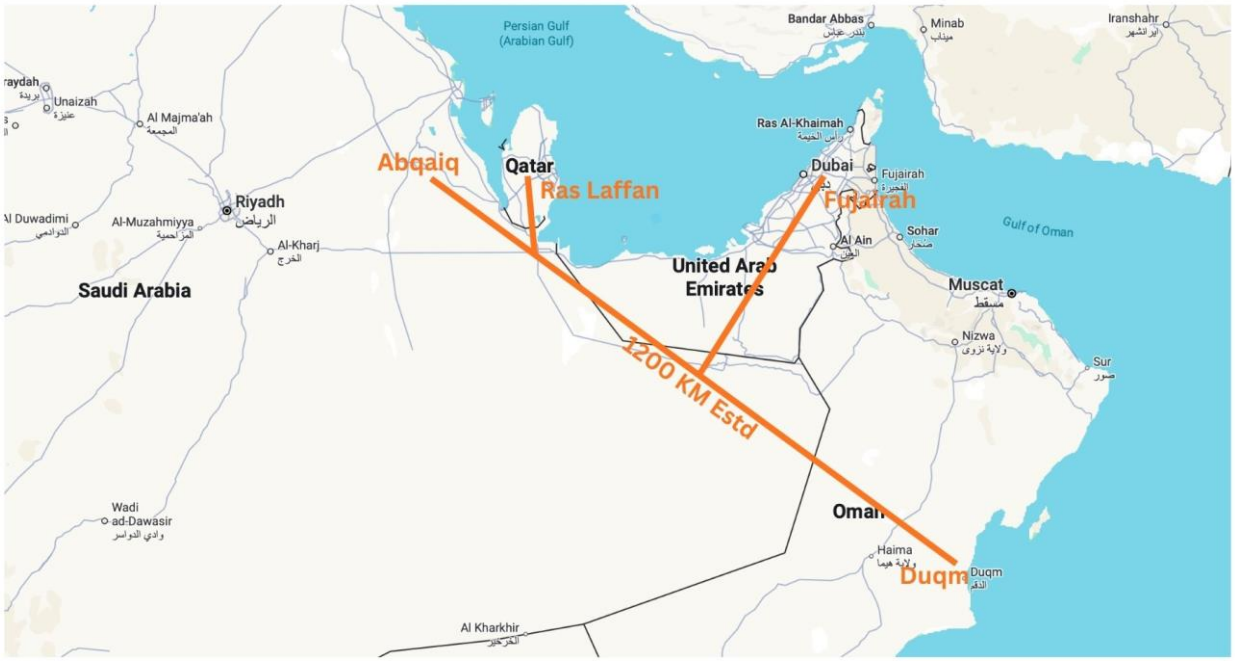
This model offers several strategic advantages. First, it aligns infrastructure investment with long-term demand, enhancing financial viability and ensuring sustained utilization. Second, it transforms the corridor into a **shared economic asset**, reducing the likelihood of geopolitical conflict by distributing ownership and interests across multiple stakeholders. Third, it enhances supply security for Asian markets, which are the primary beneficiaries of Gulf energy exports.

Equally important is the corridor's positioning as a **Saudi-led, GCC-anchored initiative with selective international participation**, while deliberately avoiding direct military alignment. By excluding overt military involvement and emphasizing economic collaboration, the AEC reduces geopolitical sensitivities and enhances its acceptability across diverse stakeholders.

4.7 Link to Economic Framework

The geopolitical realities outlined above directly inform the economic logic of the Arabian Energy Corridor. The persistent risk associated with the Strait of Hormuz provides the foundation for the concept of the **Energy Security Premium**, which captures the economic value of reducing disruption risk. Accordingly, the economic viability of the corridor cannot be assessed solely in terms of transport efficiency or cost savings. Instead, it must incorporate the broader benefits of risk mitigation, supply stability, and strategic diversification. This integrated perspective forms the basis for the economic model developed in the subsequent section.

AEC PART 1 & PART 2



5. Economic Model and Scenario Analysis

5.1 Conceptual Structure of the Economic Model

The economic evaluation of the Arabian Energy Corridor (AEC) is structured as a **two-stage analytical framework**, distinguishing between:

- **Part 1:** A standalone crude oil pipeline connecting Abqaiq to Duqm
- **Part 2:** A fully integrated, multi-stream energy corridor incorporating regional participation

This distinction is critical, as the economic viability of the project evolves significantly when transitioning from a single-user infrastructure model to a multi-user, multi-stream energy system.

5.2 Part 1: Standalone Abqaiq–Duqm Crude Corridor

5.2.1 Strategic Context and Benchmarking

Saudi Arabia transported approximately **5.5 million barrels per day (mb/d)** of crude oil and condensate through the Strait of Hormuz in recent years, representing one of the highest levels of exposure to a single maritime chokepoint (EIA, 2024). At the same time, alternative bypass capacity in the region remains limited, creating a significant structural vulnerability in export infrastructure.

Duqm, however, is not a greenfield location. The port already hosts refining and storage facilities, including large-scale crude storage capacity at Ras Markaz, making it a strategically viable endpoint for a land-based export corridor. Additionally, comparable regional infrastructure—such as the Abu Dhabi Crude Oil Pipeline (ADCOP)—provides a useful benchmark for estimating capital costs and operational parameters.

5.2.2 Base Case Assumptions

The standalone corridor is modeled using the following base assumptions:

- **Pipeline capacity:** 1.5 mb/d
- **Utilization rate:** 90%
- **Annual throughput:** approximately 492 million barrels
- **Economic lifespan:** 25 years
- **Discount rate:** 10%

These parameters are derived from regional infrastructure benchmarks and industry standards, providing a realistic foundation for economic modeling.

5.2.3 Capital Cost Estimation

Using ADCOP as a benchmark (~$8–9 million per kilometer), a fully greenfield pipeline of similar scale would imply capital expenditure exceeding $10 billion. However, due to **existing infrastructure at both Abqaiq and Duqm**, a brownfield-adjusted estimate is more appropriate.

Accordingly, the modeled CAPEX range is:

- **Low case:** $4.9 billion
- **Base case:** $5.5 billion
- **High case:** $6.5 billion

These estimates reflect realistic cost adjustments while maintaining alignment with regional benchmarks.

5.2.4 Breakeven Analysis

Using standard capital recovery assumptions over a 25-year period, the estimated **capital cost per barrel** ranges between:

- $1.10–$1.45 per barrel

When operational costs (e.g., pumping, maintenance, and security) are included, the **total breakeven cost** increases to approximately:

- **$1.4–2.0 per barrel**

5.2.5 Economic Interpretation

A key finding of this analysis is that the standalone pipeline **cannot be economically justified solely on the basis of transport cost savings**. Maritime freight savings are relatively marginal compared to pipeline costs, making traditional cost-efficiency arguments insufficient.

Instead, the value of the corridor must be interpreted through a broader framework incorporating **strategic and systemic benefits**, including:

- Export route diversification
- Reduced dependence on the Strait of Hormuz
- Enhanced supply reliability

- Improved market timing flexibility through storage

5.2.6 Energy Security Premium

To address this limitation, the study introduces the concept of an **Energy Security Premium (ESP)**, defined as:

The economic value associated with reducing geopolitical risk and ensuring continuity of energy supply.

This concept expands traditional infrastructure evaluation by incorporating risk mitigation as a measurable economic benefit. Under this framework, the standalone corridor is best understood as:

A strategically valuable infrastructure asset with moderate direct financial returns but high systemic importance.

5.3 Part 2: Integrated Arabian Energy Corridor

5.3.1 Structural Transformation

The transition from Part 1 to Part 2 represents a fundamental shift in the economic logic of the project. Rather than functioning as a single-purpose pipeline, the AEC evolves into a **multi-stream energy platform**, integrating:

- Saudi crude flows (1.5 mb/d)
- UAE crude participation (~1.0 mb/d modeled)
- Qatar gas integration (~2.0 bcf/d modeled)
- Duqm as a regional hub for storage, refining, and re-export

5.3.2 Throughput and Scale Effects

Under base assumptions, the integrated corridor handles approximately:

- **2.5 mb/d of crude oil**
- **2.0 bcf/d of natural gas**

This translates into an annual throughput of nearly **900–950 million barrels of oil equivalent (boe)**.

The scale of operations significantly enhances economic viability by distributing fixed costs across higher volumes.

5.3.3 Capital Cost Structure

The total CAPEX for the integrated corridor is estimated as follows:

- Saudi trunk line: $4.9–6.5 billion
- UAE integration: $1.5–2.5 billion
- Qatar gas infrastructure: ~$3.5 billion
- Duqm expansion: $0.5–1.5 billion

Total estimated range: $10.4–14.0 billion

5.3.4 Corridor Economies of Scale

A central economic advantage of the integrated model is the emergence of **economies of scale**, which reduce the **blended capital cost per unit of energy transported**.

The estimated blended capital burden declines to:

- **~$1.0–1.2 per barrel of oil equivalent (boe)**

This represents a substantial improvement compared to the standalone pipeline.

5.3.5 Revenue Diversification

Unlike Part 1, the integrated corridor generates multiple revenue streams:

- Crude oil transportation tariffs
- Natural gas transmission fees
- Storage and terminal services
- Blending and trading opportunities
- Export handling and logistics

This diversification enhances financial resilience and reduces dependence on a single revenue source.

5.3.6 Market Alignment

The corridor is strongly aligned with global energy demand patterns. A significant proportion of Gulf energy exports is directed toward Asian markets, including China, India, and Japan (EIA, 2024). By providing direct access to the Arabian Sea, the AEC improves logistical efficiency and strengthens supply chains serving these markets.

5.4 Comparative Economic Interpretation

The comparison between Part 1 and Part 2 yields a critical conclusion:

- **Part 1 (pipeline-only):**
  Strategically valuable but economically limited
- **Part 2 (full corridor):**
  Economically viable, scalable, and strategically transformative

This distinction highlights the importance of **integration and scale** in infrastructure design.

5.5 Overall Economic Conclusion

The analysis demonstrates that the Arabian Energy Corridor achieves its full potential only when conceptualized as a **multi-stream, multi-user energy platform** rather than a standalone pipeline. By integrating geopolitical risk mitigation, economies of scale, and demand-side participation, the corridor becomes both economically viable and strategically essential.

The AEC is not justified by transport efficiency alone, but by its ability to internalize risk, scale operations, and align with global energy demand.

Table 3: Economic Model Summary – Scenario Comparison

Parameter	Part 1: Standalone Pipeline	Part 2: Integrated Corridor
Structure	Single crude pipeline	Multi-stream energy corridor
Throughput	~1.5 mb/d	~2.5 mb/d + gas
CAPEX	$4.9–6.5 billion	$10.4–14.0 billion
Cost per barrel	$1.4–2.0	~$1.0–1.2 (boe)
Revenue streams	Transport only	Transport + gas + storage + trading
Economic viability	Limited	Strong
Strategic value	High	Very High

Source: Author's compilation based on EIA (2024), IEA (2023), and industry data

6. Discussion

6.1 Overview of Key Findings

This study evaluates the feasibility and strategic relevance of the Arabian Energy Corridor (AEC) as an alternative energy transport system designed to bypass the Strait of Hormuz. The analysis integrates geopolitical assessment with economic modeling to provide a comprehensive evaluation of both strategic necessity and financial viability.

The findings demonstrate a clear distinction between two configurations of the proposed infrastructure. The standalone crude pipeline (Part 1) offers limited commercial viability when assessed solely on the basis of transport cost efficiency. However, it provides substantial strategic value by enhancing export diversification and reducing dependence on a single maritime chokepoint. In contrast, the integrated corridor model (Part 2), incorporating crude and gas flows from multiple Gulf producers, significantly improves economic performance through economies of scale, increased throughput, and diversified revenue streams.

A central contribution of the study is the conceptualization of the **Energy Security Premium**, which captures the economic value associated with mitigating geopolitical risks in energy supply chains. This framework challenges conventional infrastructure evaluation models that prioritize cost minimization while overlooking systemic vulnerabilities.

6.2 Policy Implications

The findings of this study have important implications for energy and infrastructure policy in the Gulf region. First, they highlight the limitations of existing **military-based energy security frameworks**, which focus on protecting maritime routes rather than addressing structural vulnerabilities. While naval protection and strategic alliances may provide short-term stability, they do not eliminate the underlying risk associated with chokepoint dependency.

Second, the study supports a shift toward **infrastructure-based energy security**, emphasizing the role of strategic investments in reducing systemic risk. The AEC represents a proactive policy approach that addresses the root cause of vulnerability by diversifying export routes and enhancing resilience.

Third, the proposed **Saudi-led, GCC-anchored model with selective international participation** provides a balanced framework that preserves regional control while enabling external investment. This approach minimizes geopolitical sensitivities and enhances the feasibility of large-scale infrastructure development.

6.3 Practical and Operational Implications

From a practical perspective, the implementation of the Arabian Energy Corridor would require coordinated planning across multiple dimensions, including infrastructure development, regulatory alignment, and operational integration. The transition from a standalone pipeline to a multi-stream corridor necessitates collaboration among Gulf producers, particularly Saudi Arabia, the United Arab Emirates, and Qatar.

The development of Duqm as a regional energy hub is a critical component of this strategy. Investments in storage, refining, and export facilities would enhance the corridor's operational flexibility and create additional value through downstream activities.

Moreover, the corridor would improve supply chain efficiency by reducing transit risks and enabling more predictable delivery schedules. This is particularly important for long-term supply contracts with Asian markets, where reliability is a key determinant of competitiveness.

Table 4: Proposed Investment and Governance Structure

Stakeholder	Role	Contribution
Saudi Arabia	Lead developer	Core pipeline investment
Oman	Host country	Land + port infrastructure (Duqm)
UAE	Integration	Crude participation
Qatar	Gas supplier	Gas infrastructure integration
Asian countries (China, India, Japan, Pakistan)	Demand-side investors	Capital + long-term offtake
Private sector	Strategic partners	Logistics, storage, trading

Source: Author's compilation based on EIA (2024), IEA (2023), and industry data

6.4 Theoretical Contributions

This study contributes to the academic literature by advancing an integrated framework that combines **geopolitical risk analysis with economic infrastructure modeling**. Traditional approaches to energy infrastructure evaluation often treat economic and geopolitical factors as separate domains. By contrast, this study demonstrates the importance of integrating these dimensions into a unified analytical framework.

The introduction of the **Energy Security Premium** represents a novel conceptual contribution, extending existing theories of infrastructure valuation by incorporating risk mitigation as a quantifiable economic benefit. This concept has broader applicability beyond the Gulf region and may be relevant for evaluating infrastructure projects in other geopolitically sensitive contexts.

Furthermore, the study contributes to the literature on energy corridors by redefining them as **multi-stream, multi-user platforms**, rather than single-purpose pipelines. This conceptual shift has implications for future research on infrastructure design and regional integration.

6.5 Commercial and Investment Implications

The economic analysis suggests that the viability of the Arabian Energy Corridor is significantly enhanced through **scale, integration, and diversification**. For investors, this highlights the importance of viewing the corridor not as a standalone pipeline but as a comprehensive energy platform with multiple revenue streams.

The proposed **demand-side participation model** offers a particularly compelling investment framework. By involving major Asian energy-importing economies—such as China, India, Japan, and Pakistan—the project aligns capital investment with long-term demand. This reduces financial risk, improves project bankability, and ensures sustained utilization.

In addition, the corridor creates opportunities for investment in related sectors, including storage infrastructure, refining capacity, logistics services, and energy trading. These complementary activities enhance the overall economic ecosystem and increase the attractiveness of the project for both public and private investors.

6.6 Regional and Global Implications

At the regional level, the Arabian Energy Corridor has the potential to transform the strategic landscape of the Gulf. By reducing dependence on the Strait of Hormuz, the corridor enhances the resilience of GCC economies and strengthens their position in global energy markets.

The inclusion of Asian stakeholders further reinforces the corridor's global significance. As energy demand continues to shift toward Asia, the alignment of infrastructure with demand centers becomes increasingly important. The AEC facilitates this alignment by providing a direct and secure export route to the Arabian Sea, improving connectivity between producers and consumers.

At a broader level, the corridor contributes to the stability of global energy markets by reducing the risk of supply disruptions. In doing so, it supports not only regional energy security but also global economic stability.

6.7 Linking Geopolitics and Economics

A key insight emerging from this study is the inseparability of geopolitical and economic considerations in energy infrastructure planning. The risks associated with the Strait of Hormuz are not merely strategic concerns but have direct economic implications, influencing costs, investment decisions, and market behavior.

The Arabian Energy Corridor demonstrates how infrastructure can serve as a bridge between these domains, transforming geopolitical challenges into economic opportunities. By internalizing risk through the concept of the Energy Security Premium, the corridor aligns strategic objectives with financial incentives.

6.8 Summary of Discussion

In summary, the findings of this study suggest that the Arabian Energy Corridor represents a viable and strategically significant solution to the vulnerabilities associated with the Strait of Hormuz. While the standalone pipeline offers limited economic justification, the integrated corridor model emerges as both economically viable and strategically transformative.

The study underscores the importance of adopting a holistic approach to energy infrastructure, one that incorporates geopolitical realities, economic efficiency, and long-term demand dynamics. In this context, the AEC is not merely an infrastructure project but a reconfiguration of regional energy architecture.

Table 5: Key Strategic Benefits of the Arabian Energy Corridor

Dimension	Impact
Energy Security	Reduces reliance on Strait of Hormuz
Economic Efficiency	Lower cost via scale (Part 2)
Risk Mitigation	Avoids chokepoint disruptions
Market Access	Direct route to Asian markets
Regional Integration	GCC cooperation platform
Investment Attractiveness	Multi-revenue infrastructure

Source: Author's compilation based on EIA (2024), IEA (2023), and industry data

7. Conclusion and Recommendations

7.1 Summary of Key Findings

This study has examined the feasibility and strategic significance of the Arabian Energy Corridor (AEC) as an alternative energy transport system designed to reduce dependence on the Strait of Hormuz. By integrating geopolitical analysis with economic modeling, the research provides a comprehensive assessment of both the structural vulnerabilities of existing energy routes and the potential of infrastructure-based solutions to enhance resilience.

The findings demonstrate that the Strait of Hormuz represents a persistent and systemic risk to global energy security. The concentration of a substantial share of global oil and gas flows within a single maritime chokepoint exposes markets to disruptions arising from geopolitical tensions, military confrontations, and strategic competition. These risks are not hypothetical but have been increasingly evident in recent regional developments, where even perceived threats have affected shipping flows and market stability.

The economic analysis reveals a clear distinction between two configurations of the proposed infrastructure. The standalone crude pipeline offers limited commercial viability when evaluated solely on the basis of transport efficiency. However, it provides significant strategic value by enhancing export diversification and reducing reliance on a single transit route. In contrast, the fully integrated corridor model, incorporating crude and gas flows from multiple Gulf producers, demonstrates strong economic viability through economies of scale, increased throughput, and diversified revenue streams.

A central contribution of this study is the introduction of the **Energy Security Premium**, which captures the economic value of reducing geopolitical risk in energy supply chains. This concept extends traditional infrastructure evaluation frameworks by incorporating risk mitigation as a core component of economic value.

7.2 Contributions to Knowledge

This study contributes to the academic and policy literature in several important ways. First, it develops an integrated analytical framework that combines geopolitical risk assessment with economic infrastructure modeling. This approach addresses a key gap in existing literature, where these dimensions are often analyzed separately.

Second, the study introduces the concept of the **Energy Security Premium**, providing a novel perspective on how infrastructure projects can be evaluated in geopolitically sensitive environments. This concept has broader applicability beyond the Gulf region and may inform future research on energy security and infrastructure planning.

Third, the research advances the conceptualization of energy corridors as **multi-stream, multi-user platforms**, rather than single-purpose pipelines. This shift has significant implications for infrastructure design, investment strategies, and regional integration.

7.3 Policy Recommendations

The findings of this study suggest several important policy directions.

First, policymakers in the Gulf region should prioritize the development of **infrastructure-based energy security solutions** as a complement to existing military frameworks. While defense mechanisms remain

important, they are insufficient to address the structural vulnerabilities associated with chokepoint dependency.

Second, the Arabian Energy Corridor should be positioned as a **Saudi-led, GCC-anchored initiative**, ensuring regional ownership and strategic alignment. At the same time, selective international participation should be encouraged to enhance financial viability and global relevance.

Third, governments should adopt a **phased development approach**, beginning with a core Saudi–Oman corridor and gradually expanding to include additional regional and international partners. This approach allows for risk management, financial flexibility, and incremental scaling.

Fourth, regulatory frameworks and institutional mechanisms should be developed to facilitate cross-border infrastructure collaboration, including agreements on tariffs, access, and operational governance.

7.4 Investment and Commercial Recommendations

From an investment perspective, the Arabian Energy Corridor should be structured as a **multi-layered economic platform**, offering diverse revenue streams and opportunities for both public and private sector participation.

The proposed **demand-side participation model** should be actively pursued, inviting major Asian energy-importing economies—such as China, India, Japan, and Pakistan—to co-invest in corridor infrastructure. This approach aligns investment with long-term demand, enhances project bankability, and reduces geopolitical risks by distributing ownership.

In addition, investment opportunities should extend beyond pipeline infrastructure to include:

- Storage and terminal facilities
- Refining and petrochemical complexes
- Logistics and trading platforms

This integrated approach increases the overall economic value of the corridor and strengthens its position within global energy markets.

7.5 Regional and Global Implications

At the regional level, the Arabian Energy Corridor has the potential to reshape the strategic landscape of the Gulf by reducing dependence on the Strait of Hormuz and enhancing the resilience of GCC economies. By diversifying export routes, the corridor strengthens the ability of Gulf producers to respond to geopolitical and market uncertainties.

At the global level, the corridor contributes to the stability of energy markets by reducing the risk of supply disruptions. As global energy demand continues to shift toward Asia, the alignment of infrastructure with demand centers becomes increasingly important. The AEC facilitates this alignment, improving connectivity between producers and consumers and supporting long-term supply security.

7.6 Final Conclusion

The Arabian Energy Corridor represents a fundamental shift in the approach to energy security—from reliance on vulnerable maritime routes and reactive military protection toward proactive, infrastructure-driven resilience. While the standalone pipeline offers limited economic justification, the integrated corridor model emerges as both economically viable and strategically transformative.

Ultimately, the value of the AEC lies not only in its capacity to transport energy but in its ability to **redefine the architecture of regional energy systems**. By integrating geopolitical risk mitigation,

economic scalability, and international cooperation, the corridor offers a forward-looking solution to one of the most critical challenges in the global energy landscape.

The future of energy security will not be determined solely at sea, but through the strategic design of resilient infrastructure on land.

EXISTING & PROPOSED PIPELINES

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