PIONEER
ACADEMIC PUBLISHING LIMITED

Journal of Research in Social Science and Humanities
ISSN 2709-1910
www.pioneerpublisher.com/jrssh
Volume 4 Number 1 January 2025

Safeguarding India's Energy Security: Challenges and Strategic Approaches

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doi:10.56397/JRSSH.2025.01.03

Abstract

This paper focuses on India's energy security. Data shows that India's domestic energy reserves and production alone are insufficient to meet its rapidly growing energy demands, necessitating substantial energy imports from abroad. Major import sources include the Middle East, Russia, the United States, and Africa. However, this heavy reliance on energy imports poses risks to India's energy security. To address these challenges, India can enhance its energy security by maintaining and expanding energy import channels, ensuring the safety of energy transportation, and vigorously developing clean energy sources.

Keywords: India, energy security

1. Introduction

Since the First Industrial Revolution in the 18th century, energy has been a key driver of societal development and progress. The demand for energy has continued to grow, prompting the exploration and utilization of various energy sources. From traditional fossil fuels like coal and oil to the rise of clean energy such as nuclear and hydro-power, and more recently, the rapid development of renewable energy like solar and wind power, humanity has diversified its energy portfolio. Yet, despite the abundance and variety of energy resources, global demand remains unmet, making energy security an increasingly pressing issue.

Since the 1990s, economic globalization has not only expanded in scope but also deepened in intensity, drawing more countries into global economic cooperation. This has led to varying degrees of economic growth worldwide. India, a populous and emerging developing nation, initiated economic reforms in the 1990s, actively integrating into the international division of labor. These efforts significantly boosted domestic economic growth, positioning India as one of the fastest-growing emerging economies today. Despite challenges such as financial crises and the COVID-19 pandemic in the 21st century, India's growth momentum has remained resilient, showcasing immense potential.

2. Overview of India's Energy Landscape

As an emerging developing power, India boasts a population exceeding 1.4 billion and a land area of approximately 2.97 million square kilometers. In 2023, its GDP reached $3.57 trillion, ranking first in population, seventh in

land area, and fifth in GDP globally. With a GDP growth rate of 8.15% in 2023, India became the fastest-growing major economy in the world. This rapid economic growth reflects India's immense and continuously expanding energy demand.

2.1 Traditional Fossil Fuels

India's fossil fuel reserves are relatively modest on a global scale, especially when compared to its impressive economic and demographic statistics. As of the end of 2020, India's proven oil reserves were approximately 4.5 billion barrels, accounting for only 0.3% of the global total. In contrast, China, which has a similar population size, holds around 26 billion barrels, five times India's reserves. Likewise, India's natural gas reserves amount to about 1.3 trillion cubic meters, about 0.7% of global reserves, while China has 8.4 trillion cubic meters, six times more India' s reserves. However, India's coal reserves are relatively abundant, totaling approximately 111,052 million tons, which represents 10.3% of the global total and ranks fifth worldwide.

In terms of production and consumption, India produced around 33 million tons of oil in 2022, equivalent to 737,000 barrels per day, representing 0.7% of global production. Oil production growth rates were -3.8% for 2022 and -2.3% for the decade from 2012 to 2022. Meanwhile, consumption was significantly higher, at approximately 5,288,000 barrels per day, with growth rates of 8.2% in 2022 and 3.6% over the same decade. For natural gas, production reached approximately 29.8 billion cubic meters in 2022, accounting for 0.7% of global production, with a growth rate of 4.4% for the year but a decade-long decline of -2.2%. However, consumption was much higher at about 58.2 billion cubic meters, with a decline of -6.3% in 2022 but a modest growth rate of 0.4% over the decade. As for coal, India produced approximately 15.02 exajoules (EJ) in 2022, representing 8.6% of global production, with growth rates of 12.2% for the year and 3.5% over the decade. Coal consumption was approximately 20.09 EJ, with growth rates of 4.1% in 2022 and 4% over the decade.

These figures demonstrate that India's domestic fossil fuel reserves and production are insufficient to meet the demands of its large population and rapidly growing economy, making imports of fossil fuels necessary. In 2022, India imported approximately 5,752,000 barrels of oil per day, accounting for 8.4% of global oil imports, with growth rates of 8.5% for the year and 3.3% over the decade. Natural gas imports stood at approximately 28.4 billion cubic meters, representing 2.9% of global imports, but saw a sharp decline of -15.4% in 2022, despite a decade-long growth rate of 4.4%. Coal imports totaled approximately 5.01 EJ in 2022, accounting for 15.4% of global coal imports, with growth rates of 6.7% for the year and 3.2% over the decade.

The data reveals that India has relatively favorable coal resources, with the lowest import dependency at just 25%. Natural gas follows, with an import dependency of approximately 50%, while oil shows the highest dependency, reaching 86%. India's natural gas imports are closely aligned with its domestic consumption needs, leaving little surplus, whereas coal imports fall short of fully covering the domestic demand gap. This indicates that India does not prioritize stockpiling coal or natural gas, likely due to its abundant domestic coal reserves and the high costs associated with transporting and storing natural gas. In contrast, oil, as the most versatile fossil fuel, is imported in quantities exceeding domestic demand, highlighting India's strategic focus on oil reserves and stockpiling. From a growth perspective, oil production in India has been steadily declining in both the short and long term, while consumption and imports continue to rise, underscoring an increasing reliance on foreign oil. Natural gas consumption has shown little long-term variation; however, with domestic production declining and imports dropping sharply by 15.4% in 2022, it is evident that India is currently reluctant to rely heavily on natural gas to meet its energy needs. For coal, the country has maintained a stable consumption growth rate of around 4%, with domestic production growth consistently outpacing import growth. This indicates that India seeks to stabilize its coal consumption while gradually reducing import dependency by ramping up domestic production, balancing demand, and conserving resources.

2.2 Clean Energy

As a major energy-consuming country, India not only relies on traditional fossil fuels but also actively develops and utilizes various clean energy sources such as nuclear energy and hydro-power. With the rise of new energy

sources, solar and wind energy have also begun to attract attention in India. The development and utilization of clean energy can achieve several objectives: first, it helps reduce India's dependence on traditional fossil fuels and diversify its energy sources, thereby better safeguarding its energy security; second, it contributes to reducing carbon emissions and protecting the environment, aligning with India's environmental commitments; third, it strengthens India's influence in the clean energy sector, thus enhancing its international status. Therefore, India attaches great importance to the development and utilization of clean energy and has established a dedicated government department — the Ministry of New and Renewable Energy — to promote this initiative.

According to statistics from 2022, India's nuclear energy consumption was 0.42 exajoules, accounting for 1.7% of the world total, with a growth rate of 4.8% in 2022 and a 2.9% growth rate from 2012 to 2022. Hydro-power consumption was 1.64 exajoules, accounting for 4% of the world total, with a 2022 growth rate of 8.7% and a 3.7% growth rate from 2012 to 2022. Renewable energy consumption was 2.15 exajoules, accounting for 4.8% of the world total, with a growth rate of 18% in 2022 and a 14.3% growth rate from 2012 to 2022. Among renewable energy, the installed capacity of photovoltaic reached 63,146 MW, accounting for 6% of the world total, with a 2022 growth rate of 27.1% and a 51.6% growth rate from 2012 to 2022. The installed capacity of wind turbines was 41,930 MW, accounting for 4.7% of the world total, with a 2022 growth rate of 4.6% and a 9.3% growth rate from 2012 to 2022. The production of bio-fuels was 43 thousand barrels of oil equivalent per day, accounting for 2.3% of the world total, with a 2022 growth rate of 24.5% and a 24.8% growth rate from 2012 to 2022.

From the data above, it is evident that although nuclear and hydro-power have been developed and utilized earlier than other renewable energy sources, India's renewable energy consumption exceeds the combined consumption of nuclear and hydro-power. On the one hand, this highlights India's focus on renewable energy, while on the other hand, it may indicate India's limited capacity for developing nuclear and hydro-power, which could be related to its relatively weak nuclear and hydro-power technologies and infrastructure. Within renewable energy, it is clear that solar energy has developed the fastest, followed by bio-fuels, with wind energy growing the slowest. This indicates that India places the greatest emphasis on solar energy, likely due to its favorable sunlight conditions and advancements in solar technology. Bio-fuels, with readily available raw materials and technology, have also seen rapid growth. Wind energy, however, requires specific geographical conditions and infrastructure, with high development costs, resulting in slower growth in India.

Despite the rapid development of clean energy in India, it is important to consider its share in the overall energy mix within the country. According to 2021 data from the International Energy Agency, the largest energy source in India in 2021 was coal, accounting for approximately 44.6%. The second-largest source was oil, accounting for about 23.7%. Biomass and waste ranked third at about 21.6%, followed by natural gas at 5.8%. Wind and solar energy, hydro-power, and nuclear energy each accounted for about 1.54%, 1.48%, and 1.3%, respectively. This demonstrates that India's energy structure is still primarily based on fossil fuels, especially coal. While biomass and waste from renewable energy account for over 20%, most of this energy comes from the direct combustion of animal waste, agricultural and forestry residues, household garbage, and industrial waste, which do not fully meet the standards of clean energy. Other clean energy sources still account for a relatively low proportion of India's energy structure and have not significantly reduced India's dependence on fossil fuels. However, these sources represent the future direction of development and possess great potential, experiencing rapid growth within the country.

3. Challenges to Energy Security

As discussed above, although India is vigorously developing various clean energy sources, its energy structure will remain dominated by fossil fuels in the short term. India's relatively scarce domestic resource reserves, low energy output, large population, and rapidly growing economy make it reliant on energy imports to sustain its development. However, the volatile international landscape poses challenges for India in ensuring the security of its energy imports and, consequently, its overall energy security. There are three key challenges India faces in maintaining energy security. First, as India's energy demand

continues to grow, its need for energy imports is also increasing. Finding and maintaining stable and sufficient energy import channels is a significant challenge for India. Second, after securing import channels, ensuring the safe and efficient transportation of energy back to the country remains a critical issue. Finally, developing clean energy more effectively to meet domestic energy needs and reduce dependence on fossil fuels is essential. This would, in turn, decrease India's reliance on energy imports and enhance its energy security.

3.1 Energy Import Channels

According to 2022 statistics, India's primary sources of crude oil imports include the Middle East, Russia, the United States, and West Africa. The top six countries are Iraq (55.2 million tons), Saudi Arabia (40.2 million tons), Russia (37 million tons), the United Arab Emirates (22.5 million tons), the United States (16.9 million tons), and Kuwait (11.7 million tons). India's natural gas imports mainly come from the Middle East, the United States, Russia, and Africa. The top eight countries are Qatar (14.7 billion cubic meters), the UAE (3.8 billion cubic meters), the United States (3.3 billion cubic meters), Oman and Nigeria (both tied at 1.3 billion cubic meters), Angola (0.9 billion cubic meters), and Russia and Australia (both tied at 0.6 billion cubic meters). Coal imports are dominated by Indonesia (2.37 EJ), Australia (0.97 EJ), South Africa (0.39 EJ), Russia (0.37 EJ), and the United States (0.29 EJ). This data highlights the importance of the Middle East, Russia, the United States, Indonesia, Australia, and Africa as India's key energy import channels.

3.1.1 Middle East

The Middle East, one of the world's most significant oil and gas production regions, holds vast reserves of oil and natural gas — approximately 48.3% and 40.3% of global totals, respectively. In 2022, the region accounted for about 32.7% of global oil production and 17.8% of natural gas production, with high-quality output at low costs, making it an ideal source for importing countries. India has traditionally maintained friendly relations with Middle Eastern nations, leveraging its leadership role in the Non-Aligned Movement. Post-Cold War, as economic development became a priority, India sought deeper cooperation with oil and gas-producing countries in the region. In the 21st century, India's rapid growth significantly increased its energy consumption and imports, further emphasizing the strategic importance of the Middle East. India has strengthened relations through political cooperation, long-term energy agreements, and mutual investments across upstream, midstream, and downstream energy sectors. Among these countries, Saudi Arabia stands out as the world's largest oil producer and a dominant Middle Eastern power, leading OPEC. India has prioritized its ties with Saudi Arabia, particularly under Prime Minister Narendra Modi, as part of the "Look West" policy. Bilateral relations have expanded beyond energy, trade, and investment into areas like security and military cooperation, alongside cultural exchanges. However, Saudi Arabia's close ties with Pakistan and strained Indo-Pakistani relations remain potential destabilizing factors. Additionally, domestic discrimination against Islam in India might negatively impact bilateral ties. The October 2023 Israel-Palestine conflict further tested India's relations with the Middle East. Despite maintaining a relatively neutral stance, India's reluctance to support either side decisively — resisting Western pressure to back Israel while avoiding endorsing Palestine — might affect its relationships in the region.

3.1.2 Russia

Russia, with its vast territory, boasts abundant fossil fuel reserves and remains a leading global energy producer. Since India's independence, it has maintained close ties with both the Soviet Union and Russia, fostering extensive cooperation in military and energy sectors. Despite the geopolitical challenges posed by the Russia-Ukraine conflict, India continues to import substantial energy resources from Russia. Moreover, India has re-exported Russian oil to European countries at a premium, capitalizing on market opportunities. At the February 2024 Munich Security Conference, India's Foreign Minister S. Jaishankar underscored the pragmatic value of Russian oil imports, describing them as a "smart move," even in the presence of U.S. Secretary of State Antony Blinken. Looking ahead, Russia is expected to remain a key player in India's energy portfolio. However, as India strengthens ties with the U.S. and U.S.-Russia relations deteriorate, balancing its relationships with these two major powers will pose a significant diplomatic challenge.

3.1.3 United States

The U.S., rich in fossil fuel reserves, has transformed from an energy importer to a major exporter thanks to advancements in shale oil technology. In 2022, the U.S. accounted for approximately 12.7% of global oil exports, 19.3% of natural gas exports, and 6.9% of coal exports. Despite its higher production costs compared to the Middle East or Russia, rising global energy demand and high prices have solidified the U.S. as a major energy supplier. Since the end of the Cold War, India has sought closer ties with the U.S., participating in Western-led economic systems and pursuing mutual cooperation. In recent years, U.S.-India relations have warmed further, driven by shared strategic interests, particularly in countering China's rise. Energy cooperation has become a natural extension of this partnership. However, India's commitment to an independent foreign policy means maintaining autonomy in its dealings with the U.S. amidst a complex global environment remains a challenge.

3.1.4 Indonesia and Australia

Indonesia and Australia are key coal suppliers to India, with historically friendly relations and minimal conflicts of interest. Their energy trade has been primarily driven by economic factors. Notably, the U.S.-backed Quad alliance (involving the U.S., India, Japan, and Australia) has further deepened India-Australia cooperation in recent years. However, potential trade and geopolitical competition between Indonesia and Australia could impact India's relations with both, necessitating careful navigation to balance these partnerships.

3.1.5 Africa

Africa, despite its developmental challenges, is rich in oil and gas resources, much of which remains untapped. Many African nations rely on resource exports to fuel economic growth. As India grows stronger, it has actively engaged in energy trade and resource development in Africa. The continent represents a region of significant potential for India's energy imports. Nevertheless, Africa's political instability poses risks to Indian investments. Additionally, the historical influence of Western nations like the UK and France in Africa could create resistance to India's expanding presence in the region.

3.2 Energy Transportation

As India shares no land borders with its major energy-importing countries, the transportation of energy primarily relies on shipping. Shipping offers advantages such as low cost and high capacity but comes with drawbacks, including slow speed, vulnerability to weather conditions, route adjustments, and a host of uncertainties at sea. In recent years, global instability has not only driven up shipping costs but also introduced significant security risks to maritime transportation. Examples include long-standing piracy issues, disruptions to Russian maritime energy transport due to Western sanctions following the Russia-Ukraine conflict, and attacks on commercial ships in the Red Sea by Yemen's Houthi forces amid the Israel-Palestine conflict. Piracy, though mitigated significantly through international cooperation, still poses a residual threat. Meanwhile, India's decision to defy Western sanctions and continue importing energy from Russia raises concerns that Western countries might resort to various measures to interfere with India's shipping routes, thereby increasing the costs and risks of such imports. Additionally, India's neutral stance on the Israel-Palestine conflict, combined with the indiscriminate attacks on commercial vessels by Houthi forces, has disrupted energy imports through the Red Sea. Many ships have been forced to bypass the Red Sea by taking the longer route around the Cape of Good Hope, significantly increasing transit time and costs. Furthermore, the heavy reliance on maritime transport for energy imports poses logistical challenges for India's ports, particularly in handling large energy shipments efficiently.

3.3 Development of Clean Energy

Despite the rapid growth of clean energy in India in recent years, its share in the country's overall energy mix remains relatively low. Among clean energy sources, nuclear power and hydro-power — two of the earliest forms of clean energy to be developed and utilized — account for 2.88% and 9.93% of India's electricity generation, respectively. In comparison, these figures for China, another developing country with a similar population size, are 4.74% and 15.57%, respectively. Moreover, China's total electricity generation far exceeds that of India. Considering India's abundant hydro-power resources, it is evident that the development and utilization of nuclear and hydro-power remain sub-optimal, likely due to India's relatively weak technological and infrastructure capabilities in these areas. On the other hand, solar and wind

energy, two key components of clean energy, are experiencing rapid growth in India, thanks to continuous advancements in renewable energy technology. However, despite these efforts, India, as the world's third-largest energy consumer after China and the United States, contributes only 6% and 4.7% of global solar and wind energy production, respectively. In contrast, China's contributions stand at 37.3% and 40.7%, highlighting a significant gap. Given India's geographical advantages, such as its tropical location and extensive coastline providing ample solar and wind resources, as well as its government's dedicated efforts to promote renewable energy through specialized agencies, the low development level of these resources indicates substantial room for improvement.

4. How India Can Safeguard Energy Security

By analyzing the risks India faces regarding energy security, targeted measures can be proposed to help India maintain its energy security and provide a reference for relevant stakeholders.

4.1 Securing Existing Energy Import Channels While Developing New Ones

India should aim to maintain the stability of its existing energy import channels while actively exploring new ones. On one hand, India must safeguard its bilateral relationships with major energy-exporting countries, adopting flexible diplomatic strategies based on the realities of each situation. In cases of conflict or competing interests, India should strive to strike a balance in its relationships with both parties. Additionally, India can encourage and support domestic energy companies to invest in and develop overseas energy projects, which could provide India with greater influence and priority in energy trade. On the other hand, India can explore new energy import sources. For example, Venezuela currently holds the largest proven oil reserves in the world. Although Venezuela, like Russia, is under U.S. sanctions, the U.S., in its bid to court India as a strategic partner, has refrained from imposing sanctions on India for importing energy from Russia. India can leverage this leniency to import oil from Venezuela. In terms of coal, Colombia and Canada ranked among the top coal exporters globally in 2022. These two countries can serve as alternative coal import sources for India. However, given recent diplomatic disputes between India and Canada, Colombia appears to be a more suitable choice. The absence of conflicting interests between the two nations ensures that coal trade with Colombia is unlikely to be affected by political factors. For natural gas, Iran holds the world's second-largest proven reserves. Although India and Iran do not share a border, they are separated only by Pakistan, and the maritime transport distance between the two countries is minimal. Additionally, as fellow members of the Shanghai Cooperation Organization (SCO), India and Iran maintain good relations. While Iran is under U.S. sanctions, India could choose to withstand U.S. pressure, making Iran an ideal partner for natural gas imports.

4.2 Ensuring Energy Transport Security

India needs to ensure the energy transport security. To ensure energy transport security, India can take a dual approach: safeguarding maritime energy transport and exploring pipeline transport options. For maritime transport, India must foster good relations with countries along energy transport routes and actively participate in maritime security governance and international cooperation. At the same time, India should build a strong blue-water navy to protect its maritime interests. Additionally, India needs to invest in port infrastructure to enhance energy throughput capacity and efficiency. For pipeline transport, India could collaborate with neighboring countries to establish transnational energy pipelines. However, given India's strained relations with its two major neighbors, Pakistan and China, which occupy key western and northern routes for India's energy imports, pipeline transport is not a feasible option in the short term.

4.3 Promoting Clean Energy Development

India needs to promoting clean energy development. Developing clean energy offers India a dual benefit: reducing dependence on fossil fuels and cutting pollution to protect the environment. However, due to various constraints, the development of clean energy in India remains at a relatively low level. Domestically, India should implement stronger measures to promote clean energy development. This includes establishing dedicated government agencies to oversee clean energy initiatives and incentivizing private-sector participation through subsidies and rewards.

Furthermore, India should invest heavily in research and development for clean energy technologies. Internationally, India can collaborate with other countries and global enterprises to adopt and learn from advanced technologies. Such cooperation could help India achieve leapfrog development in the clean energy sector, accelerating its transition to a more sustainable energy future.

5. Conclusion

As a populous and rapidly developing emerging economy, India has a massive demand for energy. However, it cannot rely solely on its domestic resources to meet this demand, making energy imports inevitable. This heavy dependence on energy imports exposes India to significant energy security risks. Whether India can effectively safeguard its energy security is crucial to its fundamental and long-term interests. It is evident that India is taking steps to diversify energy import channels, ensure transportation security, and promote clean energy development. However, gaps and challenges remain. To address these, India needs to act with greater determination, adopt a more proactive approach, and employ a wider range of practical measures. By doing so, India can enhance its energy security and lay a stronger foundation for sustainable development.

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