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امنیت انرژی از رهگذر معماری جدید همکاری منطقه‌ای گاز طبیعی مایع (LNG): مطالعهٔ موردی خزر

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چکیده

در حوضهٔ خزر با دارابودن حدود ۲۷/۱۷ تریلیون مترمکعب/ ۶۱۰ تریلیون فوت‌مکعب (tcf) ذخایر اثبات‌شدهٔ گاز طبیعی، هنوز پنج کشور ساحلی (شامل آذربایجان، قزاقستان، ترکمنستان، ایران و روسیه) ارزش راهبردی و تجاری بسیار کمتری از آنچه این ذخایر باید ایجاد کند، به‌دست می‌آورند. اتکای بیش از حد به دالان‌های صادراتی واحد، تجارت گاز درون‌منطقه‌ای ناچیز و نبود هرگونه زیرساخت LNG در این دریای محصور در خشکی، سبب شده است این منطقه به‌طور ساختاری در معرض ترجیح‌های ژئوپلیتیکی خریداران خارجی باشد. در این مقاله استدلال شده است که کشورهای خزر هم پایهٔ منابع و هم انگیزهٔ تجاری لازم را برای ساخت چارچوبی منطقه‌ای در حوزهٔ انرژی دارایند تا از گاز در محل ارزش اقتصادی ایجاد کنند، گزینه‌های صادراتی را متنوع سازند و قدرت چانه‌زنی قدرت‌های خارجی را کاهش دهند. در پژوهش حاضر، از تحلیل کیفی و سیاست‌محور بر پایهٔ مرور منابع ثانویه استفاده شده است؛ شامل داده‌های ادارهٔ اطلاعات انرژی (EIA) و مرکز سیاست خزر (۲۰۲۲–۲۰۲۴)، پژوهش‌های مؤسسهٔ مطالعات انرژی آکسفورد و دیدگاه‌های کارشناسان منطقه‌ای. در این مطالعه، مناقارنی‌های ذخایر تولید، پویایی‌های قیمت‌گذاری و منافع ژئوپلیتیکی روسیه، چین، اتحادیهٔ اروپا، ایالات متحده و ایران بررسی شده است. سپس پنج ابتکار همکاری منطقه‌ای ارزیابی می‌شود: مبادلهٔ گاز و ذخیرهٔ درون‌خزری، خط لولهٔ انتقال خزر، کاسپین استریم، طرح‌های تبدیل گاز به برق/گاز به داده و دالان انرژی سبز. یافته‌های تحلیل نشان می‌دهد فروپاشی نظم پیشین جهانی LNG، که با منازعهٔ روسیه-اوکراین و بحران خلیج فارس تشدید شده است، پنجره‌ای برای همکاری منطقه‌ای گشوده است. خط لولهٔ انتقال خزر و بازارهای ذخیره از نظر تجاری توجیه‌پذیر شده است، اما پیشرفت به چارچوب‌های حقوقی، تأمین مالی فراتر از نهادهای گروه هفت (G7)، قیمت‌گذاری شفاف شاخص‌شده به TTF/JKM و اعتماد دیپلماتیک وابسته است. قدرت چانه‌زنی خزر نه‌تنها در آنچه امروز عرضه می‌کند، بلکه در این است که آیا در آینده بلوک منطقه‌ای منسجمی عمل خواهد کرد؛ انتخابی که دولت‌های آن هنوز زمان و ابزار اتخاذ آن را دارند.

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Energy security through a new architecture of regional LNG cooperation: Caspian case

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Abstract

The Caspian basin holds roughly 610 tcf of proven natural gas reserves, yet its five littoral states including Azerbaijan, Kazakhstan, Turkmenistan, Iran, and Russia, capture far less strategic and commercial value than these reserves should command. Over-reliance on single export corridors, negligible intra-regional gas trade, and the absence of any LNG infrastructure on the inland sea have left the region structurally exposed to the geopolitical preferences of external buyers. This paper argues that the Caspian states possess both the resource base and the commercial incentive to construct a regional energy framework that monetises gas locally, diversifies export options, and reduces the leverage of outside powers. The study employs a qualitative, policy-oriented analysis based on a review of secondary sources, including EIA and Caspian Policy Center data (2022–2024), Oxford Institute for Energy Studies research, and regional expert commentary. It examines reserve-production asymmetries, pricing dynamics, and the geopolitical interests of Russia, China, the EU, the US, and Iran, then assesses five regional cooperation initiatives: intra-Caspian gas swap and bunkering, the Trans-Caspian Pipeline, Caspian Stream, gas-to-power/gas-to-data projects, and the Green Energy Corridor. The analysis finds that the collapse of the old global LNG order, accelerated by the Russia-Ukraine conflict and the Persian Gulf Crisis, has opened a window for regional cooperation. The Trans-Caspian Pipeline and bunkering markets are commercially viable, but progress depends on legal frameworks, financing beyond G7 institutions, transparent pricing indexed to TTF/JKM, and diplomatic trust. The Caspian's leverage lies not only in what it supplies today but in whether it can act as a coherent regional bloc tomorrow, a choice its governments still have the time and means to make.

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1. Introduction

The Caspian basin sits on roughly 243-248 trillion cubic feet (tcf) of proven natural gas reserves (Bookings, 2001) more than the combined reserves of the United States and Canada. Yet the region captures far less of the strategic and commercial value those reserves should command. Over-reliance on single export corridors, a near-total absence of intra-regional gas trade, and the absence of any LNG infrastructure on the inland Caspian Sea have left its five principal gas states- Azerbaijan, Kazakhstan, Turkmenistan, Iran and Russia structurally exposed to the geopolitical preferences of their largest buyers: Russia as an intermediary, China, and, increasingly, the EU.

The global LNG order that underwrote two decades of gas project economics has been destabilised by the Russia-Ukraine conflict, sanction regimes and latest the Persian Gulf Crisis. The old assumption that logistics efficiency and price arbitrage alone would dictate energy flows has given way to a harder calculus where sovereignty, corridor control, and buyer concentration define vulnerability.

Before the Persian Gulf Crisis nobody seriously cared about safety of gas infrastructure or international 'game rules' might be changed for fast and so radically. For the sake of global supply/demand balance all players agreed to 'sacrifice' temporary economic, political interests to keep long lasting progress. Hence recent geopolitical tensions turned the current chessboard over.

Global energy systems are entering a structurally new phase where previous and obvious conflict between global LNG companies interests and national states initial objectives became hotter. Some countries have already declared that their energy policy is defined by the primacy of energy security, systemic resilience over cost optimisation (Srinivasan et al., 2025). Current energy crisis showed that real sovereignty is not about diversified suppliers. It is about who sets the rules. So, new rules shall be developed by the regional players to protect their national interests. Key energy hubs have always experienced strong impact from consuming countries and international energy players. Geopolitical tensions harm fragile balance and can ruin their inner structure and capability to supply effectively. Rising external geopolitical complexity makes local tensions-territorial disputes, great-power competition, and the enduring disputes between diversification and dependency on external markets even higher. What cooperation mechanisms shall be executed to unite the regional players and make them able to resist outer centrifugal forces?

This paper argues that the Caspian states have both the resource base and the commercial incentive to construct a regional energy framework that monetises gas locally, diversifies export options, and reduces the leverage of outside powers, that is eventually could cool down regional geopolitical risks. The window for doing so is open, but not indefinitely.

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2. The resource base: Asymmetry between reserves and capture

The scale of what the Caspian holds is not in question. The challenge is the mismatch between the region's reserve endowment and what it actually earns and controls from those reserves.

Table 1. Caspian gas-reserves, production & market concentration (data on 2022-2024)

Country	Gas reserves (tcf)	Gas production (tcf/yr)	Primary export market	Key constraint
Azerbaijan	60	1.8 (2024)	Europe/Turkey via SGC	SGC capacity ceiling
Kazakhstan	85	1.0 (2023)	China (gas); EU (oil via CPC)	CPC over-dependence
Turkmenistan	400 (5th globally)	3.0+	China >70% of exports	Single buyer dependency
Uzbekistan	65	1.5 (declining)	Russia (imports gap)	Domestic deficit emerging

Sources: EIA (2025); Caspian Policy Center (2025); Pirani (2020)

Azerbaijan is the most commercially developed of the four. Gas production reached 50.4 bcm in 2024, up from 28.6 bcm in 2017 following the Shah Deniz Stage 2 ramp-up. Total exports were 25.2 bcm, with 12.9 bcm reaching Europe-a near-60% increase in just three years. BP's $6 billion Azeri Central East platform, commissioned in April 2024, is stabilising declining ACG oil output while also contributing condensate. A further $2.9 billion compressor investment approved in June 2025 targets an additional 50 bcm over the Shah Deniz project life (Caspianbarrel.org).

Kazakhstan is the region's largest hydrocarbon economy by volume but its gas story is constrained by reservoir type. Most gas is sour and associated with oil at Kashagan and Tengiz, roughly 35% of gross output is reinjected. Net marketed gas production was 1.0 tcf in 2023, and 80% of crude exports flow through the Caspian Pipeline Consortium (CPC) to Novorossiysk, a corridor that runs entirely through Russian territory and has experienced deliberate disruptions (iea.org).

Turkmenistan is the paradox of the group. With 400 tcf of proven reserves (fifth-largest globally) and annual production exceeding 3 tcf, Ashgabat is a major gas power by any metric. But over 70% of exports go to China, with Turkmenistan receiving roughly $9.6 billion of its $14.2 billion in gas revenues from Beijing in 2023 alone. That concentration is a dependency that structurally caps Ashgabat's negotiating leverage on price, volume, and contract terms (EIA, 2025).

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Uzbekistan doesn't have Caspian shore but usually is mentioned in Caspian studies as it is tightly connected with regional infrastructure. Now it is moving in the opposite direction from its neighbours: production has declined from a peak of 2.4 tcf in 2008 to 1.5 tcf in 2023, and the country has already become a net gas importer in winter months, drawing supplies from Russia and Turkmenistan. Tashkent's focus is domestic gas-to-power conversion and covering a growing consumption gap - it is a potential buyer of regional gas, not a long-term exporter (ibid).

Iran and Russia being Caspian countries don't have any export oriented gas production in this basin. In 2023 Russian gas reserves was declared as 575 bln cm but it was mostly associated petroleum gas (11 oil&gas fields discovered by 2023 by Lukoil company). Both countries are initially interested in pipeline infrastructure development (gas transit) and gas utilisation in the local Caspian markets (itek.ru).

3. Market realities: What gas is worth in the Caspian context

Pricing in the Caspian has historically been set by whoever controls the pipe. Turkmenistan sold gas to Russia at around $110/mcm at the border in the early 2020s; below Gazprom's own cost of production and far below European TTF equivalents. China has used its monopsony position to drive Turkmen contract prices down, with terms rarely disclosed publicly. Azerbaijan, by contrast, has managed to lock in European long-term contracts at international TTF-linked prices, which during the 2022–23 energy crisis briefly exceeded $50/MMBtu at spot (Pirani, 2020: NG-155).

The structural pricing problem for Central Asian producers is the transport cost and route availability. Getting gas from Galkynysh in Turkmenistan to a European buyer requires crossing multiple sovereign jurisdictions, all of which extract transit rents. The Trans-Caspian Pipeline, if built with a design capacity of 30 bcm/year, would change this economics materially; Turkmenistan's annual gas revenues could increase by an estimated $6–8 billion per year at current European reference prices (ibid).

The similar impact on local export architecture could have so-called Caspian Stream- a underwater 1100 km pipeline that is supposed to supply Russian gas to North Iran for future swap and local utilisation. Since 2024 it has been under inter-government negotiations but its commercial and political feasibility is still unclear.

Within the Caspian basin itself, the pricing environment for potential regional gas trade is more tractable. Bunkering LNG for the Caspian shipping fleet, supplying gas-fired power plants in Kazakhstan's industrialising east, Iranians households in the north provinces or supporting gas-to-data centre projects in the corridor are all markets where delivered costs are manageable and willingness-to-pay is higher than in pipeline gas to China. The basin's five littoral states collectively

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operate over 700 vessels, a captive LNG bunkering market that currently runs almost entirely on cheaper but dirtier heavy fuel oil (EIA, 2025, Regional analysis brief: Caspian sea).

4. The geopolitical overlay: Who gains, who resists

The energy politics of the Caspian is a complex game. External powers– Russia (but also internal), China, the EU and the United States– all have interests that cut across the preferences of the producing states themselves.

Russia's strategic interest is in retaining transit revenues and controlling Central Asian gas volumes for European markets. Moscow has historically opposed the Trans-Caspian Pipeline on environmental grounds; a legal argument that the 2018 Caspian Sea Convention has partially neutralised, giving coastal states the right to develop pipelines within their own zones. The shutdown of the last Gazprom-to-Europe pipeline via Ukraine in January 2025 has removed Russia's cheapest gas from European buyers and created an acute supply gap that Caspian gas might fill. Also cut of export gas Gazprom needs to compensate developing local demand including Caspian areas promoting NGV, bunkering, etc. Since 2024 Russia and Iran are negotiating a new underwater pipeline connection Caspian Stream that could help both gas reach countries to solve their tasks- supply South Asia regions and balance local demand (http://en.kremlin.ru/supplement/5328).

China's interest runs the other way: Beijing benefits from Turkmen gas dependency and has little commercial motivation to see Ashgabat gain alternative markets. It is notable that the 2024 Turkey-Azerbaijan gas cooperation agreement, which explicitly contemplated transiting Turkmen gas westward through the SGC, was met with characteristic silence from Beijing.

The EU has pledged to end all Russian gas imports by end-2027 and signed a strategic energy partnership with Azerbaijan in 2022 targeting 20 bcm/year by 2027. The gap between that ambition and reality is visible in the numbers: Azerbaijani exports to Europe were 12.9 bcm in 2024, barely moving from 12.4 bcm in 2023. The SGC is operating near capacity, and European financial institutions have stopped lending for fossil fuel infrastructure (Caspian Policy Center, 2025).

The United States has endorsed the Trans-Caspian Pipeline at the highest level: Secretary of State Rubio called its implementation "possible" in a Senate Foreign Relations hearing in April 2025. Washington's interest is explicitly in disrupting both Russian transit leverage and Chinese energy security offtake from Central Asia aligning U.S. geopolitical goals with Caspian producers' diversification interests. The extent of the EU dependence on US LNG is so high that no possible diversification in this region could seriously damage American interests (cbsnews.com).

Iran is a key Caspian player that is coming back to active gas

development strategy in the region. Actually, the country being under strong sanction pressure shall solve two key tasks: to strengthen its export ability (mostly to traditional clients; Turkey and Iraq but also explore the potential of Pakistan, Afghanistan, Oman cooperation) and provide gas for its north, north-east provinces.

5. The regional architecture gap and what fills it

The Caspian is not a global LNG market in any conventional sense. There are no LNG carriers on an inland sea. The conventional export trade that defines global LNG– floating terminals, spot cargoes, price discovery at Henry Hub or TTH– is structurally absent and will remain so. But this is not a constraint; it is a design specification for a different kind of architecture.

Regional energy cooperation in the Caspian context means something more specific: multilateral projects that serve local markets, build shared infrastructure, and reduce each member state's exposure to a single dominant external actor. The building blocks exist. What has been missing is a credible institutional and commercial framework to bring them together.

Table 2. Regional energy cooperation initiatives; status and commercial logic

Initiative	Partners	Commercial logic	Status/ Barrier
Trans-Caspian Pipeline (TCP)	Turkmenistan-Azerbaijan-EU	30 bcm/yr capacity; unlocks ~$6-8B/yr Turkmen revenue	Political momentum growing; Russia/Iran environmental veto remains
Turkmen Gas Swap via Iran-Turkey	Turkmenistan-Iran-Turkey	Near-term route; 1.3 bcm in 2025, scalable	Active since March 2025; geopolitically complex
Caspian LNG / Bunkering Hub	Kaz-Azer-Turkmen (3 party)	Serve inland sea fleet; Gas-to-Power for local grids	Concept stage; no transnational legal framework yet
Green Energy Corridor (Black Sea Cable)	Azer-Georgia-Romania-Hungary	1,155 km, 1,300 MW; 'Project of Mutual Interest' EU status	Feasibility underway; target 2032
Caspian Stream	Russia-Iran	1,100 km gas supply to North/North-East provinces of Iran or for Russian gas swap to Pakistan/Gulf, etc.	Concept stage; Under inter government discussion

Based on data from Global Energy Monitor (2025); GIS Reports (2026); Caspian Policy Centre (2025); Caspian Institute for Strategic Studies

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Five directions are commercially and technically viable in the near to medium term:

- Intra-Caspian gas swap and bunkering. A trilateral framework between Russia, Iran, Azerbaijan, Kazakhstan, and Turkmenistan to develop small-scale LNG for marine bunkering and cross-border gas-to-power supply. Unit economics are supportable at current gas prices. The Turkmenistan-Iran-Azerbaijan swap arrangement (active since 2023) is a proof of concept for cross-border gas flows that bypass Russian infrastructure (newscentralasia.net).
- Trans-Caspian Pipeline. The political calculus has shifted more in the last 24 months than in the preceding 25 years. With Russia's Ukraine transit shut down, U.S. support explicit, and Turkey actively seeking a gas transit role, the window for a 30 bcm/year underwater interconnector between the Turkmen and Azerbaijani pipeline networks has probably never been more open (Caspian institute for strategic studies). The project's commercial viability depends on SGC expansion, which in turn depends on EU long-term commitment and Russia/China opposition to this project.
- Caspian Stream. Relatively new Iran-Russia initiative to develop underwater pipeline to transit Russian gas to Iran. Political and commercial feasibility depends on other Caspian countries approval and gas price reform in Iran (current low and subsidised local gas price make profitless to utilise Russian gas)
- Gas-to-Power and Gas-to-Data. Kazakhstan and Turkmenistan face electricity deficits and rapidly growing data infrastructure demand. A regional gas-fired power and digital infrastructure programme, structured as a three- or four-country joint venture, would create local market offtake that does not depend on export corridor access and generates revenue in domestic currency, reducing FX risk for investors.
- Green Energy Corridor. The Azerbaijan-Georgia-Romania-Hungary undersea electricity cable (1,155 km, 1,300 MW, EU 'Project of Mutual Interest' status, target 2032) represents the logical next step in the Caspian's evolution from hydrocarbon exporter to energy corridor. Azerbaijan's 200 GW+ renewable potential being developed with ADNOC (Masdar) and ACWA Power provides the upstream resource base (news.az).

6. What needs to happen: Conditions for a regional architecture

The obstacles are real. But they are manageable if disaggregated from the political noise that has historically smothered them.

On the legal and regulatory side, the 2018 Caspian Sea Convention resolved the headline sovereignty question but left seabed pipeline

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rights in the hands of bilateral and trilateral negotiation. A dedicated Caspian Energy Cooperation Framework modelled loosely on the Energy Charter Treaty (unctad.org) but limited to the five littoral states would create the institutional basis for joint infrastructure development, dispute resolution, and third-party transit access.

On the financing side, the withdrawal of G7 and World Bank lending from fossil fuel infrastructure creates a gap, but does not close the project space. The Asian Development Bank, the Asian Infrastructure Investment Bank, SOCAR's own $14 billion gas capex programme through 2030, and direct sovereign investment funds from Azerbaijan, Kazakhstan, Russia are all available levers (Pirani, 2020: NG-155). The EU's decision not to fund SGC expansion through EIB effectively transfers that decision to Baku, which is making the point, loudly, that it will redirect gas eastward if Europe does not engage seriously.

On pricing and market access, the critical discipline is refusing to replicate the Turkmen-China dynamic: long-term volume contracts at suppressed prices with no indexation to market benchmarks. Any regional cooperation architecture needs a transparent pricing mechanism ideally indexed to a basket of TTF, JKM, and local hub references to protect producers from monopsony compression over time.

Finally, the governance of shared infrastructure requires political trust that does not currently exist between all parties. Turkmenistan and Azerbaijan have an unresolved maritime boundary dispute. Kazakhstan's strategic ambivalence between Moscow and Western partners is genuine, not performative. Iran's re-emergence as an active Caspian player adds both a potential transit option and a layer of U.S. sanctions risk. None of these are deal-killers, but each requires deliberate diplomatic groundwork alongside the commercial negotiations. And only local multilateral gas/LNG midstream and downstream projects could maintain the necessary resilience for local energy hub and make all five countries prioritise regional development to international prospects.

7. Conclusion

The Caspian's energy story is not over. It is, in a real sense, only now beginning to be written on Caspian terms rather than on terms dictated by Beijing, Brussels or Washington. The collapse of the old global LNG order is, paradoxically, an opportunity for a region that was never fully integrated into that order to build something more durable: a self-reinforcing regional energy market that converts vast reserves into sovereign economic strength.

What the region lacks is not resources, technology, or even money. It lacks a shared framework for making collective decisions about shared infrastructure. Building that framework is the political task of this decade for Caspian energy policymakers. The alternative is

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continued dependence on external actors who will always prioritise their own interests over those of the producing states.

The Caspian's leverage lies not just in what it supplies today, but in whether it can act as a coherent regional bloc tomorrow. That is a choice its governments still have the time and the means to make.

Conflict of interest

The authors declared no conflicts of interest.

Ethical considerations

The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc. This article was not authored by artificial intelligence.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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