RAJIV GANDHI
INSTITUTE FOR CONTEMPORARY STUDIES

Meeting India's Ever Growing Energy Demand – Implications for Domestic and Foreign Policy

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Jawahar Bhawan
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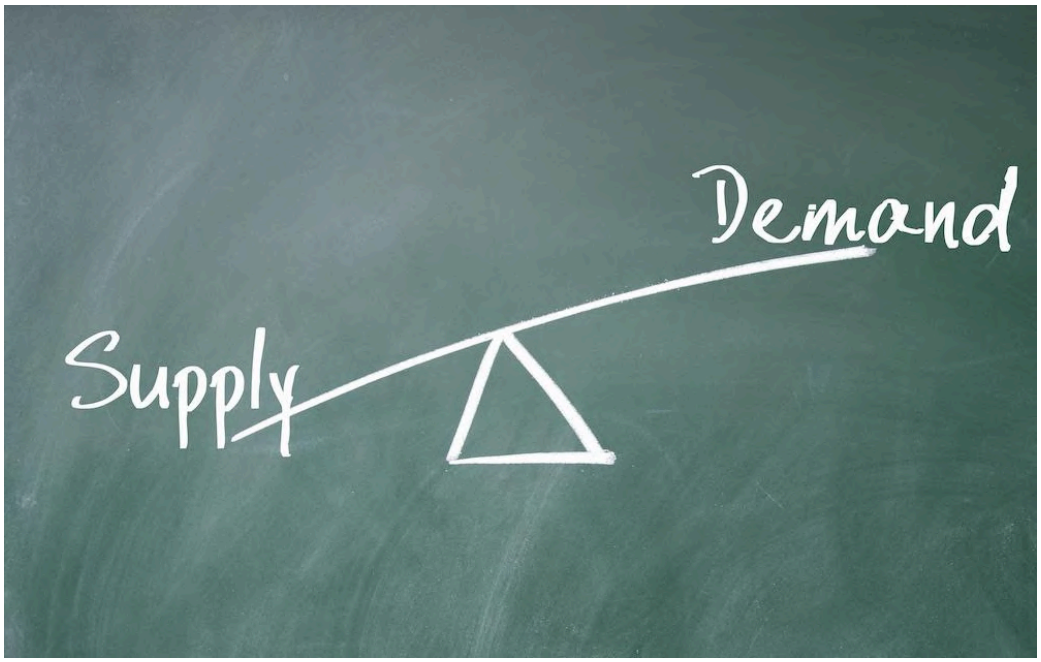

Source: Image

India's final commercial energy consumption was 525,708 Kilo Tons of oil Equivalent (KToE), a unit that is used to compare different sources of energy. As can be seen from the Table 1 below, India's total commercial energy supply was 739,386 KToE. Of this, coal accounted for 56.2 percent, crude oil for 33.4 percent and natural gas for 8.1 percent, adding up to 97.8 percent of all commercial energy supply.

Energy supply was more than final energy consumption of 525,708 KToE due to transportation losses and pilferage of coal, conversion losses from coal to electricity, transmission and distribution losses of electricity, and stock changes for storable fuels like coal. It should be noted that total energy use includes self-collected biomass by households and is not included in the commercial energy figures. This was about 13 percent of total energy consumption in 2020, commercial and non-commercial.[1]

Table 1 – Energy Supply in India by source and type, FY 2021-22. All figures in KToE

	Coal	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Solar, Wind, etc	Electricity	Total
Production	323,501	30,344	0	31,471	12,278	13,070	15,429	0	426,093
Imports	115,985	216,643	42,216	28,468	0	0	0	653	403,965
Exports	-791	0	-65,425	0	0	0	0	-794	-67010
Stock changes	-23,662	0	0	0	0	0	0	0	-23,662
Total primary energy supply	**415,033**	**246,987**	**-23,209**	**59,939**	**12,278**	**13,070**	**15,429**	**-141**	**739,386**

Source: Energy Statistics 2023[2], Table 7.4, p.73

[1] IEA(2021) India Energy Outlook 2021 https://www.iea.org/reports/india-energy-outlook-2021

[2] Govt of India –MOSPI (2024) Energy Statistics 2023. https://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2023/Energy%20Statistics%20India%202023_07022024.pdf

How dependent India is on imports for its energy can be inferred from the fact that in the FY 2021-22, India imported 27.9 percent of its coal, 47.5 percent of its natural gas and 87.7 percent of its crude oil (67.6 percent if oil products are added to crude oil, since India is a net exporter of oil products).

As the rest of the sources did not involve much import, the weighted average of imports was about 40 percent of total energy supply in 2021-22.

However, this was an average for all types of energy use. For transportation, which was largely dependent on oil products (petrol, diesel and aviation fuel), the dependence on imports was nearly 76.6 percent.

Since transportation is a critical aspect of a running economy, the import dependence of India on imports is exceptionally high. The only other large economy which was so import dependent was Japan, which 97 percent of its oil demand in 2022.[3]

Source: Image

Thus managing this demand supply imbalance for energy has been a crucial policy task for India's economic planners and political leaders.

As crude oil imports are heavy, and that commodity has been a major factor for geo-politics, it is but natural that managing energy imports became a central concern for India's foreign policy makers as well.

This paper examines what India has done since Independence to manage this chronic demand supply imbalance for its energy requirements, and within that the role played by both domestic energy policies as well as foreign policy.

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[3] https://www.eia.gov/international/analysis/country/JPN

1.1 Energy Demand – Substantial and Ever-growing

Source: Image

By 2022 India was the third largest energy-consuming country in the world and its energy and related non-fuel materials needs are increasing faster than its GDP growth rate, as the economy moves towards modes of production and consumption which are more energy intensive.

Total energy consumption had increased rapidly over 2010-2020 at 3.5 percent per annum. It continued to grow very rapidly at 8 percent in 2021 and 6.5 percent in 2022.

However, per capita energy consumption remains around 7 toe (2022), half the Asian average. Within this, per capita electricity consumption reached 930 kwh in 2022, about a third of Asian average.[4]

While India's energy use on a per capita basis is well under half the global average – and there's widespread differences in energy use and quality of services across states and between rural and urban areas – the unfolding scenario Is quite different.

According to IEA's India Energy Outlook 2021, because of expanding economy, population, urbanisation and industrialisation, India will see the "largest increase in energy demand of any country, across all scenarios by 2040".

As per the National Electricity Policy-14, (NEP14) document, the projected all India peak electricity demand and electrical energy requirement is 277.2 GW and 1907.8 Billion Units (BU) for the year 2026-27 and 366.4 GW and 2473.8 BU for the year 2031-32 as per the 20th Electric Power Survey (EPS) Demand projections.

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[4] https://www.enerdata.net/estore/country-profiles/india.html

1.2 Consuming Sectors

As can be seen from the table -2 below, in 2021-22, the industrial sector was the largest consumer of energy in the country with this sector itself using more than half, i.e., 50.6 percent of the total final energy consumption. The transport sector accounted for 10.9 percent. The residential sector was close with 11.2 percent of the total consumption.[5]

Table 2 – Energy Consumption in India by Sector, 2021-22. All figures in KToE

	Coal	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Solar, Wind, etc	Electricity	Total
Final consumption	**172,115**	**0**	**208,077**	**34,033**	**0**	**0**	**0**	**111,482**	**525,707**
Industry	**172,115**	**0**	**47,185**	**767**	**0**	**0**	**0**	**45,881**	**265,948**
Iron and steel	39,561	0	1,091	0	0	0	0	0	40,652
Chemical and petrochemi	780	0	13,478	0	0	0	0	0	14,258
Non-ferrous metals	0	0	393	0	0	0	0	0	393
Machinery	0	0	163	0	0	0	0	0	163
Mining and quarrying	0	0	1,723	0	0	0	0	0	1,723
Paper, pulp and print	845	0	0	0	0	0	0	0	845
Construction	4,377	0	1,183	0	0	0	0	0	5,560
Textile and leather	818	0	51	0	0	0	0	0	869
Non-specified (industry)	125,733	0	29,104	767	0	0	0	45,881	201,485
Transport	**0**	**0**	**43,802**	**11,712**	**0**	**0**	**0**	**1,703**	**57,217**
Road	0	0	35,063	11,262	0	0	0	0	46,325
Domestic aviation	0	0	5,338	0	0	0	0	0	5,338
Rail	0	0	1,808	0	0	0	0	1,703	3,511
Pipeline transport	0	0	0	450	0	0	0	0	450
Domestic navigation	0	0	1,593	0	0	0	0	0	1,593
Non-specified (transport)	0	0	0	0	0	0	0	0	0
Other	**0**	**0**	**117,091**	**1,134**	**0**	**0**	**0**	**63,898**	**182,123**
Residential	0	0	30,093	0	0	0	0	28,724	58,817
Comml and public service	0	0	63	0	0	0	0	9,245	9,308
Agriculture/forestry	0	0	667	144	0	0	0	19,694	20,505
Non-specified (other)	0	0	86,268	990	0	0	0	6,235	93,493
Non-energy use	**0**	**0**	**0**	**20,421**	**0**	**0**	**0**	**0**	**20,421**
Non-energy use industry	0	0	0	20,421	0	0	0	0	20,421
Non-energy use in trpt	0	0	0	0	0	0	0	0	0
Non-energy use in other	0	0	0	0	0	0	0	0	0

Source: Energy Statistics 2023[6], Table 7.4, p. 73

According to the International Energy Agency (IEA) report of January 2024, India's electricity demand is set to grow fastest among major economies, and the forecasted demand over the next three years is projected to be roughly equivalent to the current electricity consumption of the United Kingdom.[7] India's electrical energy use nearly quadrupled in the two decades between 2001 and 2021. The projected demand for 2030 will again nearly double.

[5] Ibid.

[6] Govt of India –MoSPI (2024) Energy Statistics 2023, op.cit.

2 Supply sources – Conventional

Table 3 - Installed Electricity Generation Capacity (Fuel wise) as on 29.02.2024

Category	Installed Generation Capacity (MW)	Percent share in Total
Fossil Fuel		
Coal	2,10,969	48.6 percent
Lignite	6,620	1.5 percent
Gas	25,038	5.8 percent
Diesel	589	0.1 percent
Total Fossil Fuel	2,43,216	56.0 percent
Non-Fossil Fuel		
Hydro	46,927	10.8 percent
Wind	45,154	10.4 percent
Solar	75,576	17.4 percent
BM Power/Cogen.	10,262	2.4 percent
Waste to Energy	584	0.1 percent
Small Hydro Power	4,995	1.2 percent
Nuclear	7,480	1.7 percent
Total Non-Fossil Fuel :	1,90,978	44.0 percent
Total Installed Capacity(Fossil Fuel & Non-Fossil Fuel)	4,34,195	100 percent

(Source: Government of India, Ministry of Power, Power Sector at a Glance All India https://powermin.gov.in/en/content/overview)

Since non-renewable sources of energy meet 75 percent of India's total energy needs, and 95 percent of the commercial energy needs in the following sub-sections, we will deal with coal, oil and natural gas.

2.1 Coal: Production and Imports

Coal is the main source of energy in India as it fulfils almost 67 per cent of the total commercial energy consumed in the country. Total estimated reserves of coal as on 1st April 2022 were 361.40 billion tonnes.

Out of the total reserves in the country, proven reserves i.e. those available for extraction in terms of economic viability, feasibility study and geologically exploration level, account for 51.76 percent of the total.

[7] https://energy.economictimes.indiatimes.com/news/power/indias-electricity-demand-set-to-grow-fastest-among-major-economies-global-demand-rises-iea/107115739

There are four types of coal: anthracite, bituminous, sub-bituminous, and lignite. Anthracite is the highest ranked coal with the carbon percentage of above 87 percent. Today, anthracite coal mines account for roughly 1 percent of the world's total coal reserves; in other words, only a very small portion of the overall coal industry.

The carbon content in bituminous is 77-87 percent, in sub-bituminous is 71-77 percent and in lignite is 60-70 percent. Lignite has the least carbon content and hence highest ash content. Ash content of coal produced in the country is generally 25 to 45 percent whereas average ash content of imported coal varies from 10 to 20 percent.

In 2021, India consumed 1.05 billion metric tons of coal, setting an all-time high for itself and surpassing every country's annual consumption except for China, according to the International Energy Agency's coal market update published in July 2022.

At the time, the IEA forecast India's coal demand would grow to 1.16 billion metric tons in 2023. Through sustained programme of investment and greater thrust on application of modern technologies, it has been possible to raise the all India production of coal and during 2022-23 it was 893.19 MT with a growth of 14.77 percent over the previous year.

Coal India Limited (CIL) and its subsidiaries accounted for production of 703.20 MT during 2022-23. Singareni Collieries Company Limited (SCCL) is the main source for supply of coal to the southern region. SCCL production of coal during 2022-23 was 67.14 MT.

For FY 2023-24, the government had set a coal production target of 1 billion tonnes. India's Coal Minister Pralhad Joshi anncounced that the coal and lignite production target of 1 billion tonnes was crossed on 22nd Mar 2024.[8]

Source: Image

[7] https://energy.economictimes.indiatimes.com/news/power/indias-electricity-demand-set-to-grow-fastest-among-major-economies-global-demand-rises-iea/107115739

[8] https://timesofindia.indiatimes.com/india/coal-production-hits-1-billion-tonne-mark-eases-import-dependence/articleshow/108738951.cms

The import of coal rose due to the inability of the domestic coal mining industry, dominated by state owned Coal India Limited (CIL), to meet growing demand for coal. With domestic coal production not keeping pace, a reduction in import duty on coal was necessary to keep price of imported coal low.[9] A reduction of ash content in imported coal enabled import of coal from certain 52 countries.

In spite of sufficient coal reserves, thermal coal imports grew, rising from 8.7 million tonnes (MT) in 2004 to 50.2 MT in 2014 and further to 181.6 MT in 2022-23.[10] (India also exported 16.3 MT of coal in 2022-23.) Interventions to reduce imports and increase energy security: Speaking to reporters on January 25, 2024 the Coal Minister said the government wants to eliminate coal imports for power generation by the financial year 2025-26.

"The first thing what we had to achieve is making domestic coal available in the country. That is almost there today. Currently blending of imported coal for power generation is around 3 percent. Railways is doing a great effort. But there are constraints also...We are trying to address the logistics problems. If all these things happen, there is absolutely no need for coal imports," he said.[11]

But since India has currently 15 imported coal based (ICB) plants with a cumulative capacity of around 17 GW. In this connection, the coal ministry would request imported-coal based (ICB) power plants to make changes to their technologies and design so that they can use domestic coal:

> "We will also request imported coal based power plants to change technology and design in the next one or two years. There will be adequate coal availability," the minister said, adding that eventually it would be upon the plants to decide on their operations.[12]

Source: Image

[9] Low import duty has been necessitated to meet shortfall in domestic production and keep imported coal prices low

[10] https://coal.gov.in/en/major-statistics/production-and-supplies

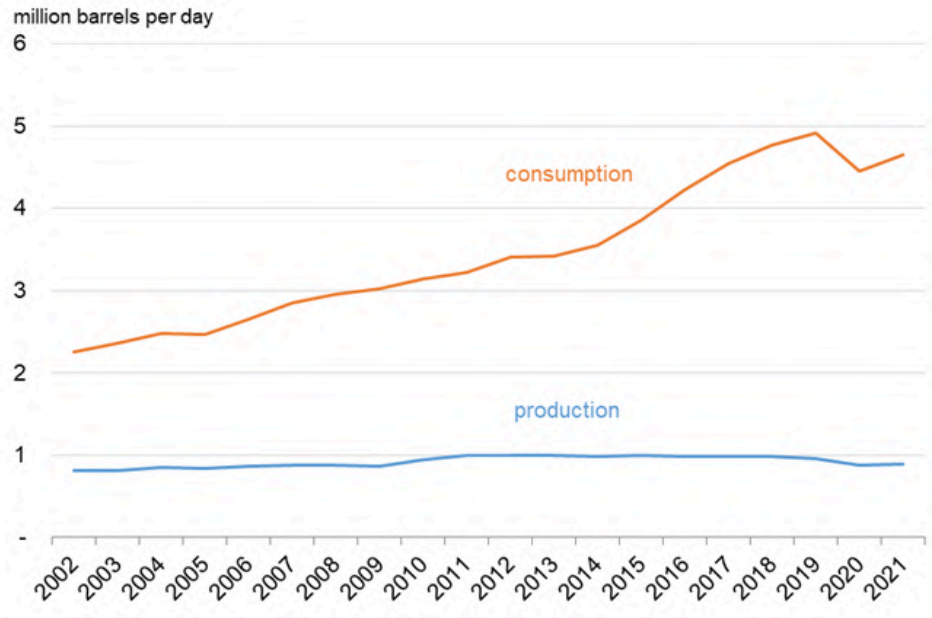
[11] Rituraj Baruah, *Mint*, 25 Jan 2024 https://www.livemint.com/industry/energy/coal-imports-for-power-to-end-by-fy26-11706190901211.html

[12] Ibid

2.2 Crude Oil: Production and Imports

India is the world's third largest oil consumer in the world and since domestic production is inadequate, it is also the world's third largest oil importer. See Fig 1 below:

Figure 1 - India's petroleum and products production and consumption 2002-2021



Source: US Energy information administration, Short Term Energy Outlook, August 2022

The IEA's India Energy Outlook 2021report points out that "India's oil demand rises by almost 4 million barrels per day (mb/d) to reach 8.7 mb/d in 2040 – the largest increase of any country. As per a statement by Petroleum Minister Hardeep Singh Puri, inaugurating the 26th Energy Technology Meet on 10th Oct 2023 in Delhi

> "India's energy demand will continue to provide fuel for future economic growth and is bound to grow exponentially in coming years... At present the country is world's 3rd largest consumer of oil, 3rd largest LPG consumer, 4th largest LNG importer, 4th largest refiner, and 4th largest automobile market. India is likely to account for 25 percent of global energy demand growth over the next two decades." [13]

Below we present a snapshot of India's oil and gas data, as of December 2023: [14]

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[13] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1966227

[14] Snapshot of India's Oil & Gas Data, p. 6. Petroleum Planning & Analysis Cell, Ministry of Petroleum and Natural Gas, https://ppac.gov.in

Table 4- Crude oil, LNG and petroleum products at a glance

Details	Unit/Base	2021-22	2022-23
Crude oil production in India	MMT	29.7	29.2
Consumption of petroleum products	MMT	201.7	223.0
Production of petroleum products	MMT	254.3	266.5
Gross natural gas production	MMSCM	34,024	34,450
Natural gas consumption	MMSCM	64,159	59,969
Crude oil imports	MMT	212.4	232.7
	$ Billion	120.7	157.5
Import dependency of crude oil (on petroleum products consumption basis)	percent	85.5	87.4

Why is India so overwhelmingly dependent of imported crude oil? The basic answer is inadequate reserves. India's main oil exploration and production orgnaisation is the Oil and Natural Gas Corporation (ONGC).

The ONGC's production of crude oil has seen a steady decline from its flagship and largest oilfield, Bombay High, which is 50 years old – by when most fields of that vintage go out of production.

The field hit a peak of 4,76,000 barrels of oil per day and 28 billion cubic meters of gas in 1989 and has since seen a gradual decline in output. It is currently producing some 1,35,000 bpd of oil and 13 bcm of gas.[15]

What were the policies, strategies and initiatives taken by the ministry of petroleum in order to achieve the desired objective? In 1997-98 New Exploration Licensing Policy (NELP) – also refered to as Hyderocarbon Exploration Licensing Policy (HELP) - was formulated by the Government of India, during 1997-98 to provide level playing field for all the investors and providing several concessions and incentives to both Public and Private sector companies in exploration and production of hydrocarbons with Directorate General of Hydrocarbons to act as the nodal agency.

Soon after assuming office in May 2014, Prime Minister Narendra Modi had vowed to reduce by 10 per cent India's dependence on imported crude by the year 2022. However, this could not be achieved.

A *"National Data Repository"* was set up by Directorate General of Hydrocarbons on 28 June 2017. There were some other initiatives like conducting 2D seismic survey of the hitherto *'unappraised areas'*. *"Discovered Small Fields"* were given on contract with a view to monetising their reserves.

[15] "ONGC's Mumbai high: 50 years on still going strong", *The Economic Times*, Feb 19, 2024 https://economictimes.indiatimes.com/industry/energy/oil-gas/ongcs-mumbai-high-50-years-on-still-going-strong/articleshow/107825606.cms?from=mdr

The *Annual Report 2022-23* of the Ministry of Petroleum and Natural Gas lists twenty-one policies, Hydrogen Exploration Licensing Policy (HELP) with notification of Open Acreage Licensing Policy (OALP). It appears to be a paradigm shift from Production Sharing Contract (PSC) regime to Revenue Sharing Contract (RSC) regime "which completely overhauls the regulatory regime for the future Exploration and Production (E&P) activities by reducing the regulatory burden based on the principles of 'Ease of doing business".[16]

The question is how far all these initiatives have helped in the main task of reducing import of crude by 10 per cent by the year 2022? The answer was in the negative. On the contrary, the domestic production of crude has considerably declined, and its consumption in the country substantially increased.

2.3 Natural Gas: LNG, LPG and CNG

Source: Image

The Indian government has identified the enhancement of share of natural gas as energy source for three critical reasons. First, diversification helps in reducing dependence on any single source. Second is combination of cost and efficiency.

Third, natural gas is environment friendly, reduces greenhouse gases and move towards attaining goals of Kyoto protocol. We will deal with each of these forms of natural gas one by one.

In 2020, India imported 1.3 trillion cubic feet (Tcf) of LNG. Next year, in 2021, importing about 1.2 trillion Tcf there was a 10 percent decrease; yet India was still the world's fourth-largest LNG importer.

Qatar was the primary source of India's LNG imports (42 percent), followed by the United States (16 percent) and the United Arab Emirates (13 percent) (see Figure below). The main drivers for the decrease in imports were high LNG spot prices and increased domestic natural gas production.[17]

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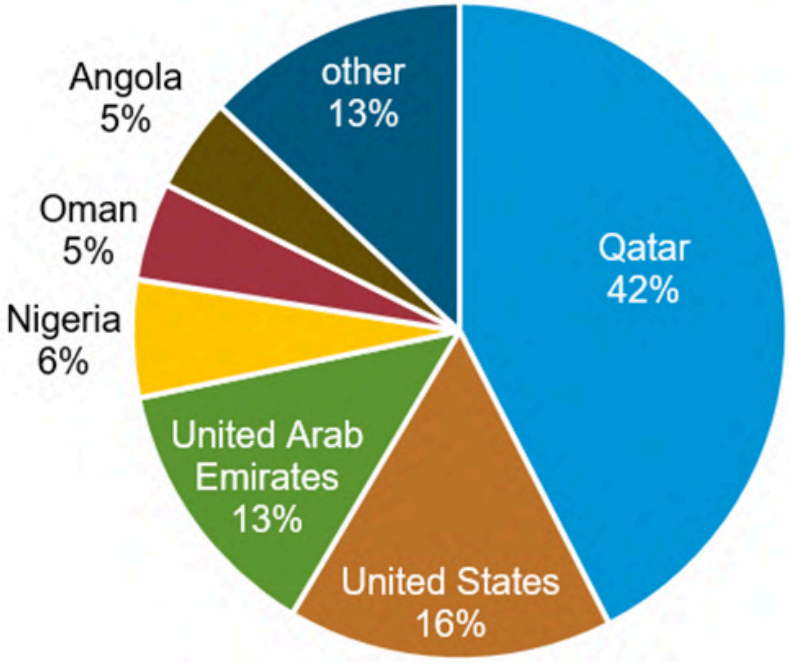
[16] Ministry of Petroleum and Natural Gas, *Annual Report 2022-23*

[17] International Energy Agency, Gas Market Report 2019, page 31; Verma, Nidhi. "India's Gail Sets 2040 Goal for Net Zero Carbon Emissions." Reuters. Thomson Reuters, August 26, 2022.

Figure 2- Main sources of LNG imports of India, 2021



Source: International Gas Union, 2022 World LNG report

2.4 Hydroelectric Energy

Hydroelectric power plants in India play a pivotal role in India's energy sector. They deliver clean and renewable electricity to millions. India ranks 5th in the world in terms of potential hydropower capacity. The hydropower potential of India is around 1,45,000 MW and at 60% load factor, it can meet the demand of around 85,000 MW.

Installed large hydroelectric capacity in Mar 2022 was 46,722 MW, or 11.7 percent of its total utility power generation capacity. Additional smaller hydroelectric power units with a total capacity of 4,683 MW (1.3 percent of its total utility power generation capacity) had been installed. There are 197 hydroelectric power plants in India. India's global position is 5th in terms of installed hydroelectric power capacity.

In general, there has been rising opposition to hydroelectric projects all around the country as people are concerned about displacement due reservoir inundation after the dam is constructed, and also changes in the rivers' ecology both upstream and downstream.

Some notable hydroelectric projects which were opposed strongly by the people were the Tehri dam in Uttarakhand and the Narmada dams in MP and Gujarat. Nevertheless both were constructed. But the opposition to hydroelectric projects is a cause for rethinking this source.

India is building its biggest hydropower project in in the mountainous region of Arunachal Pradesh, near the China border which is likely to be fully operational by end 2024. The USD 2.6 billion project on the 442 km long Subansiri River which originates from Tibetan Himalayas and makes its way to India via Arunachal is the biggest tributary of the Brahmaputra river, merging at Majuli in Assam.

The project will generate 2000 MW of electricity. The project has eight units of 250 MW each; the construction of dam M was completed in all blocks by July, 2023[18] This key project has been in the works for the last twenty years, since 2003 as protests and litigation delayed the project. Concerns over environmental damage put a halt to the project. National Green Tribunal (NGT) allowed work in 2019 after eight years of suspension.

The project in Arunachal Pradesh is crucial for India from a strategic point of view. Experts say China has only 5 percent of freshwater reservoir from Brahmaputra in the Tibet region, but India's Arunachal has the largest freshwater reservoir from the Brahmaputra river. Experts say that water could be one of the main reasons behind China eyeing Arunachal.

China is also building a 60,000 MW dam on the Yarlung Tsangpo river. New Delhi fears that China could divert the water of Brahmaputra once the dam is completed. China could use this to create a flood or cause water shortage in Assam and Arunachal. India's hydropower project in Arunachal is seen as a counter to Chinese dam. The mega hydel project will also help counter China's water diversion tactics. Here energy policy and foreign policy overlap.

2.5 Nuclear Energy

Source: Image

Nuclear energy could be a major source of energy for India, far larger and long-lasting than coal or oil. Only solar energy can match the potential of this source.

The installed generation capacity of nuclear energy in India in Mar 2022 was 6780 MW, over seven nuclear power stations, which was 1.5 percent of total installed capacity from both fossil fuel and non-fossil fuel. While India has less than 2 percent of the world's Uranium reserves and is this dependent on imports, India has approximately 400,000 Tons of thorium reserves, close to 25 percent of the global reserves. The technology for converting non-fissile Thorium 232 to fissile Uranium -233 which can then undergo fission to produce energy, is called the breeder technology.

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[18] Ministry of Power, Press Release: "Subansiri Lower Hydroelectric Project Achieves Construction of Dam till Top Level", 30 Jun 2023 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1936491#

Dr Homi Bhabha, the father of India's atomic energy program articulated the logic of the three stage nuclear energy program as follows:[19]

> The total reserves of thorium in India amount to over 500,000 tons in the readily extractable form, while the known reserves of uranium are less than a tenth of this. The aim of long range atomic power programme in India must therefore be to base the nuclear power generation as soon as possible on thorium rather than uranium...
>
> The first generation of atomic power stations based on natural uranium can only be used to start off an atomic power programme...
>
> The plutonium produced by the first generation power stations can be used in a second generation of power stations designed to produce electric power and convert thorium into U-233, or depleted uranium into more plutonium with breeding gain...
>
> The second generation of power stations may be regarded as an intermediate step for the breeder power stations of the third generation all of which would produce more U-233 than they burn in the course of producing power.

Unfortunately, the thorium based breeder program took decades to get established . The design of the prototype fast breeder reactor (PFBR) reactor was started in the 1980s at Kalpakkam, near Chennai. This was to serve as a prototype for two 600 MW fast breeder reactors. A fast breeder test reactor has been in operation at the Indira Gandhi Centre for Atomic Research (ICGAR) since 1985, although it did not reach its full 40 MW design capacity until 2021. As of FY 2021, around ₹6,840 crore had been spent in the construction and commissioning of the reactor.

In Jan 2024, a Demonstration Fast Reactor Fuel Reprocessing Plant was inaugurated at ICGAR as a precursor to large-scale plants for the reprocessing of fast reactor fuel. In Mar 2024, the "core loading" of the PFBR was finally done and this means that the reactor could be operational within a few months. If this breakthrough happens, and the FBR technology is mastered, this can go up significantly. India's foreign policy initiatives despite two "peaceful" nuclear explosions, has enabled India to proceed further.

Source: Image

[19] Venkataraman, Ganesan (1994), Bhabha and His Magnificent Obsessions, Universities Press (India) Ltd., ISBN 978-81-7371-007-0

3 India's Renewable Energy Sector

Source: Image

Renewable energy sources include hydroelectric, solar, wind, biomass and geothermal. Worldwide, fossil-fuels accounted for 78.9 percent of all energy generation in 2021 as per the United Nations Environment Programme (UNEP).[20] India stands 4th globally in renewable energy installed capacity (including large hydro), 4th in wind power capacity and 4th in solar power capacity.

Most of the developments so far in the solar and wind energy segments. Solar and wind energy are poised to drive two-thirds of India's power generation growth by 2032 if the nation successfully attains its renewable energy targets. India's power generation growth, which was predominantly coal-driven over the past decade, could shift toward solar and wind sources in the next ten years.

3.1 Solar Energy

India inaugurated the Jawaharlal Nehru National Solar Mission (JNNSM) in January 2010, has been revised twice and had a target of 100,000 MW of solar generation by 2022. The objective of JNNSM is to establish India as a global leader in solar energy by creating the policy conditions for its deployment across the country. It was conceived in three phases. Each phase was supported by differing key policies and targets.[21]

Phase I (2010 – 2013):
- Target for grid-connected PV (including rooftop) target: 1 000 MW
- Target for off-grid solar PV applications: 200 MW

[20] UNEP (2023). Renewables 2023: Global Status Report
https://www.ren21.net/wp-content/uploads/2019/05/GSR2023_GlobalOverview_Full_Report_with_endnotes_web.pdf

[21] IEA (2021) - Jawaharlal Nehru National Solar Mission
https://www.iea.org/policies/4916-jawaharlal-nehru-national-solar-mission-phase-i-ii-and-iii

Phase II (2014 – 2017):
• Cumulative target for grid-connected solar PV (including rooftop): 4 000 – 10 000 MW
• Target for off-grid solar PV applications: 1 000 MW
• Scheme for at least 25 solar parks (34 approved currently under Government) and the Ultra Mega Solar Power Projects to target 40 GW solar PV13th Plan

Phase III (2017 – 2022):
• Cumulative target for grid-connected solar PV (including rooftop): 100 000 MW
• Target for off-grid solar PV applications (as share of cumulative): 2 000 MW.

According to IEA's India Energy Outlook 2021,

"the Indian electricity sector is on the cusp of a solar-powered revolution... Solar power is set for explosive growth in India, matching coal's share in the Indian power generation mix within two decades or even sooner in the Sustainable Development Scenario." [22]

Solar power in India has evolved significantly since 2017 when it accounted for only 1 per cent of the country's power mix. Should India meet its solar targets outlined in the 14th National Electricity Plan (NEP14), its share is expected to surge from 5 per cent to 25 per cent during the period 2022-2032, marking a period of rapid expansion.

India's policy ambitions, notably the target to reach 450 GW of renewable capacity by 2030, are driven by plentiful availability of sunlight and the extraordinary cost-competitiveness of solar, which out-competes existing coal-fired power by 2030 even when paired with battery storage. Beyond large-scale projects, applications like rooftop solar are being encouraged.

Source: Image

[22] IEA (2021) India Energy Outlook 2021. https://www.iea.org/reports/india-energy-outlook-2021

3.2 Wind Energy

With an installed capacity of 42633 MW of Wind Energy as of Mar 2023, this source accounts for about 10.5 percent of installed electricity capacity in India, Wind power accounts for nearly 10 percent of India's total installed utility power generation capacity and generated 71.814 TWh in the fiscal year 2022–23, which is nearly 4.43 percent of total electricity generation.

Gujarat has the highest share (around 24%) of the total installed wind power capacity of the country. Tamil Nadu's wind production capacity was 2nd highest (around 23% share) after Gujarat as of 31 May 2023.

3.3 Bio-energy - Biogas, Biomass and Biofuel

In the 1970s, India initiated the National Biogas and Manure Management Program (NBMMP) to address the challenge of gas shortages. Through extensive research and diverse implementations, the program aimed to enhance self-sufficiency, irrespective of the availability of traditional gasoline and other fossil fuel-based products.

Despite its long history, India's biogas production remains relatively modest, standing at approximately 2.07 billion m3 per year. However, there is considerable untapped potential, as estimates suggest that India could potentially produce up to 48 billion m3 per year.[23]

Source: Image

Additionally, biomass, with a current capacity of approximately 750 million metric tonnes per annum, remains a significant component of India's renewable energy portfolio. Installed capacity of biomass production in India has grown at a CAGR of 4 percent reaching 10GW in FY22; and the biomass market in India is expected to reach Rs. 32,000 crore. It is for this reason that the India biomass market is attracting investment from global green energy companies. There's a growing demand for supply of clean and reliable power to businesses in India and biomass as a source of energy is expected to play a crucial source of energy.

[23] Ibid.

A significant new initiative has been announced by the Minister for Road Transport and Highways, Nitin Gadkari for the production of ethanol as a substitute to gasoline. Gadkari called for an increase in ethanol production, suggesting that it could be a game-changer for the Indian economy, projecting it to create an Rs 2 lakh crore economy.

It would boost farmer income as ethanol is produced from paddy, beetroot, etc. Gadkari envisioned the gradual expansion of ethanol use beyond automobiles, including drones with flex engines, marine vessels, and power generator sets.

3.4 Geothermal Energy

Source: Image

Geothermal energy is heat found just under the earth's surface, usually close to tectonically active regions. This energy can be used either directly, such as by channelling steam rising from the ground through a building, or indirectly, such as using heated geothermal fluids or steam to power a turbine and generate electricity.

According to the Ministry of New and Renewable Energy, India has a geothermal potential of 10 GW. This is not much as most of India's renewable energy push is being shouldered by solar and wind energy. Yet, geothermal energy has four advantages over wind and solar: it is continuous, doesn't require any kind of storage, emits the least carbon, and takes up less of land footprint. So, even though geothermal is likely to make up only a fraction of India's energy mix, its introduction — especially in a place like Ladakh — is important.

3.5 Renewable energy storage needs non-fuel energy minerals

Since the energy produced can only be relative to availability of sunshine or wind, how do we store the energy for use during times when neither of these two natural resources is not available? Renewable energy output is projected to surpass demand, particularly around midday, before 2030. To address this, Energy Storage Systems (ESS) are needed. The Central Electricity Authority (CEA) has a target of 27GW/108GWh of grid-scale storage by 2030.

This would provide enough capacity to maintain power supply for four hours, even during blackouts. In addition, as India embarks on its journey toward widespread adoption of electric vehicles (EV) , the demand for EV batteries will go up exponentially. By 2040, India aims to have 140 GW of battery capacity in the identified steps and nearly 200 GW, making it the world's largest.[24]

As India embarks on its journey toward building batteries for renewable power storage and for electric vehicles, its demand for essential minerals such as copper, silver, lead, zinc, lithium, cobalt, and rare earth elements will increase. Many of these, notably heavy rare earth elements and cobalt face supply risks, emphasizing the importance of securing domestic sources.[25]

India is endowed with significant but underexplored resources of nickel, cobalt, molybdenum, and heavy rare earth elements, must commit to further exploration to ascertain the extent of these reserves.

Some minerals, such as lithium and indium, are entirely absent from India's known resources, necessitating a strategic focus on securing global supply chains and acquiring foreign mineral assets to ensure a continuous and reliable supply.[26] Recent discoveries of lithium in Jammu and Kashmir offer a potential solution.

Source: Image

[24] Renewable energy for sustainable development in India: Current status, future prospects, challenges, employment, and investment opportunities. (2020, January 7). BioMed Central. https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-019-0232-1

[25] Sariya, K (2023)

[26] Ministry of Mines. (2023, October 11). Is India's infrastructure ready to be electrified? ETAuto.com. https://auto.economictimes.indiatimes.com/news/auto-technology/is-indias-infrastructure-ready-to-be-electrified/104339315

4 Policy Responses

4.1 Domestic Policies, Strategies and Initiatives

We shall now delve into some of the policies, strategies and initiatives of the government in the energy landscape.

India's energy policies have focused on meeting energy demand in transportation, power generation and consumption needs in industry, services and general populace. Government responses have been reflected in four key areas.

First is the institutional arrangements in terms of managing the energy sector, reflected in the structure and functioning of relevant ministries and departments. Policy interventions come next, buttressed by strong state action. Third is the introduction of various schemes, programs and support functions. Finally, the state's role in bringing together various stakeholders, often with competing interests.

4.1.1 Institutional Capacity Building

The Indian energy sector represents a continuous saga of institutional evolution in response to the challenges. In the early years, it was coal-based thermal and hydro-electric power, most of the production being with the public sector. Old style utilise were run like government department – State Electricity Boards were in charge of generation, transmission and distribution.

After decades of indifferent performance, it was decided in the 1980s to first unbundle these three functions and establish more professionally run utilise under the GOI. The National Thermal Power Corporation (NTPC) and then the National Power Transmission Corporation (NPTC) were established. Similarly a hydro-electric power entity was set up called NHPC. This led to significant technical improvement in the power sector.

Source: Image

In the next round of institutional evolution, the energy sector was opened to private capital and that led to numerous private generation, transmission and distribution companies. To regulate these, the Indian Electricity Act 1910 was completely revamped into a new Electricity Act 2003.

Among other things, it established Electricity Regulatory Commission at each state level to establish power tariffs. As generation, transmission and distribution companies were often separate, the concept of Power Purchase Agreements was established. Eventually, power trading was encouraged to match demand and supply and a Power Exchange India was established for providing an electronic platform for transactions in power and allied products. A separate power Finance Corporation was also established.

4.1.2 Quest for Self-Reliance in Coal and Oil

How have these functioned; what results have they yielded? While India has one of the largest proven coal reserves in the world, India's attempt to attract world class mining companies to invest in coal mining has not had the desired outcome. The manner of auctioning coal blocks, the small size of the blocks put up for auctions, the control on coal prices along with the absence of long term leases were among the many reasons why Indian coal blocks did not attract long term risk capital from overseas investors. The key factor that differentiates India from other large importers of energy is that India, remains a country with a perpetual trade deficit.

Next, in response to market uncertainties, investing in equity oil has emerged as a prominent and consistent policy approach. Despite the Integrated Energy Policy Report of 2006 acknowledging that obtaining equity oil, coal, and gas abroad contributes only to diversifying supply sources rather than enhancing energy security, subsequent sections advocated investing in equity oil to bolster energy security. IEA defines energy security as the uninterrupted availability of energy sources at an affordable price. Energy security has many aspects: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and environmental needs.

In 2000, a report commissioned by the then Indian Prime Minister to address energy security recommended an intensified focus on exploration and acquiring interests in countries deemed highly attractive for ensuring sustainable long-term supplies, such as Russia, Iran, Iraq, and North Africa.[27] The establishment of an 'energy security' division within the Ministry of External Affairs in 2011 further underscored the commitment to coordination of foreign policy with energy policy with various stakeholders, emphasizing facilitation of energy equity investment and bilateral energy agreements in countries across Africa, Latin America, Central Asia, and Southeast Asia.

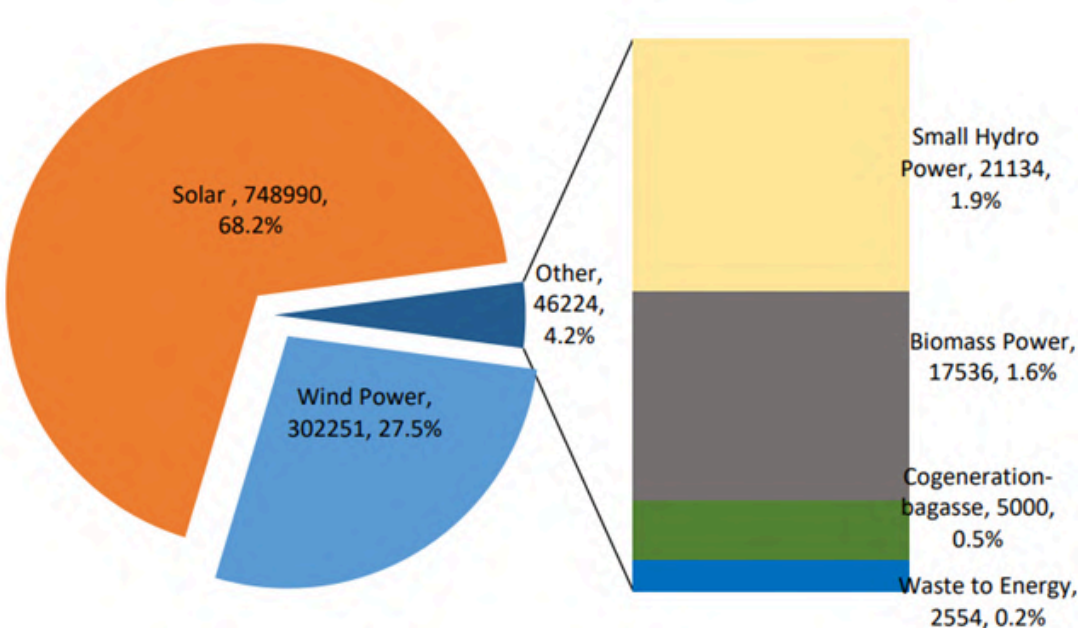
4.1.3 Thrust towards renewable energy

India is also making strides in renewable energy, with the government setting a target of 450 GW of renewable energy capacity by 2030. This shift is propelled by two primary factors: the advent of more affordable energy technologies and the urgent need to address air pollution, which leads to over a million premature deaths in India annually.[28]

To achieve this, the Government of India has set targets to reduce India's total projected carbon emission by 1 billion tonnes by 2030, reduce the carbon intensity of the nation's economy by less than 45 percent by the end of the decade, achieve net-zero carbon emissions by 2070 and expand India's renewable energy installed capacity to 500 GW by 2030.[29] India possesses substantial potential for renewable energy generation from various sources, as per Figure below, solar and wind power stand out as the most significant contributors, with vast capacities identified for development.

Leveraging these renewable resources not only aids in meeting energy demands but also contributes to environmental sustainability and reduces reliance on fossil fuels. The potential for biomass, small hydro, cogeneration, and waste-to-energy also presents opportunities for decentralized and eco-friendly energy solutions.[30]

Figure 3: Estimated Potential of Renewable Power as on 31.03.2020 Source wise



[27] Government of India (2011), Background information circulated among bidders to become consultant to the MEA, Department of Energy Security

[28] Peter N Varghese, R. (2018, April 27). AN INDIA ECONOMIC STRATEGY TO 2035. http://indiaeconomicstrategy.dfat.gov.au/. https://www.dfat.gov.au/publications/trade-and-investment/india-economic-strategy/ies/chapter-7.html

[29] Renewable energy present status and future potentials in India: An overview Subhashish Dey * , Anduri Sreenivasulu, G.T.N. Veerendra, K. Venkateswara Rao, P.S.S. Anjaneya Babu Civil Engineering Department, Gudlavalleru Engineering College, Andhra Pradesh, India

[30] Ibid.

As a part of its net-zero goals, India is aiming to meet 50 percent of its electricity needs from renewable sources by 2030. India stands as a significant hub for renewable energy resources, pioneering the establishment of the Department of Non-Conventional Energy Sources (DNES) under Ministry of Energy in **1982 —the first of its kind globally.**[31] **India's installed renewable energy capacity is expected to increase to about 170 GW by March 2025 from the level of 132 GW as of October 2023, according to research agency ICRA.**[32]

As a part of its net-zero goals, India is aiming to meet 50 percent of its electricity needs from renewable sources by 2030. This has the potential to transform how microenterprises access electricity supply. A significant aspect relates to Decentralised renewable energy (DRE) which stands for two related concepts: distributed generation of electricity and decentralised renewable energy.

Distributed generation is the term used when electricity is generated from sources, often renewable energy sources (such as solar, wind, biomass, or small hydro), near the point of use instead of centralized generation sources from power plants. These technologies aim to provide clean and sustainable energy solutions to communities, particularly in rural and peri-urban areas.

4.2 Foreign Policy and Initiatives

In the context of India's energy landscape, policies, strategies and initiatives should serve at least three purposes. First, they should help increase production and thereby reduce import dependence. Second is to ensure energy security in the face of import compulsion and geo-political instability. Finally, and perhaps more importantly, some policy shifts can move the needle towards achieving new goals.

4.2.1 Purchase of overseas assets

India aims to secure energy security through overseas acquisitions of oil, gas, and coal assets, echoing the rhetoric of the Minister of State for Petroleum and Natural Gas. However, conflicting policies hinder state-owned firms, financially strained by subsidies, from significant purchases. Unlike China, India's overseas energy assets are just a fraction, with a tenth of the holdings.

The Indian private sector, although making some acquisitions, lacks strategic impact, especially in oil and gas. The government contemplates leveraging foreign policy to address energy system distortions, exploring alternatives such as shifting from Japan Custom Cleared (JCC) to Henry Hub prices for natural gas imports.[33] Despite efforts, reshaping the global gas market faces challenges due to overt dependence on Qatar and domestic infrastructure limitations.[34]

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[31] In 1992, DNES was rechristened Ministry of Non-Conventional Energy Sources, and in October 2006 it was further rechristened as Ministry of New and Renewable Energy.

[32] Www.ETEnergyworld.com. (2023, December 7). India's renewable energy capacity to reach 170 GW by March 2025: ICRA. Economic Times. https://energy.economictimes.indiatimes.com/news/renewable/indias-renewable-energy-capacity-to-reach-170-gw-by-march-2025-icra/105807041

[33] Japan Custom Cleared (JCC) vs.Henry Hub index: The JCC is a natural gas pricing benchmark used in Japan, representing the average cost of liquefied natural gas (LNG) delivered to Japan. The Henry Hub index represents the average spot price of natural gas in the US, which is not an LNG exporter.

4.2.2 Equity Oil and Gas from Abroad

Source: Image

In a major shift in its stance on acquisition of foreign assets, India is gradually moving from pure dividend-based investment model to entitlement on equity oil model. This will help India secure crucial oil for its growing energy needs.

> To explain, India started investing in oil assets abroad in the 1990s. Some of these earn dividends, while other investments are for equity oil. The 'equity oil' issue got highlighted recently, after India faced the double whammy of spike in oil prices following the decision by OPEC nations to cut production and Russia's Rosneft stating it will give dividends, not equity oil, to India. For India, which imports 87 percent of its oil needs, equity oil is a key energy-security tool.
>
> Equity oil is the share of oil production that an investor is entitled to receive based on their ownership stake in an oil field. If a company owns a 20 percent stake in an oil field which produces 100,000 barrels of oil per day, the company is entitled to receive 20,000 barrels of oil per day as its share of production.[35]

Import dependence, instead of falling from 77 percent in 2015 to 67 percent by 2022 as Modi had wished, shot up to 87 percent in FY23. And, the import bill rose 30 percent to nearly $147 billion in FY23. No new oil blocks were awarded in most part of the last decade.

State-run ONGC, India's largest oil and gas producer, hasn't made any major recovery after the drying up of Bombay High as higher dividends constrain its cash reserves and capex. Therefore,[36] in this context, to ensure energy security, investing in equity oil is a viable strategy.

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[34] Fragmented and fitful: India's energy diplomacy. (2015, March 13). Rhodium Group. https://rhg.com/research/fragmented-and-fitful-indias-energy-diplomacy/

[35] See Manish Gupta, "India's interests in equity oil", *Financial Express*, April 27, 2023 https://www.financialexpress.com/market/commodities-indias-interests-in-equity-oil-3064506/

[36] Ibid

"[T]ill 1st April 2022, Indian PSUs have invested approximately US$ 37.94 billion in various E&S overseas assets. During FY 2021-22, the share of equity oil and gas for Indian PSUs from these assets was approx. 21.7 MMTOE, which works out to 34.1 percent of India's domestic production"[37]

4.2.3 Diversifying Sources of Imported Energy

In 2021, India experienced a notable 8 percent growth in its crude oil imports, reaching a daily average of 4.2 million barrels. Iraq emerged as the leading oil supplier, contributing 24 percent to India's total crude oil imports.

A significant share, approximately 61 percent, originated from the Middle East, with Saudi Arabia and Iraq being the primary sources (Figure 3).

India had augmented its crude oil imports, including condensates, from Iran in 2016 following the lifting of sanctions on Iran's oil exports by the United States and Europe.

Source: Image

However, with the re-imposition of sanctions on Iran's oil exports by the U.S. government in 2020 and 2021, India recorded zero imports from Iran.[38]

In diversifying its sources, India witnessed significant contributions from the Western Hemisphere (14 percent) and Africa (14 percent), predominantly from the United States and Nigeria. U.S. exports to India experienced an almost twofold increase from 2020 to 2021, comprising approximately 5 percent of India's total crude oil imports in 2020 and escalating to nearly 10 percent in 2021.[39]

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[37] Ministry of Petroleum and Natural Gas, *Annual Report 2022-23*

[38] India's Russian oil buy is now more than Saudi, UAE, Iraq and US combined. (2023, June 4). The Economic Times. https://economictimes.indiatimes.com/industry/energy/oil-gas/indias-import-of-russian-oil-scales-new-high-in-may/articleshow/100739640.cms?from=mdr

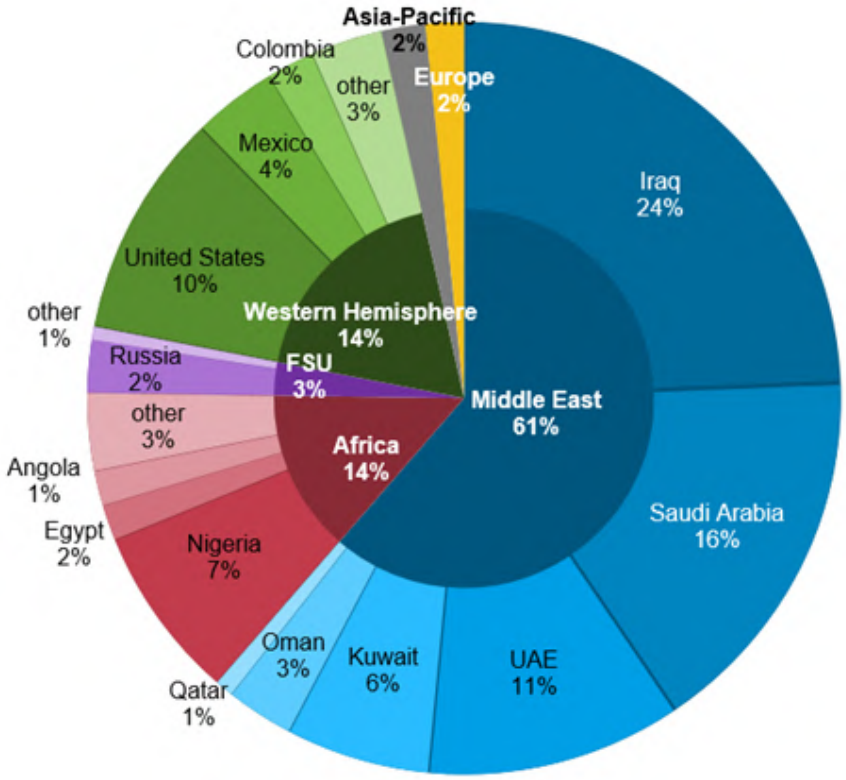
[39] Ibid.

According to Ministry of Petroleum and Natural Gas Annual Report 2022-23, during FY 2021-22, India imported 86 percent (220 MMT) of crude oil and 48 percent (23.4 MMT) of Natural Gas to meet the demand. The government recognises that over-reliance on a single geographical region has the potential to adversely affect India's energy security.

Considering that majority of India's hydrocarbon imports are sourced from the Middle East region, the Strait of Hormuz can be both a choke point as well as a geopolitical flashpoint. In the recent past, we have seen supply disruption and price volatility as a result of US sanctions on Iran and Venezuela and the Russia-Ukraine war.So, to insulate India from vulnerabilities in supply of crude oil and natural gas, and to reduce dependency on OPEC, the government of India emphasized diversification of supply sources of oil and gas.

The Annual Report cited above informs us that over the last few years, new suppliers of crude oil such as USA, Canada, Angola and Guyana have been added while crude oil imports from existing suppliers such as Russia have been increased. Similarly, LNG imports have been diversified from Qatar to new sources namely Australia, USA and Russia.

Figure 4 : India's crude oil imports by source, 2021



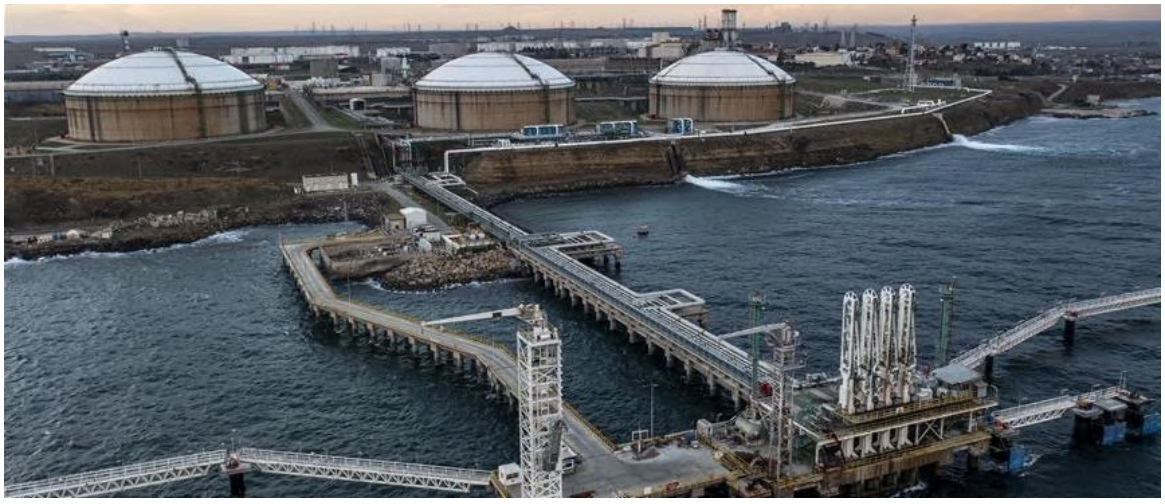
Source: Global trade tracker

Interestingly, of late, there have been some shifts in the import pattern. In 2023, imports from the Middle East declined by about 28 percent to 1.97 million barrels per day, dragging down the region's share in India's overall oil imports to 44 percent from 60 percent during the same year-ago period. However, the share of oil from the Commonwealth of Independent States (CIS), which includes Azerbaijan, Kazakhstan and Russia, nearly doubled to 43 percent mainly due to higher purchases from Russia. More on this below.

4.2.4 Using the Russia Factor

India's economic ties with Russia have shifted over time, becoming less significant than during the Cold War era. Russia's investment in India since 2000 has been minimal at $1.2 billion. In recent times, the primary focus of their economic relationship is on oil trade, especially crucial since the events in Ukraine.[40] India, ranking third globally in oil consumption, imports 83 percent of its oil, a figure expected to rise with economic growth.

So, when Russian oil was slapped with sanctions by G7 countries, including a $60 price cap, after the country invaded Ukraine, Russian oil was available for a discount. At one point, the discount on Russian oil was as high as $30 a barrel. Indian oil marketing companies (OMC) latched on to the opportunity. Russian crude oil which accounted for only 2 percent of our basket in FY22, jumped to 22 percent in FY23.[41]



Source: Image

India has emerged as the top buyer of the discounted Russian seaborne oil after Western nations stopped buying from Moscow following its invasion of Ukraine." A Reuters report[42] captioned *"Russia makes up 40 percent of Indian oil imports, dents OPEC's share"* has this to say: "The share of Russian oil in India's overall imports rose to about two-fifths in the first half of fiscal 2023/24, consolidating Moscow's position as the top supplier as refiners curbed purchase from the Middle East, industry data showed.

But international trade is in turbulent waters when nations are at war. It is difficult to predict when the dice will change. And change it did. By mid-March 2024, just months after reaping such windfall profits, Indian refiners, both state owned giants like Indian Oil, Bharat Petroleum, and Hindustan Petroleum, and private players are now shying away from Russian crude oil transported by OJSC Sovocomflot tankers. This move comes amid tightened US sanctions and growing scrutiny to avoid any violation.[43]

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[40] *India's geo-economic foreign policy*. (2023, March 27). The India Forum. https://www.theindiaforum.in/international-affairs/indias-geo-economic-foreign-policy

[41] "Has the rally of Oil Marketing Companies run out of Fuel?", *Finshots*, 23 March 2024, https://finshots.in/markets/omc-rally-run-out-of-fuel/

[42] https://www.reuters.com/world/india/russia-makes-up-40-indian-oil-imports-dents-opecs-share-2023-10-20/#:~:text=India percent20imported percent20on percent20average percent201.76,data percent20from percent20industry percent20sources percent20showed

So, while India emerged as a major buyer of discounted Russian oil since the Ukraine war began, US sanctions have complicated the trade landscape. The latest developments adds another layer of difficulty, potentially impacting the flow of Russian oil to India. It remains to be seen how India will navigate this situation and whether alternative arrangements for transporting Russian oil will be explored.

4.3 India opposed coal phase-out in COP26, Glasgow and COP 28, Dubai

Source: Image

Another arena where foreign policy and energy policy have interplay is the global negotiation forums for climate change, known as the Conference of Parties (COP). Taking account of India's dependency on coal as a major source of energy and the fact that it has ample reserves of thermal coal, India was concerned about pressure from developed countries which wanted a commitment from India and China on phasing out coal so as to reduce carbon dioxide emissions.

In COP26 at Glasgow, India and China negotiated hard to dilute the coal phase-out term to phase down. They argued in favour of CBDR (common but differentiated responsibilities) which means countries that have signed the UN climate deal have a common responsibility to fight climate change, but have different capacities to do so given that they are in different stages of economic development.

In COP28 at Dubai the draft text proposed eight steps to keep the global temperature rise within the ambit of 1.5 degrees Celsius:

1.) Tripling renewable energy capacity globally and doubling the global average annual rate of energy efficiency improvements by 2030;

2.) Rapidly phasing down unabated coal and limitations on permitting new and unabated coal power generation;

[43] "Indian Refiners Wary of US Sanctions, Reject Russian Oil on Sovcomflot Tankers", *Indian Defence Research Wing*, March 22, 2024 https://idrw.org/indian-refiners-wary-of-us-sanctions-reject-russian-oil-on-sovcomflot-tankers/

3.) Accelerating efforts globally towards net zero emissions energy systems, utilizing zero and low carbon fuels well before or by around mid-century;

4.) Accelerating zero and low emissions technologies, including, *inter alia*, renewables, nuclear, abatement and removal technologies, including such as carbon capture and utilization and storage, and low carbon hydrogen production, so as to enhance efforts towards substitution of unabated fossil fuels in energy systems.

5.) Reducing both consumption and production of fossil fuels, in a just, orderly and equitable manner so as to achieve net zero by, before, or around 2050 in keeping with the science;

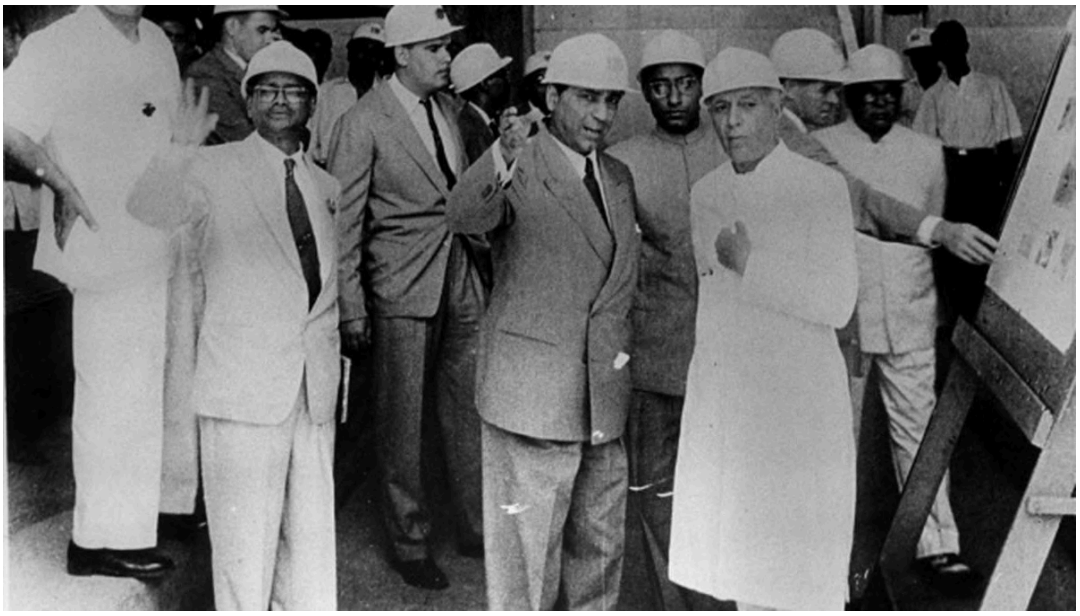
6.) Accelerating and substantially reducing non-CO2 emissions, including, in particular, methane emissions globally by 2030;

7.) Accelerating emissions reductions from road transport through a range of pathways, including development of infrastructure and rapid deployment of zero and low emission vehicles;

8.) Phasing out of inefficient fossil fuel subsidies that encourage wasteful consumption and do not address energy poverty or just transitions, as soon as possible.

For India, the second, third and eighth steps — covering rapid coal cuts, achieving net zero at mid-century and stopping fossil fuel subsidies — were problematic. India lodged a protest with the Conference of Parties (COP) Presidency on the Global Stocktake (GST) draft in COP 28 in Dubai. Indian opposed the phrase 'rapid' coal phasedown and fossil fuel cut.[44]

4.4 Indian efforts to achieve nuclear energy capability



Source: Image

[44] https://www.downtoearth.org.in/news/climate-change/india-opposed-rapid-coal-phaseout-part-in-gst-text-demanded-entire-operative-part-on-fossil-fuel-be-modified-93350

India began an atomic research program soon after independence under the leadership of Dr Homi Bhabha, with positive support from Prime Minister Nehru. It required a lot of adroit foreign policy work to keep India's nuclear program going over the decades.

While the first reactor was built with the support of Canada and was based on Uranium and Heavy Water, subsequently India tried building thorium based reactors as it had large reserves of Thorium.

In the 1950s, the US and Britain, too wanted to build thorium-based reactors. In 1951, when Nehru appealed to the US for food aid as India reeled under near-famine conditions, the US Congress made it conditional on India lifting its ban on exports of Kerala's thorium-rich monazite sands, and exporting them to US. Nehru refused to give in. That export ban stands even today. We need the thorium ourselves.

The foreign policy issues became extremely difficult when India conducted the first nuclear explosion test in 1974. Enriched uranium nuclear fuel supplies dried up and the country had to move to alternative technologies. India had to rely on the USSR for uranium supplies. It significantly increased its efforts on the fast breeder thorium reactor (FBTR) technology.

After the second nuclear explosion test in 1998, France, which was helping us design the experimental FBTR, backed off from cooperation and refused to sell the special mixed-oxide (MOX) fuel required, India's breeder reactor dreams seemed at an end. India was not in a position, at the time, to make the MOX fuel. C Ganguly, a young PhD who had researched on an alternative carbide fuel was able to offer a solution. In October 2004, PM Manmohan Singh laid the foundation stone for the PFBR in October 2004.

The US-India Civil Nuclear Cooperation Initiative of 2005 had three objectives : to remove core differences that impeded our strategic relationship for more than 30 years, to support India's economic growth and energy security in an environmentally sound way, and to strengthen the global non-proliferation regime. Under the parameters of this initiative, India committed all of its civilian nuclear facilities to IAEA safeguards.

On August 1, 2008 the IAEA Board of Governors approved India's safeguards agreement, paving the way for India's consideration at the Nuclear Suppliers Group to permit trade with India's expanding peaceful nuclear sector. The accompanying agreement for peaceful nuclear cooperation was to foster growth in India's civil nuclear sector, create a clean energy source and offer India greater energy security for its growing economy.[45]

In March 2024, leaders from 34 countries met in Brussels for the first Nuclear Energy Summit. The purpose of the summit was to provide participating governments the opportunity to share their vision and plans for using nuclear power to achieve net-zero emissions and promote sustainable development. Ajit Kumar Mohanty, the current Atomic Energy Commission (AEC) Chairman said that India aims to triple its nuclear power generation capacity in the next five years with the aim for nuclear energy to have a significant share in the electricity mix of India.

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[45] US-India: Civil Nuclear Cooperation https://2001-2009.state.gov/p/sca/c17361.htm#

4.5 The International Solar Alliance (ISA)

Source: Image

This was an important initiative taken by India, in the field of renewable (solar) energy, in which a lot of adroit foreign policy work had to be done, both for launching it and then for keeping it going.

"The International Solar Alliance (ISA) was conceived as a joint effort by India and France to mobilize efforts against climate change through deployment of solar energy solutions. It was conceptualized on the sidelines of the 21st Conference of Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in 2015... At present, 116 countries are signatories to the ISA Framework Agreement, of which 94 countries have submitted the necessary instruments of ratification to become full members of the ISA."

The ISA aims to mobilise USD 1,000 billion of investments in solar energy solutions by 2030, while delivering energy access to 1,000 million people using clean energy solutions and resulting in installation of 1,000 GW of solar energy capacity. This would help mitigate global solar emissions to the tune of 1,000 million tonnes of CO2 every year. For meeting these goals, the ISA has 9 comprehensive programmes, each focusing on a distinct application that could help scale deployment of solar energy solutions." [46]

The ISA has a permanent headquarter in India in NOIDA near Delhi. It is the first international organization headquartered in India. At the first assembly of the ISA in October 2018, PM Modi laid down the vision for "One Sun, One World, One Grid" (OSOWOG), which will be a transnational electricity grid supplying solar power across the globe (PIB, 2018).

As per a draft plan, OSOWOG will connect 140 countries in three phases: the first phase would connect the Indian grid with the Middle East, South Asia, and South-East Asia; the second phase would connect to Africa and the third phase globally.

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[46] https://isolaralliance.org/about/background

At the Glasgow COP 26 – UN Climate Conference, 2021, India, UK, and ISA announced the Green Grids Initiative to create a global grid for trading solar energy.[47] ISA has signed up over 20 partner organisations like the UNIDO, the European Investment Bank and the Latin American Energy Organisation.

India is using the ISA as an instrument for geopolitical influence. Whether the ISA can enhance India's geopolitical status depends on whether the ISA can offer joint gains to members. Before India took the ISA initiative, it had offered direct assistance of $33 million and $10–12 billion in solar export credits for Africa.

However, India's limited financial capacity and solar panels manufacturing capability tend to reduce India's leadership potential.[48] By partnering with France in setting up the ISA, since 2018 India raised over EUR 1 billion worth of financing commitments. It is to be noted that in the same period France has become one of the larger defence suppliers to India.

Source: Image

[47] UN Climate Change Conference. COP 26 (2021, November 2). Green grids initiative—One Sun One World One Grid: One sun declaration

[48] Sarang Shidore, Joshua W. Busby (2019). One more try: The International Solar Alliance and India's search for geopolitical influence, Energy Strategy Reviews, Volume 26, https://doi.org/10.1016/j.esr.2019.100385

5 Conclusion

This review article indicates that to tackle the issue of meeting the ever growing demand for energy in India, and given our high dependency on imports policy action is required on both the domestic as well the foreign policy fronts.

India imported 27.9 percent of its coal, 47.5 percent of its natural gas and 87.7 percent of its crude oil in FY 2020-21. The weighted average of imports was about 40 percent of total energy supply in 2021-22.

On the domestic front, policy correctives have been initiated, some over the previous decades and some in the last decade. In case of coal, domestic production has been enhanced through regulatory and operation improvements.

Though India has ample coal, it became a large importer and only recently has domestic production taken off to the point where coal imports will stop by 2026.

Diversification of sources of energy sources has been attempted – towards hydroelectric in the early years after independence, then nuclear energy since the 1970s and renewable sources of energy since the 1990s, with a major thrust towards solar since 2010.

For substituting petrol, ethanol production is being enhanced since the last decade. For moving away from the use of petrol for mobility, electric vehicles are being introduced. With all the efforts to diversify away from petroleum, India continues to need to import large quantities.

Given the criticality of imports to India's energy security, it requires adroit action on the foreign policy front as well. To begin with, the geo-political circumstances require India to diversify its sources of petroleum crude imports.

In the process, India has had to deal with the issue of importing petroleum crude from countries which are facing sanctions. In national interest India has insisted on importing from Iran and more recently Russia.

Another area where foreign policy plays a role is in ensuring uninterrupted supply of fuel for our nuclear reactors. India had become very dependent on China for import of photovoltaic panels for solar power generation, with 92 percent of the imports coming from China in FY 2022-23. This had to be cut down through domestic manufacturing as well as imports from other nations.[49]

Moving from defensive to pro-action India has tried to counter China's one-belt-one-road initiative at least in the field of solar energy by proposing a Green Grids Initiative for transmitting solar energy around the world, as part of its vision for the International Solar Alliance. It is to be seen how far this initiative will fructify.

[49] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1983772

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