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Rearchitecting Global Oil Security: The UAE Inland Canal as a Systemic Redundancy Solution (A Real-Options and Capacity-Reservation Approach to the Sharjah-Fujairah Corridor)

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ABSTRACT

This study addresses a core problem in infrastructure finance and public-goods provision: how to finance and govern a costly, non-excludable, crisis-contingent transit asset that markets systematically underprovide, using a proposed 116-kilometre Sharjah-Fujairah corridor as the empirical case. The paper combines a single-case analysis of the 2026 Strait of Hormuz closure, comparative analysis of canal, tunnel and pipeline analogues, and transparent financial modelling, capital-recovery, break-even-toll, capacity-reservation and real-options valuation, drawing on International Energy Agency, Energy Information Administration, maritime-intelligence, Brookings, OPEC, FATF and Central Bank of the UAE sources. The pipelines cannot structurally replace the chokepoint, leaving only 3.5-5.5 of roughly 20 million barrels per day redirectable. A canal-pipeline hybrid is the only buildable reference design, costing a reference $130-160 billion once documented megaproject-overrun rates are applied. A capacity-reservation fee of about 3 percent of importers' Hormuz-crude value covers the capital charge and, under real-options valuation, is recovered within roughly 16-27 crisis days. Governance must be anchored in enforceable AML/CFT and sanctions controls. The corridor is viable only as a global energy-insurance instrument aligning payment with benefit through reservation contracts, evidence-gated phasing, and engineered financial integrity. The framework generalises to other concentrated transport nodes.

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1. Introduction

Some economically valuable assets are chronically underprovided because the market cannot easily charge those who benefit from them. Redundant transport infrastructure, a second route that earns its keep only when the first one fails, is a paradigmatic case. Its benefits are largely non-excludable and realised only in a crisis, its capital cost is enormous and sunk, and the parties who would gain most from it are dispersed across several jurisdictions. Classic public-goods theory predicts that such assets will be underfunded, and that the actors best placed to pay will free-ride on the hope that someone else builds first (Olson, 1965; Kaul et al., 1999). The central question of this study is therefore a problem of finance and governance rather than of engineering: how can a costly, non-excludable, crisis-contingent transit asset be financed, priced and governed so that it is actually built and responsibly run?

The 2026 Strait of Hormuz crisis supplies an unusually clean empirical setting for that question. When passage through the strait was effectively closed from late February 2026, the world did not run short of oil, global observed inventories stood near their highest level in five years, yet roughly 20 million barrels per day (bpd) could not move, and existing regional pipelines could redirect only 3.5-5.5 million bpd (International Energy Agency [IEA], 2026c; Dunn & Barden, 2025). The episode exposed a transport-layer vulnerability that reserves and spare production capacity cannot address, and it has prompted real capital decisions: the United Arab Emirates (UAE) has fast-tracked a second pipeline to its Gulf-of-Oman coast, and Asian importers are reassessing their dependence on Gulf crude (Reuters, 2026c). Decisions about the next generation of Gulf export infrastructure, and about how to pay for it, will be taken within two to three years.

This study uses and builds on an academically proposed project concept of a 116-kilometre corridor between Sharjah and Fujairah, the only continuous land bridge between the Arabian Gulf and the Gulf of Oman, as the case through which to develop a financing and governance framework for redundant transit infrastructure. A prior policy article by the present author floated the idea of such a corridor (Tamhane, 2026); the present study subjects it to a harder economic and financial test. The emphasis throughout is on the business and economics of the asset: how its benefits can be converted into an excludable, priceable right; how its capital cost should be reckoned once documented cost-overrun rates are applied; how its flexibility is valued under deep uncertainty; and how the large, multi-jurisdictional capital flows it would attract can be governed against illicit-finance risk.

Three research questions organise the analysis. First, what does the 2026 crisis reveal about the economic structure of transit vulnerability, that is, why reserves, spare capacity and incremental pipelines cannot substitute for route redundancy? Second, how should a redundant corridor of this kind be financed and priced, given that its benefits are non-excludable and realised mainly in a crisis? Third, how should the capital and commodity flows associated with such an asset be governed so that financial integrity is preserved? The engineering and strategic-security questions, central to the earlier treatment, are retained here only insofar as they bound the financial case: the design must be buildable with proven methods, and the asset must be defensible, or the finance is moot.

The study makes three contributions to the business and economics literature. First, it treats chokepoint-bypass infrastructure explicitly as a global public good and designs an excludability mechanism, capacity reservation, that aligns payment with benefit and bounds the free-riding that collective-action theory predicts. Second, it brings megaproject cost-performance evidence and real-options valuation to bear on a concrete infrastructure-finance problem, reconciling divergent cost estimates into a defensible planning basis and valuing the corridor as a standing option rather than a static investment. Third, it specifies a financial-integrity and sanctions architecture for a large, state-linked capital project adjacent to an active sanctioned shadow fleet, extending the governance-of-capital-flows literature to infrastructure finance. The framework is intended to generalise to any proposal to bypass a concentrated transport node.

2. Literature Review

The study sits at the intersection of five literatures, each of which contributes one element of the financing-and-governance framework developed below. This section synthesises them critically rather than surveying them exhaustively, and in each case draws out the implication for the corridor case.

2.1 Public goods and the underprovision of redundancy

Transit security has the defining features of a public good: it is largely non-rival (one importer's assured access does not diminish another's) and hard to exclude (an open strait benefits all shippers regardless of who paid to keep it open). Olson (1965) showed that such goods are

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systematically underprovided because rational actors free-ride, and that the problem worsens as the group of beneficiaries grows larger and more heterogeneous, precisely the condition of a global oil-transit system serving dozens of exporters and importers. Kaul et al. (1999) extended the analysis to goods whose benefits cross borders, arguing that global public goods require deliberate institutional design to overcome the collective-action gap. The design problem for a redundant corridor is therefore to convert a diffuse, non-excludable benefit, assured transit in a crisis, into an excludable, contractible right for which beneficiaries will pay. This framing, developed in Section 4.4, is the study's organising economic idea.

2.2 Megaproject performance and the economics of cost escalation

Large infrastructure projects systematically exceed their budgets. Flyvbjerg et al. (2002), analysing 258 transport projects, found average cost escalation of 45 percent for rail, 34 percent for fixed links such as bridges and tunnels, and 20 percent for roads, with costs underestimated in nine projects out of ten; large dams display the same pattern (Ansar et al., 2014). Flyvbjerg (2014) attributes the regularity to a mix of optimism bias and strategic misrepresentation, and argues that credible appraisal must apply documented outturn distributions rather than promoters' point estimates. This literature does two things for the present study. It supplies the empirical overrun rates used in Section 4.3 to convert an optimistic engineering estimate into a reference planning basis, and it warns against accepting any single headline cost figure, an injunction the cost reconciliation below takes literally.

2.3 Real options and the valuation of flexibility under uncertainty

Standard discounted-cash-flow appraisal undervalues assets whose payoff is contingent and whose construction can be staged. Real-options theory, developed by Dixit and Pindyck (1994) and Trigeorgis (1996), values the right, but not the obligation, to act once uncertainty resolves, and shows that under deep uncertainty the option to wait, to stage, and to abandon carries measurable economic value. A crisis-contingent corridor is, in these terms, a standing option to keep oil moving when the primary route is contested, and its phased construction embeds further options to expand or to abandon. Section 4.4 applies this apparatus to value the corridor's flexibility, and Section 5 draws on it to justify an evidence-gated construction programme.

2.4 Capacity reservation and tolling of non-excludable assets

Infrastructure whose peacetime utilisation is low but whose crisis value is high cannot be financed from usage tolls alone, because users have little reason to pay when the primary route is open and free. Reservation and availability-payment structures, familiar from pipeline capacity markets, liquefied-natural-gas regasification contracts and capacity mechanisms in electricity, decouple revenue from throughput by charging for guaranteed access rather than for flow. The study adapts this logic in Section 4.4, specifying a capacity-reservation contract that converts the public good into an excludable right and prices it as an insurance premium rather than a transport toll.

2.5 Financial integrity and the governance of large capital flows

A project that pools state-linked capital from several continents and moves commodities beside a sanctioned shadow fleet is a governance problem as much as a financing problem. The financial-integrity literature and the standards of the Financial Action Task Force (FATF) establish that large trade and project flows are vulnerable to trade-based money laundering, sanctions evasion and terrorist financing, and that mitigation depends on beneficial-ownership transparency, enhanced due diligence and information-sharing (FATF & Egmont Group, 2020; FATF, 2013). The UAE's own trajectory, grey-listing in 2022 and removal in 2024, illustrates both the exposure of a high-connectivity hub and the institutional capacity to address it (Norton Rose Fulbright, 2024; FATF, 2023). Section 4.4 builds these requirements into the corridor's governance by design rather than treating them as a compliance afterthought.

2.6 The strategic context, in brief

The security-studies literature on chokepoints and coercion supplies motivation rather than framework for this study and is therefore treated compactly. The modern energy-security debate dates to Yergin's (2006) framing, and scholarship on the Strait of Hormuz has long disputed whether a closure could be sustained or whether markets would adapt (Talmadge, 2008; Gholz & Press, 2010). Chokepoints concentrate commercial flows and hence vulnerability (Rodrigue, 2004), and actors at network nodes can "weaponise" interdependence by raising the cost partners bear if a relationship is cut (Farrell & Newman, 2019; Hirschman, 1945). Snyder's (1961) distinction between deterrence by punishment and by denial, and Schelling's (1966) insistence that coercion depends on the target's vulnerability, explain why

redundant capacity matters: bypass capacity denies a closure its payoff. Network-fragility and energy-security scholarship reinforces the point, hub-dominated networks collapse under targeted attack on their hubs (Albert et al., 2000; Perrow, 1984), diverse portfolios outperform concentrated ones under deep uncertainty (Cherp & Jewell, 2014; Sovacool & Mukherjee, 2011; Stirling, 2010), and resilience scholarship distinguishes absorbing a shock from transforming the system that bore it (Holling, 1973; Linkov et al., 2014). The economic translation of these ideas, pursued in this study, is that redundancy is a form of insurance whose value rises with the concentration of the risk it hedges.

3. Research Methodology

3.1 Design

The study combines three methods: a single information-rich case study of the 2026 Strait of Hormuz closure; comparative analogue analysis of canal, tunnel and pipeline projects used to test whether proposed dimensions and costs are feasible; and transparent financial modelling of the corridor's cost, revenue and option value. The case-study and comparative components establish the economic structure of the problem and the buildability of the asset; the financial model quantifies the financing question that is the study's focus. The approach is explicitly a planning-stage appraisal, not a feasibility study: it rests on secondary data and transparent arithmetic, and it is designed to be reproducible rather than definitive.

3.2 Data

Chronology and volumes for the 2026 crisis were drawn, in order of preference, from IEA reports and factsheets, U.S. Energy Information Administration (EIA) analyses, Lloyd's List Intelligence, the Center for Strategic and International Studies (CSIS), the International Crisis Group and the Brookings Institution, supplemented by contemporaneous specialist and wire reporting (IEA, 2026a, 2026b, 2026c; Dunn & Barden, 2025; Funaiole et al., 2026; Gross & Beane, 2026). Demand, price and long-run outlook data are taken from OPEC (2025) and the IEA. Financial-integrity and sanctions material relies on primary instruments and official guidance from the FATF and the Central Bank of the United Arab Emirates (CBUAE, 2025). The empirical record was last verified on 5 October 2026; because the status of the strait has changed repeatedly since February 2026, the case description should be read as current to that date.

3.3 Analytical techniques

Four techniques are used. Capital recovery converts the reference capital cost into an equivalent annual charge using the capital-recovery factor, $CRF = r \div [1 - (1 + r)^{-n}]$, with $n = 40$ years and $r = 3$, 5 and 7 percent. Break-even-toll analysis derives the per-barrel toll that would recover that charge under alternative peacetime-utilisation assumptions. Capacity-reservation analysis prices guaranteed crisis access as an annual fee per reserved barrel of daily capacity. Real-options valuation estimates the corridor's exercise value during a crisis as the price spike and war-risk premiums that reservation holders avoid on the volumes it protects. Scenario analysis then varies closure frequency and duration to bound the corridor's expected value and its break-even closure probability.

3.4 Replicability and limitations of the model

All principal figures, their sources and their derivations are set out in Appendix B so that the arithmetic can be checked and the assumptions varied; the engineering parameters underlying the reference design are documented in Appendix C. The model deliberately excludes operating costs, taxes and financing structure, which means required revenues are understated; its real-options and scenario estimates are illustrative; and its loss figures count exporters' revenue only. These simplifications are stated so that readers can judge the direction of the resulting bias, which is conservative with respect to the corridor's value.

4. Results

4.1 The transport-layer gap

The first result establishes why the problem is one of route redundancy rather than resource adequacy. Hormuz carried about 20 million bpd in 2024, more than a quarter of seaborne oil trade, with 84 percent of its crude and condensate going to Asia; around one-fifth of global liquefied-natural-gas (LNG) trade also passed through it (Dunn & Barden, 2025). Read comparatively (Table 1), Hormuz is the extreme chokepoint: Malacca carries more oil but tankers can divert to the Sunda or Lombok Straits, Suez has the SUMED pipeline and the Cape route, and even Panama has a pipeline. Only at Hormuz does closure leave most of the flow with nowhere to go, because the producers themselves sit inside the chokepoint. The remedy must therefore be infrastructural rather than navigational.

Table 1. Principal oil chokepoints compared

Chokepoint	Oil flow, 2023 (mb/d)	Main alternatives	Bypass capacity (mb/d)	Legal regime	Principal threat
Strait of Hormuz	20.9	Saudi East-West; UAE ADCOP	3.5-5.5 redirectable	Transit passage (UNCLOS Part III); Iran not a party	State coercion; mines; soft closure
Strait of Malacca	23.7	Sunda and Lombok Straits	Rerouting only	Transit passage	Navigational density; maritime crime
Suez Canal/SUMED	8.8	SUMED pipeline; Cape route	2.5 (SUMED)	Egyptian sovereignty; Constantinople Convention (1888)	Regional conflict; blockage
Bab el-Mandeb	8.6	Cape route; East-West to Yanbu	Rerouting only	Transit passage	Missile and drone attacks
Panama Canal	2.1	Trans-Panama pipeline; Cape Horn	0.86	Panamanian sovereignty; Neutrality Treaty (1977)	Drought and water-level limits

Source: EIA (2024) for flows and the SUMED and Trans-Panama capacities; IEA (2026c) for Hormuz bypass capacity. Threat characterisations are the author's.

The 2026 closure demonstrated the point in operation. It worked commercially before it worked militarily: the International Group of P&I Clubs let war-risk cover lapse, and when underwriters returned, premiums rose from about 0.25 percent of hull value to roughly 1 percent, lifting the insurance bill for a single very-large-crude-carrier (VLCC) voyage from about $250,000 to $2-3 million (Bao, 2026). A littoral state need not achieve sea control; it need only push the expected cost of transit above what commercial actors will bear (Yildiz, 2026). Strategic stocks cannot close a gap of this size: against a net loss of roughly 10 million bpd, a 400-million-barrel coordinated release covers about forty days, and stocks deplete precisely when needed (IEA, 2026b). Only transport capacity outside the chokepoint can close a gap of that magnitude.

The closure also had an illicit-finance dimension directly relevant to the governance case developed later. When mainstream cover is withdrawn or priced out, cargo migrates toward operators willing to sail uninsured or under opaque cover, and freight markets reward them; spiking war-risk surcharges and opaque charter chains become convenient channels for moving value between related parties, a classic trade-based-laundering pattern (FATF & Egmont Group, 2020). The shadow fleet that absorbs such cargo numbered some 978 tankers in September 2025, about 18.5 percent of the global fleet, many uninsured and in the habit of disabling transponders during offshore transfers (Lin, 2025), and the same channels have financed armed non-state actors (U.S. Department of the Treasury, 2021). Redundant, audited routes keep trade inside insured channels during a crisis, which is a financial-integrity benefit as well as a commercial one.

Exposure is highly concentrated (Table 2). In 2025 Hormuz carried 5.43 million bpd of Saudi crude, 3.32 million of Iraqi, 2.02 million of Emirati and smaller volumes from Kuwait, Iran and Qatar, with 96 percent of the UAE's crude and 93 percent of Qatar's LNG transiting the strait (IEA, 2026c). On the import side, Japan, South Korea, India and China together take about 69 percent of Hormuz crude, so a month's interruption withholds roughly $31 billion of crude at $100 per barrel before any price premium on their other imports (Reuters, 2026a; Banchero Costa, 2026). Supply-disruption and precautionary-demand shocks of this kind have preceded most postwar recessions (Hamilton, 2009; Kilian, 2009), which is why the losses extend well beyond the Gulf.

Table 2. Gulf exporters' dependence on the Strait of Hormuz

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Exporter	Crude via Hormuz, 2025 (mb/d)	Main non-Hormuz outlet (mb/d)	Approx. share of crude exports via Hormuz
Saudi Arabia	5.43	Yanbu (Red Sea), 1.3-1.4 before the war	~80%
Iraq	3.32	Limited northern flows	Nearly all seaborne exports
UAE	2.02	Fujairah via ADCOP, ~1.1 in use	~65%
Kuwait	1.40	None	100%
Qatar	0.73 (93% of LNG)	None	~100%

Source: IEA (2026c); Reuters (2026b). Shares are the author's calculations (Appendix B).

4.2 Existing bypass capacity and its limits

The second result establishes the ceiling of the incremental, pipeline-only response. The UAE's existing hedge is the Abu Dhabi Crude Oil Pipeline (ADCOP), a 380-kilometre line from Habshan to Fujairah built for a reported $3.29 billion (about $4.61 billion in 2025 prices; see Appendix B) and operating since 2012 at 1.5-1.8 million bpd (Offshore Technology, 2024). In 2026 it became crucial to maximising exports from the Gulf-of-Oman coast, and in May 2026 the UAE directed its national oil company to fast-track a West-East pipeline intended to double Fujairah export capacity by 2027, the clearest official signal that existing capacity is insufficient (Reuters, 2026c). Saudi Arabia's East-West pipeline, the region's other major bypass, offers 7 million bpd to Yanbu but relocates exposure to the Red Sea, where unhindered transit through Bab el-Mandeb remained elusive in 2026 (Gross & Beane, 2026; IEA, 2026a). The load-bearing figure is the IEA's: Saudi and Emirati pipelines offer 3.5-5.5 million bpd of redirectable capacity, or 18-28 percent of normal flows (IEA, 2026c).

Table 3. Chokepoint bypass systems compared

Chokepoint	Bypass	Capacity (mb/d)	Cost	In service	Status
Hormuz	Saudi East-West pipeline	7.0	Not reported in sources used	Operating	Ran near capacity in 2026
Hormuz	UAE ADCOP	1.5-1.8	$3.29B	2012	Operating; expansion fast-tracked
Hormuz	Iran Goreh-Jask	0.3 (1.0 planned)	Not reported	2021	Partially built out
Suez Canal	SUMED pipeline	2.5	Not reported	Operating	Operating
Panama Canal	Trans-Panama pipeline	0.86	Not reported	Operating	Operating
Hormuz	Sharjah-Fujairah corridor (proposed)	20-25 (equivalent)	$130-160B (reference)	2035 earliest	Proposed

Source: Gross and Beane (2026); Offshore Technology (2024); Eqbali (2021); EIA (2024); corridor figures from Section 4.3.

Scaling from ADCOP's cost benchmark, a new 1.5-2 million bpd line on the mountainous Sharjah-Fujairah alignment would plausibly cost $4-6 billion, and a ten-line network approaching Hormuz throughput $40-60 billion before tunnelling premiums (Table 4). But three structural limits remain however many lines are laid. Pipelines are product-specific, so a crude line carries neither LNG nor the 4.93 million bpd of products that transit Hormuz; they are origin-specific, serving particular fields rather than all Gulf cargoes; and they concentrate risk at a few pumping stations and terminals. Pipelines stabilise markets during disruptions; on their own they do not replace the chokepoint.

Table 4. Hormuz flows and bypass options

Infrastructure	Capacity (mb/d)	Share of normal Hormuz flow	Indicative cost
Strait of Hormuz (2024-25)	~20	100%	-
Redirectable Saudi and UAE pipeline capacity	3.5-5.5	18-28%	Existing
Additional Sharjah-Fujairah crude line	1.5-2	7-10%	$4-6B
Ten-line pipeline network	~20	~100%	$40-60B, before tunnelling premiums
Canal-pipeline hybrid, Phase 1	8-10	40-50%	Within reference case
Canal-pipeline hybrid, full system	18-24 (20-25 with DRAs)	90-125%	$130-160B (reference)

Source: IEA (2026c); Dunn and Barden (2025); ADCOP-scaled costs and hybrid figures are the author's estimates (Section 4.3 and Appendices B and C).

4.3 The canal-pipeline hybrid reference design

The third result settles what is buildable, because the cost basis for the financial model depends on it. The source proposal envisaged a sea-level ship canal carrying laden VLCCs across the Hajar Mountains. That design fails a dimensional test: VLCCs are about 60 metres in beam, no existing canal takes them laden, the largest tunnel-boring machine ever built measured 17.63 metres, and a pure surface cut would require 2-3 billion cubic metres of excavation in hard ophiolite rock (Ahmed, 2024; Guinness World Records, n.d.; Searle & Cox, 1999; Oxford Business Group, 2016). The study therefore adopts a canal-pipeline hybrid in which no VLCC crosses the peninsula: a sea-level western channel of about 70 kilometres feeds a Western Transfer Terminal, twin bored tunnels of 15-18 metres carry twelve 48-inch pipelines beneath the Masafi gap delivering 18-24 million bpd (20-25 million with drag-reducing agents), and an eastern marine terminal at Fujairah reloads cargoes (Appendix C). Ships discharge on one side and reload on the other, using bore diameters within proven range. The navigable channel is retained not for throughput but for three economic reasons developed below, a protected marine buffer, commercial dual-use revenue, and optionality, and the phased programme allows it to be dropped if feasibility work does not justify its incremental cost.

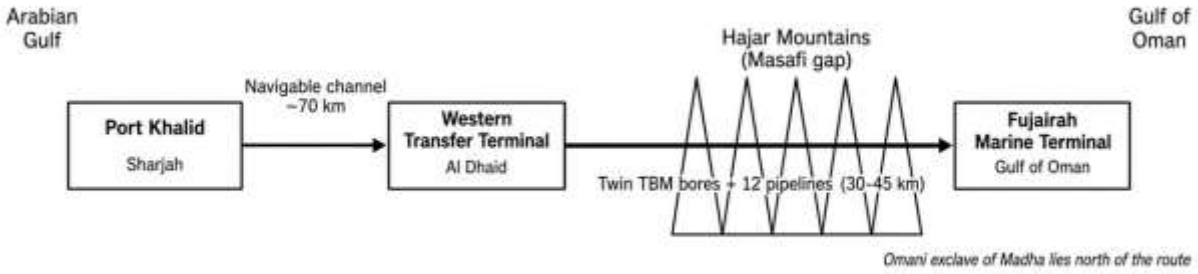


Figure 1. Schematic of the Sharjah-Fujairah corridor (reference alignment), not to scale. The figure shows the sequence of nodes and the position of the Omani exclave of Madha relative to the route; it makes no coordinate or boundary claim. Source: Author.

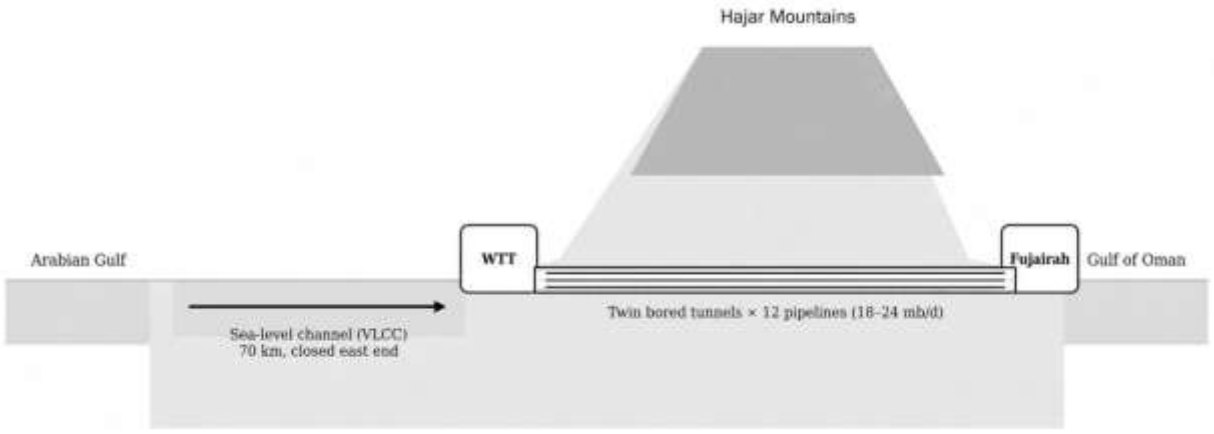


Figure 2. Canal-pipeline hybrid reference design, schematic cross-section, not to scale. Source: Author.

The cost basis is deliberately conservative. Two cost sets have circulated, $80-110 billion over six to nine years, and $180-220 billion over ten to fifteen, and they describe different worlds. Following the megaproject-performance evidence (Flyvbjerg et al., 2002), the study reconciles them by applying the documented average escalation for fixed links (34 percent) and rail (45 percent) to the optimistic estimate, yielding a reference planning basis of roughly $130-160 billion over nine to twelve years (Tables 5 and 6). The Panama expansion, which opened in 2016 after stoppages and contractor claims of up to $2.6 billion against a $5.25 billion budget, is a sobering comparator (Oxford Business Group, 2015). The optimistic case is possible; planning on it would be imprudent.

Table 5. How the Hajar Mountains are crossed: design options

Option	Mountain crossing	Laden VLCCs cross?	Excavation	Cost	Timeline	Technical status
A. Sea-level open cut	Deep cut through lowest pass	Yes	2-3 billion m^3	$70-100B	10-15 yrs	Proven methods; unprecedented scale in hard rock
B. Large-span ship tunnels	Drill-and-blast caverns	Yes	0.5-0.8 billion m^3	$120-150B	8-12 yrs	No precedent at this size
C. Canal-pipeline hybrid (reference)	Twin TBM bores with pipelines	No (transfer)	1.0-1.5 billion m^3	$80-110B	6-9 yrs	Within proven TBM range

Source: Design data underlying Author (2026), reassigned by the author to the crossing methods described. All are optimistic planning-stage estimates.

Table 6. Reconciled cost and timeline cases for the hybrid corridor

Case	Assumptions	Capital cost	Timeline
Optimistic	Favourable geology; surge construction at 10-15 sites; no major overrun	$80-110B	6-9 yrs
Reference (planning basis)	Optimistic case plus 34-45% escalation (fixed-link and rail norms)	$130-160B	9-12 yrs
Conservative	Adverse geology, full surface works or redesign, upper-tail overruns	$180-220B	12-15 yrs

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Source: Author's synthesis; escalation rates from Flyvbjerg et al. (2002); conservative range from the author's source data. Derivation in Appendix B.

4.4 Funding architecture and financial integrity

A global energy-insurance instrument

The fourth result is the study's core economic contribution: a financing and governance architecture that makes the corridor viable. The corridor is better understood as a global energy-insurance instrument than as a national project. Those most exposed to Hormuz risk, Gulf exporters and Asian importers above all, have the strongest reason to pay, but because transit security is non-rival and hard to exclude, it tends to be underprovided, and Olson (1965) predicts free-riding in exactly these conditions. The design task is to convert a diffuse benefit into an excludable right, guaranteed crisis access, that justifies payment. Hold-up risk runs the other way, since contributors fear the host could reprice access once the asset exists; a statutory open-access charter and transparent, published reservation contracts answer both problems.

Capital structure and sovereign-investor governance

The proposed capital structure (Table 7) blends sovereign, importer, institutional and multilateral capital. UAE sovereign-wealth funds would take 40 percent, reflecting the UAE's direct exposure and the strategic value of hosting the asset; Asian importers 30 percent, the minimum consistent with the reservation rights they would receive and with bounding the free-riding Olson predicts; Western institutional investors 20 percent, bringing long-duration capital and governance discipline through revenue bonds issued partly as asset-backed sukuk; and multilateral finance 10 percent, which helps the project read internationally as a public good rather than a national advantage. Spread over nine to twelve years, a $52-64 billion share is a modest annual allocation for institutions of the scale of the Abu Dhabi Investment Authority, Mubadala and ADQ (Cabral, 2025; ADQ, 2025). The sovereign investors would bring their own governance, ESG and compliance obligations to their stakes, raising the bar for every other contributor.

Table 7. Estimated funding structure for the Sharjah-Fujairah corridor

Funding source	Share	Optimistic case ($80-110B)	Reference case ($130-160B)
UAE sovereign wealth funds	40%	$32-44B	$52-64B
Asian importers	30%	$24-33B	$39-48B
Western institutional	20%	$16-22B	$26-32B
Multilateral finance	10%	$8-11B	$13-16B

Source: Author's estimates; amounts are the stated shares applied to the cost ranges in Table 6.

Figure 3. shows the same structure at the reference-case midpoints, underscoring that no single contributor carries a share large enough to dominate governance while each has a stake proportionate to its exposure.

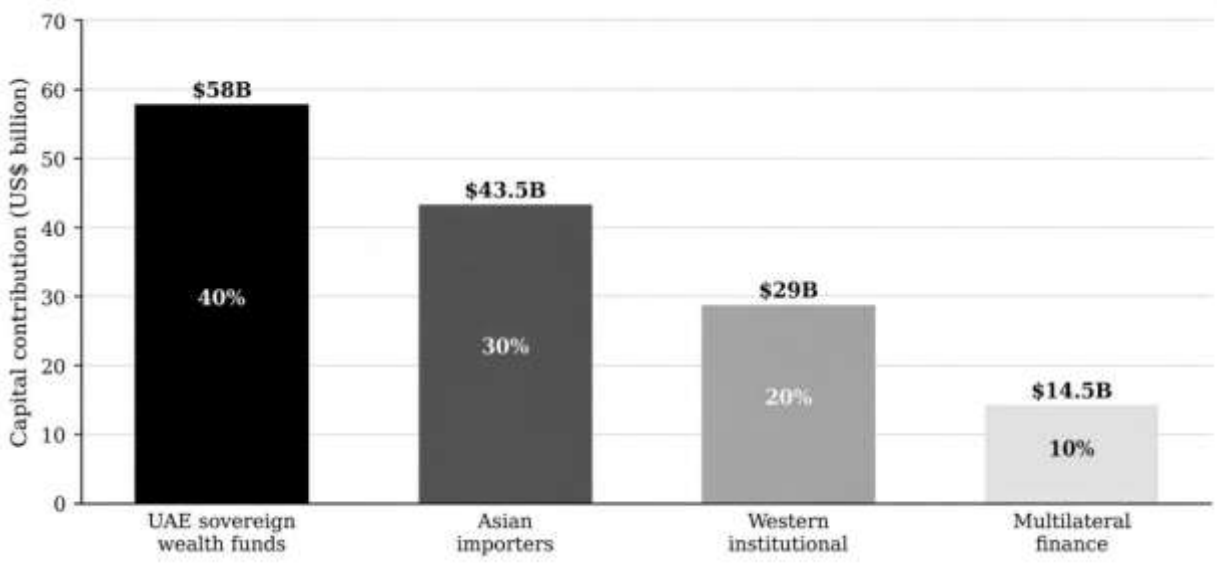


Figure 3. Estimated funding structure under the reference case, midpoints (US$ billion). Source: Author's estimates, Table 7.

Financial integrity by design

A project that pools state-owned capital from several continents and moves tens of millions of barrels a day beside an active shadow fleet is an obvious target for illicit finance, and the governance must be built in rather than added on. The legal anchor exists: Federal Decree-Law No. 10 of 2025, in force since 14 October 2025, tightened beneficial-ownership requirements, made proliferation financing a standalone offence, and raised corporate fines to AED 100 million (Kochar et al., 2025). The reputational anchor is the UAE's exit from the FATF grey list in February 2024 (Norton Rose Fulbright, 2024). Four controls follow, consistent with FATF Recommendations 10 and 24. Every capital contributor, reservation holder and terminal user would undergo enhanced due diligence with ultimate beneficial owners disclosed and screened; all payments would pass through UAE-regulated banks into segregated, independently audited accounts, with no cash, third-party payments or netting against cargoes; every barrel would be metered, documented and matched to a screened vessel with continuous automatic-identification-system history; and contractors would be screened to the same standard, because construction supply chains are where trade-based laundering finds room (FATF & Egmont Group, 2020).

These controls work only if they connect to the national system. The canal authority would be a reporting entity under Decree-Law No. 10, filing suspicious-transaction reports with the UAE Financial Intelligence Unit and housing a dedicated integrity unit with a direct reporting line to it; the unit's Egmont Group membership gives it secure channels to exchange information with counterpart units in contributors' and shippers' jurisdictions (CBUAE, 2023). Banks financing the corridor's trade would apply the Central Bank's November 2025 guidance on trade-based laundering and transshipment, which warns that the UAE is "particularly vulnerable to transshipment abuse" and requires review of vessel data for high-risk commodity trades (CBUAE, 2025). Operationally, the integrity unit would work from a short list of triggers, a change in a reservation holder's beneficial ownership, payment routed through a third country or exchange house, a nominated vessel with gaps in its AIS history, a cargo whose declared origin conflicts with its assay, or procurement invoices out of line with benchmarks, each corresponding to a documented FATF or Central Bank typology. In practice correspondent banks would see a single, well-documented counterparty rather than a cloud of intermediaries, which lowers their de-risking incentive.

Sanctions compliance

The hardest governance question is sanctioned oil. UN sanctions on Iran were reimposed under the snapback mechanism in September 2025, the European Union reinstated restrictions the next day, and the UAE implements UN measures through Cabinet Decision No. 74 of 2020, which requires freezing "without delay and without prior notice" (Cogman et al., 2025). A credible corridor needs a published sanctions policy: it would carry no cargo whose origin, ownership or financing involves a designated person or entity; it would screen cargo origin through documentary evidence, AIS history and laboratory fingerprinting where origin is doubtful; and it would maintain liaison with the U.S. Office of Foreign Assets Control and EU authorities so that participating banks and insurers can rely on its screening without fear of secondary exposure. That policy narrows the corridor's immediate benefit to Iran, but a corridor that carried sanctioned cargoes would lose its banks, insurers and Western investors overnight and would then serve no one.

Revenue: why tolls fail and reservation works

The revenue structure is where the public-goods problem is solved in practice. A toll of $0.50 per barrel on 20 million bpd yields $3.65 billion a year, far short of the capital charge on $145 billion over 40 years, $6.3 billion at 3 percent, $8.5 billion at 5 percent, $10.9 billion at 7 percent, and the deeper problem is utilisation: when Hormuz is open and free, ships have little reason to pay to avoid it, so break-even tolls rise sharply as peacetime utilisation falls (Table 8). Capacity reservation aligns revenue with what the asset actually provides. The annual fee per reserved barrel of daily capacity is $F = [K \times CRF(r, n) + O - T] \div Q_res$, where K is capital cost, O annual operating cost, T toll and service revenue, and Q_res the reserved capacity. With O and T set aside, a $145 billion corridor at 5 percent over 40 years needs about $8.45 billion a year; if importers reserve 12 million bpd, the fee is about $704 per reserved barrel of daily capacity per year, which for the four largest Asian importers works out to roughly 3 percent of the value of their Hormuz crude at $75 per barrel. Revenue then arrives whether or not ships transit in peacetime, while channel services and crisis tolls add upside. Reservation contracts would be standardised and published, priced on a disclosed formula, held only by screened state or regulated entities, non-transferable without regulatory approval, and paid through audited accounts, unlike the opaque prepayment and offtake structures that FATF typologies flag (FATF & Egmont Group, 2020).

Table 8. Break-even toll (US$ per barrel) by discount rate and peacetime utilisation

Discount rate	25% utilisation (5 mb/d)	50% utilisation (10 mb/d)	100% utilisation (20 mb/d)
3%	3.44	1.72	0.86
5%	4.63	2.32	1.16
7%	5.96	2.98	1.49

Source: Author's calculations. Capital cost $145B (reference midpoint), 40-year recovery, operating costs excluded. Annual charge = $K \times r \div [1 - (1 + r)^{-40}]$. The 100% utilisation column is illustrative; peacetime utilisation is expected to be substantially lower, which is why capacity reservation is the reference revenue structure.

A real-options view

Treating the corridor as a static investment undervalues it. Following Dixit and Pindyck (1994) and Trigeorgis (1996), the corridor is a standing option to keep oil moving when Hormuz is contested: its peacetime cost is the annual carrying charge of about $8.45 billion, and its exercise value appears only in a crisis, as the price spike and war-risk premiums that reservation holders avoid on the volumes it protects (Table 9). In a severe or extreme crisis the corridor repays a full year's carrying cost in roughly 16-20 days, and even in a moderate one in under a month; a 30-day crisis delivers more value to importers than the corridor costs them in a year. That is the logic of insurance, and it is why the reservation fee should be read as a premium rather than a subsidy. The phasing adds a second layer of optionality: the second bore is itself an option to expand that need be exercised only if Phase 1 performs, and the channel can be abandoned in favour of a pipeline-only crossing if feasibility work fails to justify it, staged commitments of exactly the kind real-options theory recommends under deep uncertainty.

Table 9. Real-options value of the corridor during a crisis

War-risk scenario	Price spike avoided ($/bbl)	War-risk premium avoided per VLCC voyage	Value per crisis day to reservation holders	Days to recover annual carrying cost	Value of a 30-day crisis
Moderate	30	$1 million	~$0.32B	~27	~$9.4B
Severe	40	$2 million	~$0.42B	~20	~$12.7B
Extreme	50	$3 million	~$0.53B	~16	~$15.9B

Source: Author's calculations. Protected volume 10.3 mb/d (the four largest Asian importers' Hormuz crude), about 5.2 VLCC voyages per day; annual carrying cost $8.45B (Table 8 assumptions). Exporters' preserved revenue is excluded; including it would shorten the recovery period to under a week.

5. Discussion

5.1 What the case says about public-goods provision

The corridor case clarifies how a global public good can actually be financed. The theoretical obstacle, non-excludability and the free-riding it invites (Olson, 1965; Kaul et al., 1999), is overcome not by exhortation but by engineering an excludable right. Capacity reservation converts assured crisis access into a contractible, priceable product; linking reservation rights to governance seats and to security contributions gives each contributor a durable stake; and a statutory open-access charter answers the hold-up problem that would otherwise deter outside capital. These design choices sit within the Gulf monarchies' political economy, in which secure export revenues underpin stability and the UAE has pursued an autonomous, diversified posture (Krane, 2019; Ulrichsen, 2017). The legal and governance scaffolding can borrow from established models: Egypt's Suez Canal Authority shows that an international free-access guarantee can be written into domestic law, on the model of the Constantinople Convention (1888) and the Panama Canal Neutrality Treaty (1977); Panama's authority shows how staggered board terms insulate an asset from electoral cycles; and the Port of Rotterdam and DP World show that public ownership and commercial discipline can coexist (Boomer & Sadek, 2021; Autoridad del Canal de Panamá, n.d.; Port of Rotterdam Authority, n.d.; DP World, 2020). The general lesson is that excludability is a design choice: public goods are underprovided until someone builds the institution that makes their benefits chargeable.

5.2 What it says about project finance under geopolitical risk

The case also illustrates how megaproject appraisal should handle geopolitical and construction risk. First, cost discipline requires documented outturn distributions, not promoters' point estimates; applying fixed-link and rail escalation rates turns an optimistic $80-110 billion figure into a defensible $130-160 billion planning basis (Flyvbjerg et al., 2002). Second, flexibility has value that static discounted-cash-flow appraisal misses: valuing the corridor as a real option, and sequencing it so that pipelines deliver in two to three years while the canal commitment remains contingent on independent studies, both raises the expected value and bounds the downside (Dixit & Pindyck, 1994; Trigeorgis, 1996). Scenario analysis sharpens the point: across capital costs of $95-200 billion and discount rates of 3-7 percent, the corridor pays for itself on exporters' losses alone if the annual probability of a 180-day closure exceeds roughly 1.6-6.0 percent, one such closure every 17 to 61 years (Table 10). Before 2026 a closure of that length was thought improbable; that assumption no longer holds. Even the scenario in which the strait stays open is not a loss, because the corridor will have lowered the strategic value of closing it and given markets reason to price less risk into Gulf crude and freight.

Table 10. Corridor value under three futures

Scenario	Assumption	Expected avoided exporter losses per year	Value under capacity reservation
(a) Hormuz reopens and stays open	No closure over the asset's life	~$0	Reservation fees carry the capital; value lies in the option and lower risk premiums
(b) Recurrent short closures	One 30-day closure every five years	~$8.4B	Avoided losses roughly equal the annual capital charge
(c) Prolonged closure	One 180-day closure every 25 years	~$10.1B	Avoided losses exceed the annual capital charge

Source: Author's calculations, assuming 14 mb/d of disrupted Gulf output (Gross & Beane, 2026) at $100 per barrel; importers' and wider economic losses excluded. Note: Scenario (c) assumes one 180-day closure every 25 years; the loss per event is 14 mb/d × $100 × 180 days = $252 billion (total), which annualised over the 25-year interval is about $10.1 billion per year.

The economic logic also has a structural corollary visible in Figure 4: as corridor capacity is delivered in phases, a progressively larger share of normal flows is placed beyond the reach of a closure. A Phase 1 system of 8-10 million bpd, added to the 3.5-5.5 million bpd of redirectable pipeline capacity, would put roughly 60-80 percent of normal flows beyond a closure's reach, and the full system approaches parity with Hormuz throughput. For a business and economics readership the point is not strategic but financial: redundancy at this scale compresses the risk premium that markets price into Gulf crude and freight, whether or not the strait is ever closed again.

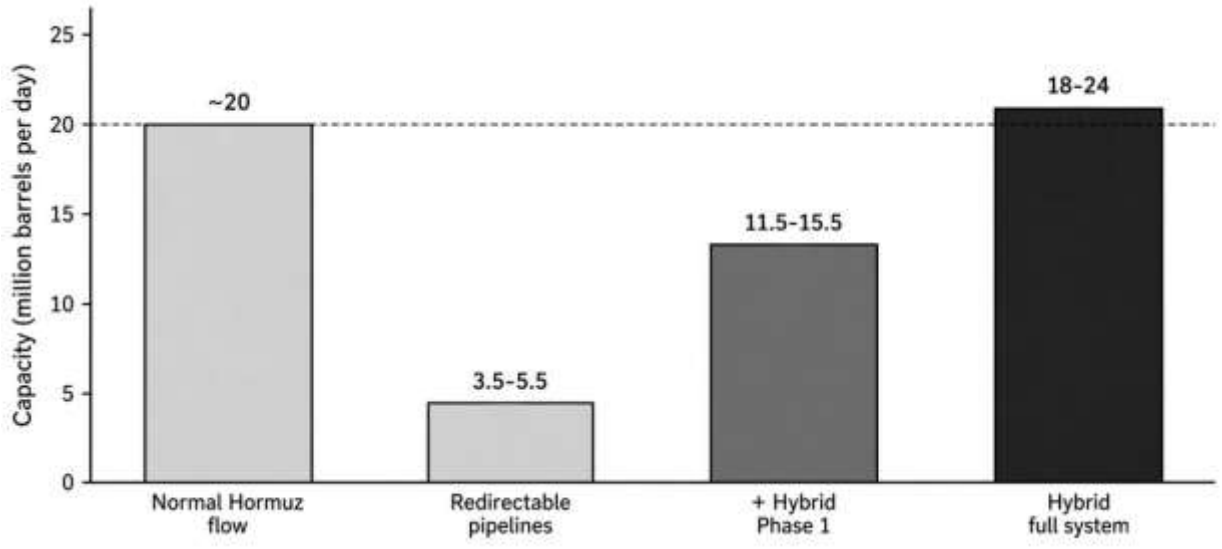


Figure 4. Hormuz flows and bypass capacity, 2025 baseline and corridor phases (million barrels per day). Source: IEA (2026c); author's reference-design estimates.

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Data availability. This study relies on publicly available secondary data from IEA, EIA, Lloyd's List Intelligence, CSIS, Brookings, OPEC, FATF and CBUAE sources. All figures and calculations are documented in Appendix B and are reproducible from the cited sources. No new datasets were generated.

Ethics. This research did not involve human participants, human data, or animal subjects, and no ethical approval was required.

Author contributions (CRediT) and author identity. Full CRediT roles, authorship and affiliation details are provided on the separate title page and are withheld from this file to preserve anonymity for double-blind review.

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References

ADQ. (2025, December 19). Tahnoon bin Zayed chairs ADQ Board of Directors meeting. https://www.adq.ae/newsroom/tahnoon-bin-zayed-chairs-adq-board-of-directors-meeting-2

Ahmed, Z. (2024, June 29). 5 biggest tanker ships in the world. Marine Insight. https://www.marineinsight.com/5-biggest-tanker-ships-in-the-world/

Albert, R., Jeong, H., & Barabási, A.-L. (2000). Error and attack tolerance of complex networks. Nature, 406(6794), 378-382. https://doi.org/10.1038/35019019

Ansar, A., Flyvbjerg, B., Budzier, A., & Lunn, D. (2014). Should we build more large dams? The actual costs of hydropower megaproject development. Energy Policy, 69, 43-56. https://doi.org/10.1016/j.enpol.2013.10.069

Autoridad del Canal de Panamá. (n.d.). Fundamentos legales. Retrieved October 5, 2026, from https://pancanal.com/fundamentos-legales/

Banchero Costa. (2026, March 7). Tanker market: Almost half of China's crude oil imports in 2025 arrived from the Arabian Gulf. Hellenic Shipping News. https://www.hellenicshippingnews.com/?p=1125438

Bao, Z. (2026, March 7). War risk insurance returns to Strait of Hormuz, at a price. Caixin Global. https://www.caixinglobal.com/2026-03-07/war-risk-insurance-returns-to-strait-of-hormuz-at-a-price-102420420.html

Boomer, E., & Sadek, G. (2021, April). Stuck in the Suez Canal: What are the legal implications? In Custodia Legis. Law Library of Congress.

https://blogs.loc.gov/law/2021/04/stuck-in-the-suez-canal-what-are-the-legal-implications/

Cabinet Decision No. 74 of 2020 Regarding Terrorism Lists Regulation and Implementation of UN Security Council Resolutions (United Arab Emirates). https://www.uaeiec.gov.ae/en-us/laws-regulations-listing/cabinet-resolution-no-74-of-2020

Cabral, A. R. (2025, October 1). Abu Dhabi tops MENA sovereign wealth fund spending. The National. https://www.thenationalnews.com/business/economy/2025/10/01/abu-dhabi-wealth-funds-top-mena-swf-spending/

Central Bank of the United Arab Emirates. (2023, July 4). Annual Egmont Group of FIUs plenary commences in Abu Dhabi with participation from over 500 senior officials [Press release]. https://centralbank.ae/media/u5layr22/

Central Bank of the United Arab Emirates. (2025). Guidance for licensed financial institutions on risks related to trade-based money laundering (TBML) and transshipment. https://centralbank.ae/media/50uhfenk/

Cherp, A., & Jewell, J. (2014). The concept of energy security: Beyond the four As. Energy Policy, 75, 415-421. https://doi.org/10.1016/j.enpol.2014.09.005

Cogman, S., Meakin, K., Head, E., Critchley, R., Mattout, J., Jouaneton, R., Mancuso, E. M., & Van Den Hende, L. (2025, September 29). The snapback of sanctions on Iran. Herbert Smith Freehills. https://www.hsfkramer.com/notes/fsrandcorpcrime/2025-posts/the-snapback-of-sanctions-on-iran

Constantinople Convention (Convention Respecting the Free Navigation of the Suez Maritime Canal), October 29, 1888. https://www.suezcanal.gov.eg/English/About/CanalTreatiesAndDecrees/Pages/ConstantinopleConvention.aspx

Dixit, A. K., & Pindyck, R. S. (1994). Investment under uncertainty. Princeton University Press. https://doi.org/10.1515/9781400830176

DP World. (2020, February 17). DP World to delist from Nasdaq Dubai [Press release]. https://www.dpworld.com/news/dp-world-to-delist-from-nasdaq-dubai/

Dunn, C., & Barden, J. (2025, June 16). Amid regional conflict, the Strait of Hormuz remains critical oil chokepoint. U.S. Energy Information Administration. https://www.eia.gov/todayinenergy/detail.php?id=65504

Eqbali, A. (2021, July 22). Iran inaugurates new oil exports terminal outside Strait of Hormuz. S&P Global Commodity Insights. https://www.spglobal.com/energy/en/news-research/latest-news/shipping/072221-iran-inaugurates-new-oil-exports-terminal-outside-strait-of-hormuz

Farrell, H., & Newman, A. L. (2019). Weaponized interdependence: How global economic networks shape state coercion. International Security, 44(1), 42-79. https://doi.org/10.1162/isec_a_00351

Federal Decree-Law No. 10 of 2025 Regarding Combating Money Laundering Crimes, Combating the Financing of Terrorism and the Financing of Arms Proliferation (United Arab Emirates). https://rulebook.centralbank.ae/en/rulebook/federal-decree-law-no-10-2025-regarding-anti-money-laundering-and-combating-financing

Financial Action Task Force. (2013). The role of hawala and other similar service providers in money laundering and terrorist financing. FATF. https://www.fatf-gafi.org/media/fatf/documents/reports/Role-of-hawala-and-similar-in-ml-tf.pdf

Financial Action Task Force. (2023). The United Arab Emirates' progress in strengthening measures to tackle money laundering and terrorist financing [Follow-up report]. FATF. https://www.fatf-gafi.org/en/publications/Mutualevaluations/FUR-UAE-2023.html

Financial Action Task Force & Egmont Group. (2020). Trade-based money laundering: Trends and developments. FATF. https://www.fatf-gafi.org/en/publications/methodsandtrends/documents/trade-based-money-laundering-trends-and-developments.html

Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. Project Management Journal, 45(2), 6-19. https://doi.org/10.1002/pmj.21409

Flyvbjerg, B., Holm, M. K. S., & Buhl, S. L. (2002). Underestimating costs in public works projects: Error or lie? Journal of the American Planning Association, 68(3), 279-295. https://doi.org/10.1080/01944360208976273

Funaiole, M. P., Prétat, H., Powers-Riggs, A., & Verschuur, J. (2026, April 22). The Strait of Hormuz in 8 charts. Center for Strategic and International Studies. https://www.csis.org/analysis/strait-hormuz-8-charts

Galil, B. S. (2007). Loss or gain? Invasive aliens and biodiversity in the Mediterranean Sea. Marine Pollution Bulletin, 55(7-9), 314-322. https://doi.org/10.1016/j.marpolbul.2006.11.008

Gholz, E., & Press, D. G. (2010). Protecting "the prize": Oil and the U.S. national interest. Security Studies, 19(3), 453-485. https://doi.org/10.1080/09636412.2010.505865

Gross, S., & Beane, R. (2026, June 8). From chokepoint to crisis: The Strait of Hormuz and global oil markets. Brookings Institution. https://www.brookings.edu/articles/from-chokepoint-to-crisis-the-strait-of-hormuz-and-global-oil-markets/

Guinness World Records. (n.d.). Largest tunnel boring machine. Retrieved October 5, 2026, from https://www.guinnessworldrecords.com/world-records/78259-largest-tunnel-boring-machine

Hamilton, J. D. (2009). Causes and consequences of the oil shock of 2007-08. Brookings Papers on Economic Activity, 2009(1), 215-261. https://doi.org/10.1353/eca.0.0047

Hirschman, A. O. (1945). National power and the structure of foreign trade. University of California Press. ISBN 978-0520040847

Holling, C. S. (1973). Resilience and stability of ecological systems. Annual Review of Ecology and Systematics, 4, 1-23. https://doi.org/10.1146/annurev.es.04.110173.000245

International Energy Agency. (2026a, August 12). Oil market report: August 2026. https://www.iea.org/reports/oil-market-report-august-2026

International Energy Agency. (2026b, March 12). Oil market report: March 2026. https://www.iea.org/reports/oil-market-report-march-2026

International Energy Agency. (2026c). Strait of Hormuz [Factsheet]. https://www.iea.org/about/oil-security-and-emergency-response/strait-of-hormuz

Kaul, I., Grunberg, I., & Stern, M. A. (Eds.). (1999). Global public goods: International cooperation in the 21st century. Oxford University Press. https://doi.org/10.1093/0195130529.001.0001

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. American Economic Review, 99(3), 1053-1069. https://doi.org/10.1257/aer.99.3.1053

Kochar, S., Aggarwal, K., & Gera, S. (2025, November 19). Federal Decree by Law No. (10) of 2025 regarding anti-money laundering, and combating the financing of terrorism and proliferation financing. Mondaq. https://www.mondaq.com/money-laundering/1707064/

Krane, J. (2019). Energy kingdoms: Oil and political survival in the Persian Gulf. Columbia University Press. ISBNs 9780231179300

Lin, M. (2025, September 3). Factbox: Shadow fleet expands to maintain sanctioned oil flows. S&P Global Commodity Insights. https://www.spglobal.com/energy/en/news-research/latest-news/crude-oil/090325-factbox-shadow-fleet-expands-to-maintain-sanctioned-oil-flows

Linkov, I., Bridges, T., Creutzig, F., Decker, J., Fox-Lent, C., Kröger, W., Lambert, J. H., et al. (2014). Changing the resilience paradigm. Nature Climate Change, 4(6), 407-409. https://doi.org/10.1038/nclimate2227

Norton Rose Fulbright. (2024). UAE removed from the FATF grey list. https://www.nortonrosefulbright.com/en-me/knowledge/publications/eb06aa7c/uae-removed-from-the-fatf-grey-list

Offshore Technology. (2024, November 8). Abu Dhabi crude oil (Habshan-Fujairah) pipeline project. https://www.offshore-technology.com/projects/abu-dhabi-pipeline/

Olson, M. (1965). The logic of collective action: Public goods and the theory of groups. Harvard University Press. https://doi.org/10.4159/9780674041660

OPEC. (2025, July 10). OPEC launches WOO 2025 and sees global oil demand at almost 123 mb/d in 2050 [Press release]. Organization of the Petroleum Exporting Countries. https://www.opec.org/pr-detail/1518570-10-july-2025.html

Oxford Business Group. (2015). Canal plus: The eight-year expansion programme. In The report: Panama 2015. https://oxfordbusinessgroup.com/canal-plus-the-eight-year-expansion-programme/

Oxford Business Group. (2016). Expanding Suez: A new canal opens. In The report: Egypt 2016. https://oxfordbusinessgroup.com/expanding-suez-a-new-canal-opens/

Panama Canal Neutrality Treaty (Treaty Concerning the Permanent Neutrality and Operation of the Panama Canal), September 7, 1977, 33 U.S.T. 1. https://treaties.un.org/doc/Publication/UNTS/Volume%201161/volume-1161-I-18342-English.pdf

Perrow, C. (1984). Normal accidents: Living with high-risk technologies. Basic Books. https://doi.org/10.1515/9781400828494

Por, F. D. (1978). Lessepsian migration: The influx of Red Sea biota into the Mediterranean by way of the Suez Canal. Springer. https://doi.org/10.1007/978-3-642-66728-2

Port of Rotterdam Authority. (n.d.). Our organisation. Retrieved October 5, 2026, from https://portofrotterdam.com/en/about-port-authority/our-organisation

Reuters. (2021, July 7). Factbox: The Ever Given's stranding in the Suez Canal. Nippon.com. https://www.nippon.com/en/news/reu20210707KCN2EC2EF/

Reuters. (2026a, March 3). Factbox: Global oil and LNG dependence on the Middle East. Baird Maritime. https://www.bairdmaritime.com/shipping/tankers/factbox-global-oil-and-lng-dependence-on-the-middle-east

Reuters. (2026b, March 18). Saudi Red Sea oil exports set to jump to 3.8m bpd in March. Baird Maritime. https://www.bairdmaritime.com/shipping/tankers/saudi-red-sea-oil-exports-set-to-jump-to-38m-bpd-in-march

Reuters. (2026c, May 15). UAE to accelerate oil pipeline project to help bypass Strait of Hormuz. BNN Bloomberg. https://www.bnnbloomberg.ca/business/2026/05/15/uae-to-accelerate-oil-pipeline-project-to-help-bypass-strait-of-hormuz/

Rodrigue, J.-P. (2004). Straits, passages and chokepoints: A maritime geostrategy of petroleum distribution. Cahiers de Géographie du Québec, 48(135), 357-374. https://doi.org/10.7202/011797ar

Schelling, T. C. (1966). Arms and influence. Yale University Press. https://doi.org/10.12987/9780300253481

Searle, M. P., & Cox, J. (1999). Tectonic setting, origin, and obduction of the Oman ophiolite. GSA Bulletin, 111(1), 104-122. https://doi.org/10.1130/0016-7606(1999)111<0104:TSOAOO>2.3.CO;2

Sheppard, C., Al-Husiani, M., Al-Jamali, F., Al-Yamani, F., Baldwin, R., Bishop, J., Benzoni, F., et al. (2010). The Gulf: A young sea in decline. Marine Pollution Bulletin, 60(1), 13-38. https://doi.org/10.1016/j.marpolbul.2009.10.017

Snyder, G. H. (1961). Deterrence and defense: Toward a theory of national security. Princeton University Press. https://doi.org/10.1515/9781400877164

Sovacool, B. K., & Mukherjee, I. (2011). Conceptualizing and measuring energy security: A synthesized approach. Energy, 36(8), 5343-5355. https://doi.org/10.1016/j.energy.2011.06.043

Stirling, A. (2010). Multicriteria diversity analysis: A novel heuristic framework for appraising energy portfolios. Energy Policy, 38(4), 1622-1634. https://doi.org/10.1016/j.enpol.2009.02.023

Talmadge, C. (2008). Closing time: Assessing the Iranian threat to the Strait of Hormuz. International Security, 33(1), 82-117. https://doi.org/10.1162/isec.2008.33.1.82

Tamhane, V. "Building Energy Resilience beyond the Strait of Hormuz," The Defence Horizon Journal, March 19, 2026, https://doi.org/10.5281/zenodo.19456464.

Trigeorgis, L. (1996). Real options: Managerial flexibility and strategy in resource allocation. MIT Press. ISBN 9780262201025

Ulrichsen, K. C. (2017). The United Arab Emirates: Power, politics and policymaking. Routledge. https://doi.org/10.4324/9781315677385

U.S. Department of the Treasury. (2021, June 10). Treasury sanctions network financing Houthi aggression and instability in Yemen [Press release]. https://home.treasury.gov/news/press-releases/jy0221

U.S. Energy Information Administration. (2024). World oil transit chokepoints. https://www.eia.gov/international/content/analysis/special_topics/World_Oil_Transit_Chokepoints/wotc.pdf

Yergin, D. (2006). Ensuring energy security. Foreign Affairs, 85(2), 69-82. https://doi.org/10.2307/20031912

Yildiz, G. (2026, July 28). Hormuz is becoming a fee-and-permission regime. Forbes. https://www.forbes.com/sites/guneyyildiz/2026/07/28/hormuz-is-becoming-a-fee-and-permission-regime/