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Original Article

Beyond Crude: How Saudi Arabia's Liquid-to-Chemicals Strategy Accelerates Vision 2030

Translating Vision 2030 from strategy to reality through disciplined LTC delivery systems

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Abstract - *Saudi Arabia's Vision 2030 is a very ambitious plan to radically reshape the Saudi economy away from being solely dependent on oil into one with a greater focus on industrial and petrochemical growth.[1] At the initial start of the liquid-to-chemical strategy, where crude oil is turned right into valuable chemical products like ethylene, polyethylene, and specialty chemicals without going through the usual refining first. The current Liquid-to-chemical is estimated at 1.8 million barrels per day, which is expected to reach 4 million barrels per day by the time Vision 2030 is successful. Research focuses on developing and executing the Liquid-to-chemical strategy in Saudi Arabia through the involvement of foreign partners, full utilization of feedstock, rigorous project control measures, and the IKTVA (In-Kingdom Total Value Add) program for local content development. With case studies of major projects like AMIRAL, SAMREF, and YASREF, the paper shows how a well-disciplined project delivery can convert the strategy into working assets. The results show that the key to Liquid-to-chemical lies in having a strong governance structure, getting international partners on board early, being prepared for operations, developing the workforce, and being technologically innovative. Execution of several megaprojects in a coordinated manner is a must as a strategy, capital, and technology alone will not be enough to fulfill Vision 2030 goals. The Liquid-to-chemical case presents how Saudi Arabia, through its natural resources, labor force, and international partnerships, can take the chemical industry as its forte and remain a leading name for a very long time.*

Keywords *- Liquid-to-Chemicals, Vision 2030, Saudi Arabia, Petrochemicals, Strategic Partnerships, Project Execution, IKTVA, Local Content.*

1. Introduction

Saudi Arabia is well known as a major crude oil exporter, but the situation has been changing recently.

The Kingdom, being aware of the global trend towards cleaner energy and thus the rising demand for petrochemicals, sees the need to climb higher on the value chain. The Long-Term Chain strategy is an important part of Vision 2030, which aims to make Saudi Arabia a leading player in the global petrochemical market. The country will not only capture more economic value but also diversify its product portfolio and become less vulnerable to the fluctuations of crude oil prices by going the chemical route instead of the fuel one.

The implementation of the Liquid-to-chemical strategy will see the commencement of several impressive projects that will transform the industrial clusters of Jubail and Yanbu. Saudi Arabia's ability to deliver on the Vision 2030 goal of reaching 4 million Barrels Per Day (bpd) will hinge on top-notch project governance, the integration of feedstocks and refineries, compliance with local content post-IKTVA, as well as the development of a skilled workforce capable of operating and maintaining the new facilities.

Saudi Arabia may still have enough crude oil for itself and many other countries, but the demand for refined fuels is estimated to go down in the long run due to the global effort to combat climate change. On the other hand, the consumption of petrochemical products, such as plastics, synthetic fibres, and advanced materials, which come mainly from petrochemicals, is on the rise, especially in Asia and other developing countries. Compared to crude oil, petrochemical products made from it are much more valuable economically—between $200 and $500 per barrel of oil equivalent, whereas crude is more like $80 to $100 per barrel—which is a strong argument for going with the liquid-to-chemical strategy.

Although crude-to-chemicals strategies have been assessed in prior industry and technical studies, most analyses strongly focus on process efficiency, ability to

expand, or market projections. Limited scholarly attention has been devoted to examining how strategies are able to function in a national economic diversification framework, especially in relation to governance mechanisms, localization policies, and workforce transformation. This gap is crucial in the context of Saudi Arabia's Vision 2030, where industrial revolution, policies, economic reform, and large-scale project execution are closely interwined.

The core problem addressed in this study is how Saudi Arabia can effectively design and implement its Long-Term Chain strategy to maximize value creation, ensuring governance efficiency, economic sustainability, and alliance with the Vision 2030's objectives.

This study addresses the following questions:

1. Taking economic perspectives into account, to what extent does this economic shift of Saudi Arabia, i.e., from exporting oil to liquid-to-chemicals production, hold economic value?
2. What governance structures, localization policies, and workforce development mechanisms are needed to implement Liquid-to-chemical projects throughout Saudi Arabia at their highest operational capacity?
3. How does the Saudi Liquid-to-chemical model differ from existing global crude-to-chemicals approaches, and what implications do these differences have for long-term economic realization?

2. Strategic Rationale for Liquid-to-Chemicals

2.1. Economic Value Creation

Nearly 40 kg of Ethylene feedstock can be extracted from a single barrel of crude oil (159 litres or 114 kg). The resulting ethylene, when converted at $1,000 per ton, gives a return of $40 per barrel. The conversion to polyethylene at $1,400 per ton results in a return of $56 per barrel. In comparison, selling crude oil or refining it generates a revenue of around $85 per barrel.

Conventional refineries chemically convert only 8%-12% of crude oil to high-value products, while most of the output is in the form of fuels. On the other hand, Liquid-to-chemical transforms 40%-70% of the crude input into chemicals, thus dramatically increasing the value of level creation.

Table 1. Comparative Value Creation of Crude Conversion

Process Pathway	Conversion Rate (%)	Product Value per Barrel (USD)	Comments
Conventional Refining	8%–12%	85	Primarily fuels
Liquid-to-chemical (Ethylene)	40%	40	Direct chemical conversion
Liquid-to-chemical (polyethylene)	70%	56	Maximizes high-value chemical output

One major aspect of the Saudi Arabian oil industry is that it not only thrives off the traditional way of generating revenue but also significantly benefits from the additional chemical extraction processes from crude oil.

This is what has been allowing this great nation to continuously score impressive financial results and, by the same token, safeguard the country against highly volatile fuel price fluctuations.

Besides, it is also on its way to becoming a predominant supplier of products that are most in demand in the global markets.

The worldwide industrial patterns, which show petrochemical products delivering superior profit margins compared to fuel products, drive the company to produce its more valuable items.

2.2. Economic Assumptions and Analytical Basis

Comparing the economics of the two options - exporting crude oil and integrating Liquid-to-Chemicals (LTC) - is based on a value-chain framework at a structural level rather than being supported by a detailed financial model for the whole project. The goal here is to figure out which part of the hydrocarbon chain will give the most value-capture depth under visible and agreed assumptions.

Initially, crude oil exports are seen as a reference point for upstream value realization, with income mainly derived from global crude pricing and thus subject to international market volatility. This setup implies that the downstream section gets a limited share of the margin, and there is hardly any domestic industrial spillover beyond extraction and transport processes.

On the other hand, the LTC arrangement is considered an integrated system where the crude feedstock is transformed into petrochemical products, thus capturing the refining and chemical conversion margins internally. Here, besides multi-stage margin capture, industrial clustering effects, and extended supply-chain participation, value creation also comes from these aspects.

The assumptions made in the comparison are:

- Prices of global crude oils are those of internationally traded benchmarks.
- The value of petrochemical outputs accounts for gross product realizations and is thus prior to detailed capital recovery modeling.
- Capital Expenditure (CAPEX) in the case of LTC projects would be relatively much higher than just for upstream extraction.
- Operating Expenditure (OPEX) covers refining, processing, and labor costs, but again, it is not plant-specific.
- The study does not constitute a Discounted Cash Flow (DCF) or Net Present Value (NPV)

2.3. Global Demand Tailwinds

The current worldwide production of ethylene exceeds 160 million tonnes per year, which shows a yearly growth rate between 3% and 4%. The demand for plastics and packaging, synthetic fibres, and industrial materials has increased in Asia and developing countries, which drives this demand for growth. Du Pont predicts that Saudi Arabia will increase its petrochemical production capacity from about 75 million tonnes per year to over 140 million tonnes in the next five years. The Kingdom will obtain approximately 20 percent of this growth because it has abundant low-cost feedstocks and complete industrial facilities. The strategic value of chemical conversion processes that transform crude oil into products requires operational adjustments to achieve their full potential. The Saudi government uses Long-Term Contracts to meet international market needs because these contracts offer financial advantages stemming from the country's resource abundance and industrial capabilities.

2.4. Risk Mitigation Through Diversification

Oil prices have experienced high volatility throughout their history, with prices ranging from $30 to $130 per barrel over the last 10 years. Chemical prices, while higher, exhibit more stability.

The Liquid-to-chemical system decreases dependence on changing crude oil prices while it establishes a diversified chemical product portfolio that serves various market needs.

The flexible design of Liquid-to-chemical products enables them to meet specific requirements of different markets, which include high-grade polyethylene packaging and specialty chemicals used in industrial applications, thus enabling Saudi Arabia to meet market demands while decreasing its dependency on a single commodity for price fluctuations.

2.5. Novelty and Comparison with Existing Research

Researchers have investigated Crude-To-Chemicals (C2C) and liquid-to-chemicals processes, but most studies focus on evaluating technical performance, product output, and market forecasts. The existing research investigates process optimization and catalyst efficiency and production capacity growth, but it does not include national economic systems and governance frameworks and workforce integration processes. [2][5] This particular study goes beyond technical assessment by incorporating economic value creation, policy agreement, and workforce development within the context of Saudi Arabia's Vision 2030. Understanding Liquid-to-chemical implementation against the Vision 2030 mission, this work shows the strategic rationale and operational unit that makes Saudi Arabia's approach distinctive.

Summarizing it, the novelty of this research depends on its holistic evaluation: combining technical, economic, and policy dimensions made within a massive national development plan, and providing a benchmark for future C2C/Liquid-to-chemical strategies globally. This positions the study as a reference point for incorporating industrial innovation with economic and workforce planning, filling a critical gap in existing literature.

3. Vision 2030 Targets and Government Support

3.1. Quantified Liquid-to-Chemical Targets

By the end of 2024, Liquid-to-Chemical will have a capacity of 1.8 million bpd. Vision 2030 targets 4 million bpd by 2030, which means that about 58 million tonnes per annum of ethylene equivalent will be required. The total capital expenditure for hitting these targets will be in the range of $20–$30 billion; this includes production costs of $3,000–$5,000 per ton of annual output. The National Industrial Strategy sets even more ambitious goals after 2030, planning to quadruple downstream chemical production by 2035. Apart from that, the chemical industry is expected to make a significant contribution to the economy with a GDP of 58.2 billion SAR and provide 108,000 permanent jobs, thus being marked as a major economic pillar.

Table 1. Liquid-to-Chemical Capacity Targets and Economic Impact

Year	Liquid-to-chemical Capacity (bpd)	Investment Required (USD Billion)	GDP Contribution (SAR Billion)	Jobs Created
2024	1.8 million	N/A	N/A	N/A
2030	4 million	20–30	58.2	108,000
2035	Quadrupled	Additional TBD	58.2+	108,000+

3.2. Government and Institutional Support

The government is giving considerable help to the Long-Term Care (Liquid-to-chemical) sector through several measures, such as the upgradation of infrastructure at Ras Al-Khair port and utility projects at Jubail, which are meant to support the major construction activities. The Public Investment Fund (PIF) is partnering with private companies by co-investing to share the financial risk, thus showing that it is an institutionally committed move. [9]

The Saudi Industrial Development Fund offers projects that fulfil the eligibility criteria, the privilege of getting financed on preferential terms. The Standard Incentives Program, which became operational in 2025, offers financing to qualified chemical and manufacturing projects by covering 35% of their capital expenses, which enhances their financial viability while reducing investment hazards.

4. Liquid-to-chemical Economics and Competitive Advantages

4.1. Integration Economics

Standard crude-to-chemical processes involve multiple steps: First, crude oil is refined into fractions such as naphtha, diesel, kerosene, and residue, which are then further processed into chemicals. [2] Liquid-to-chemical changes this by directly converting crude into ethylene and polyethylene within a single integrated plant, helping lower energy use, intermediate processing costs, and capital expenditures.

Table 2. Economics of One Barrel of Crude via Liquid-to-chemical vs Conventional Refining

Step	Conventional Refining (USD/Barrel)	Liquid-to-chemical Pathway (USD/Barrel)	Comments
Crude Purchase	80	80	Feedstock cost
Conversion to Chemicals	40	40–45	Lower energy and capital cost
Total Value	120	125–130	Liquid-to-chemical offers higher efficiency

4.2. Saudi Arabia's Competitive Advantages

Saudi Arabia derives its advantages through secure feedstocks, which include 12 to 13 million barrels per day of crude oil, 10 billion cubic feet of natural gas, and 600,000 barrels per day of ethane, and it enjoys extremely low production expenses, which range from 2 to 4 dollars per barrel. It has built industrial networks.

5. Delivery Mechanisms: International Joint Ventures

5.1. Partnership Rationale

Aramco operates its Liquid-to-chemical projects in a joint venture, which forms the development of local production resources. Moreover, operational facilities while leveraging international technical expertise. The partnerships enable organisations to share their financial resources and technological assets, which helps them access worldwide markets for their business operations while achieving successful outcomes and consistent profits.

5.2. Major Liquid-to-chemical Partnerships

The AMIRAL project (Aramco-TotalEnergies, $11 billion) will produce 1.64 million tons of ethylene annually. [4] SAMREF (Aramco-ExxonMobil) focuses on refinery upgrades and integrated petrochemical expansion. YASREF (Aramco-Sinopec) is expanding the Yanbu refinery with mixed-feed crackers that produce 1.8 million tons of ethylene annually. The projects together produce between 2.2 million and 2.8 million barrels per day, which supports the Vision 2030 objectives. [13]

5.3. Partnership Governance

The achievement of Liquid-to-chemical projects in Saudi Arabia depends on two factors, which are obtaining joint venture agreements and developing strong governance systems. The governance system guarantees that important decisions are made through complete processes, which reserve the rights of all stakeholders incorporated.

AMIRAL, SAMREF, and YASREF joint ventures demonstrate two main types of governance frameworks. The majority owner of AMIRAL, which includes Aramco (62.5%) and TotalEnergies (37.5%), holds full power to make strategic decisions that will help the organization resolve disputes and enhance its operational efficiency.

This structure works best when organizations deal with projects that require large financial investments and complex operations, which need rapid decision-making abilities. Equal partnerships need both parties to agree on important business decisions according to their partnership agreement.

The agreement requires both parties to work together, which may increase decision-making time, but it helps them equally control the process while they maintain their shared interests and build their long-term partnership.

The 41-year history of SAMREF shows that equal partnerships succeed when both companies develop a shared long-term vision and establish distinct operational procedures.

Table 3. Governance Models for Liquid-to-Chemical Joint Ventures

Project	Ownership Structure	Decision-Making Approach	Advantages	Challenges
AMIRAL	Aramco 62.5%, Total 37.5%	Majority owner authority	Fast decisions, centralized control	Minority partner influence is limited
SAMREF	Aramco 50%, ExxonMobil 50%	Consensus-based board approval	Equal partner control, long-term alignment	Slower decision-making
YASREF	Aramco 50%, Sinopec 50%	Consensus-based board approval	Balanced risk sharing	Potential delays in approvals

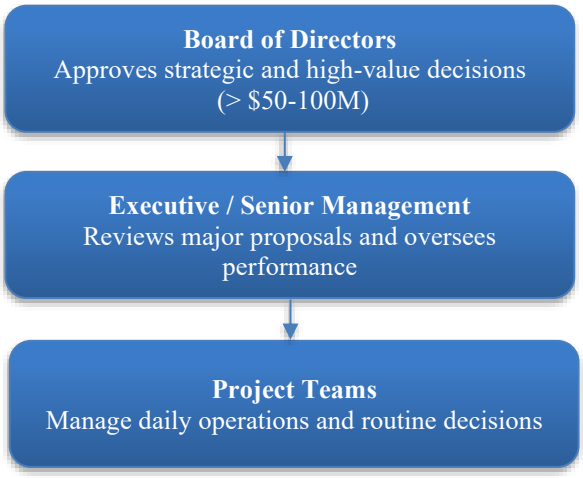

Fig. 1 Three-Tier Decision-Making Framework

The organization assesses a three-tier decision-making framework, which lets project teams deal with daily operations as per the committed boundaries, whereas board members should approve these strategic decisions involving $50 and $100 million. The process guarantees that nonessential matters do not create delays in work progress because critical projects need complete monitoring.

6. Project Execution Discipline

Execution discipline serves as the fundamental component that supports the Liquid-to-Chemical strategy. The Kingdom of Saudi Arabia needs to manage its many megaprojects because its ambitious development targets require simultaneous execution of all three projects.

6.1. Integrated Feedstock and Refinery Planning

Refineries require their integration with Liquid-to-Chemical complexes because their combined operation produces better economic results. The AMIRAL project operates its system by using the existing SATORP infrastructure, which is located in Jubail. SATORP processes 400,000 to 460,000 barrels per day of crude oil, while AMIRAL's cracker operates with off-gases and naphtha and ethane as its primary feedstocks. SATORP recovers excess heat that chemical processing generates to power its furnaces, creating better energy efficiency while reducing feedstock competition.

YASREF operates its system together with the Yanbu refinery, which enables its two facilities to achieve optimal feedstock delivery and thermal energy recovery for both refinery operations and chemical processes. Integrated planning methods create lower conversion expenses while they create better operational dependability and increase investment returns. [11]

6.2. Cost and Schedule Controls

The process of risk management for project costs and schedule needs to be handled with utmost importance. Saudi Liquid-to-chemical projects employ Earned Value Management (EVM) systems, which execute monthly assessments by comparing their planned work and expenditures against the actual progress made. The steering committee needs to evaluate all project costs that go beyond the initial budget by 10%, while the board needs to handle all cost variances that exceed 20%.

The organization employs various cost control methods, which include entering fixed-price contracts with construction companies and using detailed 3D modeling to achieve better material procurement efficiency, purchasing essential equipment in advance to avoid price hikes, and procuring goods from IKTVA-approved Saudi vendors to decrease expenses while promoting local content development. [10]

6.3. Phased Startup and Commissioning

The utility services training program starts with training programs, which provide training for water delivery, electricity supply, compressed air production, and steam generation. The chemical production units begin their operational schedule after the first two months, which starts with light cracker operations and continues with ethylene and polyethylene production. The procedure ends with the implementation of specialty chemical integration.

The process of phased commissioning includes three components, which are loop testing, operator training, and as-built documentation. The process takes 2 to 3 months to complete, which starts from the initial production phase until the system reaches its maximum operational potential. The method establishes operational stability while it creates safer equipment operations, and it trains employees for their duties in complete business functions.

7. IKTVA and Local Content Integration

The IKTVA initiative of Saudi Arabia supports local workforce development and industrial content requirements for Liquid-to-chemical projects. The IKTVA system assesses performance through five evaluation categories, which include local spending at 40%, Saudization at 30%, training at 10%, supplier development at 15%, and R&D at 5%.

7.1. AMIRAL IKTVA Impact

The AMIRAL budget of $11 billion designates funding of $7.7 billion for equipment and engineering costs, $3.3 billion for construction labor expenses, and $0.7 billion for pre-operating expenditures. IKTVA targets include: employing 70% Saudi nationals, training 5,000 Saudi workers, and engaging 210 Saudi suppliers. The initiatives create 7,000 jobs while supporting the development of 350 new industrial sites.

Table 4. AMIRAL IKTVA Targets

Component	Target Value	Outcome Expected
Local Spending	$7.7 billion	Saudi supplier engagement
Saudization	70% workforce	Job creation for Saudi nationals
Training	5,000 Saudis	Skills development
Supplier Development	210 companies	Supply chain localization

7.2. Broader IKTVA Impact Across Liquid-to-Chemical Strategy

Liquid-to-Chemical projects will create 150,000 new employment opportunities through their chemical plants and renewable energy facilities, which will hire 75 per cent of their staff from the local community.

The National Industrial Strategy forecasted job growth will create 108000 new employment opportunities by 2035, which will result in $15 billion to $20 billion of economic growth for Saudi Arabian businesses, their suppliers, and workforce training programs.[3]

The petrochemical sector evolves into a sophisticated industrial ecosystem that supports the development of engineering and logistics, equipment manufacturing, and chemical conversion industries. [7]

8. Technology Development and Innovation

Saudi Arabia invests significantly in next-generation Liquid-to-Chemical technologies, ensuring global competitiveness and the overall operational efficiency.

8.1. Aramco-SABIC Crude-to-Chemicals Program

Aramco and SABIC had a joint research project on advanced catalytic and thermal methods that are direct for crude-to-chemicals conversion. Their collaboration focuses on one-step conversion processes that are capable of changing crude into light olefines, ethylene, and other high-value products efficiently. [8]

8.2. Aramco-Honeywell-KAUST Joint Development Agreement

In 2025, Aramco, Honeywell, and KAUST made a pact to scale next-generation direct crude-to-chemical technology. This pact focused on diminishing capital expenditures, lowering overhead costs, and improving the carbon footprint. [5]

8.3. Technology as Competitive Differentiator

- The advanced proprietary technologies of Liquid-to-Chemical facilities give Saudi Arabia a permanent edge over its competitors.
- The possession of advanced thermal and catalytic technologies improves operational performance.
- The system allows the Kingdom to generate increased profit through its operations.
- The development of chemical production facilities gives Saudi Arabia a stronger position in international chemical markets.
- The system provides protection against competitive threats from foreign markets.

9. Conclusion

The Liquid-to-chemical strategy of Saudi Arabia constitutes a complete transformation of its economic approach. The Kingdom achieves higher market demand and

lower price fluctuations while meeting its Vision 2030 goals through its decision to produce high-value chemical products instead of exporting crude oil. [12] The achievement of 4 million bpd Liquid-to-chemical capacity for 2030 and chemical downstream expansion until 2035 requires organizations to implement structured processes while collaborating with international partners, developing their staff, and acquiring new technologies.

The AMIRAL, SAMREF, and YASREF projects demonstrate how Saudi Arabia combines its local raw materials with its trained workers and foreign knowledge. The Kingdom's petrochemical industry will develop into a vital industrial system that will support economic development for years through its strategic leadership, controlled operational startup, IKTVA implementation, and development programs. [6]

10. Limitations, Sustainability, Risk, and KPIs

10.1. Limitations

The research includes industry standard assumptions, which will show different results during actual implementation. Further, long-term projections are subjected to market volatility and policy changes.

10.2. Environmental and Sustainability Impacts

Liquid-to-Chemical projects serve as vital components for both emissions control and energy consumption reduction. The environmental effects of a project can be reduced through the implementation of planning methods, heat recovery systems, and optimal feedstock processing methods.

10.3. Risk Management

Key risks include crude price volatility, project delays, and challenges with technology adoption. Mitigation measures include phased commissioning, a joint pact, robust governance, and diversification of the chemical product range.

10.4. Technology Roadmap

Saudi Arabia's LTC strategy emphasizes continuous R&D, joint development agreements, and next-generation catalytic and thermal technologies. Future expansion aims to increase efficiency, reduce costs, and maintain global competitiveness.

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