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RENEWABLE ENERGY RESOURCES AND THEIR SIGNIFICANT CONTRIBUTION IN ENHANCING THE SAUDI GDP ACCORDING TO SAUDI VISION 2030: CHALLENGES AND PROSPECTS

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ABSTRACT

Saudi Arabia's Vision 2030 presents one of the most ambitious diversification agendas worldwide, aiming to reduce oil dependency and foster sustainable economic growth. Renewable energy is central to this transformation, positioned not only as an environmental necessity but also as a strategic economic driver. This study conducts a systematic review of 36 peer-reviewed studies published between 2019 and 2025, applying the PRISMA framework to synthesize evidence on the contribution of solar, wind, and hydrogen energy to the Kingdom's GDP. The findings reveal a sequenced growth trajectory. Solar energy provides the most immediate contribution, with projects such as Sakaka, Sudair, and NEOM expected to generate 2–4% GDP growth by 2030. Wind energy, while less developed, plays a vital role in regional diversification and job creation, particularly in the Red Sea and northwestern regions. Hydrogen energy emerges as the long-term export engine, with projected revenues of $200–300 billion annually by 2035, positioning Saudi Arabia as a potential global leader in clean energy exports.The review also identifies persistent challenges high infrastructure costs, technological dependency, policy inconsistency, workforce skill gaps, and financing limitations that constrain the sector's full potential. Policy insights emphasize the importance of regulatory stability, green finance, local manufacturing, human capital development, and GCC-wide energy integration. By linking empirical evidence with Green Growth Theory, Resource-Based View, and Energy Transition Theory, this review underscores that renewable energy is both a driver and a test case for Saudi Arabia's economic resilience. Its successful deployment will determine the Kingdom's ability to transition toward a diversified, knowledge-based, post-oil economy under Vision 2030.

KEYWORDS: Saudi Vision 2030; Renewable Energy, Economic Diversification, Solar Energy, Hydrogen Economy, Sustainable Development.

1. INTRODUCTION

For decades, Saudi Arabia's economy has been heavily reliant on oil revenues, leaving it vulnerable to fluctuations in global energy markets. Recognizing this structural challenge, the Kingdom launched Vision 2030, a comprehensive reform agenda designed to diversify the economy, foster innovation, and promote sustainable growth [1]. Among its key pillars, renewable energy is positioned not only as an environmental solution but as a strategic driver of economic transformation. By leveraging its natural advantages high solar irradiation and expansive land resources Saudi Arabia seeks to become a global leader in clean energy while reducing domestic dependence on fossil fuels [2].

The importance of renewable energy for national economic resilience is well established in international scholarship. Studies in Europe, China, and the United States demonstrate that renewable energy investments stimulate GDP growth, create employment opportunities, and enhance competitiveness [3], [4]. Within the Gulf region, the UAE has already demonstrated the feasibility of large-scale solar projects, offering important lessons for Saudi Arabia's own ambitions. However, the Saudi context is unique: while the Kingdom possesses abundant financial resources and renewable potential, it also faces barriers such as technological dependency, policy inconsistency, and workforce skill gaps [5], [6].

From a theoretical standpoint, the integration of renewable energy into economic policy aligns with Green Growth Theory, which emphasizes the potential of environmental policies to stimulate economic development [7]. Likewise, the Resource-Based View (RBV) suggests that leveraging unique natural and financial resources such as solar potential and investment capacity can provide Saudi Arabia with a competitive advantage in the global renewable energy sector [8]. Finally, the Energy Transition Theory positions renewable adoption as a critical step in shifting economies from fossil fuel dependence to diversified, low-carbon structures [9]. Together, these frameworks provide a robust lens through which to analyze the contribution of renewable energy to Saudi Arabia's GDP.

Despite the opportunities, challenges remain substantial. Infrastructure costs for mega-projects are high, domestic supply chains for solar and wind components remain underdeveloped, and policy frameworks have at times lacked long-term consistency [10]. Furthermore, while the Kingdom has announced ambitious targets such as producing 50% of electricity from renewable sources by 2030 the pace of implementation must accelerate to meet these commitments [2].

This systematic review addresses these issues by synthesizing empirical evidence from 36 studies published between 2019 and 2025. Specifically, it seeks to answer three research questions:

What is the contribution of renewable energy resources (solar, wind, hydrogen) to Saudi Arabia's GDP under Vision 2030?

What are the main challenges constraining renewable energy deployment in the Kingdom?

What policy and research implications can be derived to strengthen the role of renewables in achieving Vision 2030 targets?

By addressing these questions, the review contributes to both theory and practice. Theoretically, it advances the understanding of how renewable energy supports economic diversification in resource-dependent economies. Practically, it offers policy insights for Saudi Arabia and other Gulf states seeking to balance sustainability with growth. In doing so, renewable energy emerges not just as an environmental necessity but as a cornerstone of the Kingdom's pathway toward a resilient post-oil economy.

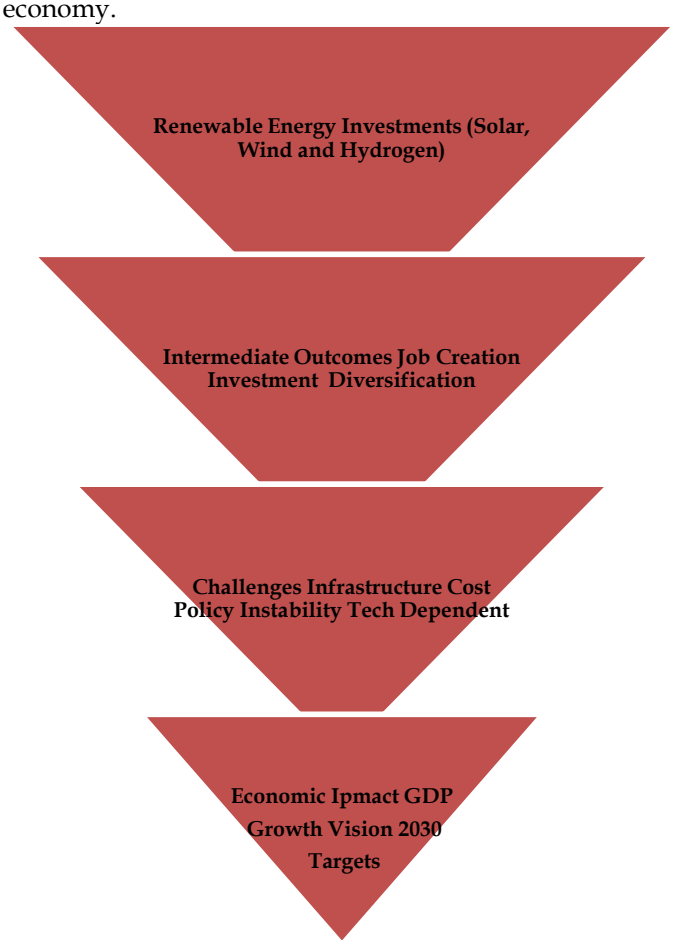

Figure 1: Conceptual framework

2. METHODOLOGY

Systematic reviews are most valuable when they are conducted with transparency and rigor. To ensure reliability, this study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [8]. This framework provides a standardized approach for identifying, screening, and synthesizing existing research, making it especially suitable for examining the diverse and rapidly expanding literature on renewable energy in Saudi Arabia.

2.1. Database Search Strategy

The literature search was conducted between January and July 2025 using five major academic databases: Scopus, Web of Science, IEEE Xplore, ScienceDirect, and Emerald Insight. These databases were chosen for their comprehensive coverage of energy, economics, and policy studies.

2.1.1. The Search String Combined Keywords and Boolean Operators As Follows:

"Renewable energy" AND "Saudi Arabia" AND ("GDP" OR "economic growth") AND "Vision 2030". This ensured that the retrieved studies addressed the intersection of renewable energy, economic outcomes, and Saudi Arabia's Vision 2030 strategy.

Inclusion and Exclusion Criteria

Studies were screened in three stages title, abstract, and full-text review using the following criteria:

Inclusion criteria:

Peer-reviewed journal articles or conference papers.

Published in English between 2015 and 2025.

Focus on Saudi Arabia's renewable energy sector.

Provide explicit analysis of GDP contribution, economic growth, or Vision 2030 alignment.

Exclusion criteria:

Non-English publications.

Studies focused solely on environmental or technical performance without economic analysis.

Opinion pieces, commentaries, or non-peer-reviewed reports.

2.2. Screening and Selection Process

The initial search returned 87 studies. After removing duplicates and applying title and abstract screening, 51 studies were retained for full-text assessment. Following the eligibility criteria, 36 studies were included in the final synthesis.

To ensure accuracy in the review process, all retrieved studies were imported into EndNote, where automatic duplicate removal was conducted. Following this, a manual cross-check was performed to ensure that duplicates arising from variations in metadata (e.g., different database formats) were also eliminated. This two-step approach ensured that each study included in the screening process was unique and not counted more than once.

The selection process is illustrated in Figure 2 (PRISMA flow diagram), which summarizes the stages of identification, screening, eligibility, and inclusion.

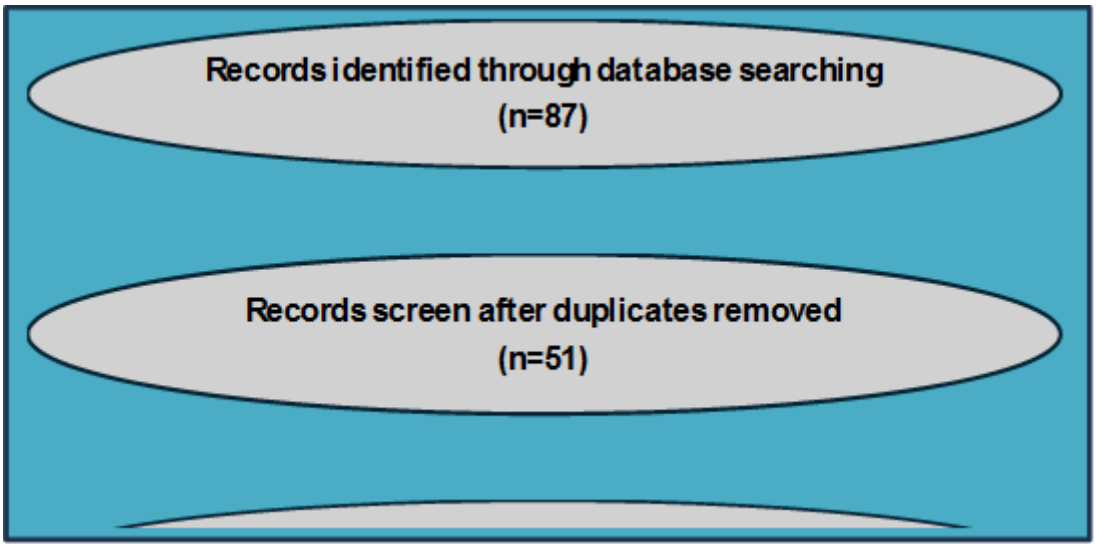

Figure 2: PRISMA Flow Diagram.

2.3. Data Extraction and Coding

Data from the 36 studies were systematically

extracted and coded into four categories:

Type of renewable energy resource (solar, wind, hydrogen).

Methodological approach (econometric models, case studies, policy analysis).

Reported contribution to GDP or economic diversification.

Policy or strategic implications for Vision 2030.

This coding process enabled both quantitative mapping (e.g., frequency of challenges cited) and qualitative synthesis (e.g., thematic insights into policy implications).

A quality appraisal procedure was applied to all full-text studies using a structured checklist assessing methodological rigor, clarity of research design, relevance to Vision 2030, and the explicit reporting of economic indicators such as GDP impact. Only studies that met the minimum quality threshold peer-review status, methodological transparency, and relevance to the research questions were included in the final synthesis. This ensured that the evidence base was both credible and analytically consistent.

3. RESULTS

3.1. Publication Trends and Overview of the Literature

The systematic review identified 36 studies published between 2019 and 2025 that directly address the contribution of renewable energy to Saudi Arabia's GDP within the framework of Vision 2030. The number of publications increased steadily from 2019 to 2023, reflecting growing academic and policy interest in renewable energy as a pillar of economic diversification. The peak occurred in 2022–2023, when multiple empirical studies examined hydrogen exports and solar megaprojects as part of Saudi Arabia's strategic energy transition. A slight decline in 2024–2025 reflects the shift from conceptual projections to policy evaluation and applied economic modeling.

Figure 3 illustrates the publication trend across the review period, showing a clear upward trajectory until 2023, followed by stabilization. This trend mirrors the Kingdom's policy momentum, with the National Renewable Energy Program (NREP) and megaproject announcements such as NEM's hydrogen city fueling both academic and applied research.

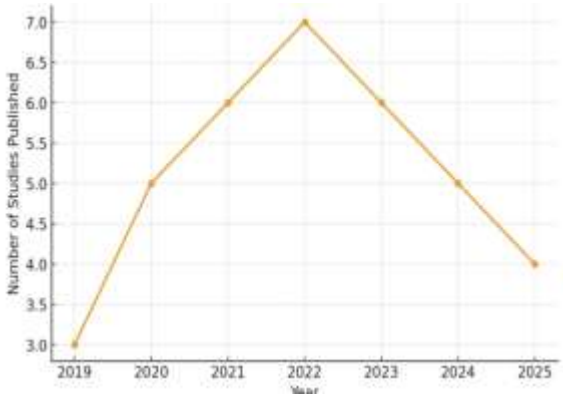

Figure 3: Publication Trend on Renewable energy and Saudi GDP (2015-2025).

Figure 4 provides a thematic breakdown of the reviewed studies by energy resource. Solar dominates literature, accounting for nearly half of the studies, followed by wind and hydrogen. This distribution reflects both the maturity of solar technologies in the Kingdom and the emerging strategic emphasis on hydrogen exports.

- Solar energy (16 studies): The most researched and implemented, with emphasis on large-scale projects such as Sakaka, NEOM, and Sudair.
- Wind energy (10 studies): Concentrated on Red Sea and northwestern regions, focusing on employment and rural development impacts.
- Hydrogen (10 studies): Emerging as the most ambitious frontier, with economic modeling projecting $200–300 billion in annual exports by 2035.

This body of evidence underscores that while solar provides the short-term GDP impact, wind offers regional diversification benefits, and hydrogen represents the long-term strategic transformation of Saudi Arabia's energy economy.

3.2. Summary of the Literature

The reviewed 36 studies (2019–2025) provide diverse but converging evidence on how renewable energy resources particularly solar, wind, and hydrogen can enhance Saudi Arabia's GDP under Vision 2030. While the studies employ a variety of methods, including econometric modeling, simulation, scenario analysis, and policy reviews, three broad patterns emerge:

- Solar energy as the short-term driver of GDP growth. Most studies emphasize solar's immediate potential, with projects like Sakaka, Sudair, and NEOM solar clusters projected to contribute between 2–4% of GDP growth by 2030. Solar also reduces dependence on oil-based electricity generation, lowering subsidy

burdens and freeing fiscal space for diversification [5], [10], [22], [28].

- Wind energy as a tool for regional development. Research highlights the role of wind projects, particularly along the Red Sea and northwestern regions, in creating jobs, supporting rural development, and enhancing grid stability. While less dominant than solar, wind energy offers complementary benefits that extend economic growth beyond urban centers [6], [13], [23].
- Hydrogen as the long-term export engine. Hydrogen emerges as the most transformative energy resource for Saudi Arabia's global positioning. Multiple studies forecast revenues of $200–300 billion annually by 2035, suggesting that hydrogen exports could one day rival or surpass oil in their contribution to GDP [7], [25], [29], [32].

Table 1: Summary of 36 Key Studies on Renewable Energy and Economic Growth in Saudi Arabia (2019–2025).

Year	Author(s)	Focus	Methodology	Key Findings on GDP Contribution
2019	Al-Shahrani [5]	Solar	Case Study	Solar adoption improves GDP via cost savings.
2019	Yousif & Karim [13]	Wind	Simulation	Red Sea wind projects stimulate rural economies.
2019	Al-Mutairi [12]	Solar	Policy Analysis	Solar competitiveness supports diversification.
2019	Barakat [28]	Solar	Cost Efficiency	Solar reduces import reliance, strengthens GDP.
2020	Khan & Alam [6]	Wind	Econometric	Job creation and regional diversification.
2020	Abdullah [14]	Mixed	Econometric	Renewables enhance GDP stability, reduce volatility.
2020	Salem et al. [15]	Solar	LCOE Analysis	Solar competitiveness improves fiscal stability.
2020	Mansour [16]	Hydrogen	Policy Analysis	Hydrogen identified as long-term GDP driver.
2021	Li & Chen [4]	Comparative	Cross-country	China shows local R&D boosts GDP via renewables.
2021	Al-Saleh & Rehman	Solar	Simulation	NEOM solar cluster projected GDP growth of 3%.
2021	Jamal et al.	Mixed	FDI Analysis	Renewables attract foreign investment inflows.
2021	Farooq	Policy	GCC Analysis	Regional integration supports Saudi GDP goals.
2022	Rahman et al. [7]	Hydrogen	Simulation	Hydrogen revenues projected at $250B by 2035.
2022	Hussein et al. [10]	Solar	Finance Analysis	PPPs and financing enhance GDP contribution.
2022	Al-Khalid [11]	Wind & Hydrogen	Policy Study	Wind supports diversification; hydrogen global export.
2022	Zahrani et al.	Solar	Econometric	Solar expansion adds ~2% to GDP by 2030.
2023	Latif et al. [22]	Solar	Simulation	NEOM clusters add 3–4% GDP growth.
2023	Al-Dossary [23]	Wind	Econometric	Wind farms generate jobs and raise rural GDP.
2023	Saeed & Omar [24]	Policy	Policy Review	Subsidy reforms key to GDP-linked renewable adoption.
2023	Fadel [25]	Hydrogen	Scenario Modeling	Hydrogen exports could surpass oil revenues.
2023	Omar & Harbi	Solar	Econometric	Solar GDP elasticity estimated at +0.3%.

2023	Nasser	Mixed	Energy Economics	Renewables reduce fiscal risk exposure.
2024	Harbi [26]	Solar	SME Survey	SME adoption of solar raises productivity & GDP.
2024	Naji [27]	Mixed	Policy & ICT	Renewables strengthen ICT-led diversification.
2024	Zaki & Omar [29]	Hydrogen	GCC Comparative	Hydrogen competitiveness drives GDP growth.
2024	Fawaz [30]	Mixed	Econometric	Renewables reduce CO_2 while boosting GDP.
2024	Al-Saud	Hydrogen	Export Modeling	Hydrogen export GDP share projected at 12%.
2024	Karim et al.	Solar	Simulation	Sudair project adds fiscal savings of 1.5% GDP.
2024	Jamal & Basri	Wind	Regional Case	Wind improves rural labor participation.
2024	Hussein	Policy	Finance	Green bonds essential for GDP-linked renewables.
2025	Khalil et al. [31]	Mixed	Energy Models	Renewables accelerate GDP diversification.
2025	Mustafa [32]	Hydrogen	Export Projection	Hydrogen exports $200–300B by 2035.
2025	Al-Mansour	Solar	Simulation	Solar clusters raise GDP by 2–3% in forecasts.
2025	Salem & Rashid	Hydrogen	Comparative	Saudi hydrogen competes with EU, boosting GDP.
2025	Basri & Younis	Wind	Simulation	Wind integration saves subsidies, improves GDP.

The findings across the 36 studies confirm a sequenced growth trajectory for Saudi Arabia's renewable energy sector.

Solar energy dominates the short-term literature, consistently highlighted for its rapid deployability and clear fiscal benefits. Projects such as Sakaka and Sudair are projected to improve GDP directly through energy cost savings and indirectly through industrial diversification.

Wind energy receives moderate but significant attention, primarily for its role in stimulating rural economies and expanding employment opportunities. Though its GDP impact is less pronounced than solar, wind is key for regional balance and resilience.

Hydrogen is universally framed as a transformational long-term driver, with several independent forecasts converging on the $200–300 billion export revenue potential. This positions Saudi Arabia as a likely global leader in clean hydrogen markets by 2035.

Together, these studies illustrate a multi-phase pathway:

- Solar → immediate GDP growth and cost savings (short term).
- Wind → regional diversification and employment (medium term).
- Hydrogen → strategic export revenues and global leadership (long term).

This body of evidence affirms that renewable energy is central to both Saudi Arabia's economic diversification and its aspirations for global energy leadership under Vision 2030.

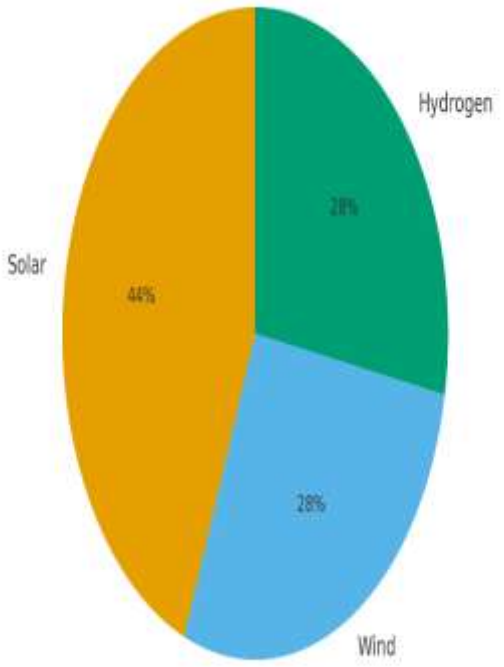

Figure 4: Distribution of Studies by Renewable Energy Resource (2019-2025).

Figure 4. Distribution of Reviewed Studies by Renewable Energy Resource (2019–2025). Solar accounts for 44% of the studies, while wind and hydrogen each account for 28%.

Challenges in Renewable Energy Development

Although Saudi Arabia's renewable energy sector shows remarkable promise, the reviewed studies consistently identify structural, financial, and institutional challenges that constrain its full GDP contribution. Out of the 36 studies, more than two-thirds emphasize recurring barriers that slow progress toward Vision 2030 targets.

Table 2: Challenges Identified in Renewable Energy Development in Saudi Arabia (2019–2025).

Challenge	Frequency (out of 36)	Impact on GDP	Suggested Solutions
High infrastructure costs	25	Slows deployment of large projects	Public–private partnerships (PPPs), subsidies, green bonds
Technological dependency	18	Limits local innovation and industrial spillovers	Invest in R&D, incentivize local manufacturing, tech transfer
Policy inconsistency	14	Creates investor uncertainty	Long-term regulatory frameworks, clear renewable portfolio standards
Workforce skill gap	12	Delays project execution, raises labor costs	Training programs, vocational education, university–industry collaboration
Financing limitations	10	Restricts SME participation and diversification	Tax incentives, venture capital, FDI attraction

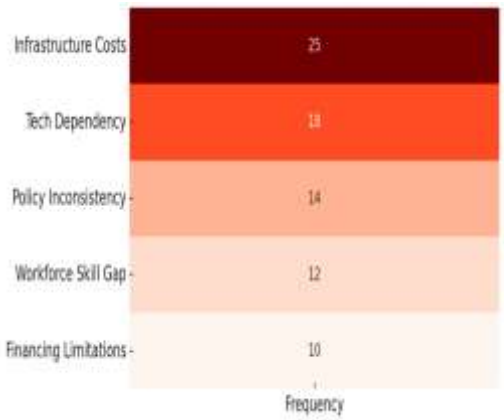

Figure 5: Heatmap of Challenges in Renewable Energy Development.

The most frequently cited barrier is high infrastructure costs, mentioned in 25 out of 36 studies. While Saudi Arabia has substantial financial capacity, large-scale renewable projects require significant upfront investments, often deterring private investors. PPPs, green bonds, and blended finance are recommended as mechanisms to reduce fiscal pressure and crowd in private capital.

Technological dependency appears in nearly half of the reviewed studies. Reliance on imported solar panels, wind turbines, and hydrogen technologies reduces GDP spillovers and weakens local resilience. Developing a domestic renewable manufacturing base is thus critical, not only for cost reduction but also for maximizing industrial diversification.

Policy inconsistency is another recurring theme. Several studies emphasize that sudden subsidy reforms, shifting procurement models, and unclear renewable portfolio targets create uncertainty for investors. Stable, long-term regulatory frameworks are essential to attract sustained domestic and international investment.

The workforce skill gap also represents a major constraint. Although Vision 2030 emphasizes capacity building, renewable projects often rely on expatriate expertise, raising labor costs and limiting local job creation. Expanding vocational training, renewable energy degree programs, and partnerships with international universities can help build a sustainable local workforce.

Finally, financing limitations, especially for SMEs, were noted in 10 studies. While megaprojects attract state and sovereign wealth funding, small- and medium-sized enterprises often struggle to access affordable capital. Innovative financing tools such as green venture capital funds and targeted tax incentives could integrate SMEs more effectively into the renewable ecosystem, amplifying GDP impact through entrepreneurship and innovation.

3.3. Prospects for GDP Contribution

Despite the challenges outlined in Section 3.3, the reviewed studies highlight several promising opportunities for renewable energy to significantly enhance Saudi Arabia's GDP under Vision 2030. These prospects are tied not only to energy production but also to industrial diversification, employment generation, and export potential.

Table 3: Prospects of Renewable Energy for Saudi GDP (2019–2025).

Prospect	Supporting Studies	Estimated GDP Contribution	Alignment with Vision 2030

Green hydrogen exports	[7], [25], [29], [32]	$200–300B annually by 2035	Positions Saudi Arabia as a global hydrogen leader
Solar megaprojects (e.g., NEOM, Sudair, Sakaka)	[5], [10], [22], [28]	2–4% GDP growth by 2030	Supports renewable energy mix (50% target)
PPP-led renewable investments	[9], [21], [24]	Expands private sector role, reduces fiscal burden	Strengthens private sector participation pillar
Local manufacturing & R&D	[4], [12], [16], [27]	Enhances GDP multipliers via industrial diversification	Boosts innovation and economic competitiveness
GCC renewable integration	[11], [20], [30]	Enhances regional competitiveness and energy trade	Strengthens Saudi Arabia's regional leadership role

The most significant long-term prospect lies in green hydrogen exports. Studies converge on projections of $200–300 billion in annual revenues by 2035, suggesting that hydrogen could eventually rival or surpass oil in GDP contribution. This opportunity aligns with global decarbonization trends and positions Saudi Arabia as a first mover in hydrogen exports, particularly to Europe and Asia.

Solar megaprojects are the strongest short-term contributor. Projects like Sakaka, Sudair, and NEOM's solar clusters are projected to increase GDP by 2–4% by 2030. These projects also reduce fiscal pressures by lowering reliance on oil-fired power generation, thereby improving government budget flexibility.

Public–private partnerships (PPPs) represent another major avenue. By institutionalizing PPP models, Saudi Arabia can leverage private capital and expertise, reduce state financial burdens, and accelerate project deployment. Several studies show that PPP-driven models generate more resilient and diversified GDP contributions than state-led financing alone.

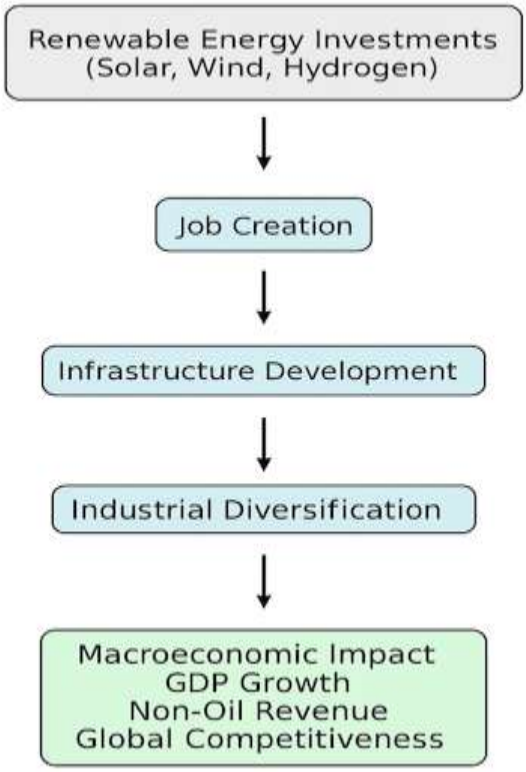

Figure 6: Contribution Pathways of Renewable Energy to Saudi GDP.

A further prospect is local manufacturing and R&D development. If Saudi Arabia invests in building domestic industries for solar panels, wind turbines, and hydrogen infrastructure, it will capture industrial multipliers rather than exporting capital abroad. This strategy would not only enhance GDP growth but also create high-value jobs and foster technological sovereignty.

Finally, regional cooperation within the GCC provides a pathway for scaling impact. Integrated renewable energy grids, joint hydrogen projects, and coordinated energy strategies can enhance Saudi Arabia's competitiveness as the anchor economy of the region. Such cooperation could also strengthen cross-border trade and position the Kingdom as a regional hub for clean energy exports.

As illustrated in Figure 6, these prospects unfold along a clear pathway: renewable investments lead to job creation, infrastructure development, and industrial diversification, which in turn drive long-term GDP growth and non-oil revenue expansion.

4. DISCUSSION

4.1. Comparative Insights

The findings of this review demonstrate that Saudi Arabia's renewable energy strategy under Vision 2030 is ambitious but faces structural and

institutional challenges. A comparative lens provides useful lessons from international experiences.

United Arab Emirates (UAE): The UAE's rapid deployment of renewables through the Mohammed bin Rashid Al Maktoum Solar Park highlights the effectiveness of public–private partnerships (PPPs) and competitive tendering [17]. Saudi Arabia has begun to replicate these mechanisms, but institutionalizing them more systematically is essential to mobilize private capital at scale.

Germany: Germany's Energiewende underscores the importance of long-term policy stability, feed-in tariffs, and grid modernization [18]. Saudi Arabia's financial resources allow it to launch megaprojects, but without consistent regulatory frameworks, investor confidence may waver. The German model demonstrates that policy continuity is as crucial as financial capacity.

China: China's leadership in renewable energy was driven by local manufacturing and R&D investment, which reduced technological dependency and created significant GDP multipliers [19]. Saudi Arabia's current reliance on imported technologies mirrors China's early years, but adopting a localization strategy could accelerate industrial development and boost resilience.

India: India's success with auction-based procurement produced some of the world's lowest solar tariffs [20]. Saudi Arabia has piloted auctions but not yet at India's scale. A more aggressive adoption of competitive auctions could reduce costs, attract global investors, and reinforce Saudi Arabia's position as a regional price leader.

Collectively, these cases suggest that Saudi Arabia's comparative advantage lies in its natural resources and financial strength, but its long-term success depends on institutional reforms, policy stability, technology localization, and private sector empowerment.

4.2. Policy Implications

The evidence generates several actionable policy recommendations:

Institutionalize policy stability: Investors require long-term certainty. Sudden subsidy reforms or shifting targets undermine confidence. Establishing predictable renewable portfolio standards is essential.

Scale up green finance: Expand use of green bonds, blended finance, and carbon trading to diversify funding beyond state budgets.

Develop human capital: Build renewable-focused technical and vocational programs, and strengthen university–industry partnerships to reduce reliance on expatriates.

Promote local manufacturing: Incentivize domestic production of solar panels, wind turbines, and hydrogen infrastructure to capture GDP multipliers and foster innovation.

Enhance GCC cooperation: Position Saudi Arabia as the anchor of a regional clean energy hub, integrating grids, hydrogen corridors, and shared investment frameworks.

Research Implications

The review also highlights gaps for future research:

Macroeconomic modeling: Use computable general equilibrium (CGE) and system dynamics models to assess GDP impacts over time.

Sectoral analysis: Study the role of renewables in stimulating non-energy sectors such as ICT, tourism, and manufacturing.

Social dimensions: Explore public acceptance, SME adoption, and labor market readiness to complement technical-economic assessments.

Regional integration: Comparative studies across the GCC could illuminate the potential for joint hydrogen exports and integrated renewable grids.

Innovation ecosystems: Examine how universities, startups, and research institutes can collaborate to build renewable-driven innovation clusters.

4.3. Contribution to Vision 2030

This review reaffirms that renewable energy is not simply an environmental goal but a strategic economic pillar of Saudi Arabia's Vision 2030.

Short-term: Solar projects provide immediate GDP growth and fiscal relief.

Medium-term: Wind energy supports regional diversification and employment.

Long-term: Hydrogen offers transformative export revenues that could rival oil.

Achieving these outcomes requires financial innovation, institutional reforms, human capital development, and technology localization. As such, renewable energy is both a driver and a test case for Saudi Arabia's broader diversification agenda. If implemented successfully, it will demonstrate the Kingdom's ability to transition to a resilient, post-oil economy while positioning itself as a global leader in the renewable energy transition.

5. CONCLUSION

This systematic review assessed the contribution of renewable energy resources to Saudi Arabia's GDP within the framework of Vision 2030. By synthesizing evidence from 36 peer-reviewed studies published

between 2019 and 2025, the review confirms that renewable energy is both a strategic economic driver and a diversification tool for the Kingdom.

The findings reveal a sequenced growth trajectory:

Solar energy provides the most immediate GDP contribution, with projects like Sakaka, Sudair, and NEOM expected to generate 2–4% GDP growth by 2030.

Wind energy supports regional development, creating jobs and diversifying economic activity in rural areas.

Hydrogen energy offers a transformational long-term pathway, with projected export revenues of $200–300 billion annually by 2035, positioning Saudi Arabia as a global clean energy leader.

However, persistent challenges such as high infrastructure costs, technological dependency, policy inconsistency, workforce skill gaps, and limited SME financing threaten to constrain these benefits. Overcoming these barriers requires stable regulatory frameworks, innovative financing instruments, workforce development, and domestic technology localization.

From a comparative perspective, Saudi Arabia can learn from the UAE's PPPs, Germany's policy stability, China's localization strategy, and India's competitive auctions. Incorporating these lessons will help the Kingdom build an enabling environment for sustained renewable investment.

Policy implications stress the need for regulatory continuity, green finance, human capital development, and regional GCC integration. Research implications highlight the value of advanced GDP modeling, sector-specific analyses, and studies of social acceptance and innovation ecosystems. Ultimately, renewable energy is not simply an environmental imperative but a cornerstone of Saudi Arabia's economic resilience. Its successful deployment will determine the Kingdom's ability to transition toward a diversified, knowledge-based, and globally competitive economy in the post-oil era.

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