



National Iranian Oil Refining and Distribution Company
(NIORDC)



Journal of Farayandno

Research Paper



DOI: 10.22034/farayandno.2026.2082524.2036



This journal is an open access journal licensed under an
Attribution-Non Commercial 4.0
International Licenses (CC BY-NC 4.0).

Strategic Investment Assessment in Iran’s Petrochemical Upstream and Downstream Sectors: A Multi-Criteria Framework for Optimizing Production Capacity, Cost Structure, and Return on Assets

Mahdi nazarisaram^{*1}, Mostafa Motadayan²

¹ Department of petroleum mining and Materials, CT.C, Islamic Azad University, Tehran, Iran

² Chief Executive Officer, Persian Gulf Petrochemical Industries Development Management Company, Tehran, Iran, Tehran, Iran

Received: 30 Dec 2025 Accepted: 6 May 2026

1. ABSTRACT

This study presents a strategic evaluation of two competing investment pathways within the Persian Gulf Petrochemical Industries Holding (PGPIDMC): (A) upstream hydrocarbon field development versus (B) downstream operational optimization and latent capacity activation. Based on real operational data from 9 key units during 2025–2026 (1404–1403), the analysis reveals that downstream units operate at an average utilization rate of only 68%, equivalent to a latent capacity of 3.6 million tons/year of petrochemical products. Simultaneously, a structural feedstock gap exists: upstream supply (4.4 Mt/year from Bidboland and Hoyezah gas plants) falls short of current downstream demand (5.0–5.5 Mt/year), with the gap projected to widen to 2.5 Mt/year if latent capacity is activated. A multi-criteria decision framework (MCDF), aligned with ISO 55000:2024 and IEA 2025 guidelines, demonstrates that Option B (optimization) requires only 20–30% of the CAPEX of a new field development, achieves 85–90% utilization, generates positive cash flow within 18 months, and reduces feedstock consumption per ton of product by 5–8%. The proposed two-stage roadmap prioritizes short-term optimization (1404–1406) to generate cash flow and de-risk the system, while simultaneously launching feasibility studies for targeted upstream development from 1407 onward.

Keywords: Investment prioritization, downstream optimization, feedstock security, asset efficiency, latent capacity, Persian Gulf Petrochemical Holding.

2. INTRODUCTION

ROP is a key indicator of drilling efficiency, directly affecting time and cost. However, it is influenced by complex, nonlinear interactions among geological (e.g., rock strength), hydraulic (e.g., mud flow), and operational factors (e.g., WOB, RPM). Traditional empirical models often fail to capture these dynamics. Deep learning, especially LSTM networks, has shown promise in modeling time-dependent, nonlinear drilling data [2]. This study applies LSTM to real Shadegan field data including formation pressure and hydraulic variables for the first time, offering a novel and practical contribution to drilling optimization in complex carbonate and evaporite formations.

While recent studies have employed ANN, SVM, or even LSTM for ROP prediction [2–5], none have incorporated real-time formation pressure as a direct input despite its critical role in controlling borehole stability and bit-rock interaction, especially in overpressured or reactive formations like Gachsaran. Moreover, most prior works rely on simulated or

* mahdinazarisaram@iauctb.ac.ir

Please Cite This Article Using:

Nazari Saram, M., Motadayan, M., “Strategic Investment Assessment in Iran’s Petrochemical Upstream and Downstream Sectors: A Multi-Criteria Framework for Optimizing Production Capacity, Cost Structure, and Return on Assets”, Journal of Farayandno – Vol. 21 – No. 93, pp. 35-46, In Persian, (2026).



synthetic data, or omit hydraulic-transient effects that dominate in deep, high-pressure wells. This study bridges this gap by leveraging high-frequency field measurements from vertical wells in Shadegan, where pore pressure gradients and lithological transitions between carbonate and evaporite layers introduce significant ROP variability.

3. MATERIALS AND METHODS

This study employs an evidence-based, multi-criteria decision framework to evaluate two competing investment pathways within the Persian Gulf Petrochemical Industries Holding (PGPIDMC): (A) upstream hydrocarbon field development versus (B) downstream operational optimization and latent capacity activation. The methodology integrates real-world operational data, dynamic financial modeling, and international best practices (ISO 55000:2024; IEA, 2025) to ensure analytical rigor and policy relevance.

Data Collection and Scope

The analysis is based on monthly operational and financial data from **9 key units** under PGPIDMC during 2025–2026 (Iranian years 1404–1403), categorized as:

- *Upstream*: Bidboland and Hoyezah gas plants (feedstock producers),
- *Downstream*: Bandar Imam, Bouali Sina, Noori (Borujerd), and Karoon petrochemical complexes,
- *Utilities*: Fajr and Mobin Energy Khaleej Fars (power and water suppliers). Primary data sources include: (1) internal monthly performance reports (nameplate vs. actual capacity, feedstock consumption, KPIs), (2) holding-level financial models for field development and optimization projects, and (3) national policy documents (Sixth and Seventh Development Plans, National Petrochemical Company guidelines).

Analytical Framework and Scenario Design

Two scenarios were rigorously modeled using **monthly cash flow projections** (superior to annual models for operational granularity [4]):

- **Scenario A (Upstream Development)**: A greenfield field project requiring ~\$500 million CAPEX, with execution phased over 30 months and production ramp-up from month 31.
- **Scenario B (Downstream Optimization)**: Process optimization across 4 key downstream units (e.g., catalyst upgrades, heat recovery, flare reduction) requiring only **20–30% of Scenario A's CAPEX**, with implementation completed within 12–24 months.

Evaluation Criteria

Both scenarios were assessed against four dimensions aligned with international standards and national priorities:

1. **Financial Risk**: Maximum cash outflow, payback period, and cash flow robustness under volatility [10].
2. **Feedstock Dependency**: Degree of reliance on Bidboland gas refinery (90% of downstream feedstock), process flexibility, and single-point-of-failure exposure [9].
3. **Capital Efficiency**: Return on investment (ROI), net present value (NPV/CAPEX), and internal rate of return (IRR).
4. **Policy Alignment**: Consistency with Iran's Seventh Development Plan mandates (e.g., 131 Mt/year production target, asset productivity [2]).

Sensitivity and Risk Analysis

A dynamic sensitivity analysis tested both scenarios under $\pm 20\%$ gas price volatility and $\pm 15\%$ exchange rate fluctuations [10]. Risk exposure was evaluated using ISO/IEC 31010: 2025 methodologies, with particular attention to systemic dependencies (e.g., 86% of downstream units rely on ethane/C5+; 100% of utilities depend on the same natural gas stream used for feedstock production) [6].

Assumptions

Key assumptions include: (1) stable domestic gas pricing for affiliates, (2) full access to domestic optimization technologies (no sanctioned imports), (3) unchanged feedstock allocation policies, and (4) sustained domestic/export demand. These reflect historical trends and official policy continuity [12].

4. RESULTS AND DISCUSSION

The analysis reveals two critical, simultaneous challenges facing PGPIDMC: (1) underutilization of downstream units, with an average operating rate of only 68%—equivalent to 3.6 million tons/year of latent capacity; and (2) a structural feedstock gap, where current demand (5.0–5.5 Mt/year) already exceeds upstream supply (4.4 Mt/year), a deficit projected to widen to 2.5 Mt/year if latent capacity is activated. Comparing the two investment scenarios shows that Scenario B (downstream optimization) requires only 20–30% of the CAPEX of a new field development (Scenario A), achieves a payback period of 18–30 months (versus 35+ months for Scenario A), and generates positive cash flow from month 15. Moreover, optimization reduces feedstock consumption per ton of product by 5–8%, directly easing pressure on the Bidboland gas refinery—currently operating at 92% capacity and serving as a single point of failure for 90% of downstream units.



Dynamic sensitivity analysis confirms that Scenario B maintains financial robustness in 92% of stress-test scenarios ($\pm 20\%$ gas price, $\pm 15\%$ exchange rate), while Scenario A faces high execution risk, long capital lock-up (peak cash outflow in months 24–30), and limited alignment with near-term national priorities.

Critically, optimization does not delay feedstock security—it enables it: by generating internal cash flow and reducing system-wide feedstock intensity, it creates the financial and operational foundation for smarter, data-driven upstream investment from 1407 onward. Thus, the dichotomy between “upstream vs. downstream” is false; the optimal path is sequenced integration: optimize first, then expand.

5. CONCLUSION

This study demonstrates that optimizing downstream units—by activating the existing 3.6 million tons/year of latent capacity—is a low-cost, low-risk, and high-return strategy that aligns with Iran’s national priorities of asset efficiency and economic resilience. Unlike upstream field development, which requires ~\$500 million in CAPEX and a 35+ month payback, optimization demands only 20–30% of that investment, achieves 85–90% utilization, and generates positive cash flow within 18–30 months. Crucially, it also reduces feedstock consumption by 5–8% per ton, directly alleviating pressure on the overstretched Bidboland gas refinery—the system’s single point of failure. Rather than choosing between upstream or downstream, the optimal path is a two-stage roadmap :

Short-term (1404–1406): Prioritize process optimization to boost ROA and generate cash flow .

Long-term (from 1407): Use internal cash flow to de-risk and fund targeted upstream development.

This integrated approach ensures both immediate financial health and long-term feedstock security, transforming a false dichotomy into a synergistic strategy for national value creation.

6. REFERENCES

- [1] Smith, R., Chen, J., and Wang, L., "Indirect upstream resource management through downstream optimization in integrated petrochemical networks," *Chemical Engineering Research and Design*, vol. 198, pp. 112–125, 2025.
- [2] Zhang, L., Ebrahimi, M., and Farhadi, A., "Data-driven asset performance optimization in petrochemical holding companies: A case study from Iran," *Energy Economics*, vol. 118, pp. 107142, 2025.
- [3] Nguyen, T., Rahimi, S., and Omidvar, K., "Single point of failure analysis in hydrocarbon supply chains: Risk mapping in Persian Gulf petrochemical clusters," *Journal of Loss Prevention in the Process Industries*, vol. 87, p.p105431, 2025.
- [4] Jensen, M. and Alizadeh, P., "Monthly cash flow modeling for high-uncertainty energy investments: Evidence from emerging economies," *Applied Energy*, 361, pp. 122894, May 2025.
- [5] International Energy Agency (IEA), "Investment decision framework for integrated energy infrastructure under volatility," *IEA Energy Investment Report*, Paris: IEA Publications, pp. 45–67, Jun. 2025.