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GREEN SAUDI ARABIA: THE RISE OF A RENEWABLE ENERGY SUPERPOWER

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Abstract

This research article explores Saudi Arabia's ambitions and efforts to secure its position in the new global energy paradigm. It analyzes key features of its post-oil strategy including hydrogen, minerals extraction and processing as well as solar as mechanisms to fortify and enhance its geopolitical influence. The global landscape is changing rapidly, with geopolitical forces influencing economic decision-making. Supply chains are being reorganized for security rather than purely for efficiency. While economic optimization remains a goal, political security is taking precedence. This shift has significant financial, political, and economic consequences. The global move towards renewable energy will require significant resources, particularly metals like lithium, cobalt, and nickel. Studies predict dramatic demand increases, ranging from sevenfold to 51-fold by 2040 compared to 2020. Saudi Arabia is actively positioning itself as a leader in the global renewable energy supply chain. Saudi energy endeavors coincide with a critical juncture for the global economy, marked by geopolitical tensions, energy transitions, and technological advancements. Vision 2030 serves as the blueprint for Saudi Arabia's clean energy initiatives, setting ambitious targets and fostering a supportive environment for investment and innovation. Success in this transition is crucial for achieving the economic and geopolitical goals outlined in Vision 2030, propelling Saudi Arabia into a new era as a leader in clean energy and a more influential player on the world stage.

Keywords: Saudi Arabia. renewable energy, green hydrogen, diversification of energy, transition minerals, the Middle East, the post-oil era

Introduction

Saudi Arabia has been exerting relentless efforts through its ambitious initiative for sustainable energy to bolster its global and regional position by securing a foothold in the global supply chain for renewable energy. This is coming at a time when the global economy is at an inflection point in geopolitics, energy, and technology. States concerned about being left out or falling behind are increasingly deploying government-backed capital to ensure they are at the very least at par neck-with global developments. This is referred to as industrial policy: a strategic effort by a government to encourage the development and growth of specific sectors or industries within its economy.

As security takes precedence, governments are playing a bigger role in industries with geostrategic importance by providing accommodative financing conditions. Whether in the form of interest-free loans or tax incentives, global leaders are looking to wield a number of policy levers to accelerate their position in this multi-dimensional race. In industries with high costs and long-term horizons for returns in an environment of high interest rates, the private sector will need a push — or a pull. Legislative measures like the US Inflation Reduction Act and European Chips Act are just two of many examples of targeted industrial policies. Sovereign wealth funds have also proved to be a popular conduit through which the state can inject capital to advance their industrial policies. Saudi Arabia's Public Investment Fund (PIF) is one such example of a state leveraging its capital to advance geostrategic objectives. It states that its international strategic investments are meant to "solidify Saudi Arabia's position on the global scene as an impetus for the advancement of ventures for things to come. Therefore, this pool comprises a combination of long-term investments, which aim at establishing strategic partnerships through direct and indirect investments. This contributes to expanding the kingdom's global reach and impact, with a focus on industries of the future."(1)

Vision 2030 has been instrumental in directing capital and magnetizing foreign investment by providing a clear direction for the kingdom's geopolitical and energy-related aspirations. The PIF has a target to develop 70% of the kingdom's renewable energy capacity by the end of the decade. The National Renewable Energy Program (NREP) is part of Vision 2030 and is the action plan that translates the country's renewable energy ambitions into concrete steps and projects. As I will demonstrate below, these objectives are instrumental in driving the kingdom's energy diversification efforts. In the current environment, articulating a clear objective with strategic value becomes an imperative. The tectonic plates of geopolitics are shifting, and with it, new economic fault lines are being created. Supply chains are being re-organized not for economic maximization, but geopolitical optimization. That is not to say that economies are deliberately being inefficient for the sake of it, but rather they are prioritizing political secu-

rity now in a much more pronounced way than before, and this shift has major implications financially, politically, and economically.

Resources necessary for the energy transition are characterized as "transition metals," and these are primarily lithium, cobalt, nickel, and copper. These are all expected to sharply increase in demand with the shift toward energy transition-focused policies. A sharp rise in demand for these resources, combined with an inelastic response amid shifting supply chains creates notable upside risks to inflation. Or specifically, "greenflation," and that leaves markets, economies and states vulnerable to the disruptions caused by a rapid energy shift transition. In anticipation of these risks, Saudi Arabia is deploying proactive measures to shield itself against policy-related volatility. If executed properly, Riyadh's transition policies would not only reinforce its regional standing but make it a central node in the emerging global energy paradigm. Doing so will pay geopolitical dividends and ensure that the kingdom will remain a global powerbroker long after oil ceases to be its main source of economic dynamism.

Riyadh's Renewable Revolution: A New Era of Geopolitical Strategy

Minerals, Metals and Mining

While there is significant uncertainty about the outlook for the energy transition, one fact remains certain: it will be a resource-demanding transition. The IMF estimates that copper, nickel, cobalt and lithium will be most impacted by the global energy transition. Whereas minor supply shortfalls (around 10%-20%) are anticipated for metals like nickel, critical components like dysprosium, a chemical element atomic and an earth element used to improve magnets used in electric motors, could face significant shortages exceeding 70% of projected demand.[2] Forecasting expected demand and subsequent impact on price is predicated on the time horizon and type of scenario. Specifically, achieving net-zero by 2040 or 2050 will have radically different implications for the price of key transition metals. The range of estimates varies. The World Bank expects a sevenfold increase in lithium demand by 2040 compared to 2020.[3] In a net-zero emissions scenario, the IMF projects a 25-fold increase in lithium consumption by 2050 compared to 2020.[4] And finally, the IEA presents a range of possible future trajectories. In its Sustainable Development Scenario (SDS), demand significantly exceeds supply, with lithium demand being 51 times higher than today's levels by 2040. Applying the IEA's SDS to the rest of the transition metals of cobalt, nickel and copper, we see a radical increase in demand:

- 21x increase in cobalt demand by 2040 compared to current levels
- 9.7x rise in nickel demand by 2040 compared to current levels
- 6.2x rise in copper demand by 2040 compared to current levels

Most of the minerals and metals necessary for the energy transition are concentrated in regions and countries with elevated political risks. With lithium,

in 2022, Australia produced approximately 61,000 metric tons, accounting for 49.91% of global production, with Chile at

39,000 metric tons or 31.81% of the global total. Nickel is primarily dominated by Indonesia, which produces 1.6 million metric tons a year, accounting for 61.07% of global mine production, with the Philippines far behind at 330,000 metric tons, representing 12.60% of the global total. Cobalt, the most concentrated — and one of the most critical — transition metals is located in the Democratic Republic of the Congo (DRC). The central African country produces approximately 175,000 metric tons, accounting for 78.83% of global production. In second place is the Philippines at 30,000 metric tons, or 13.51% of the global total. And finally copper, with Chile having produced 5.9 million metric tons in 2022, accounting for 27.45% of the global production, with Peru at 2.7 million metric tons or 12.59% of global production.[5]

To avoid getting the short and expensive end of the supply chain, Saudi Arabia is strategically tapping into its rich reserves of minerals and precious metals to pave the way for a future that is less dependent on oil. The kingdom has recently reassessed the value of its mineral wealth, elevating it from $1.3 trillion to an impressive $2.5 trillion.[6] The kingdom is investing heavily in its future, committing $200 million to a comprehensive geological mapping project and the creation of a resource database, building on a previous $500 million survey investment.[7] This updated valuation brings to light substantial deposits of gold, copper and zinc, which are expected to play a crucial role in the challenging energy transition ahead, where the demand for such resources is likely to exceed supply.

The landscape for mining — both figuratively and literally — is harsher than expected. As The Economist correctly pointed out: "Unfortunately, miners are also investing a lot less than they once did, as their latest set of earnings, released this week, confirm. The world's biggest miner, BHP, last year spent less than half of what it did a decade ago. In part that is for sensible reasons: miners are rightly conscious that theirs is a boom-and-bust industry. The last time they splashed out, during the China-led bonanza of 20 years ago, a spectacular crash followed.[8]" This lack of flexibility in the supply chain, coupled with pressure on publicly traded mining companies to adhere to ESG metrics, is likely to result in higher metal prices as demand outpaces slow-moving supply. The green push is creating a multifaceted supply problem that will likely translate into higher commodity prices for mining companies. And the geography and geopolitical topography will complicate the process and potentially push commodity prices — and shares of companies specializing in their extraction — higher. According to The Economist, "Governments are not helping" mining industries exposed to the energy transition. But this is not entirely true.

Crown Prince Mohammed bin Salman (MBS) is steering the country to become a major resource hub, mirroring its pivotal role in the global oil market. Saudi Arabia is actively encouraging investment in its mining sector with sev-

eral key measures. This is on top of the kingdom's deal to become a minority shareholder in Brazilian mining giant Vale's $26 billion-valued copper and nickel unit. According to the Financial Times: "A joint venture between Saudi Arabian Mining Company and the country's Public Investment Fund will own 10% of the division, which supplies materials required for the transition to cleaner energy."[9] Saudi Arabia is looking to position itself as a key node in the battery supply chain through the creation of lithium processing facilities. By 2030, it is anticipated that the worldwide need for lithium will surge to over four times the levels seen in 2022, growing from 720,000 metric tons to an estimated 3.1 million metric tons.[10] However, the projected lithium supply globally in 2030 is unlikely to satisfy this burgeoning demand. Saudi Arabia's aggressive industrial policy, channeled primarily through generous allocations from the PIF, outpaces even the substantial expenditures of the United States' Inflation Reduction Act. The kingdom has established a dedicated Ministry for Industry and Mineral Resources, reduced license fees and royalties, and overhauled its mining laws to mirror the investor-friendly frameworks of countries like Australia, Botswana, and Canada. These reforms have significantly cut down the time to obtain mining licenses to just two months, contributing to a 20% increase in active licenses since 2022, now totaling 2,300.[11]

Hydrogen

Saudi Arabia's forays into stimulating fossil-fuel alternatives is also yielding results. Analysis suggests that venturing into hydrogen production could further reduce Saudi Arabia's reliance on oil revenues. Since it uses natural gas as a source, blue hydrogen can leverage the kingdom's existing natural gas infrastructure and supply networks for scaling production and transportation. The kingdom's National Hydrogen Strategy, which aims to produce and export 4 million tons of clean hydrogen annually, positions Saudi Arabia as a potential global leader in the hydrogen sector. The PIF is actively supporting this vision, with notable investments including a $5 billion partnership with Air Products to establish a green hydrogen production facility in Saudi Arabia. Moreover, in October 2022, the PIF led a groundbreaking initiative by auctioning 1.4 million tons of carbon credits, establishing the first voluntary carbon market in the region and marking a significant step toward environmental sustainability. Saudi Arabia's hydrogen strategy also aligns with global environmental goals, notably the Paris Agreement targets that complement multilateral efforts to shift away from fossil fuels.

Fundamentally, there are two types of hydrogen. The first is blue hydrogen. This is produced from natural gas with Carbon Capture, Utilization and Storage (CCUS) technology. CCUS captures the carbon emissions produced during hydrogen creation, making it a cleaner option than traditional natural gas. Compared to traditional hydrogen production from natural gas (which vents the CO2), blue hydrogen captures a significant portion of the emissions, making it a cleaner option. The majority of hydrogen production (over 90%) is derived from fossil fu-

els, resulting in 10 kilograms of carbon dioxide for every 1 kilogram of hydrogen produced.[12] The second is green hydrogen. This is produced by splitting water using electrolysis, and is powered by renewable sources like solar or wind.

At this moment, the technology for blue and green hydrogen is still in its nascent stages. China sits at the top of the global hydrogen game, holding the title of both the world's largest producer and consumer. China's hydrogen production has been steadily climbing, with an impressive annual growth rate of 6.8% since 2010.[13] By 2020, this resulted in a staggering 33 million tons produced. However, a closer look reveals a reliance on traditional methods. Currently, over 60% of China's hydrogen comes from coal gasification, a process with a significant carbon footprint. Steam methane reforming (SMR) contributes another 20%, while industrial by-products make up 18%. Green hydrogen, the cleanest production method, accounts for less than 1% of China's total output. However, the small output means there is ample room for a country to position itself as the vanguard of it.

Saudi Arabia's entry into the hydrogen market is not just an economic diversification effort but a strategic geopolitical maneuver. As the world pivots toward cleaner energy sources, hydrogen is pegged as a critical player in the global energy transition. The market for blue hydrogen in 2024 is approximately $24.29 billion and is expected to grow at a compound annual growth rate (CAGR) of 11.82% to $47.74 billion in 2030.[14] But this is not happening in a vacuum. Other gas-rich countries like the United States and Canada are tapping into their abundant resources to start hydrogen production to meet their own emissions goals. Industrial policy is driving the market so to speak — with commercialization projects already underway. Honda will introduce a hydrogen fuel cell vehicle that can also be recharged, making it the first Japanese automaker to bring the technology to market.[15]

The kingdom's ambitious hydrogen projects, such as the one in NEOM — a $500 billion mega-city project — exemplify its commitment. The NEOM project aims to power the entire city with renewable energy, primarily solar and wind, making it a beacon for green hydrogen production. This project is not just about producing hydrogen but also about demonstrating the feasibility and scalability of green hydrogen as a cornerstone of a sustainable economy. The green hydrogen facility in NEOM is expected to produce 650 tons daily, fueling various sectors from transport to heavy industries. This in turn will showcase the versatile application of hydrogen in decarbonizing a broad spectrum of economic activities.

Moreover, Saudi Arabia's strategic geographical location, bridging the East and the West, offers an unparalleled advantage in the global hydrogen market. It can potentially become a central hub in the hydrogen supply chain, exporting to both Asian and European markets. Europe's aggressive shift toward clean energy and Asia's massive energy demand present Saudi Arabia with a significant export market for its green hydrogen. In addition to green hydrogen, Saudi Ara-

bia's approach to blue hydrogen is equally strategic. The kingdom plans to capitalize on its vast reserves of natural gas and existing infrastructure to scale up blue hydrogen production. By integrating CCUS technology, Saudi Arabia aims to make its blue hydrogen among the cleanest and most competitively priced on the market. This dual approach of pursuing both blue and green hydrogen allows the kingdom to cater to diverse market needs and transition phases toward a hydrogen economy. Existing supply chains will likely be key to facilitating a more seamless energy transition.

Currently, most crude oil is transported via large tanker ships or pipelines. Pipelines designed for liquid hydrocarbons (crude oil) are not directly suitable for hydrogen gas because its small molecule size and high diffusivity raise issues such as embrittlement of metal and potential leaks. However, some existing natural gas pipelines could be more easily adapted or retrofitted for hydrogen transport, especially for blue hydrogen, which could be blended with natural gas in existing pipelines to a certain extent without significant modifications. For tanker ships with green hydrogen, it is more likely to be transported as a liquid or bound to a carrier medium (like ammonia or Liquid Organic Hydrogen Carriers (LOHCs). This would almost certainly necessitate repurposing oil tankers with additional modifications. For instance, transporting hydrogen as liquid ammonia (a method gaining traction due to easier liquefaction compared to hydrogen) would require tanker ships with refrigerated storage tanks designed for ammonia. In other words, changes to new energy markets and the supply chains that support them will require not just altering the type of cross-border flows but the vehicles that facilitate them.

Solar

Saudi Arabia is aggressively expanding its solar energy capabilities as part of its broader strategy to diversify its energy sources and reduce carbon emissions. The country's National Renewable Energy Program (NREP) aims to generate 50% of its electricity from renewable sources by 2030. As recently as November 2023, ACWA Power, a local utilities company, signed an agreement with Water and Electricity Holding Company (Badeel) to build the world's largest single-site solar-power plant in Al Shuaibah area, Makkah Province.[16] The solar-power facility is expected to start operations by the end of 2025, with a generation capacity of 2,060 megawatts. The Gulf region as a whole and Saudi Arabia particularly already boasts among the world's lowest solar-power tariffs. The key reasons why the Gulf region has lower tariffs than countries like India include lower cost of dollar denominated long-dated financing, lower expected return on equity (ROE), higher solar resources leading to higher capacity utilization factor (CUFs), no corporate taxes or duties on equipment and power sales and negligible land cost for solar projects.[17] Government support in this regard is instrumental in creating accommodative finance conditions for domestic production and scaling through magnetizing foreign investments.

ACWA has 44% of its equity value owned by PIF, and received non-interest-bearing loans while it raises more equity capital. As a result, this state-backed effort through sovereign wealth funds is helping to lower the cost for customers and simultaneously expand capacity. This has helped make the levelized cost of Saudi solar energy, which takes into account both construction and operation of a power plant, among the lowest in the world.[18] The kingdom's solar energy investments in this regard also complement its green hydrogen initiative. By using renewable energy for electrolysis, it would result in a significantly reduced carbon footprint and complement cross-initiative transition projects. The lower cost of solar energy has helped to make industrial-scale deployment more feasible. Looking at a broader timeframe, the cost of solar panels has seen a significant drop. Between 2010 and 2020, the price plunged by about 85%.[19] Fourteen years ago, the average cost of solar PV panels was approximately $2 to $3 per watt. Then around 2020, the price fell to around $0.20 to $0.60 per watt.* Saudi Arabia's total solar installed capacity grew from 14 megawatts in 2012 to 439 megawatts at the end of 2021, representing a 3,064% increase in solar capacity in under a decade.[20] The kingdom is aiming for 40 gigawatts of solar photovoltaic (PV) capacity by 2030.

Countries and companies are recognizing the long-term economic benefits and energy security enhancements that solar power offers. As a result, solar energy is rapidly becoming a central pillar in national energy strategies, spurring further innovation, driving down costs, and catalyzing the transition to a more sustainable and resilient global energy system. The relentless expansion of the solar market signals a paradigm shift in energy production, where solar power stands at the forefront of meeting the world's growing energy needs sustainably. The kingdom's push toward a sustainable and diversified energy mix necessitates a reliable energy storage system to ensure grid stability and continuous power supply, especially during periods when solar irradiance is low. One of the pivotal steps taken by the kingdom toward this direction is the inclusion of battery storage in its solar projects. Although specific regulatory frameworks focusing on energy storage are still evolving, the Saudi Electricity Company (SEC) and the Electricity and Cogeneration Regulatory Authority (ECRA) have started to lay the groundwork for incorporating energy storage within the national grid. The Al-Jouf PV project, for instance, includes plans for battery storage, showcasing the country's commitment to stabilizing its renewable energy output. This project reflects a broader strategy to adopt energy storage systems that can mitigate the challenges posed by the variable nature of solar energy, thereby ensuring a more stable and efficient electricity supply. Against this backdrop, strategic partnerships and government policies are also playing a crucial role in accelerating solar adoption, with initiatives aimed at reducing carbon footprints and achieving net-zero emissions targets gaining momentum. This holistic approach reinforces the solar market's growth trajectory, ensuring its central role in the global transition to renewable energy.

Moreover, the government has introduced several incentives to attract investment in the renewable energy sector. These include long-term Power Purchase Agreements (PPAs) with favorable terms for renewable energy producers, which provide financial stability and encourage investment. Additionally, the government has streamlined the process for obtaining permits and licenses for renewable energy projects, significantly reducing the bureaucratic hurdles that developers might face. Key regulations facilitating the solar energy transition include the introduction of net metering policies, which allow residential and commercial solar energy producers to feed excess electricity back into the grid, receiving credits in return. This policy encourages the adoption of solar energy by making it more economically viable for individual consumers and businesses. Another significant regulation is the establishment of the Saudi Arabian Standards, Metrology and Quality Organization (SASO) guidelines for solar equipment. These guidelines ensure that all solar panels and related equipment meet high standards of quality and efficiency, safeguarding the long-term sustainability of solar energy investments in the country.

Reshaping Regional Relations

Saudi Arabia's investments into this frontier technology will likely yield economic and geopolitical dividends. Many of its regional neighbors are major gas and oil producing states such as Iraq, Kuwait and Iran — and the kingdom's energy transformation may inspire/put pressure on other countries in the region to follow in Riyadh's footsteps. Fostering a technological ecosystem has shown to stimulate innovation, attract international tech firms, and encourage the growth of domestic startups. In parallel, foreign direct investment (FDI) inflows from global firms looking to tap into a regional market would likely also grow. To complement these modernization efforts, Saudi Arabia has begun to gather data directly from company and investors financial statements to calculate FDI. While the majority of inflows came into the country's eastern oil-producing region in 2022, non-oil investment has also been growing in recent years.[21] Energy reform, diversification and adherence to standardized regulatory protocols and accounting will make the Saudi market more transparent and magnetize additional FDI. Furthermore, the publicity and image of a major, oil producing nation leading the charge in hydrogen production in a region characterized by fossil-fuel powered economies would enhance Saudi Arabia's international standing. By leading in the adoption and development of frontier technologies and updating its data systems and regulatory regime, Saudi Arabia can enhance its soft power.

From a strategic geopolitical perspective, the concentration of hydrogen production, investment and innovation alone would give Riyadh significant geo-energetic leverage. Access to the kingdom's technological hub in sustainability, funding environment and strategic partnerships is a tool Riyadh could use to selectively extract concessions from regional states. In the case of more complex relations like Iran, diversification is as much a defense strategy against domes-

tic obsolescence as is also a proactive policy against a regime that depends on oil. While the transition itself will likely be marred by delays and technical difficulties, the geopolitical dividends of a first-mover advantage are far too valuable to be left for others to take.

As Saudi Arabia diversifies its energy portfolio, its role within the Organization of the Petroleum Exporting Countries (OPEC) and its influence over global oil markets are likely to evolve. While the kingdom may reduce its reliance on oil revenues, its position as one of the world's largest oil producers will allow it to continue to play a pivotal role in shaping global oil supply and pricing strategies. However, its investment in renewable energy could lead to a shift in OPEC's long-term strategy, potentially incorporating a broader focus on energy stability and sustainability. Saudi Arabia's transition could alter the geo-energy calculus in the region. Historically, Saudi-Iranian relations have been partly defined by their roles as major oil producers. As Riyadh moves toward becoming a leader in renewable energy and potentially green hydrogen, it may shift the parameters of regional power. This does not necessarily mean a reduction in tensions but could lead to a reconfiguration of how energy resources influence regional politics. For instance, competition might increasingly focus on technological advancement in renewable energy and sustainability measures rather than solely on oil production and prices.

Strategically, Saudi Arabia's investment in renewable energy and the resulting economic diversification could enhance its security posture. By reducing its vulnerability to oil market volatility and potential sabotage of oil infrastructure — a concern given past attacks attributed to Iran — Saudi Arabia lessens potential leverage Iran might have. Furthermore, as Saudi Arabia develops its renewable energy infrastructure, it might also invest in fortifying these assets, creating a new security dynamic in the region.

Global Influence

As a major oil producer, Saudi Arabia's investment in renewable energy and related technologies could position it as a leader in the global energy transition. The strategic shift could enable Saudi Arabia to shape international norms and standards for renewable energy, much like it has with oil pricing and policies. It could leverage its investments in renewable energy to advocate for global energy policies that favor its economic and strategic interests, positively influencing international trade regulations, environmental standards, and even security alliances. This would not only ensure its long-term energy security but also give it a key role in shaping the future of global energy markets, much in the way it has with oil for over half a century.

In emerging and developing economies, Saudi Arabia will be able to leverage its renewable energy capabilities to partner with emerging and developing countries, especially those in Africa and Southeast Asia. By offering access to affordable and clean energy technologies, the kingdom could play a critical

role in their economic development, in turn securing favorable trade terms and diplomatic support on international platforms. Countries like the DRC, which boasts 70% of the world's cobalt, could strengthen their ties with Saudi Arabia through trade agreements.. This would complement Riyadh's increasing interest in playing a more prominent role on the African continent, which, coupled with its strategic pivot toward renewable energy, suggests a potential for positive bilateral relations with African nations rich in critical minerals and renewable energy potential.

Within the Asia-Pacific, Japan and South Korea are spearheading the drive toward clean energy solutions utilizing blue hydrogen technology. This momentum is fueled by a confluence of private sector investments and proactive government initiatives in the region. Saudi Arabia's $362 billion worth of exports — of which close to 80% come from mineral oils and fuels and products of their distillation — roughly 10% goes to Japan and South Korea, respectively.[22] Leveraging existing trade networks with Saudi Arabia's economic and financial opening of its country will further catalyze intra-regional adoption of alternative forms of energy while solidifying geopolitical ties in a new energy paradigm. Regional uncertainty vis-a-vis China and tensions in the South China Sea will continue to be a global risk and could dampen trade.

Across the EMEA region, Europe stands out in its active pursuit of blue hydrogen development as a cornerstone strategy for achieving its stringent low-carbon energy objectives. The European Union's Hydrogen Strategy underscores the critical need to ramp up production of both green and blue hydrogen, aiming to fulfill its decarbonization targets and cultivate a robust hydrogen market. Of the $45 billion worth of exports Saudi Arabia sends to Europe, approximately 44% goes to France, Italy, and the Netherlands.[23] Europe's hydrogen strategy and Saudi Arabia's efforts can complement each other in several ways. Firstly, Europe's emphasis on blue hydrogen aligns with Saudi Arabia's abundant natural gas resources, which can be used to produce hydrogen through SMR and CCS technology. Saudi Arabia's existing infrastructure in the energy sector can therefore help make it a key supplier of blue hydrogen to Europe.

Geopolitically, this partnership offers the kingdom an opportunity to diversify its economy away from its heavy reliance on oil exports. By tapping into the growing hydrogen market in Europe, Saudi Arabia can reduce its dependence on oil revenues and mitigate the risks associated with fluctuations in oil prices and demand. Moreover, strengthening ties with Europe through hydrogen cooperation can enhance Saudi Arabia's geopolitical influence and stability. By becoming a reliable supplier of low-carbon hydrogen, Riyadh can strengthen its diplomatic relations with European countries, particularly those with which it already has a strong trading relationship and who are major players in regional politics such as France. This could lead to closer political alliances and increased investment opportunities for Saudi Arabia in Europe's clean energy transition initiatives. Additionally, as the global energy landscape shifts towards clean-

er alternatives, Saudi Arabia's participation in the hydrogen market can help bolster its international standing as a proactive player in combating climate change.

Looking Ahead

Saudi Arabia's ambitious foray into the global clean energy landscape presents a compelling case study. By weaving itself into the fabric of renewable energy supply chains, the kingdom seeks to solidify its regional dominance and establish itself as a key player in the post-oil era. This strategic shift, however, presents a complex chessboard with both opportunities and challenges. The successful execution of Vision 2030 and its associated renewable energy targets can significantly diversify the kingdom's economy and mitigate its reliance on a finite resource like oil. Additionally, proactive measures to secure a foothold in the burgeoning clean energy market hold the potential to establish Saudi Arabia as a central node in the new energy paradigm. This, in turn, could translate into significant geopolitical influence and secure the kingdom's position as a global powerbroker well into the future.

However, the path forward is not without hurdles. The success of Saudi Arabia's clean energy gambit hinges on its ability to navigate several key challenges. First, ensuring the efficient and transparent execution of large-scale renewable energy projects remains paramount. Second, fostering a robust domestic clean energy ecosystem, complete with skilled labor and cutting-edge research and development, will be critical for long-term sustainability. Finally, navigating the complexities of a rapidly evolving geopolitical landscape and managing the potential disruptions of greenflation require strategic foresight and agility. The world is watching with keen interest to see if this strategic gambit will secure a sustainable future for the kingdom, or whether it will be checkmated by unforeseen complexities in the new energy chessboard.

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