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Strategic Alliances of Multinational Corporations in Egypt's Emerging Green Hydrogen Sector: A Case Study of the "Egypt Green Hydrogen" Project and Its Alignment with Egypt Vision 2030

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ABSTRACT

The global transition to sustainable energy systems has positioned green hydrogen as a pivotal solution for decarbonizing hard-to-abate sectors such as heavy industry and ammonia production. This study examines the Egypt Green Hydrogen project—a multinational strategic alliance in an emerging market—to analyze how such collaborations align strategic objectives, governance structures, and national development agendas. Using Chandler's Strategy-Structure Paradigm and institutional theory, the research employs a qualitative case study approach, drawing on secondary data from corporate reports, policy documents, and academic literature.

The findings reveal that the consortium, comprising Scatec ASA, Fertiglobe, Orascom Construction, and Egyptian public entities (the Sovereign Fund of Egypt and EETC), leverages complementary capabilities: renewable energy expertise, ammonia production, local infrastructure development, and policy alignment. The alliance's governance structure, characterized by defined roles, majority-minority equity participation, and hybrid public-private oversight, effectively balances commercial agility with national priorities under Egypt Vision 2030. Key outcomes include technology transfer, risk mitigation through joint financing models (e.g., DFI-backed concessional loans), and contributions to sustainable energy transition, economic diversification, and foreign direct investment (FDI) attraction.

The study underscores the critical role of public-sector anchoring in legitimizing projects and aligning them with institutional frameworks, while private partners drive innovation and scalability. Derived actionable recommendations—including structured public-private governance models, de-risking frameworks, and localized capacity-building strategies—are proposed to guide policymakers and firms in designing scalable green hydrogen alliances. By demonstrating how strategic-structural alignment fosters sustainable industrialization, the Egypt Green Hydrogen project offers a replicable model for emerging markets seeking to harness green hydrogen's potential. This research contributes insights into the design of multinational renewable energy partnerships, highlighting the interplay between organizational strategy, governance, and policy coherence in advancing global decarbonization goals.

Keywords: Green Hydrogen, Strategic Alliances, Public-Private Partnerships, Egypt Vision 2030, Governance Structure, Sustainable Development, Emerging Markets, Chandler's Strategy-Structure Paradigm, Institutional Theory, Renewable Energy Transition, Technology Transfer, Decarbonization, Economic Diversification, Foreign Direct Investment (FDI), Policy Alignment

Introduction

The global pursuit of decarbonization and sustainable energy transition has positioned green hydrogen as a critical element in future energy systems. Produced through the electrolysis of water using renewable electricity, green hydrogen offers a clean alternative for industrial applications, transport, and energy storage [1]. Anticipated to play a vital role in hard-to-abate sectors such as steelmaking and ammonia production, green

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hydrogen is increasingly prioritized by nations with favorable renewable resources and strategic export ambitions.

Egypt, a country endowed with vast solar and wind energy potential and located at the intersection of Africa, Asia, and Europe, has identified green hydrogen as a national strategic priority. The Egyptian government's Sustainable Development Strategy, articulated through Egypt Vision 2030, emphasizes economic diversification, renewable energy integration, foreign investment attraction, and environmental sustainability [2]. Within this context, the Egypt Green Hydrogen project—Africa's first integrated green hydrogen plant—has emerged as a flagship initiative.

This project, launched in 2021 and showcased during the 2022 United Nations Climate Change Conference (COP27), is being developed by a consortium comprising Scatec ASA (Norway), Fertiglobe (a joint venture between OCI N.V. and ADNOC), Orascom Construction (Egypt), the Sovereign Fund of Egypt (SFE), and the Egyptian Electricity Transmission Company (EETC). The pilot phase began in late 2022 in Ain Sokhna within the Suez Canal Economic Zone, aiming to produce approximately 13,000 tons of green hydrogen annually, powering the production of up to 90,000 tons of green ammonia for international export [3,4].

The consortium brings together diverse capabilities: Scatec contributes renewable energy expertise and project leadership; Fertiglobe provides ammonia production facilities and international market access; Orascom offers local engineering and construction capabilities; and SFE and EETC ensure public sector anchoring, policy alignment, and infrastructure integration. This strategic alliance aims to combine foreign direct investment, advanced technology, and public policy facilitation to foster green industrial development.

Despite widespread attention and political support, scholarly inquiry into how such multinational alliances function in emerging economies—particularly in terms of strategic coordination, governance design, and national development alignment—remains limited. This study seeks to address this gap through an in-depth case analysis of the Egypt Green Hydrogen alli|

Research Problem and Objectives

Strategic alliances are increasingly vital for companies and governments aiming to address complex challenges such as energy transition and sustainable development.

However, there is a notable gap in research concerning how these alliances function within emerging markets, particularly in sectors such as green hydrogen. Even less is known about how internal strategic objectives and alliance structures interact and whether such collaborations align with national long-term visions such as Egypt Vision 2030 [2].

This Study Aims to fill that gap by using the Egypt Green Hydrogen project as a case study. It examines both the strategic goals of the alliance's partners and the structure through which they collaborate, in light of Egypt's Vision 2030 goals.

This Research is Guided by the Following Objectives:

- To analyze the strategic motivations and objectives behind the participation of each key partner – Scatec, Fertiglobe, Orascom Construction, and the Sovereign Fund of Egypt – in the alliance.
- To examine how the organizational structure and governance mechanisms of the alliance support or constrain the achievement of its strategic objectives and the individual goals of its partners.
- To assess the degree to which the project's strategies and outcomes align with the key economic, environmental, and social pillars and goals articulated in Egypt Vision 2030 [2].
- To offer strategic and structural recommendations for enhancing the effectiveness and national alignment of future public-private green energy partnerships in Egypt and other emerging markets.

Research Questions

Based on the research objectives, this study will seek to answer the following questions:

- What are the primary strategic objectives of each partner involved in the Egypt Green Hydrogen alliance?
- How does the alliance's structure — including its governance framework, defined roles, equity participation, and operational control mechanisms — support or limit the realization of these partner and alliance-level strategies?
- How effectively does the Egypt Green Hydrogen project, as a strategic alliance, align with the pillars and targets of Egypt Vision 2030, particularly in the domains of sustainable energy transition, economic growth, and attracting international investment [2].
- What generalizable lessons can be derived from this case study regarding the interaction between strategy and structure in multinational strategic alliances operating within the emerging market renewable energy sector?

Literature Review

Strategic Alliances in Renewable Energy and Emerging Markets

Strategic alliances are essential in high-capital, high-risk sectors like renewable energy, where they enable risk-sharing, resource pooling, and knowledge transfer. The emergence of green hydrogen as a next-generation energy carrier has intensified the formation of such alliances, particularly in regions with policy uncertainty and infrastructure gaps [5]. Recent studies emphasize that these alliances are increasingly used to integrate renewable energy systems into scalable, cross-sectoral solutions [6].

In emerging markets, alliances between multinational corporations and local entities are critical due to regulatory complexity and the need for local legitimacy. These partnerships allow foreign firms to mitigate host-country risks while contributing capital and expertise, and enable domestic actors to pursue development goals and technology transfer [7,8]. Public-private partnerships (PPPs) remain a dominant model, combining private sector innovation and efficiency with public sector authority and legitimacy [1,8].

The Egypt Green Hydrogen alliance exemplifies this model. It brings together Scatec ASA (Norway), Fertiglobe (a joint venture between OCI N.V. and ADNOC), Orascom Construction

(Egypt), and the Sovereign Fund of Egypt (SFE). Each partner contributes distinct capabilities: Scatec provides renewable energy expertise; Fertiglobe offers ammonia production and export infrastructure; Orascom delivers local engineering and construction; and SFE ensures alignment with national policy and investment strategy [3,4]. This alliance structure reflects the growing importance of hybrid models in managing complex, multi-sectoral green hydrogen projects.

Alignment with National Strategies and Institutional Expectations

Strategic alliances in emerging markets often operate within national development frameworks to gain access to incentives, regulatory support, and public legitimacy. Egypt Vision 2030 emphasizes inclusive growth, environmental sustainability, and innovation-driven sectors, making it a key reference for green hydrogen initiatives [2].

Institutional theory suggests that organizations seek legitimacy by aligning with societal norms and policy expectations. Projects that reflect national priorities are more likely to attract support and succeed [9,10]. The Egypt Green Hydrogen alliance demonstrates this alignment through the inclusion of public entities like the Sovereign Fund of Egypt and the Egyptian Electricity Transmission Company (EETC), which institutionalize policy goals within the alliance structure [2].

Strategy–Structure Paradigm in Alliance Governance

The principle that "structure follows strategy" remains a foundational concept in alliance governance [11]. In the context of green hydrogen, this means designing governance models, equity structures, and decision-making protocols that support strategic objectives. Recent research highlights that alliances with clear governance, transparent roles, and equitable risk-sharing are more resilient and effective [12,13].

Cross-border alliances face additional complexity due to legal, cultural, and institutional differences. In public-private collaborations, structural design must balance commercial agility with public accountability. The Egypt Green Hydrogen alliance exemplifies this hybridity, combining private-sector leadership with embedded public oversight to serve both commercial and national development goals [1,2].

Theoretical Framework

To comprehensively examine the Egypt Green Hydrogen alliance, this study employs an integrated theoretical framework centered on Chandler's Strategy–Structure Paradigm. This framework enables a holistic analysis of the alliance's internal mechanics, stakeholder dynamics, and its interaction with broader policy and legitimacy environments.

Strategy–Structure Paradigm

Alfred Chandler's foundational principle that "structure follows strategy" posits that an organization's design must be aligned with its strategic objectives to avoid inefficiencies and internal conflict [11]. While originally developed in the context of large corporations, this paradigm has been widely applied to joint ventures and strategic alliances, particularly in sectors undergoing rapid transformation such as renewable energy and green hydrogen [6,14].

In the case of the Egypt Green Hydrogen alliance, this framework is used to assess whether the structural configuration—including the formation of Egypt Green Hydrogen S.A.E., majority control by Scatec ASA, and clearly defined partner roles—supports the strategic goals of the consortium. By mapping the strategic objectives of each partner (e.g., Scatec, Fertiglobe, Orascom Construction, and the Sovereign Fund of Egypt) and the alliance as a whole, the study evaluates the alignment between these objectives and the governance mechanisms adopted.

Methodology

This study adopts a deductive qualitative, desk-based case study methodology, focusing on the Egypt Green Hydrogen project as a single, bounded case. The project is selected for its relevance to strategic alliances in the emerging market green hydrogen sector and its alignment with national development goals such as Egypt Vision 2030.

A deductive methodological approach is employed, applying established theoretical concepts—primarily Chandler's Strategy–Structure Paradigm and institutional theory—to analyze empirical data. The aim is to explore how these theories manifest in the context of a real-world alliance operating in a complex, policy-driven environment.

Data Sources

Data for this study is drawn exclusively from publicly available secondary sources, including:

- **Official company documents:** Sustainability reports, investor presentations, and joint venture announcements from Scatec, Fertiglobe, Orascom Construction, and the Sovereign Fund of Egypt.
- **Public communications:** Press releases, news articles, and statements from governmental bodies and industry publications.
- **National strategy documents:** Egypt Vision 2030 and related energy or hydrogen strategies to assess alignment with national objectives.
- **Academic and policy literature:** Studies on strategic alliances, organizational structure, green hydrogen markets, and public-private partnerships [14,15].

Analytical Framework

The analysis is guided by Chandler's Strategy–Structure Paradigm, which is used to examine the relationship between the strategic objectives of the alliance and its observed governance and organizational structure. Insights from institutional theory and recent literature on green hydrogen alliances further inform the interpretation of findings, particularly regarding the alignment with Egypt Vision 2030 and the broader implications for public-private partnerships in emerging markets [14,15].

Findings

The findings of the study are structured around the research questions, presenting evidence gathered from secondary sources.

Strategic Objectives of Alliance Partners

The Egypt Green Hydrogen alliance comprises partners with distinct yet complementary strategic objectives:

- Scatec ASA aims to expand its renewable energy portfolio, strengthen its position as a global independent power

producer (IPP), and demonstrate leadership in green hydrogen production. Its involvement in the project aligns with its strategy of pursuing profitable growth in emerging markets through sustainable energy solutions [16].

- Fertiglobe seeks to diversify its product offerings, capitalize on the emerging green ammonia market, and enhance its sustainability profile. The alliance provides a secure supply of green hydrogen, a critical feedstock for green ammonia, enabling Fertiglobe to meet rising global demand for low-carbon fertilizers [17].
- Orascom Construction intends to leverage its local engineering and construction expertise to support Egypt's energy transition, expand its renewable energy footprint, and contribute to national infrastructure development. The project enhances Orascom's technical capabilities in green hydrogen infrastructure [18].
- The Sovereign Fund of Egypt (SFE) aims to attract foreign direct investment, promote economic diversification, and drive sustainable development in line with Egypt Vision 2030. The alliance serves as a vehicle for mobilizing private capital, fostering innovation, and creating high-value jobs [19].
- Egyptian Electricity Transmission Company (EETC) plays a key role in modernizing and expanding Egypt's electricity grid to accommodate renewable energy and ensure reliable transmission to the green hydrogen facility.

Table 1: Strategic Objectives of Alliance Partners

Partner	Strategic Objectives
Scatec ASA	Expand renewable energy portfolio; lead in green hydrogen; grow in emerging markets.
Fertiglobe	Diversify products; enter green ammonia market; enhance sustainability profile.
Orascom Construction	Leverage local expertise; support energy transition; build green hydrogen infrastructure capacity.
Sovereign Fund of Egypt	Attract FDI; promote economic diversification; align with Egypt Vision 2030.
EETC	Modernize grid; support renewable integration; ensure reliable power for hydrogen production.

Alliance Structure and Governance

The Egypt Green Hydrogen project is structured as a joint venture, Egypt Green Hydrogen S.A.E., incorporated in Egypt. Its governance framework balances the diverse interests and capabilities of the partners:

- **Equity Participation:** Scatec holds the majority stake, granting it operational control and consolidating the project within its financial reporting. Minority partners align their interests with the project's success while limiting direct financial exposure.
- **Governance Bodies:** A Board of Directors with representatives from each partner provides strategic oversight. Technical and operational committees manage daily activities, leveraging each partner's expertise.
- **Defined Roles and Responsibilities:**
- **Scatec:** Leads development, construction, and operation of renewable energy facilities.
- **Fertiglobe:** Manages offtake and conversion of green hydrogen into ammonia.
- **Orascom Construction:** Oversees local construction and infrastructure development.
- SFE: Facilitates land access, permits, and government coordination.
- EETC: Ensures grid connectivity and reliable electricity supply.
- **Coordination Mechanisms:** The alliance uses contractual agreements, regular meetings, and shared platforms to ensure effective communication. Key performance indicators (KPIs) track progress and accountability.

Table 2: Defined Roles and Responsibilities in the Alliance

Partner	Role and Responsibility
Scatec ASA	Develop, construct, and operate renewable energy facilities.
Fertiglobe	Offtake and convert green hydrogen into ammonia.
Orascom Construction	Execute local construction and infrastructure development.
Sovereign Fund of Egypt	Facilitate land access, permits, and government coordination.
EETC	Provide grid connectivity and ensure electricity supply.

Alignment with Egypt Vision 2030

The project demonstrates strong alignment with Egypt Vision 2030's key pillars:

- **Sustainable Energy Transition:** By producing green hydrogen from renewable sources, the project supports Egypt's goal of increasing renewable energy's share in the national mix and reducing fossil fuel dependence.
- **Economic Growth and Diversification:** The project attracts foreign investment, creates jobs, and fosters new industries, contributing to export diversification through green ammonia production.
- **Attracting International Investment:** The involvement of global firms like Scatec and Fertiglobe enhances Egypt's profile as a renewable energy investment hub.
- **Environmental Sustainability:** The project promotes clean energy and supports Egypt's climate commitments by reducing greenhouse gas emissions.

Interplay of Strategy and Structure in the Alliance

The study reveals a strong interplay between the strategic objectives of the partners and the alliance's organizational structure:

- The joint venture structure reflects the strategic priorities of the partners. Scatec's operational control aligns with its leadership ambitions, while SFE and EETC ensure national policy alignment.
- Defined roles match each partner's core competencies—Fertiglobe's ammonia expertise, Orascom's construction capabilities, and SFE's policy facilitation.
- Governance mechanisms like the Board of Directors and technical committees ensure coordination and strategic alignment across the consortium.

In summary, the Egypt Green Hydrogen alliance's structure has

been purposefully designed to support its strategic objectives and align with Egypt's long-term development goals under Vision 2030.

Discussion and Implications

The Egypt Green Hydrogen project offers a compelling case study of how multinational strategic alliances can be structured to advance renewable energy development in emerging markets. The findings reveal several key insights with broader implications for alliance design, governance, and policy alignment.

Alignment of Strategic and National Objectives

One of the most notable outcomes of the alliance is its ability to harmonize diverse strategic objectives. Commercial partners such as Scatec, Fertiglobe, and Orascom Construction pursue profitability, market expansion, and technological leadership, while public entities like the Sovereign Fund of Egypt (SFE) and the Egyptian Electricity Transmission Company (EETC) focus on national development priorities. The alliance demonstrates that through a carefully designed governance structure and clearly defined roles, it is possible to align private sector incentives with public policy goals—an essential condition for sustainable infrastructure development in emerging economies.

The Enabling Role of the Public Sector

The active involvement of public sector institutions has been instrumental in the project's success. SFE and EETC not only provide regulatory facilitation and access to strategic resources but also ensure that the project remains aligned with Egypt's Vision 2030. Their participation enhances the legitimacy of the alliance and reduces institutional risk, underscoring the importance of public-private partnerships (PPPs) in accelerating clean energy transitions in developing contexts.

Technology Transfer and Local Capacity Building

The alliance facilitates the transfer of advanced green hydrogen technologies to Egypt, contributing to the development of local technical expertise. Orascom Construction's role in the engineering and construction of the facility exemplifies how local firms can benefit from exposure to cutting-edge technologies. This dynamic supports long-term capacity building and positions Egypt as a regional hub for green hydrogen infrastructure.

Risk Mitigation and Financial Structuring

The project's joint venture model, which combines international and domestic partners, serves as a mechanism for risk-sharing and financial de-risking. The presence of globally recognized firms such as Scatec and Fertiglobe enhances the project's credibility and bankability, attracting international financing while reducing reliance on public funds. This structure offers a replicable model for financing large-scale green infrastructure in other emerging markets.

Contribution to Sustainable Development

The Egypt Green Hydrogen project contributes meaningfully to Egypt's sustainable development agenda. It supports the decarbonization of key sectors, promotes economic diversification through green ammonia exports, and generates employment opportunities. Moreover, it reinforces Egypt's position as a leader in the green energy transition across Africa and the Middle East.

Conclusion and Recommendations

The Egypt Green Hydrogen project exemplifies a successful multinational strategic alliance in the emerging green hydrogen sector. Its alignment with Egypt Vision 2030, the strategic clarity among partners, and a robust governance structure have been central to its progress. The project demonstrates how public-private collaboration can drive sustainable industrial transformation in emerging markets.

Recommendations and Action Plan for the Egyptian Government

- **Develop a Comprehensive National Strategy:** Establish a clear, long-term roadmap for green hydrogen development, including targets, incentives, and integration with national energy and industrial policies. This will provide clarity for investors and ensure alignment with Egypt's sustainable development goals.
- **Strengthen Regulatory Frameworks:** Implement transparent, predictable, and streamlined regulations for permitting, land access, and environmental compliance. A stable regulatory environment is essential for attracting long-term investment.
- **Promote Public-Private Partnerships (PPPs):** Actively facilitate PPPs by offering co-financing mechanisms, infrastructure access, and policy support. These partnerships can accelerate technology deployment and reduce public sector burden.
- **Ensure Inclusive Stakeholder Engagement:** Engage local communities, civil society, and environmental groups early in the project lifecycle to build trust, address concerns, and maximize social benefits.
- **Establish Monitoring and Evaluation Systems:** Develop robust mechanisms to track project performance, assess socio-economic and environmental impacts, and ensure accountability and continuous improvement.

Table 3: Gov Recommendations

Recommendation	Details
Develop a Comprehensive National Strategy	Establish a clear, long-term roadmap for green hydrogen development, including targets, incentives, and integration with national energy and industrial policies.
Strengthen Regulatory Frameworks	Implement transparent, predictable, and streamlined regulations for permitting, land access, and environmental compliance.
Promote Public-Private Partnerships (PPPs)	Actively facilitate PPPs by offering co-financing mechanisms, infrastructure access, and policy support.
Ensure Inclusive Stakeholder Engagement	Engage local communities, civil society, and environmental groups early in the project lifecycle to build trust, address concerns, and maximize social benefits.
Establish Monitoring and Evaluation Systems	Develop robust mechanisms to track project performance, assess socio-economic and environmental impacts, and ensure accountability and continuous improvement.

Table 4: Gov Action Plan

Objective	Time Frame	Est. Cost	KPIs	Responsible Parties	Risks/Mitigation
Develop hydrogen policy frameworks	6–12 months	$200k–$500k	National strategy published; 5+ incentive schemes launched	Ministry of Energy	**Risk:** Bureaucratic delays. **Mitigation:** Private sector taskforce
Streamline PPP approvals	3–9 months	$100k–$300k	50% faster approvals; 3+ PPPs initiated	Investment Authority	**Risk:** Investor skepticism. **Mitigation:** Transparent guidelines
Build enabling infrastructure	24–60 months	$200M–$500M	500 MW renewable grid added; 1 hydrogen-ready port built	Ministry of Infrastructure	**Risk:** Funding gaps. **Mitigation:** Multilateral loans (e.g., EBRD)
Mandate local value creation	Ongoing	$1M–$5M	40% local workforce; 20% local procurement	Ministry of Industry	**Risk:** Non-compliance. **Mitigation:** Penalties for unmet quotas

Recommendations and Action Plan for Multinational Companies

- **with National Development Priorities:** Ensure that project objectives are consistent with host country strategies such as Egypt Vision 2030. This enhances legitimacy, facilitates regulatory support, and strengthens local partnerships.
- **Implement Transparent Stakeholder Management:** Maintain open communication with government agencies, local communities, and NGOs to build trust and mitigate social and environmental risks.
- **Design Robust Governance Structures:** Establish clear roles, decision-making protocols, and conflict resolution mechanisms to ensure effective collaboration and operational efficiency.
- **Prioritize Technology Transfer and Capacity Building:** Invest in training, local hiring, and knowledge sharing to build domestic capabilities and foster long-term sustainability of the green hydrogen sector.
- **Commit to High Sustainability Standards:** Adhere to international best practices in environmental and social governance (ESG) to minimize negative impacts and maximize developmental benefits.

Table 5: Companies Recommendations

Recommendation	Details
Align with National Development Priorities	Ensure that project objectives are consistent with host country strategies such as Egypt Vision 2030.
Implement Transparent Stakeholder Management	Maintain open communication with government agencies, local communities, and NGOs to build trust and mitigate social and environmental risks.
Design Robust Governance Structures	Establish clear roles, decision-making protocols, and conflict resolution mechanisms to ensure effective collaboration and operational efficiency.
Prioritize Technology Transfer and Capacity Building	Invest in training, local hiring, and knowledge sharing to build domestic capabilities and foster long-term sustainability of the green hydrogen sector.
Commit to High Sustainability Standards	Adhere to international best practices in environmental and social governance (ESG) to minimize negative impacts and maximize developmental benefits.

Table 6: Companies Action Plan

Objective	Time Frame	Estimated Cost	KPIs	Responsible Parties	Risks/Mitigation
Align goals with Egypt Vision 2030	0–6 months	$50k–$100k	2+ MoUs signed with ministries; inclusion in national strategy	Corporate Strategy Team	**Risk:** Policy shifts. **Mitigation:** Regular government dialogue
Partner with local/ public entities	3–12 months	$200k–$500k	2+ local partners onboarded; public entity holds 10–20% equity	Business Development & Legal	**Risk:** Partner conflicts. **Mitigation:** Clear governance agreements
Secure long-term offtake agreements	6–18 months	$1M–$2M	10+ year contract signed; 80% revenue secured	Commercial & Finance Teams	**Risk:** Market fluctuations. **Mitigation:** Price escalation clauses
Invest in local capacity building	12–24 months	$500k–$1M	500+ workers trained; 30% local procurement	HR & Operations	**Risk:** Skill gaps. **Mitigation:** Partner with vocational institutes

By implementing these recommendations, Egypt and other emerging markets can unlock the full potential of green hydrogen and accelerate their transition to a low-carbon, inclusive, and resilient energy future.

Future Work

This study provides a foundational analysis of the Egypt Green Hydrogen alliance, but several avenues remain for further exploration:

- **Longitudinal Case Analysis:** Future research could track the evolution of the alliance over time, examining how its structure, strategy, and performance adapt across project phases.
- **Comparative Case Studies:** Cross-country comparisons with similar green hydrogen alliances in other emerging markets could reveal common success factors, challenges, and policy lessons.
- **Stakeholder-Centered Research:** In-depth interviews with government officials, corporate executives, and community representatives could provide richer insights into motivations, expectations, and lived experiences.
- **Quantitative Performance Metrics:** Developing indicators to measure economic, environmental, and social outcomes would enable more rigorous evaluation of project effectiveness and sustainability.
- **Policy and Regulatory Studies:** Further research could explore how different policy instruments—such as subsidies, carbon pricing, or green procurement—affect the viability and scalability of green hydrogen projects.
- **Technological Innovation Pathways:** Investigating the role of emerging technologies (e.g., advanced electrolyzers, AI-driven grid integration) could inform strategies for reducing costs and improving efficiency in hydrogen production.

By pursuing these research directions, scholars and practitioners can deepen their understanding of green hydrogen alliances and contribute to the design of more effective, inclusive, and sustainable energy transitions in emerging economies.

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