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India



Last Updated: March 18, 2013 ([Notes](#))

[full report](#)

Overview

India is the fourth largest energy consumer in the world after the United States, China, and Russia.

In 2011, India was the fourth largest energy consumer in the world after the United States, [China](#), and [Russia](#). India's economy grew at an annual rate of approximately 7 percent since 2000 and proved relatively resilient to the 2008 global financial crisis. India was the 10th largest economy in the world in 2011, as measured by nominal gross domestic product (GDP). In the *International Energy Outlook 2011*, EIA projects India and China to account for the biggest share of Asian energy demand growth through 2035. Risks to economic growth in India include high debt levels, infrastructure deficiencies, and political polarization between the country's two largest political parties.

India's energy policy above all focuses on securing energy sources to meet the needs of its growing economy. Primary energy consumption has more than doubled between 1990 and 2011. At the same time, India's per capita energy consumption remains lower than that of developed countries, according to the International Energy Agency (IEA). Given that the service industry accounts for more than half of India's output, further economic growth could remain relatively non-energy intense.

The government may not be able to deliver secure supplies to meet demand because of fuel subsidies, increasing import dependency, and inconsistent energy sector reform. Some parts of the energy sector, such as coal production, remain relatively closed to private and foreign investment. Despite having large coal reserves and a healthy growth in natural gas production over the past two decades, India remains very dependent on imported crude oil. In early 2013, India's petroleum minister Veerappa Moily announced that the ministry would work on an action plan to make India energy independent by 2030 through increased hydrocarbon production, unconventional resources such as coalbed methane and shale, foreign acquisitions by domestic Indian companies, and reduced subsidies on motor fuels. These actions either increase India's energy supply or lower demand.

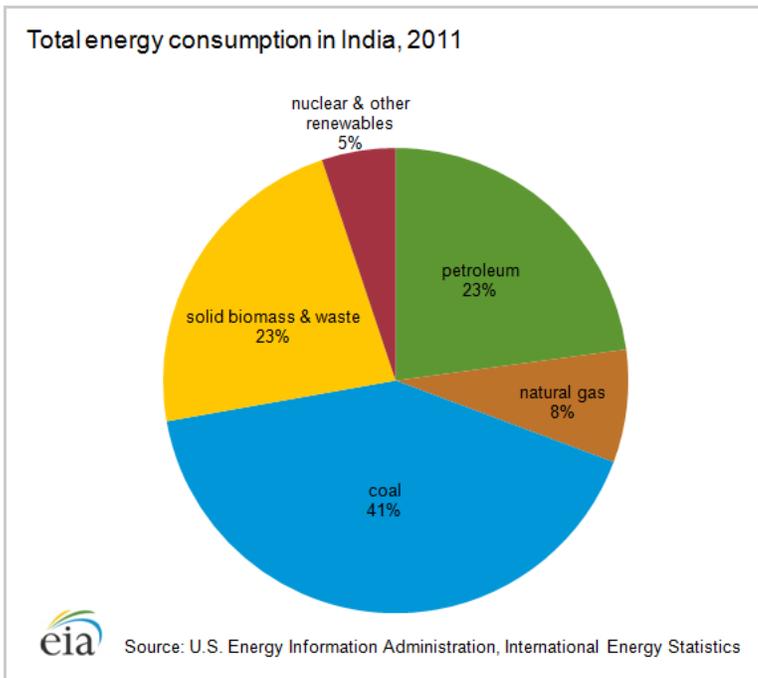
India's largest energy source is coal, followed by petroleum and traditional biomass (e.g., burning firewood and waste). Since the beginning of the New Economic Policy in 1991, India's population increasingly has moved to cities, and urban households have shifted away from traditional biomass to other energy sources. The industrial sector is the largest energy consumer, representing over 40 percent of India's total primary energy demand in 2009, and is mostly fueled by traditional biomass, according to the International Energy

Agency (IEA). The power sector is the fastest growing area of energy demand, increasing from 23 percent to 38 percent of total energy consumption between 1990 and 2009.

A 2012 report by the IEA estimated that nearly 25 percent of the population lacks basic access to electricity, while electrified areas suffer from rolling electricity blackouts. The government seeks to balance the need for electricity with environmental concerns from the use of coal and other energy sources used to produce that electricity.



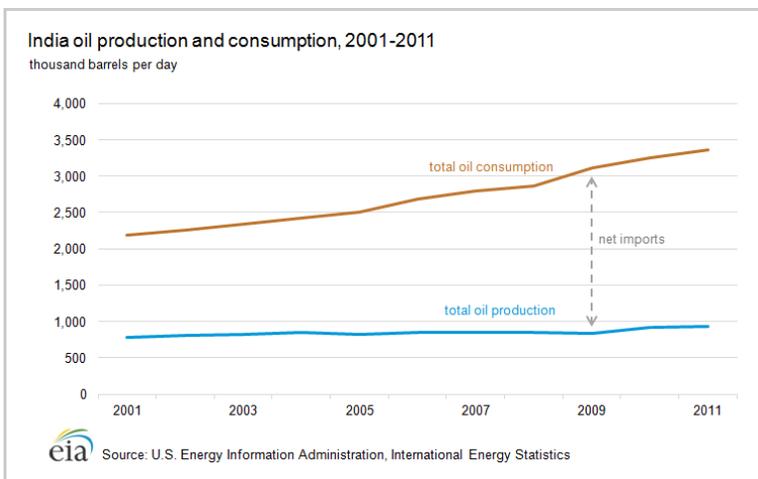
Source: U.S. Energy Information Administration
Representation of international boundaries and names is not necessarily authoritative.



Oil & other liquids

India was the fourth largest consumer of oil and petroleum products in the world in 2011, after the United States, China, and Japan. The country depends heavily on imported crude oil, mostly from the Middle East.

India was the fourth largest consumer of oil and petroleum products after the United States, China, and [Japan](#) in 2011. It was also the fourth largest importer of oil and petroleum products. The high degree of dependence on imported crude oil has led Indian energy companies to attempt to diversify their supply sources. To this end, Indian national oil companies (NOCs) have purchased equity stakes in overseas oil and gas fields in South America, Africa, and the Caspian Sea region to acquire reserves and production capability. However, the majority of imports continue to come from the Middle East, where Indian companies have little direct access to investment.



Sector organization

Almost two decades after nationalizing the country's hydrocarbon resources in the 1970s, the Indian government embarked on the New Economic Policy in 1991 that pushed for open market competition across a variety of energy sectors. The government introduced the New Exploration Licensing Policy (NELP) in 1999 that allowed investors to bid on development blocks with up to 100 percent foreign control. Currently, the NELP is in the 9th round of bidding. International investment is still relatively low, and most analysts agree that the NELP has had only limited success in reducing India's oil dependence. In 2011, several government agencies agreed to establish a sovereign wealth fund that could also aid in overseas energy acquisitions.

The Ministry of Petroleum and Natural Gas (MOPNG) regulates the entire value chain of the oil sector, including exploration and production (E&P), refining, supply, and marketing. The ministry releases five-year plans that serve as rough guidelines to the energy sector. Under the MOPNG, the Directorate General of Hydrocarbons regulates the upstream side of the oil sector, as well as coalbed methane (CBM) projects. Another sub-ministry, the Petroleum and Natural Gas Regulatory Board (PNGRB), acts as a downstream regulator, including petroleum product sales and distribution.

Until 2002, the government set the price of petroleum products through the Administered Pricing Mechanism (APM), which followed the principle of allowing a pre-determined return (rather than market-based prices) on investments in the oil sector. After 2002, only certain products (namely kerosene and liquefied petroleum gases, or LPG) remained regulated, while oil companies could set their own prices for other fuels. The government began domestic fuel price reform and officially deregulated gasoline prices in June 2010. However, many oil marketing companies still set retail prices at below-market levels so they can claim "under-recoveries" (the difference between a global market price and local price) from the Ministry of Finance for certain products at favorable rates.

Competition in the oil sector is now relatively open, particularly when it comes to the upstream market. On the one hand, two state-owned companies, the Oil and Natural Gas Corporation (ONGC) and Oil India Limited (OIL), control the majority of production and refining activity in India. On the other hand, the government has slowly reduced ownership in ONGC in an effort to raise revenue, and several private companies have emerged as important players in the last decade. Cairn India, a subsidiary of UK company Cairn Energy, controls 20 percent of India's crude oil reserves through major stakes in the Rajasthan region, and private companies like Reliance Industries (RIL) and Essar Oil have become major refiners. Other international oil companies have few stakes in the Indian oil market.

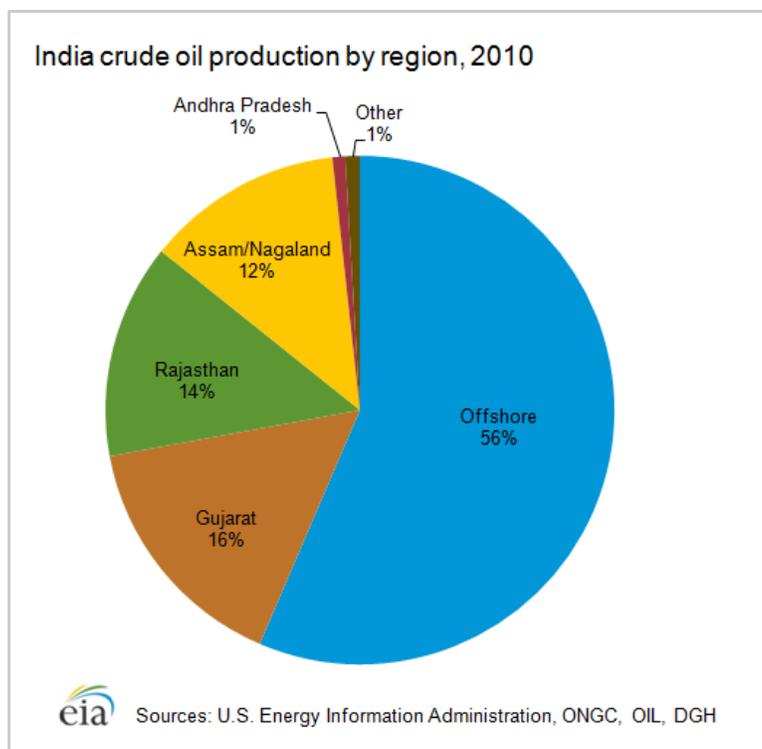
Exploration and production

India had 5.5 billion barrels of proved oil reserves at the end of 2012, mostly in the western part of the country. Domestic production has stagnated in recent years, and Indian national oil companies increasingly purchase equity stakes in overseas oil fields.

According to the *Oil & Gas Journal*, India had 5.5 billion barrels of proved oil reserves at the end of 2012. About 53 percent of reserves are from onshore resources, while 47 percent are offshore reserves. Most reserves are found in the western part of India, particularly western offshore, Gujarat, and Rajasthan. The Assam-Arakan basin in the northeast part of the country is also an important oil-producing region and contains more than 10 percent of the country's reserves.

Historically, ONGC dominated the upstream oil sector and relied on production from Mumbai High oilfield and its associated fields in western offshore. However, domestic crude production has stagnated and grown at an annual rate of one percent since 1990. In recent years, major discoveries in Barmer basin in Rajasthan and the offshore Krishna-Godavari basin by smaller companies such as Gujarat State Petroleum Corp and Andhra Pradesh Gas Infrastructure Corp. hold some potential to diversify the country's production.

India's relatively small land-based resource endowment means companies require more upstream technical expertise to tap into offshore reserves. Foreign companies historically took the lead in exploring new offshore opportunities. For example, Cairn India brought on line the largest field, Mangala, of the RJ-ON-90/1 block in Barmer basin in 2009, with a production capacity of 130,000 barrels per day (bbl/d). However, foreign investment in India has waned in recent years, both because of increased competition from domestic Indian companies and India's complex exploration and production laws. Cairn Energy has sought to sell off its stake in Mangala, and several major oil companies, including ExxonMobil, Chevron, and BP, did not participate in the most recent NELP auction.



Downstream and refining

India's government promotes the country's refining sector, and India became a net exporter of petroleum products in 2001. India has several world-class refineries in Jamnagar, and the refining industry is largely privately owned.

India's government encouraged energy companies to invest in refineries, and the investment helped the country become a net exporter of petroleum products beginning in 2001. In particular, the government eliminated customs duties on crude imports, lowering the cost of fuel supply for refiners. These reforms made domestic production of petroleum products more economic for Indian companies. In its 11th Five-Year Plan (2007-2012), India's Government set the goal of making India a global refined product exporting hub.

However, India still imports kerosene and liquefied petroleum gas (LPG) products for domestic use, and some export-oriented refineries began reorienting production for domestic use in 2009 to help ease demand shortages of motor gasoline, distillate fuel oil, kerosene, and LPG. These products make up over 60 percent of India's petroleum product consumption, according to the IEA. In particular, many rural areas of India use LPG and kerosene along with traditional biomass as cooking fuels (see [Biomass and Waste](#) below).

Today, the refining industry is an important part of India's economy and is largely privately owned. At the end of 2012, India had a refining capacity of 4.3 million bbl/d, according to the *Oil & Gas Journal*, making it the third largest refiner in Asia after China and Japan. The two largest refineries by crude capacity are world-class export facilities and are privately owned. They are located in Jamnagar and together account for 30 percent of India's total refining capacity. These refineries are close to crude producing regions in the Middle East, which allows them to take advantage of lower transportation costs.

India refining sector

Refinery location	Name of company	Crude refining capacity (1,000 barrels/day)
Public Sector		
Barauni, Bihar	Indian Oil Corp. Ltd.	130
Bongaigaon, Assam	Indian Oil Corp. Ltd.	51
Digboi, Assam	Indian Oil Corp. Ltd.	14
Guwahati, Assam	Indian Oil Corp. Ltd.	20
Haldia, West Bengal	Indian Oil Corp. Ltd.	162
Koyali, Gujarat	Indian Oil Corp. Ltd.	297
Mathura, Uttar Pradesh	Indian Oil Corp. Ltd.	173
Panipat	Indian Oil Corp. Ltd.	300
Mumbai	Hindustan Petroleum Corp. Ltd. (HPCL)	132
Visakhapatnam	Hindustan Petroleum Corp. Ltd. (HPCL)	166
Mahul, Mumbai	Bharat Petroleum Corp. Ltd.	260
Kochi	Bharat Petroleum Corp. Ltd.	206
Manali	Chennai Petroleum Corp. Ltd.	67
Nagapattinam	Chennai Petroleum Corp. Ltd.	22
Numaligarh, Assam	Numaligarh Refinery Ltd.	65
Mangalore	Mangalore Refinery & Petrochemicals Ltd.	194
Tatipaka, Andhra Pradesh	Oil & Natural Gas Corp. Ltd. (ONGC)	1
Joint-Venture		
Bina, Madhya Pradesh	Bharat-Oman Refinery Ltd.	120
Bathinda	HPCL-Mittal Energy Ltd.	180
Private Sector		
Jamnagar	Reliance Industries Ltd.	660
SEZ, Jamnagar	Reliance Industries Ltd.	580
Vadinar	Essar Oil Ltd.	405

Note: SEZ = Special Economic Zone

Sources: U.S. Energy Information Administration, India Ministry of Petroleum & Natural Gas, Oil & Gas Journal

Trade

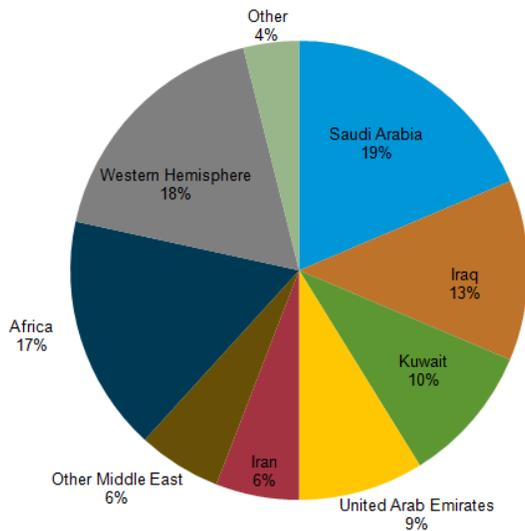
The Indian Ocean historically has been a major transit route, bringing crude oil from suppliers in the Persian Gulf and Africa to markets in Asia. Tanker sea lanes pass near Indian waters between major chokepoints such as the Strait of Malacca and the Strait of Hormuz (See the [World Oil Transit Chokepoints](#) report). The majority of Indian ports are located on the country's western side to receive shipments of crude oil from these routes.

India has increased its oil imports from about 40 percent of demand in 1990 to more than 70 percent of demand by 2011. Saudi Arabia is India's largest supplier, at about 19 percent of oil imports; in total, approximately 64 percent of India's imported oil came from Middle East countries in 2012. The second biggest source of imports is Africa (17 percent), with the majority of that oil coming from [Nigeria](#).

The government has encouraged companies to acquire overseas upstream assets as a way to shield the domestic energy sector from global price volatility. Indian companies hold large stakes in [Sudan's](#) GNOP block and Russia's Sakhalin-1 project. Recently, Indian firms have also explored assets in the Caspian Sea and Central Asia. For example, ConocoPhillips announced it was selling its stake in a north Caspian Sea production sharing agreement to ONGC in late 2012. Hess Corp. announced a similar deal with ONGC for oil fields in [Azerbaijan](#).

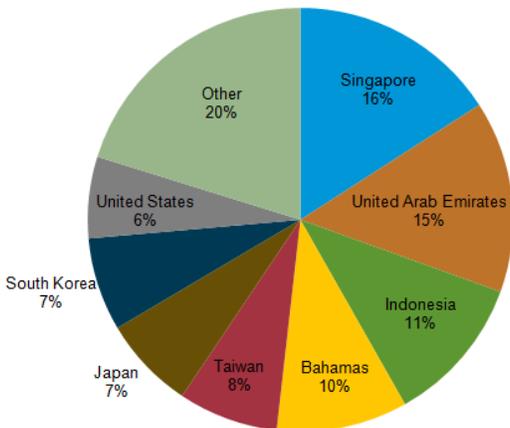
Despite being a net importer of crude oil, India has become a net exporter of petroleum products by investing in refineries designed for export, particularly in Gujarat. Essar Oil and RIL export naphtha, motor gasoline, and distillate fuel oil to the international market, particularly to [Singapore](#), the [United Arab Emirates](#), and [Indonesia](#). RIL has also targeted U.S. markets and leased storage space in New York harbor in 2008. However, the government encourages the companies to focus on supplying domestic markets before selling abroad.

India crude oil imports by source, 2012



Source: U.S. Energy Information Administration, International Energy Statistics, Lloyd's List Intelligence.

India motor fuel, kerosene jet fuel, and naphtha exports by destination, 2011



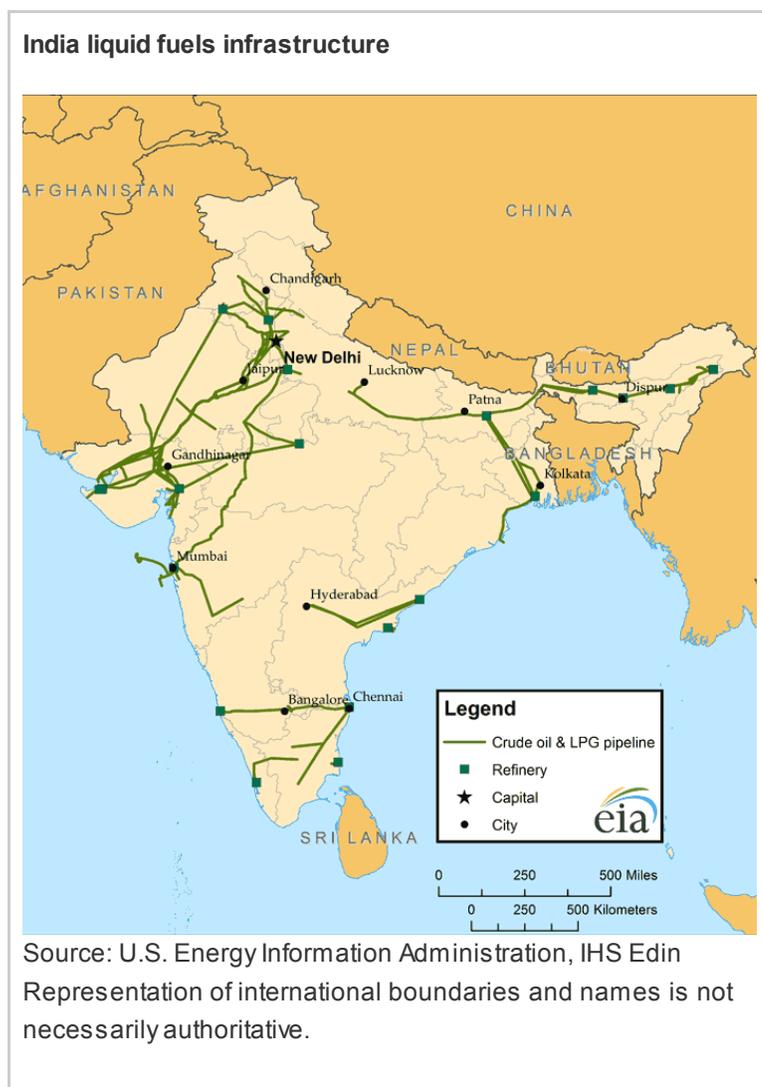
Source: U.S. Energy Information Administration, GTI Global Trade Atlas

Pipelines and infrastructure

According to IHS, India's crude oil pipeline network spans just under 4,000 miles and has a total capacity of 1.9 million bbl/d. Approximately 30 terminals, mostly on the northwest coast, take in crude oil imports. Pipelines run from these ports and producing areas (particularly from Gujarat) to major oil refineries in Gujarat, Mathura, Uttar Pradesh, and Haryana. On the eastern part of the country, pipelines run from West Bengal to the Paradip oil refinery. Refineries are generally located in coastal areas, because the majority of crude oil comes from tanker imports and offshore fields. Central and southern areas have few major pipelines, since the bulk of refining capacity is in the northwest and northeast.

The Indian Oil Corporation (IOC) controls and operates the oil product pipelines and supplies most of the oil products going to the domestic market. Product pipelines cluster in the north and northeast parts of India, while central and southern areas must rely on oil distributed through other means, such as cargo trucks. IOC plans to build additional product lines to move supplies from refineries to growing demand centers, such as

Jharkhand, Orissa, and Chhattisgarh.



Strategic petroleum reserve

In 2005, the Indian Government decided to set up strategic storage of 37 million barrels of crude oil at three locations (Visakhapatnam, Mangalore, and Padur). The Indian Strategic Petroleum Reserves Limited (ISPRL), a special purpose legal entity owned by the Oil Industry Development Board, would manage the proposed facilities, which have not yet been completed. In late 2011, the government unveiled plans to reach a crude reserve capacity of 132 million barrels by 2020.

Natural gas

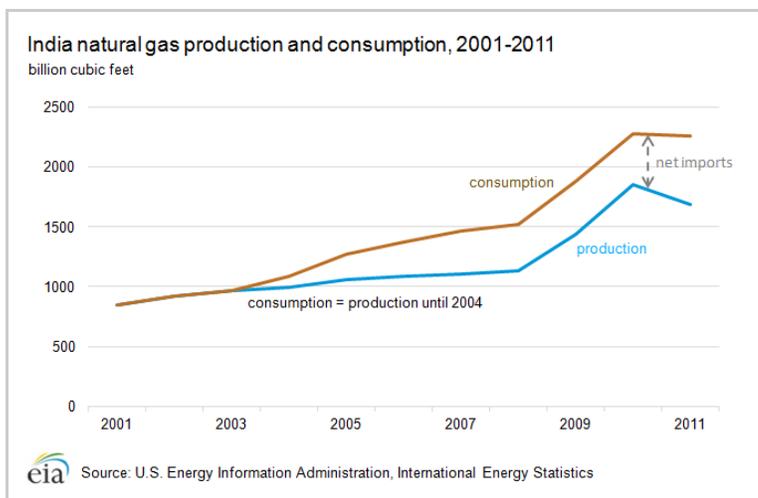
Natural gas serves as a substitute for coal for electricity generation in India. The country began importing liquefied natural gas from Qatar in 2004 and increasingly relies on imports to meet domestic natural gas needs.

Natural gas mainly serves as a substitute for coal for electricity generation in India. The country was self-sufficient in natural gas until 2004, when it began to import liquefied natural gas (LNG) from [Qatar](#). Because it has not been able to create sufficient natural gas

infrastructure on a national level to meet domestic demand, India increasingly relies on imported LNG. It was the sixth largest LNG importer in 2011 with over five percent of the global market, according to data from PFC Energy. Indian companies use both long-term supply contracts and more expensive spot LNG contracts. Indian companies have attempted to secure new longer-term deals with suppliers such as Russia's Gazprom.

Gas consumption has grown at an annual rate of 10 percent from 2001-2011, although supply disruptions in 2011 halted some consumption. In 2011, India consumed 2.3 trillion cubic feet (Tcf), and LNG imports accounted for about a quarter of total gas demand. The Indian Oil Ministry projects this trend to continue, with India's gas demand more than doubling in the next five years. LNG will account for an increasing portion of use.

The power sector and fertilizer sector made up the majority of natural gas demand in 2010 at 45 percent and 28 percent, respectively. The government labeled these as priority sectors for domestic programs, which ensures that they receive larger shares of any new gas supply before other consumers.



Sector organization

As with the oil sector, India's Ministry of Petroleum and Natural Gas oversees exploration and production activities. MOPNG's Directorate of Hydrocarbons functions as an upstream regulator and monitors coalbed methane projects. Until 2006, the Gas Authority of India Limited (GAIL) functioned as a near-monopoly on operating gas pipelines. However, the government has begun to reform gas pricing and created the Petroleum Natural Gas Regulatory Board to regulate downstream activities such as distribution and marketing.

Different producers of natural gas have different pricing schemes in India. The government directly sets prices for public sector companies through the Administrative Price Mechanism (APM), while joint-venture producers generally index their prices to international rates. LNG prices are completely market-driven.

New private companies such as Petronet LNG Limited have formed in recent years to benefit from growing LNG imports in India by building re-gasification plants. Privately-owned Reliance Industries (RIL) emerged as an important upstream player in the natural gas market after discovering significant reserves in the Krishna-Godavari basin in 2002. RIL also operates the important East-West gas pipeline from Andhra Pradesh to Gujarat.

International firms have some stake in the natural gas sector. BP owns part of the D6 field in the Krishna-Godavari basin, and Royal Dutch Shell has invested in potential future LNG facilities.

Exploration and production

India had 43.8 trillion cubic feet of natural gas reserves at the end of 2012, mostly located offshore. The two biggest state-owned oil companies, ONGC and Oil India, dominate the country's upstream gas sector.

According to the *Oil & Gas Journal*, India had 43.8 Tcf of proved natural gas reserves at the end of 2012. About 30 percent of these are onshore reserves, while 70 percent are offshore reserves. In 2002, energy companies made a number of large gas discoveries in the Krishna-Godavari (KG) basin off of India's eastern coast, pushing up both the reserve base and production. However, some of the more mature fields have declined in recent years, and RIL cut the reserves of the major D6 field in the KG basin from 10.3 Tcf estimated in December 2006 to 3.4 Tcf in 2012 because of unexpected declines.

The two biggest state-owned companies, ONGC and Oil India Ltd. (OIL), dominate India's upstream gas sector. ONGC operates the Mumbai High Field, which provides a large amount of India's natural gas supply. However, the government has encouraged private and foreign companies to enter the upstream sector in recent years. Reliance industries (RIL) is becoming a major upstream force because of natural gas discoveries in Krishna-Godavari basin. RIL has a strategic partnership with BP, which has a 30 percent stake in 21 of RIL's production-sharing contracts. Other major international oil companies are largely absent from India's upstream sector.

The D6 field came on line in early 2009, ramping up production from about 3 Bcf/d in March 2009 to almost 6 Bcf/d a year later. However, the field has experienced production shortfalls in recent years and output dropped to about 1 Bcf/d in mid-2012. RIL has considered shutting down the D6 fields because of the disappointing performance.

ONGC and Gujarat State Petroleum Corporation Limited (GSPCL) are also developing several offshore areas in Krishna-Godavari basin. Another promising producing area is the Cambay basin in western India, where independent company Oilex has done some preliminary work assessing the potential for "tight" natural gas.

Unconventional hydrocarbons

India began awarding coalbed methane (CBM) blocks for exploration in 2001, although it has taken more than a decade to begin producing at these fields. The Indian Ministry of Oil partnered with the U.S. Geological Survey (USGS) and ONGC to conduct a resource assessment and estimates anywhere between 9 and 92 Tcf of CBM resources both onshore and offshore India. Foreign companies have largely stayed out of CBM production, leaving domestic Indian companies struggling to attract enough expertise and technology to develop these resources. Great Eastern Energy Corporation (GEEC) has developed the Raniganj block in West Bengal, with an estimated 1 TCF of gas potential. Essar Oil and RIL have also been developing blocks in Bengal, although there has not been any significant commercial production.

Companies are interested in exploring the Cambay basin in Gujarat, the Assam-Arakan basin in northeast India, and the Gondwana basin in Central India for shale gas resources, although there has been no commercial production or publicly released reserve figures. Joshi Technologies made the first shale oil discovery in Cambay Basin in mid-2010. India's oil ministry announced that the government will unveil a shale gas and oil policy in the near future and begin to sell shale gas development blocks, although it has not made any awards to date.

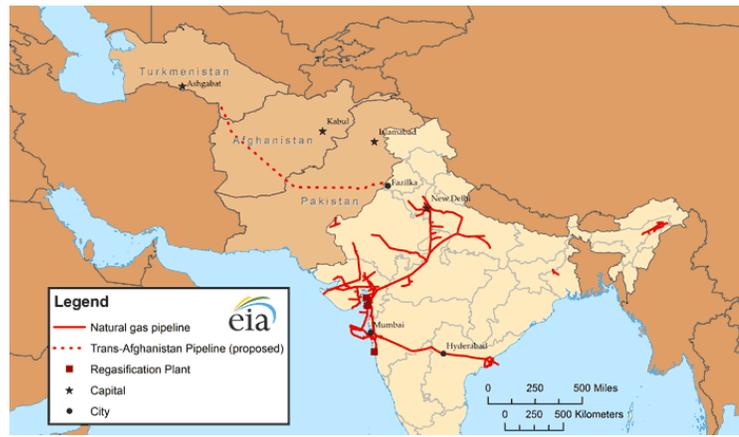
Pipelines and infrastructure

The two most important companies operating India's large gas pipeline system are GAIL and RGTIL. GAIL, the state-owned gas transmission and marketing company, operates the major gas pipelines in India: the 1,740-mile Hazira-Vijaipur-Jagadishpur (HVJ) line running from Gujarat to Delhi, and the 480-mile Dahej-Vijaipur (DVPL) line. Reliance Gas Transportation Infrastructure (RGTIL) is the biggest private investor in the gas transmission structure. RGTIL's East-West Gas Pipeline takes gas from RIL's Krishna-Godavari basin fields and pumps it to north and western Indian markets. Other players like Petronet and Assam Gas Company have significant pipeline investments servicing demand centers in northeast India.

Insufficient pipeline infrastructure constrains natural gas demand in India. The country's own pipeline network primarily services the northwest region. Reliance Gas Transport Infrastructure (owned by RIL) brought the East-West pipeline online in 2009 to link the promising D6 gas field to industrial centers in the north and west regions of the country. Smaller companies such as Petronet LNG and GSPC have considered building their own pipelines to link production areas to the network. GAIL announced plans to extend the network with the Hazira-Bijapur-Jagdishpur (HBJ) pipeline and a line from the D6 field to southern parts of India.

The Indian government has considered importing natural gas via pipeline through several international projects, although many of these have proved unfeasible. In 2005, negotiations between the Indian and Bangladesh governments fell through over a transnational pipeline. In 2006, India left the Iran-Pakistan-India (IPI) pipeline project. However, the government still participates in a plan to import natural gas from [Turkmenistan](#) to India. The Turkmenistan-Afghanistan-Pakistan-India (TAPI) project, also known as the Trans-Afghanistan Pipeline, has seen a decade of discussion, although major geopolitical risks and technical challenges have prevented the project from starting in earnest. The Asian Development Bank estimates the cost of the pipeline at about \$10-12 billion. However, the countries have made some progress in moving TAPI forward. The partners signed a framework agreement in 2010 and agreed on unified transit tariffs for the route in early 2012. In May 2012, India signed gas supply and purchase agreements with Turkmenistan. In early February 2013, India's government approved a special purpose legal entity to which participating members of the pipeline would contribute investment funds.

India natural gas infrastructure



Source: U.S. Energy Information Administration, IHS Edin

Representation of international boundaries and names is not necessarily authoritative.

Liquefied natural gas

India became the world's sixth largest liquefied natural gas importer in 2011. Indian companies have begun investing in new regasification facilities to meet rising demand.

Liquefied natural gas (LNG) has become an important part of India's energy mix since the country began importing it from Qatar in 2004. In 2011, India became the world's sixth largest LNG importer, with 5.3 percent of global imports, according to data from PFC energy. Petronet, a joint venture between GAIL, ONGC, and several foreign firms, is the major importer of LNG supplies to India. Petronet owns the country's two currently operational LNG terminals, Dahej and Hazira, and plans to increase capacity at both plants.

Unexpected production declines in India's D6 gas field mean the country must rely on higher LNG imports. Imported LNG is typically more than twice as expensive as domestically produced natural gas, because it is not subject to the government setting prices through the Administered Price Mechanism (see [Sector Organization](#)). Indian producers such as RIL have asked the government to raise the wellhead price for gas (the wholesale price at the point of production) as a way of justifying investment into deepwater projects.

Indian companies have invested in increasing the country's LNG regasification capacity in recent years to meet rising demand. Petronet's LNG terminal at Kochi should be operational in 2013, according to India's Oil and Gas Ministry. GAIL, NTPC, and several other smaller players have restarted the Dabhol project, originally proposed by now-defunct Enron. On India's east coast, IOC proposed a project in Tamil Nadu. Other possible projects include a floating terminal in Kakinada as a substitute for declining gas production in the Krishna-Godavari basin.

Qatar's RasGas is India's sole long-term supplier of natural gas, with two contracts for a total of 360 billion cubic feet (Bcf). India has been an active spot importer and received LNG cargoes from a variety of exporting countries. With the decline of the D6 field, Nigeria and [Egypt](#) have risen in prominence as India's short-term suppliers.

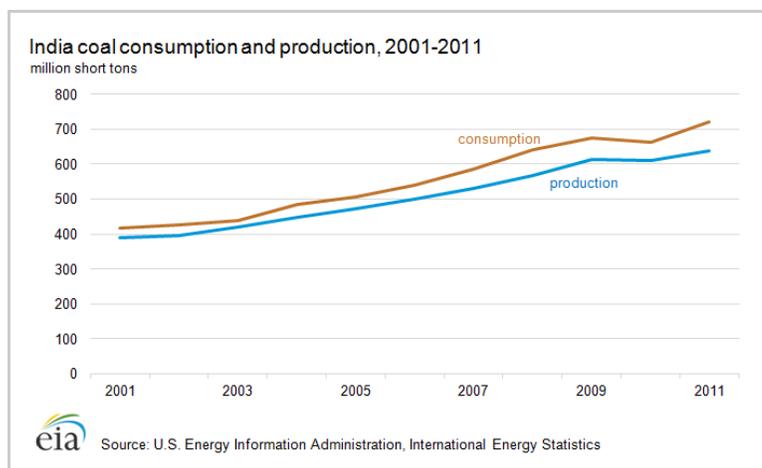
Coal

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Coal is India's primary source of energy. The country has the fifth largest coal reserves in the world. At the same time, the coal sector is one of the most centralized and inefficient sectors in India. Two state-owned companies have a near-monopoly on production and distribution. The country also faces a growing gap between demand and supply. Producers failed to reach the government's latest production target in 2012, while demand has grown by more than 7 percent per year over the last decade. Because of this gap, India's coal imports have grown by more than 13 percent per year since 2001.

The power sector is the largest consumer of coal, accounting for 73 percent of coal consumption in 2009, according to IEA. Because power plants rely so heavily on coal, coal shortages are a major contributor to shortfalls in electricity generation and consequent blackouts throughout the country.

Steel and cement industries are also significant coal consumers. India has limited reserves of coking coal, which is an important raw material for steel production. The state of Jharkhand holds most of India's coking coal reserves, but it does not supply enough to meet the industry's needs. Because of this shortage, India imports large quantities of coking coal from abroad.



Sector organization

India's government took control of the country's coal reserves with the 1973 Coal Mines Nationalization Act, establishing Coal India Limited (CIL) in 1975 as the state-owned sole producer. After 1993 it tried to encourage foreign and private investment into the coal sector through the National Mineral Policy. By 2000, the government deregulated coal prices, allowing coal companies to increase prices when there is a rise in the cost of production. However, the Ministry of Coal and Mines continues to control the distribution of coal and subsidies to various companies. In 2007, the government passed the New Coal Distribution Policy that attempted to allocate limited coal supplies to priority sectors, particularly power and fertilizer.

CIL remains the country's largest coal producer, according to the IEA, and produces about 80 percent of the country's coal. CIL underwent an initial public offering in 2010 and divested 10 percent of its government share, India's largest IPO to date. Some smaller companies also operate throughout the country. Singareni Collieries Company (SCCL) was responsible for 8 percent of the country's coal production in 2011.

Railcars transport the majority of Indian coal, according to CIL. Limited railway capacity and other project delays may be a factor in insufficient coal deliveries to users, although the Railway Ministry stated that low coal production is the biggest reason for generation shortages.

Exploration and production

India had 66.8 billion short tons of coal reserves in 2010, the fifth largest in the world (third largest in anthracite and bituminous after the United States and China). Indian coal typically has high ash and low sulfur content.

Most coal reserves are located in the eastern parts of the country. Jharkhand, Chhattisgarh, and Orissa account for approximately 70 percent of the country's coal reserves, according to the IEA. Other significant coal producing states include West Bengal, Andhra Pradesh, Madhya Pradesh, and Maharashtra.

India was the third largest producer of coal in 2011. Coal production has more than doubled between 1990 and 2011. According to the Ministry of Coal, almost all of the country's coal mines are opencast (less than 1,000 feet deep), which is cheaper and less dangerous for workers but causes more environmental impact. India lacks sufficient technology to engage in underground mining. India's coal mines are also located far away from the highest demand markets in southern and western India, posing a significant logistical challenge to coal producers and distributors.

Trade

Although traditionally not a major importer of coal, India began to import small volumes of coking coal to meet high demand in the steel and iron industry. With a widening gap between supply and demand, India has increased coal imports over recent years from several key countries. India imports thermal coal (for power plants) mainly from Indonesia and [South Africa](#) and imports coking coal (for steel production) from [Australia](#). Imports reached about 11 percent of total coal demand in 2011.

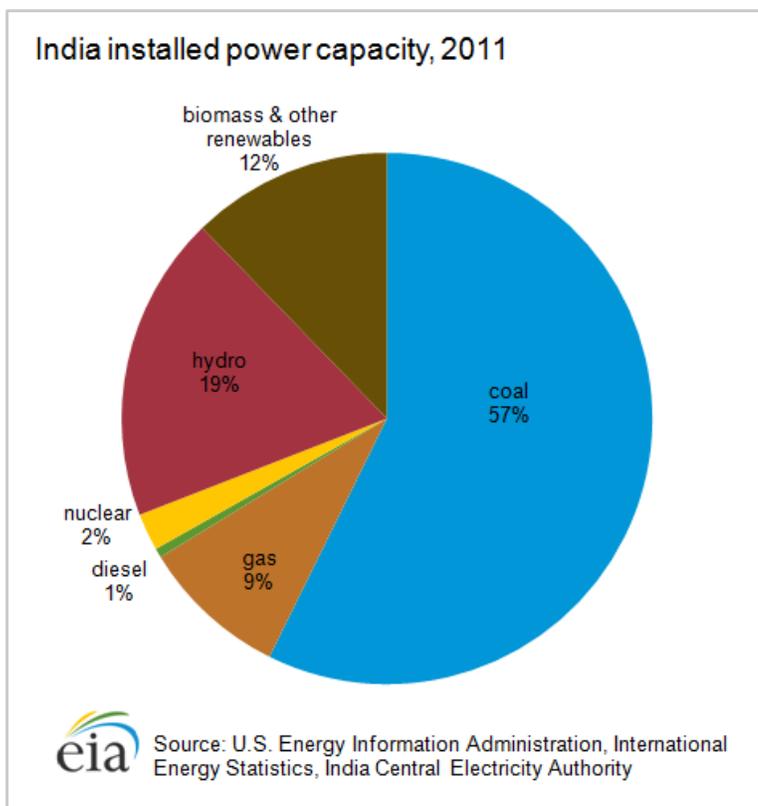
Electricity

India has 211 gigawatts of installed electricity capacity, mostly in coal-powered plants. Because of insufficient fuel supply, the country suffers from a severe shortage of electricity generation, leading to rolling blackouts.

As of September 2012, India had 211 gigawatts (GW) of installed electricity generating capacity, mostly in coal-fired power plants, according to India's Central Electricity Authority. According to the IEA, installed capacity from coal and natural gas power plants is heavily clustered in the more populated western region of the country, particularly in Maharashtra

and Gujarat. For example, Maharashtra, the largest Indian state by GDP (its capital is Mumbai, the country's largest city), contains 13 percent of the nation's generating capacity. Hydropower is the second largest source of electricity, accounting for nearly 20 percent of installed capacity and generating about 15 percent of electricity in 2011.

India suffers from severe shortages of electricity. Utilization rates in Indian power plants have fallen steadily since 2004 because of insufficient fuel supplies, according to IHS Global Insight. In addition, significant parts of the country do not have access to electricity. The 2005 India Human Development Survey reported overall household electrification in India to be 70 percent. While 94 percent of urban households had electricity, only 60 percent of rural households had access. The government began a program in 2005 called Rajiv Gandhi Grameen Vidyutikaran Yojana to provide villages electricity within 5 years through significant investments in rural electrification. While the program has succeeded in electrifying many rural areas, power supply is unreliable and frequent blackouts persist.



Sector organization

The Ministry of Power is responsible for planning and implementing India's power sector policy, with various subunits handling different parts of the sector, including thermal, hydropower, and distribution. The Central Electricity Authority (CEA) advises the central government on long- and short-term policy planning. The Central Electricity Regulatory Commission and State Electricity Regulatory Commissions set generation and transmission policies.

The source of India's current electricity regulatory framework is the 2003 Electricity Act, which attempted to reform the state electricity boards, open access to transmission and distribution networks, and create state electricity regulatory commissions (SERCs) to manage electricity on a regional basis. The government has not fully implemented many parts of the Act, and India's electricity sector continues to face challenges in distribution and

getting sufficient fuels for generation. In order to reduce supply risk from energy sources with high price volatility, such as oil, the government has encouraged more generation from renewable energy sources, such as hydropower and solar.

The government established the Power Grid Corporation of India (POWERGRID) to operate five regional electricity grids, while state transmission utilities (with some private sector participation) run most transmission and distribution segments. Although the central government finances electricity development projects, delivering electricity to customers falls on state governments. Therefore, more efficient states such as Maharashtra tend to have better electricity availability.

Different states also have varying energy mixes. For example, Gujarat is close to major gas fields and LNG terminals, allowing regional power plants to use a larger share of natural gas.

Conventional thermal

Thermal generation, mostly from coal, accounted for more than 80 percent of total electricity generation in the country, according to India's Central Electricity Authority (CEA). Coal-fired power plants dominate India's electricity generation sector and account for more than 50 percent of installed capacity.

Disruptions to a steady supply of fossil fuels to power plants are the main reason for power outages in India. According to CEA, the loss of generation from forced outages during 2011 decreased the country's actual generating capacity by over 11 percent, because of coal supply shortages and situations when plants could not transmit power to demand centers (e.g., equipment failure). About 60 percent of total forced shut downs were under 24 hours long, although some have lasted for 25 days or more.

Hydroelectric

India was the world's 7th largest producer of hydroelectric power in 2010 with 113 billion kilowatthours generated, which is about 3 percent of the world's total. Total installed capacity of hydropower in 2012 was 39,300 megawatts (MW), according to the Indian Ministry of Power.

India benefits from a tropical climate, which gives the country increased hydropower potential. In particular, states with significant river systems such as Himachal Pradesh, Jammu, Kashmir, and Uttarakhand benefit from energy surpluses in the monsoon period. However, coal and gas generation is related inversely to hydropower capacity; when hydropower utilization falls, for example with a weak monsoon season, coal-fired power plants will generate more electricity to compensate for the shortfall.

Nuclear

India has 20 operational nuclear reactors in six nuclear power plants with a capacity of 4.4 gigawatts (electric). As of September 2012, seven reactors totaling 5.3 gigawatts (electric) are under construction and expected to come online by 2016. As electricity demand in India continues to grow, the government has indicated that it plans to increase the nuclear share of total generation to 25 percent in the long term from about 4 percent in 2011.

In September 2008, India became a party to the Nuclear Suppliers' Group agreement, which opened access to nuclear technology and expertise through several cooperative agreements. The government has signed several such agreements with countries including the United States, Russia, France, and the United Kingdom. In addition, via these agreements, India gained access to reactor parts and fuel from other countries.

Indians protested nuclear power after the Fukushima disaster in Japan, and the government responded by organizing safety audits for existing reactors. The Atomic Energy Regulatory Board (AERB) conducted stress tests of all nuclear power plants. The Indian government has announced a 'three-stage nuclear development plan' to gradually shift from powering reactors with natural uranium to accumulating reserves of other fissile materials such as thorium. While the Indian nuclear sector historically has had limited access to uranium, it has abundant thorium reserves that can power more sophisticated reactors. India's commitment to the thorium fuel cycle sets it apart from most nations with nuclear power programs.

Biomass and waste

Rural areas of India tend to rely on traditional biomass (including firewood, animal dung, and agricultural residue) for cooking, heating, and lighting because they lack access to other energy supplies. These sources can be burned directly to produce heat and electricity.

Large parts of India rely on biomass as the primary fuel for cooking. According to the 2011 India census, 62.5 percent of rural households use firewood as the primary fuel for cooking, 12.3 percent use crop residue as the primary cooking fuel, and 10.9 percent use dung. By contrast, less than 2 percent of urban households use crop residue or dung, and only 20 percent use firewood as the primary fuel source in cooking. These uses can cause health problems from exposure to waste products and pollution or environmental problems when harvested unsustainably.

India also uses biomass in the power sector. According to the Ministry of New and Renewable Energy, India has 288 biomass power and cogeneration plants with 2.7 GW of installed capacity and has potential biomass electricity generation capacity of 18 GW. A large amount of biomass used for electricity generation comes from bagasse (crushed sugarcane or sorghum stalks), which can be used in combustion-powered generators. Biodiesel and other liquid biofuels consumption in India is fairly low and mostly comes from several states that mandate five-percent blending of ethanol in gasoline.

Households by primary

fuel used for cooking

Percentage

Fuel Type	Total	Rural	Urban
Firewood	49.0	62.5	20.1
Crop residue	8.9	12.3	1.4
Cowdung cake	7.9	10.9	1.7
Coal, Lignite, Charcoal	1.4	0.8	2.9
Kerosene	2.9	0.7	7.5
LPG/PNG	28.5	11.4	65.0
Electricity	0.1	0.1	0.1
Bio-gas	0.4	0.4	0.4
Any other	0.5	0.6	0.2

No cooking 0.3 0.2 0.5

*Note: LPG = Liquefied Petroleum Gases; PNG = Piped
Natural Gas*

Source: India Census 2011

Notes

- Data presented in the text are the most recent available as of March 18, 2013.
 - Data are EIA estimates unless otherwise noted.
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