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Department of Industry,
Innovation and Science

Office of the
Chief Economist

COAL IN INDIA

2019

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An aerial photograph of a densely packed urban area, likely a city in India, with a blue overlay. A diagonal road or path cuts through the center of the image. The text "2019" and "COAL IN INDIA" is overlaid in white.

2019 COAL IN INDIA

Further information

For more information or to comment on this publication, please email: chiefeconomist@industry.gov.au

Project team

Monica Philalay, Nikolai Drahos and David Thurtell

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Foreword



This report provides an update to the *Coal in India*¹ report that we released in 2015.

Since the 2015 report, India has emerged as the world's second largest producer and consumer of thermal coal, and coal continues to play a key role in India's economic growth and development. The 2015 report provides a source of reference material for coal fundamentals and the baseline for this report, which includes an update on the latest statistics and developments underpinning the outlook for Indian thermal coal consumption, production and imports.

We examine the latest developments in India's energy, electricity and mining policies and regulatory settings, and how these could impact on the future of thermal coal in India. In doing so, we discuss the opportunities for Australian producers and mining equipment and technology services companies in meeting India's growing demand for coal.

The role of coal in future energy systems will be determined by the balancing of the priorities of energy security, energy equity, and environmental sustainability. Nowhere do these issues come more to the forefront than in India. India is experiencing rapid economic and population growth, and consequently rising demand for energy. Emissions are growing at a faster rate than any other major nation, but per capita emissions remain low, and access to reliable energy remains a key challenge.

As always, anticipating the future is underpinned by considerable uncertainties and risks. Consistent with the 2015 report, there remain several factors that will influence the outlook for coal in India over the longer term. This report contributes to the debate by examining the key drivers, current trajectory and main uncertainties that could impact on future developments.

A stylized, handwritten signature in white ink, consisting of a series of loops and flourishes, representing the name David Turvey.

David Turvey

Acting Division Head

Analysis and Insights Division
Department of Industry, Innovation
and Science

Executive Summary

India's energy future will help shape seaborne thermal coal markets for decades to come.

India is the world's second largest importer of thermal coal, and has the potential to be an ongoing source of demand growth — a bright light for thermal coal exporters confronted with falling demand in Europe, North America and North East Asia. But while India is one of the great hopes for thermal coal exporters (alongside Southeast Asia), it also presents significant risk. If India's thermal coal imports decline, there could be substantial implications for seaborne markets. As Australia already exports large volumes of metallurgical coal to India, this report primarily focuses on the more uncertain, but much larger, thermal coal market.

India's future energy needs are difficult to understate. India is the world's third largest energy consumer. It has the world's second largest population and is one of world's fastest growing economies. The twin pressures of economic and population growth are expected to propel future energy demand in India. The nation has made significant progress in reducing energy poverty, but there were still 168 million people without access to electricity in 2017, and reliability is an ongoing issue. India also faces a range of other challenges in its electricity market, which have flow-on effects to the coal sector. These include inefficient state-owned generators, overcapacity in power generation, bottlenecks in transmission, distortionary subsidies, and financial pressure on distribution companies, due to losses and the underpricing of electricity.

India's thermal coal consumption is likely to continue to increase next decade, and possibly beyond, in order to meet India's increasing energy requirements. Since we released the first *Coal in India* report in 2015, India has become the world's second largest coal consumer. Further growth in thermal coal consumption is likely, despite India's authorities indicating that no new coal-fired power stations — beyond the ones already under construction

— are needed over the next five years. Given India has overbuilt its coal-fired power capacity for current levels of electricity demand, and coal-fired power generators are running well below capacity, India already has sufficient coal-fired power capacity for coal consumption to lift during the 2020s. A reversal of this trend would require India to prematurely close coal power stations before the end of their planned lives, and to rapidly address the huge challenges — regarding grid stability — that these closures would bring. Thermal coal is expected to remain a major part of India's energy mix for decades.

In the long term, the outlook for thermal coal usage in India depends heavily on the prospects for other energy sources, particularly the pace of expansion in renewable generation in India. India has set itself ambitious renewable energy targets, and recently signalled a potential target of 500 GW of installed renewable capacity (excluding large-scale hydro) in 2028, up from 79 GW in mid-2019. To achieve its renewable generation target, India would need to overcome major technical, political and economic challenges.

The pace of India's coal production growth will be the key driver of its future thermal coal import needs. India is the world's second largest producer of thermal coal, and production is dominated by the state-owned company Coal India Limited, the world's largest coal producer. Coal India has ambitions to raise domestic coal production to 1 billion tonnes by 2025–26. While India has lifted growth in thermal coal production over the last few years, it is still tracking well short of the production levels required to meet this target. India's coal output is expected to grow, but at a slower pace than government targets.

India's coal sector continues to face substantial challenges, and although reforms have moved in a positive direction, the pace of change remains slow. India's complex bureaucracy, socioeconomic issues, and financially-strained power sector are all impacting negatively on output. Approvals and land acquisition remain the primary factors

weighing on production growth, with other issues — productivity, competition, investment, transport and domestic pricing schemes — further compounding the challenges. The Indian government will need to continue to pursue reforms and policy changes to address remaining barriers to production growth.

The outlook for India's thermal coal imports is finely balanced. With around 80 per cent of India's thermal coal requirements satisfied domestically, the future for India's thermal coal imports depends on small movements in the balance of India's future coal production and consumption. In the short-term, imports are likely to remain high, as domestic output falls short of usage. In the longer term, there are more uncertainties. It is possible to imagine a scenario where India's imports lift rapidly on the back of strong growth in energy demand, challenges integrating renewable generation into the electricity grid, and barriers to increasing domestic coal production. But it is also possible to see a scenario where imports fall, due to lower than expected energy demand, the rapid reduction of barriers to higher domestic coal output, and a faster than expected uptake of renewables. We reach no firm conclusions in this report. Rather, we highlight the key drivers, current trajectory and main uncertainties likely to influence future developments.

The Indian government is aiming for self-sufficiency in thermal coal, but faces considerable barriers to achieving this goal. Illustrative of these challenges are statements in November 2014 by the Indian energy minister that India would stop importing thermal coal within two or three years. While India's thermal coal imports did fall back after peaking in 2014, they recovered to near their previous levels in 2018.

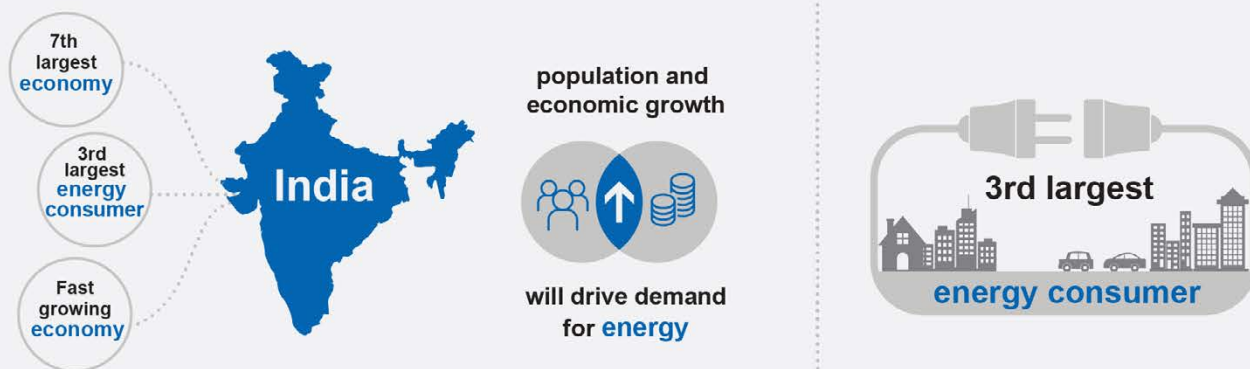
Australia is currently not a significant supplier of thermal coal to India. In 2018, Australia exported just 5 million tonnes of thermal coal to India — 2.3 per cent of Australia's thermal coal exports, and just 4.5 per cent of India's thermal coal imports. There are a number of reasons for limited Australian thermal coal exports to India. These include regulated electricity prices in India (which make it difficult for utilities to pay price premiums for higher

quality Australian coal), compatibility issues between Australian coal and India's largely sub-critical coal-fired power generation fleet, and limited Indian investment in Australian thermal coal mines (with the notable exception of Adani's Carmichael coal mine in the Galilee Basin in Queensland). Indian investment has the potential to lift thermal coal exports by vertically integrating coal mines overseas with power plants in India, thereby reducing market risks.

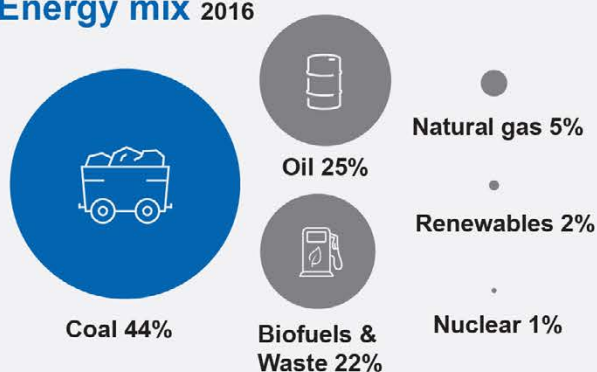
There are opportunities for Australia to lift thermal coal exports to India, although barriers will remain. The commencement of Adani's 10 million tonne Carmichael mine could triple Australia's thermal coal exports to India — although from a low base. The development of other Indian-owned mines in Australia, and the prospect that Indonesia and South Africa may not meet all of India's thermal coal import needs, could further boost Australian thermal coal exports to India. India has also made changes to plant efficiency and coal quality standards, which should be more favourable for Australian suppliers of high-energy, low-ash coal. There are also other opportunities for Australia in India, particularly in the mining equipment, technology and services (METS) sector. Australian METS companies are well placed to assist with India's desire to improve the productivity of domestic coal mines through advanced technology.

India's metallurgical coal demand and imports are expected to grow, and the outlook is characterised by fewer uncertainties. While our analysis is focused on thermal coal, we also consider metallurgical coal at various points in this report. The outlook for metallurgical coal in India is less uncertain than for thermal coal. India has ambitious targets to increase its steel production, and little in the way of domestic metallurgical coal resources. As such, India will likely need to import more metallurgical coal over the next few decades. For Australia — the world's largest metallurgical coal producer and the supplier of over 70 per cent of India's metallurgical coal imports — growing Indian demand will continue to represent a major opportunity.

India has large and rapidly growing energy needs



Energy mix 2016

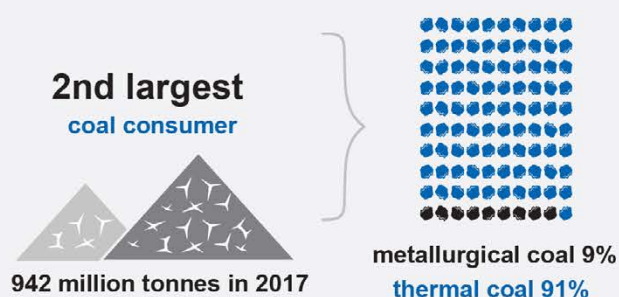


Around 1/2 billion people have **gained access** since 2000

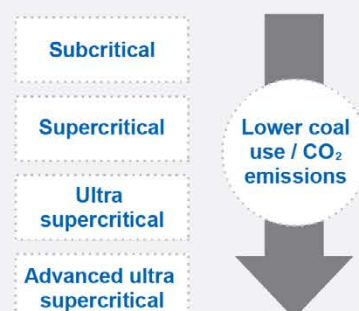
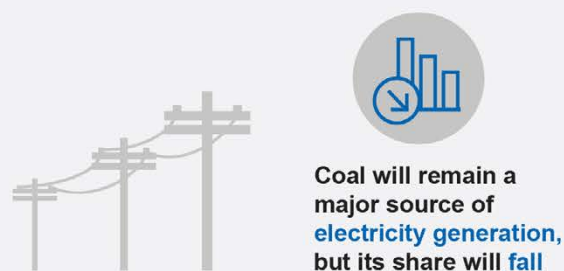
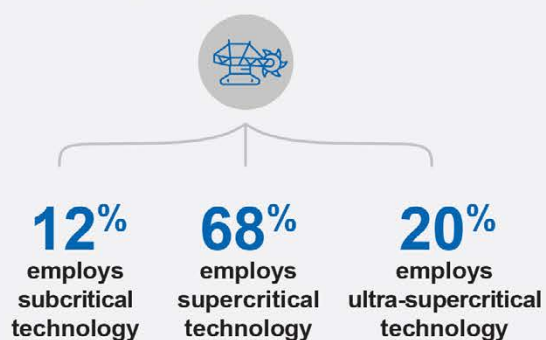
168 million people **without access** to electricity in 2017

Complex institutional arrangements make **market operation** and **reforms** difficult in the power and coal sectors

India's thermal coal consumption is set to increase over the next decade and possibly beyond



39 GW of coal-fired power capacity under construction



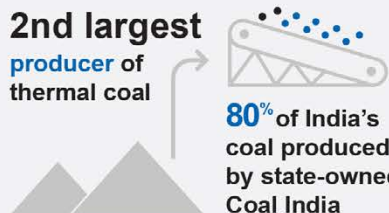
India's production of thermal coal is also increasing, but it remains to be seen whether it can catch up with demand

5th largest proved coal reserves



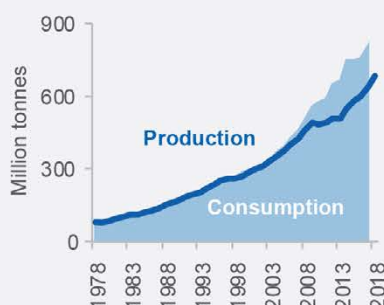
101 billion tonnes

2nd largest producer of thermal coal

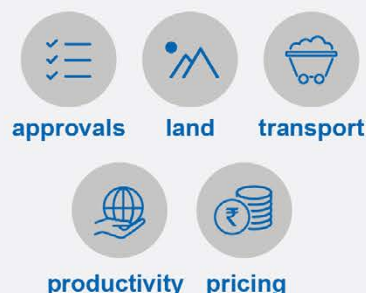


80% of India's coal produced by state-owned Coal India

India's thermal coal output hasn't kept up with its consumption over the past decade



Challenges facing India's coal sector



The outlook for India's thermal coal imports is finely balanced and uncertain

2nd largest importer of thermal coal



Imports thermal coal from



Relies on imports for



1/5

of its thermal coal consumption



Imports could fall or climb, depending on domestic production



India unlikely to achieve its goal of self-sufficiency in thermal coal in the short term

While Australia is not currently a significant supplier of thermal coal to India, there are opportunities



India's share of Aus exports, 2018



Aus share of India's imports, 2018

	India's share of Aus exports, 2018	Aus share of India's imports, 2018
Thermal	2%	4%
Metallurgical	25%	71%



Australia could triple thermal coal exports to India. Further growth possible if barriers addressed



Australia positioned to expand metallurgical coal supply to India as its steel sector grows



METS an opportunity >40 Australian METS companies operating in India's coal sector

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Glossary

AUSC	Advanced ultra-supercritical (coal plant)
BNEF	Bloomberg New Energy Finance
CAGR	Compound average growth rate
CCS	Carbon capture and storage
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CIL	Coal India Limited
COP	Conference of parties
CO ₂	Carbon dioxide
CPS	Current Policies Scenario
CSP	Concentrated solar power
DMO	Domestic Market Obligation
DWT	Deadweight tonnes
EU28	The 28 member states of the European Union
FDI	Foreign direct investment
FOB	Free on board. Seller clears export, buyer pays freight.
FSA	Fuel-supply agreement
FYP	Five-year plan
Gcal	Gigacalorie
GDP	Gross domestic product
GW	Gigawatt
GWh	Gigawatt hour
HELE	High efficiency, low emissions
HHV	Higher heating value
IEA	International Energy Agency
IGCC	Integrated gasification combined cycle
INDC	Intended Nationally Determined Contribution
INR	Indian Rupees
kcal	Kilocalorie
kWh	Kilowatt hour

LCOE	Levelised cost of electricity
VALCOE	Value adjusted levelised cost of electricity
LNG	Liquefied Natural Gas
MBtu	Million British thermal units
METS	Mining equipment, technology and services
MNRE	Ministry of New and Renewable Energy
MOC	Ministry of Coal
MOP	Ministry of Power
MOPNG	Ministry of Petroleum and Natural Gas
Mtce	Million tonnes of coal equivalent
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
NDC	Nationally Determined Contribution
NEEPCO	North Eastern Electric Power Corporation
NHPC	National Hydroelectric Power Corporation
NITI	National Institution for Transforming India
NPS	New Policies Scenario
NTPC	National Thermal Power Corporation
OECD	Organisation for Economic Co-operation and Development
PCC	Pulverised coal combustion
PPA	Power Purchase Agreement. A contract between the power generator (seller) and distribution company (buyer)
PSU	Public sector undertaking
PV	Photovoltaic
R&D	Research and development
ROM	Run of mine
SCCL	Singareni Collieries Company Limited
SDS	Sustainable Development Scenario
TJ	Terajoule
TWh	Terawatt hour
UHV	Useful heating value
UMPP	Ultra-mega power plant
UNFCCC	United Nations Framework Convention on Climate Change
USC	Ultra-supercritical
WEO	World Energy Outlook
WEPP	Platt's World Electric Power Plants database





India's energy sector

This chapter examines India's energy sector, focusing on its electricity and coal markets, and the broader governance structures and policy targets that underpin those markets. India is a large energy consumer and producer by world standards. While its energy requirements have grown rapidly, per capita energy use in India remains low. Coal has played a vital role in meeting India's energy needs, and India has become increasingly reliant on imports as demand has continued to outstrip domestic production.

India's energy sector is governed by a complex set of institutional arrangements. Both central and state governments are heavily involved in the energy sector, and policy reforms require a high degree of co-ordination and cooperation between both levels of government. As a result of this complexity, reforms to India's energy sector can be difficult, with flow-on impacts to the outlook for coal. Energy policy in India aims to deliver energy affordability and energy security (with an emphasis on self-sufficiency), while also supporting economic growth and contributing to climate and air pollution goals. In the electricity sector, India has announced ambitious targets for renewable generation, but faces challenges in achieving these targets.

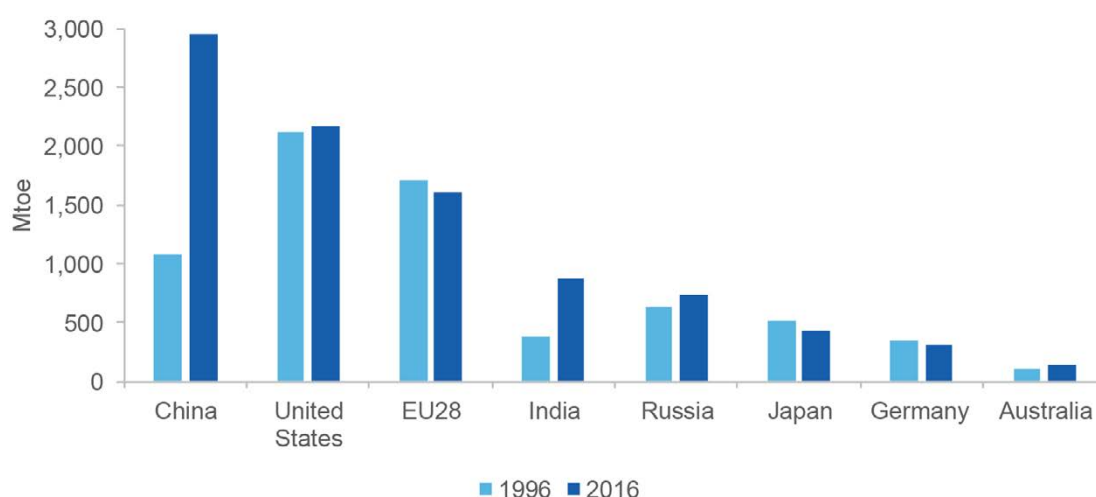
1.1 India's energy and electricity use

India's energy consumption

India is the world's seventh largest economy, with the world's second largest population.² The twin pressures of rapid population and economic growth have driven substantial increases

in India's energy demand: over the past two decades, the country's energy consumption has more than doubled. Today, India is the world's third largest energy consuming country after China and the US (Figure 1.1).

Figure 1.1: Total primary energy demand



Source: IEA (2018) World Energy Outlook, International Energy Agency

Box 1.1: Energy measurement

The following concepts are used extensively in discussions about energy, and assist in understanding developments in world energy markets. In the context of this report, energy use refers to primary energy — the use of fuels such as coal, oil and gas that have not been transformed into another energy source (such as electricity or refined petroleum); imports of refined petroleum and electricity (but not consumption of refined petroleum and electricity produced domestically, because the energy is already captured prior to transformation); and use of nuclear, hydro, wind and solar.

Fuels, such as coal, oil and gas, are measured for trading and monitoring processes that produce or use them. These can be either physical units for solid fuels (tonnes or kilograms) or volume units for liquids (cubic metres or litres). These units can be converted into energy units, to facilitate the aggregation of different fuels in different physical states. Commonly used energy units are joules, calories, British thermal units (Btu) million tonnes of oil equivalent (Mtoe), million tonnes of coal equivalent (Mtce) and gigawatt hour (GWh). The conversion equivalents are expressed in Table 1.1.

Table 1.1: Conversion equivalents between units of energy

To: From	TJ	Gcal	Mtoe	Mtce	MBtu	GWh
Multiply by:						
Terajoule (TJ)	1	238.8	2.388×10^{-5}	3.412×10^{-5}	947.8	0.2778
Gigacalorie	4.1868×10^{-3}	1	10^{-7}	14^{-7}	3.968	1.163×10^{-3}
Mtoe	4.1868×10^4	10^7	1	1.428	3.968×10^7	11630
Mtce	2.9307×10^4	7^6	0.7	1	2.777×10^7	8141
Million Btu	1.0551×10^{-3}	0.252	2.52×10^{-8}	3.599×10^{-8}	1	2.931×10^{-4}
Gigawatt hour	3.6	860	8.6×10^{-5}	1.228×10^{-4}	3412	1

Source: IEA (2019) Unit converter

The conversion of a fuel from a physical or volume unit to an energy unit requires a conversion factor that expresses the heat obtained from one unit of the fuel. This conversion factor is referred to as its calorific value. The quality of fuels, and hence their calorific values, varies across deposits and countries. The calorific value of coal is described in terms of kilocalories per kilogram (kcal/kg).

This report employs both physical units (tonnes) and energy units (tonnes of coal equivalent, tce), depending on the source used. To convert tonnes to tce, the calorific value of the coal must be known. 1 tce is equivalent to 7 million kilocalories (kcal), or the net heat content of a tonne of coal with energy content of 7,000 kcal/kg. For example 1 mtce with a calorific value of 6,000 kcal/kg is equivalent to 1.17 million tonnes of 6,000 kcal/kg coal ($1 \times 7,000 \text{ kcal} / 6,000 \text{ kcal/kg}$).

Electrical capacity is the maximum electricity output that can be generated at a plant under certain conditions. Capacity is typically measured in multiples of watts. The choice of multiple (kilo, mega, giga or tera) depends on the size of the plant.

Electricity generation and use is the amount of electricity produced or consumed over a certain period of time. Generation and consumption are measured as a multiple of watt hours. Many electricity plants do not operate at full capacity all the time; output is varied based on operating conditions, input costs and requirements.

Source: IEA (2005) Energy Statistics Manual

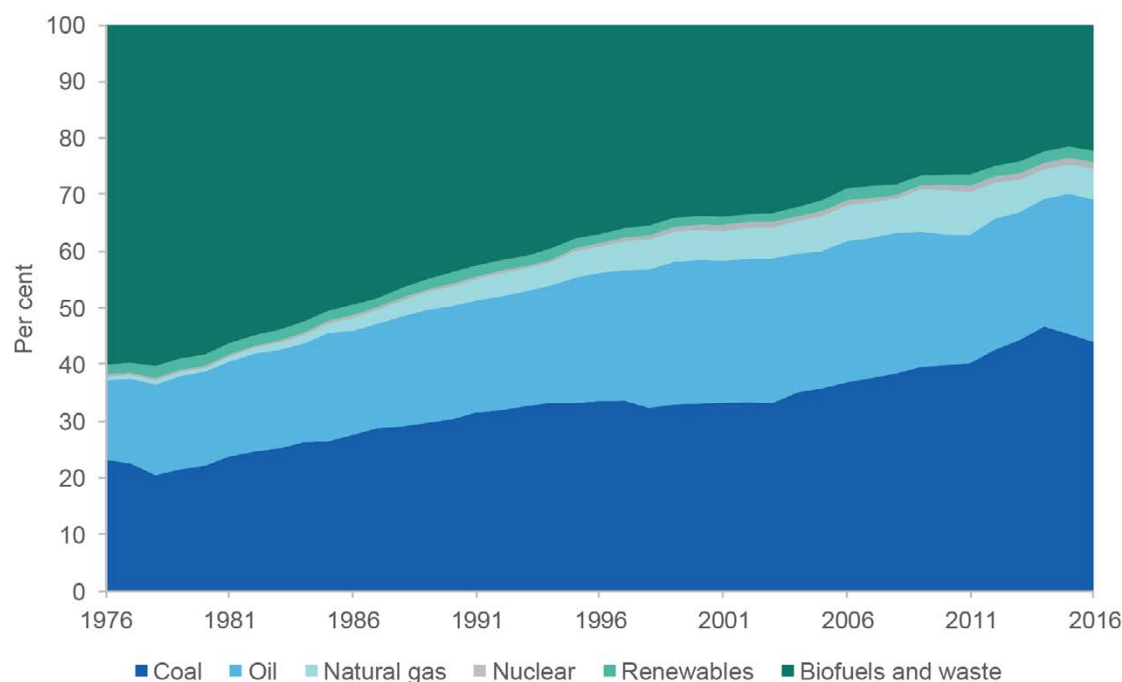
India's energy mix

The composition of India's energy mix has shifted noticeably over the past few decades (Figure 1.2). The share of biomass (such as wood used in heating and cooking) and waste in the energy mix has been declining. Coal has taken on an increasing role, although its share has edged back since its 2014 peak. Oil's share has also picked up, driven by growing transport and petrochemicals demand. Other fuels —

natural gas, renewables and nuclear — have remained a relatively minor part of India's energy mix over the past few decades.

In 2016, coal accounted for 44 per cent of India's energy mix, followed by oil at 25 per cent, biofuels and waste at 22 per cent, natural gas at 5 per cent, renewables (including hydro, wind and solar) at 2 per cent, and nuclear at 1 per cent.

Figure 1.2: India's energy mix



Notes: renewables includes hydro and other renewables (wind, solar etc.). Electricity and heat from non-specified combustible fuels are excluded for the purposes of the chart.

Source: IEA (2018) World Energy Balances

Electricity consumption in India

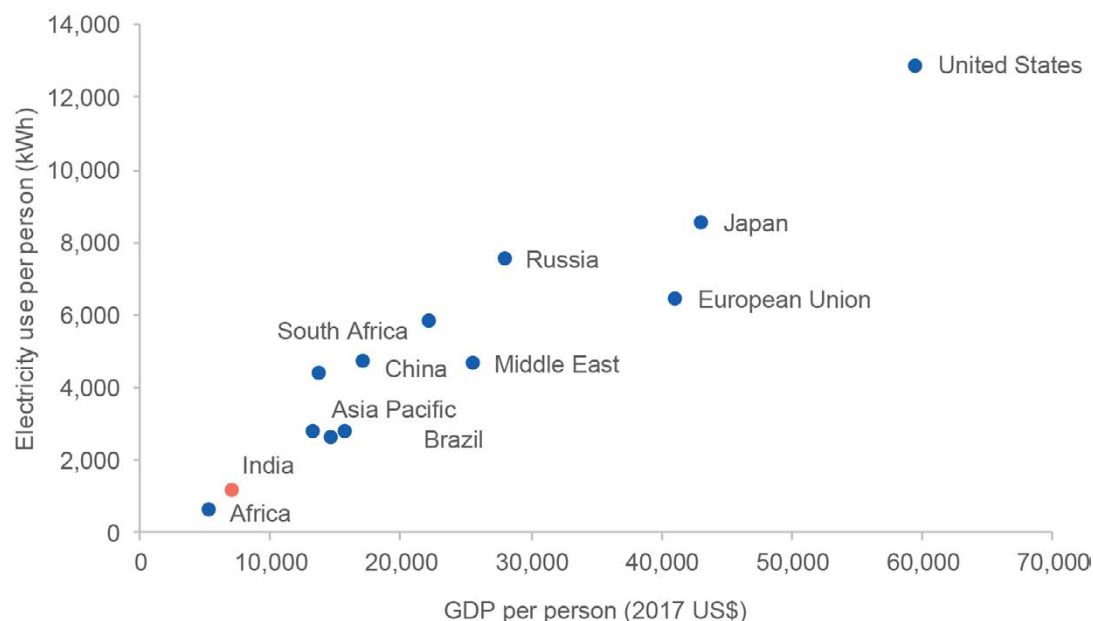
The power sector accounts for 40 per cent of India's total primary energy demand, and has been the largest contributor to growing energy consumption in India since the turn of the century.³ However, in recent years, electricity demand growth has been slower than expected, with economic and industrial production growth lower than original expectations. As outlined in Chapter 2, this slower than expected growth has been a key contributing factor to the emergence of excess capacity in the power generation sector, which has placed some Indian generators under financial pressure.

Much like total energy demand, increasing electricity consumption has been underpinned by both economic and population growth. Efforts to increase access to electricity have also supported growing electricity use. Around half a billion people have gained access to electricity in India since the year 2000.⁴

Since the 2014 national elections, the Indian government has made access to electricity a key policy priority. The Indian government launched the *Saubhagya* scheme in September 2017, which is designed to provide free or low cost electricity connections. In April 2018, the Indian government announced it had achieved its goal of providing electricity to every village in India.⁵

Attention has now turned to providing all households with electricity access, and India is aiming to achieve universal electricity access by 2022.⁶ According to the latest data from the International Energy Agency (IEA), almost 168 million people in India were without access to electricity in 2017 (around 12.5 per cent of the population).⁷ India's per person electricity use remains low compared with both advanced economies and other emerging economies (Figure 1.3).

Figure 1.3: Electricity use and economic development, 2017



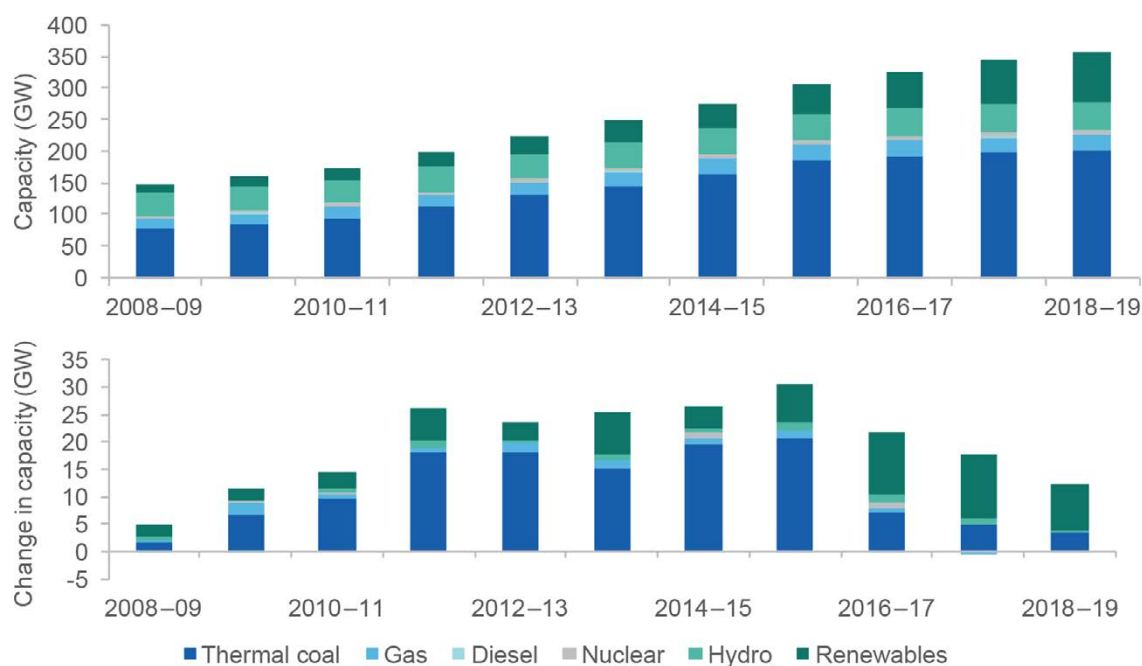
Source: IEA (2018) World Energy Outlook, World Bank (2019)

India has also made significant progress in reducing power shortages, thanks to a significant expansion in generation capacity and lower than expected demand growth in recent years.⁸ While reliability of electricity supply has improved, it remains an ongoing challenge. India's largest survey of household energy access indicated that daily electricity supply was 16 hours in 2018, up from a median of 12 hours in 2015.⁹ The political imperative to provide affordable and reliable power to Indian households is expected to shape reforms in the energy and electricity sectors moving forward.¹⁰

To meet growing demand, India's electricity generation capacity has more than doubled over the past decade. The expansion has been

primarily driven by coal-fired power generation capacity, and more recently, renewable generation (Figure 1.4). Over the past decade, coal generation capacity has increased by 123 GW, while renewable capacity (excluding large-scale hydro) has increased by 64 GW. In June 2019, coal accounted for around 56 per cent of total installed capacity in India, followed by renewables (excluding large-scale hydro) at 22 per cent, large-scale hydro at 13 per cent, gas at 7 per cent and nuclear at 2 per cent (Table 1.2).¹¹ Coal's share of India's electricity generation is larger than its share of installed electricity capacity, given it tends to run at a higher utilisation rate than renewable generation.

Figure 1.4: India's installed electricity generation capacity



Notes: Installed capacity as at March each year. Hydro refers to large-scale hydro. Renewables include wind, solar, biomass, and mini-hydro. In 2019, thermal coal includes a small amount of lignite.

Source: Central Electricity Authority (2019)

Table 1.2: India's installed electricity generation capacity, June 2019

Generation type	Capacity (GW)	Share (%)
Thermal coal	194	54
Lignite	6	2
Total coal	201	56
Gas	25	7
Diesel	1	0
Total thermal	226	63
Small-scale hydro	5	1
Wind	36	10
Bio-power	9	3
Solar	29	8
Total renewables (ex large hydro)	79	22
Large-scale hydro	45	13
Nuclear	7	2
Total installed capacity	358	100

Source: Central Electricity Authority (2019)

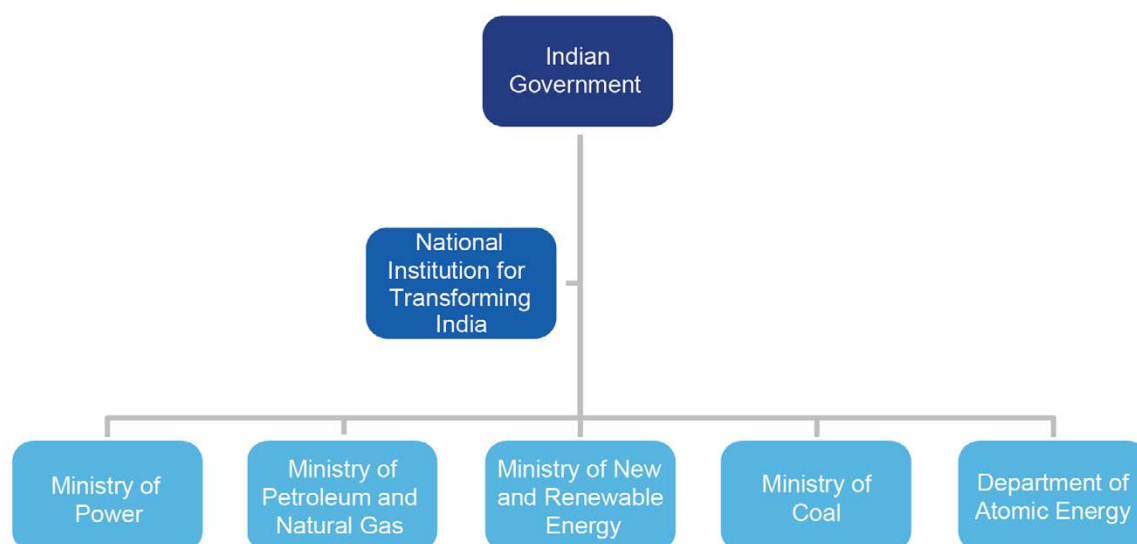
1.2 Structure of India's energy and electricity sectors

India's energy sector

India's energy sector is governed by a complex set of institutional arrangements. The Indian government is the principal agent in the energy market, with responsibility for both setting energy policy and administering the public companies that produce energy. There are five major government ministries that are directly involved in policy making, and which have responsibility for energy provision: the Ministry of Power; the Ministry of Coal; the Ministry of New and Renewable Energy; the Ministry of Petroleum and Natural Gas; and the Department of Atomic

Energy (Figure 1.5). These ministries have stakes in state-owned enterprises — known as Public Sector Undertakings (PSUs) — as well as statutory bodies and research institutions. The National Institution for Transforming India (NITI), also known as NITI Aayog, is the premier policy think tank of the Indian Government.¹² NITI Aayog designs strategy and long-term policies and programs for the Indian government, and provides technical advice to both central and state governments.

Figure 1.5: Institutional structure of energy administration in India



Source: adapted from IEA (2012) Understanding energy challenges in India

India's electricity sector

Government

India's electricity sector can be divided into regulators, generation, transmission and distribution (Figure 1.6). Both central and state governments play an important role in the power sector, which is a shared responsibility under the Indian Constitution. The central government has a key role in the electricity sector through the Ministry of Power, which has responsibility for planning and policy formulation in the sector, as well as for project approvals, monitoring and implementation.¹³ The Central Electricity Authority (CEA) — a statutory body overseen by the Ministry of Power — undertakes short and long-term policy planning and coordination in the power sector, acting as an advisory body to the central government.

State governments also play an important role in the Indian electricity sector, with state-owned utilities controlling a large share of the transmission and distribution network. State governments are responsible for the day-to-day operation and maintenance of their grids.¹⁴

Regulators

The Central Electricity Regulatory Commission (CERC) — a statutory body that plays a key role in power sector regulation in India — sets

tariffs charged by generating companies that are controlled by the central government and by independent power producers which deliver electricity to more than one state.¹⁵ The CERC also advises the central government on electricity tariff policy. State Electricity Regulatory Commissions (SERCs) set tariffs charged by state-owned utilities.

Generation

While government-owned utilities have historically dominated India's generation sector, the role of private utilities has been growing. In June 2019, government-owned utilities accounted for 54 per cent of India's installed electricity generation capacity (29 per cent state governments, 24 per cent central government).¹⁶ Private utilities accounted for 46 per cent of installed capacity. While government-owned utilities dominate thermal generation (coal and gas), private investors account for the vast majority of renewable energy generation. Captive power plants (CPPs) are another feature of India's electricity market; these are power plants owned by industry that generate electricity for self-consumption.¹⁷ Table 1.3 shows the four largest power companies in India.

Table 1.3: Key power providers in India

	Capacity (Megawatts)	Ownership
National Thermal Power Corporation	55,000	Government
Tata Power	10,957	Private
Adani Power	10,440	Private
National Hydroelectric Power Corporation	7,071	Government

Source: Department of Industry, Innovation and Science (2015) Coal in India; NTPC(2019); NHPC (2019); Tata Power (2019); Adani Power (2019).

Transmission

Transmission and distribution are dominated by state-owned companies, although they are open to the private sector. State transmission utilities (STUs) are responsible for inter-state transmission. State distribution companies (also referred to as 'DisComs') generally buy power from both public and private generators, for sale to final consumers. These purchases are generally made through power purchase agreements (PPAs), which are generally

long-lived (frequently 25 years). In financial year 2017 (April 2016 to March 2017), 90 per cent of electricity was sold on PPAs, 6 per cent on bilateral contracts and only 4 per cent through competitive wholesale markets and power exchanges.¹⁸ Distribution companies have faced mounting losses in recent years (discussed below), partly explaining why the sector has struggled to attract funding from private investors.

Figure 1.6: India's electricity sector

	Central Government	State Government	Private Sector
Policy	Ministry of Power Central Electricity Authority Bureau of Energy Efficiency	State Government State government energy agencies	
Regulation	Central Electricity Regulatory Commission	State Electricity Regulatory Commissions	
Generation	Ministry of Power National Thermal Power Corporation National Hydroelectric Power Corporation National Eastern Electric Power Corporation Joint Ventures Ministry of New and Renewable Energy Renewables Department of Atomic Energy Nuclear Power Corporation of India Ltd	State power generation companies State power generation and distribution companies	Independent Power Producers Tata power Reliance Power Adani Power Captive Power Producers Steel industry Fertiliser industry Petrochemical industry
Transmission	Central transmission utility Power Grid Corporation of India Ltd	State transmission utilities	Independent transmission service providers
Distribution		State distribution companies State generation and distribution companies	Private distribution companies

Source: Adapted from IEA (2012) Understanding energy challenges in India

India's transmission network consists of five regional grids: northern, eastern, southern, western, and north eastern. In December 2013, these grids were synchronously connected to operate at one frequency, although the process of fully integrating India's electricity grids is ongoing.¹⁹ The Power Grid Corporation of India (POWERGRID) is mandated to establish the national electricity transmission network, or 'National Grid', to operate the regional power grids and improve reliability, stability and security of the transmission sector.²⁰

India's electricity challenges

India faces a range of challenges across its electricity sector. These include inefficient state-owned generators, overcapacity in generation, bottlenecks in transmission, financial pressure on distribution companies (due to transmission and distribution losses and the underpricing of electricity), and distortionary subsidies. These challenges have flow-on effects for the speed, scale and nature of energy investment in India, and are fundamental to understanding the broader context in which the producers and consumers of electricity and coal operate.

Inefficient state-owned generation companies

A key challenge in India's electricity sector is the inefficiency of state-owned generation companies, which account for a large share of India's generation mix²¹ (see the previous section). A key driver of this inefficiency is a lack of competition in India's electricity market, which reduces the incentives of power plants to control costs. As discussed, the vast majority of electricity in India is sold under long-term PPAs, with very little electricity sold through wholesale markets and power exchanges. In addition, there are high barriers to entry for private generators seeking to enter the market. State governments, for instance, levy additional charges on consumers that purchase electricity from a party other than a state-distribution utility.

Overcapacity in generation

Despite the lack of competition in India's electricity sector, many coal-fired generators have come under financial pressure.²² Generation capacity has grown faster than electricity demand in recent years, driven primarily by an expansion in coal-fired power generation (as discussed in the previous section). This expansion has led to overcapacity in thermal (coal, gas etc.) generation.²³ Growing renewable energy generation has further added to pressure on coal generators, lowering their utilisation rates and reducing their profitability. Renewable energy in India has a de-facto 'must run' status in India — which requires any renewable power that is generated to be accepted by the grid — and therefore displaces thermal generation when available.²⁴

Transmission bottlenecks

There are also substantial bottlenecks in the transmission system. While transmission constraints have been easing, a considerable amount of electricity is lost each year due to congestion in the electricity network. According to the World Bank, almost 4 per cent more electricity could have been transmitted in financial year 2017 if it had not been for transmission congestion.²⁵

Financial pressure on distribution companies

Power distribution companies in India — the main buyers of power from the generation companies — are also under significant financial pressure. Transmission and distribution losses are a key factor. A combination of power theft, poor infrastructure, outdated equipment and faulty metering led to the loss of over one fifth of electricity in transmission and distribution in India in financial year 2016 — a much higher loss rate than elsewhere in the world. The Indian Government has launched several reforms aimed at reducing electricity losses during transmission and distribution, including the Restructured Accelerated Power Development and Reforms Program (R-ADRP) and the Integrated Power Scheme (IPDS).

The underpricing of electricity by central and state electricity commissions has also contributed to the poor financial position of distribution companies. As outlined in the previous section, electricity tariffs for end users are regulated in India and are, on average, below the cost of supply in many states. As a result, many distribution companies are losing money on the electricity they supply.²⁶ Both central and state governments provide financial support for distribution companies to cover the losses of supplying power at low rates. However, government subsidies are not always paid on time, and sometimes fall short of the amount booked by distribution companies, adding to their financial problems.

At the retail level, the Indian government finances the underpricing of electricity for households and farmers (who are the main beneficiaries of electricity price regulation) by making commercial and industrial customers pay higher rates. The use of subsidies creates distortions in the market, and artificially low electricity prices do not send the appropriate signals for consumers to improve energy efficiency or alter their electricity use. However, pricing reforms are difficult, due to the substantial social, economic and political challenges of raising electricity prices. In short, distortions exist across multiple segments of India's power generation sector. These distortions have flow-on implications to the coal sector in India (see Chapter 2).

1.3 Government policies and reforms

Economic policy

The Modi Government has instituted a number of major economic reforms since taking office in 2014. Major reforms in its first term included a demonetisation policy (designed to reduce informal economy activity, increase tax revenue, and prevent the financing of illegal activities), the introduction of a goods and services tax, and the delivery of public goods programs — in areas such as affordable housing, sanitation and electricity. The Modi Government returned to power for a second five-year term in May 2019, with a strong mandate to continue its growth agenda.

The Modi Government has also continued to push forward with the *Make in India* program — an initiative designed to transform India into a global manufacturing hub. The growth in India's manufacturing and industrial sectors will be a key contributor to rising energy demand in the country.

While the introduction of some of the Modi Government's reforms (such as demonetisation) weighed on economic activity in the short-term, they will likely help bolster economic growth and support the Government's financial position over the longer-term. The Modi Government is aiming to make India into a US\$5 trillion economy.²⁷

While the global economy is battling strong headwinds — including the escalation of trade tensions between the US and China — the International Monetary Fund (IMF) expects India to be the fastest growing major economy in the world until 2023. India's GDP grew by 7.1 per cent in 2018, and growth is expected to remain strong over the next five years, averaging an annual growth rate of around 7.6 per cent.²⁸

National energy policy

India's draft national energy policy was published by the National Institution for Transforming India (Niti Aayog) in July 2017. At the time of writing, the final version of the national energy policy had not been released.²⁹ The draft national energy policy focuses on a short-term horizon (to 2022), and a medium-term horizon (through to 2040), when the aim is to have India's economy 'energy ready'. It identifies four key energy policy objectives.

1. **Access at affordable prices.** This objective is described as being of the 'utmost importance' given 'poverty and deprivation' in India. It aims to ensure universal access to '24x7 electricity by 2022' and clean cooking fuel within a 'reasonable time'. In July 2019, the Indian Government brought forward its target for clean cooking fuel to 2022.³⁰
2. **Improved security and self-sufficiency.** The national energy policy notes that there is 'a strong case for reduced dependence on imports', given the availability of domestic oil, coal and gas, but that the diversification of import sources can also enhance energy security.
3. **Greater sustainability.** This objective seeks to address the 'catastrophic effects of climate change and detrimental effects of fossil fuel usage of local air quality' through increasing energy efficiency and renewable energy.
4. **Economic growth.** The national energy policy notes that energy policy must support rapid economic growth by underpinning economic activity across the economy, as well as support economic activity in the energy sector.

The draft national energy plan states that there are complementarities and tensions between these four objectives. For example, on the one hand, reducing fossil fuel consumption would 'promote the twin goals of sustainability and security'. However, as long as fossil fuels remain the cheapest source of energy, 'the goal of

affordable prices would come into conflict with the goal of sustainability and possibly energy security as well'. Box 2.1 outlines the costs of different types of generation in India in more detail.

The details of India's national energy plan related to coal are discussed in Chapter 2 of this report.

National electricity plan and electricity market reform

The Central Electricity Authority (CEA) published India's most recent national electricity plan in January 2018.³¹ It envisages a massive expansion in electricity generation capacity over the next decade (Table 1.4), led by renewable generation (excluding large-scale hydro), which increases by 196 GW on present levels. Coal is the next largest contributor (37 GW), followed by large-scale hydro (18 GW) and nuclear (10 GW). Gas generation capacity remains largely unchanged from present levels.

The expansion in coal-fired generation capacity is expected to be driven by a combination of capacity already under construction and additions through new projects, which will offset retirements of coal power stations. The national electricity plan notes that, other than capacity already under construction, no additional coal-fired capacity will be required before 2021–22, with new capacity expected to come online between 2022–23 and 2026–27.

Table 1.4: India's projected installed capacity

Fuel type	June 2019 (actual)	2021–22 (projection)	2026–27 (projection)	2018–19 (share)	2021–22 (share)	2026–27 (share)
Unit	GW	GW	GW	%	%	%
Coal	201	217	238	56	45	38
Renewable	79	175	275	22	37	44
Hydro	45	51	63	13	11	10
Gas	25	26	26	7	5	4
Nuclear	7	10	17	2	2	3
Total	358	479	619	100	100	100

Notes: Hydro refers to large-scale hydro. Coal includes thermal and lignite. Diesel is not included. Installed capacity figures are year ended March. According to the NEP, coal-fired capacity in 2017–18 was 192 GW and is expected to increase to 238 GW in 2026–27, driven by 48 GW of capacity already under construction and new capacity additions of 46 GW between 2022–23 and 2026–27, less retirements of 48 GW of capacity.

Source: Central Electricity Authority (2018) National Electricity Plan; Central Electricity Authority (2019) Monthly Reports Executive Summaries

In the July 2019 Union Budget speech, the Indian finance minister reaffirmed the government's commitment to the 'One Nation, One Grid' model for the electricity sector.³² One Nation, One Grid involves the integration of India's five regional grids, a plan that was first conceptualised in the early 1990s, and one that remains ongoing.³³

Climate change, renewables and air pollution

Nationally Determined Contribution

India's Nationally Determined Contribution (NDC) under the Paris Agreement includes a target to reduce the emissions intensity of its GDP by 33–35 per cent from 2005 levels by 2030.³⁴ India could meet this target by reducing the amount of energy used per unit of GDP, or by reducing the carbon content of the energy it uses. However, the nature of the target means that, even if it is met, carbon emissions may continue to rise.

Under its NDC, India will aim to increase the share of non-fossil fuel based capacity in the electricity mix to over 40 per cent by 2030.³⁵ In the shorter term, India has set itself a target of 175 GW of installed renewable energy capacity by 2022 (excluding large-scale hydro): its 2022 target is for 100 GW for solar, 60 GW of wind, 10 GW of biomass and 5 GW of small-scale hydro.³⁶

Recently announced targets and policies

In mid-2018, the Indian Government announced plans to increase renewable energy capacity to 227 GW by March 2022, a significantly more ambitious target than the 175 GW set out in its NDC and in the January 2018 National Electricity Plan.³⁷

In January 2019, the Secretary of the Ministry of New and Renewable Energy announced plans to lift installed renewable energy capacity (excluding large-scale hydro) to 500 GW in 2028, up from 79 GW in June 2019.³⁸ Solar is expected to drive the bulk of the expansion in renewable capacity. The target is divided into 350 GW of solar, 140 GW of wind and 10 GW of other technologies, and excludes large-scale hydro.³⁹

The target aligns most closely with the IEA's Sustainable Development Scenario (discussed below), which envisages almost 530 GW of installed renewable capacity in 2030 (excluding hydro). Achieving the target would likely see renewable installed capacity climb to around 60 per cent of India's total generation capacity, well in excess of the 2040 target specified in India's NDC. A target of 500 GW would represent a significant increase on the projection from the January 2018 national electricity plan for 275 GW of installed renewable capacity in 2026–27 (discussed in the previous section).

In July 2019, the Indian government committed \$5 billion to develop small-scale solar in the agriculture sector, including 10 GW of grid-connected solar plants on farmland and the roll-out of 2.75 million solar water pumps.⁴⁰

Challenges to the uptake of renewable generation

India will need to overcome significant challenges to achieve its capacity targets for renewable energy generation.⁴¹ Some of these challenges relate to cost. As discussed in Chapter 2 (Box 2.1), renewable generation may, in some circumstances, be cheaper than new coal generation, but will struggle to outcompete existing coal power generation. Other challenges are more technical. India, for example, does not currently have sufficient transmission capacity or a sufficiently dynamic transmission system to easily integrate large amounts of renewables into the grid.

There are also a wide variety of political factors to consider. The central government in India cannot require the states to align their renewable purchase obligations with national targets, and how states respond to national targets varies substantially.⁴² Recently, the renewable energy industry has found itself under pressure from the state government in Andhra Pradesh, which has sought to cancel PPAs with wind-power projects, and has asked renewable energy firms to reduce prices on previously agreed contracts and cut their grid contributions.⁴³ Any efforts to reduce coal consumption could also be resisted by coal-producing regions, and would have significant implications for railways, which are the largest civilian employers in India.

India's renewable energy targets are ambitious, and it remains to be seen whether they can be achieved. However, they do signal considerable ambition in expanding renewable energy generation on the part of the central government.

Air pollution

In January 2019, India launched its National Clean Air Program (NCAP), which aims to reduce fine particulate matter (PM_{2.5}) and particulate (PM₁₀) air pollution by 20–30 per cent by 2030. In India, exposure to PM_{2.5} contributed to 673,000 deaths and the loss of 21.3 million years of healthy life in 2017.⁴⁴ The burning of coal is one contributor to PM_{2.5} levels. According to the World Bank, around 7.6 per cent of PM_{2.5} emissions were attributable to power generation and 7.7 percent to industry coal combustion.⁴⁵

Coal production tax

In the 2010 financial year, India introduced the Clean Environment Cess⁴⁶ – an environmental tax on coal consumption. The tax was levied at 50 rupees per tonne of coal, and was subsequently increased to 100 rupees per tonne in the 2014 financial year, 200 rupees per tonne in 2015 and 400 rupees per tonne in 2016.⁴⁷ With the introduction of the GST in 2017, the tax on coal consumption was abolished, and a new cess on coal production (GST compensation cess) was put in its place at the same rate of 400 rupees per tonne. India's NDC specifies that 'the coal cess translates into a carbon tax equivalent'.⁴⁸

1.4 India's coal sector

India's coal sector plays an important role in the country. From an energy security perspective, it is the country's most abundant non-renewable fuel, and coal-fired power dominates electricity generation. It also makes an important economic contribution. Coal mining and power generation are two major industries in India, and together account for around a tenth of the country's industrial production, and directly employ around half a million people.⁴⁹ The coal sector also generates substantial additional employment through the transport sector. Rail is the largest civilian employer in India, and the coal and rail sectors are heavily interdependent through cross-subsidies (see Chapter 2).

India's coal supply

Reserves

Coal is a key commodity for India from an energy security perspective, because it is the country's most abundant non-renewable energy source. India has the world's fifth largest proved recoverable reserves of coal, at an estimated 101 billion tonnes (Figure 1.7).⁵⁰ Most of India's coal reserves are located in the east, with the states of Jharkhand, Odisha, Chhattisgarh and West Bengal accounting for most of total proved reserves.

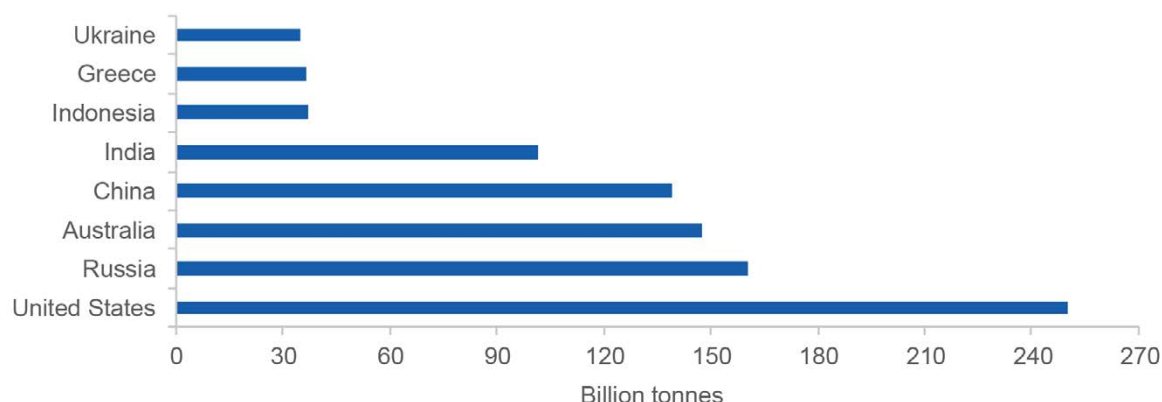
The distribution of India's coal reserves creates a supply challenge for India. The bulk of its coal reserves are geographically separated from its principal areas of consumption, and require substantial infrastructure networks for transportation from mine sites to generators (Figure 2.10).

Quality

Coal quality varies substantially across India. Compared to other internationally traded coals, Indian coals typically have lower energy content. Indian coals also have high ash content and low sulphur content. The moisture content of Indian coal is variable, and is typically higher in coal produced during the monsoon season. Over the last two decades, data suggests that there has been a continuous decline in the quality of indigenously produced coals, with average calorific values falling and mineral-ash content increasing.⁵¹

To improve the combustion efficiency of India's coal-fired fleet, the quality of India's coal can be improved either by blending domestic coal with higher quality imported coal, or washing domestic coal to reduce the impurities.

Figure 1.7: Proved reserves of coal at end 2018



Source: BP (2019) Statistical Review of World Energy

Production

India's total coal production in the 2018–19 Indian financial year (April to March) was an estimated 730 million tonnes.⁵² Thermal coal accounted for 94 per cent of India's domestic coal production, at 683 million tonnes in the same period.

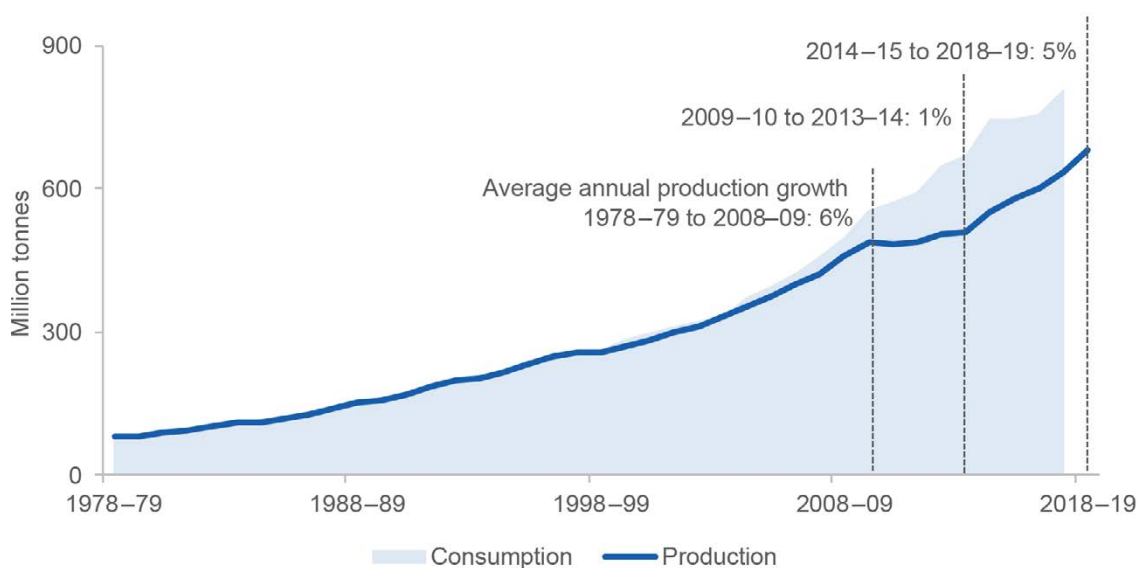
India's thermal coal production increased more than six-fold between 1978–79 and 2009–10, in response to rapid growth in coal consumption in the electricity generation sector (Figure 1.8).

Production growth slowed considerably after 2009–10, dropping from an annual average growth rate of 6.0 per cent between 1978–79 and 2008–09, to 1.1 per cent between 2009–10 and 2013–14. Coal India — the state-owned coal producer which accounts for over 80 per cent of coal production (see Box 1.2) — was not able to meet its annual production targets, and its inability to meet domestic requirements from the mid-2000s was one of the key challenges underpinning India's energy policies.

Production growth has recently rebounded, with annual average growth accelerating to 5.5 per cent between 2014–15 and 2018–19. In 2016, India overtook the US to become the world's second largest producer of thermal coal after China. Coal India has boosted production by improving mechanisation and restructuring its coal operations to improve efficiency, progressing more projects through the complex approvals process, and expanding existing operations.

Nevertheless, production still remains substantially lower than consumption, with the development of new greenfield coal mines in India constrained by ongoing challenges with land acquisition, approvals processes, and inadequate transport infrastructure. The Indian government will need to continue to pursue reforms so that production can keep up with growing power and industrial demand. However, the complex regulatory and institutional settings for India's electricity and coal industries remain a barrier to implementing these reforms (discussed further in Chapter 2).

Figure 1.8: India's thermal coal production and consumption



Note: Data is for the Indian financial (April to March)

Source: IEA (2018) Coal Information 2018, IHS (2019) India coal data tables, June 2019

Box 1.2: India's coal market structure

India's coal sector is primarily government owned and coordinated. Coal production in India has been controlled by the central government since the nationalisation of India's coal mines in the early 1970s. State governments approve mining licences and leases. The complex institutional interactions make streamlining and reforming the approvals process challenging.

Figure 1.9: Structure of India's coal sector

	Central Government	State Government	Private Sector
Policy	Ministry of Coal Central Mine Planning and Design Institute Coal Controller	State Government	
Production	Ministry of Coal Coal India Limited Singareni Collieries Company Limited Neyvelli Lignite Corporation Joint Ventures	State Government Singareni Collieries Company Limited Gujarat Mineral Development Cooperation	Captive Producers Power Industry
Consumption	National Power Generators	State Power Generators	Private Power Generators Industry Cement Brick Iron/steel

Source: IEA (2012), Ministry of Coal (2014)

Key government agencies include:

The Ministry of Coal: Responsible for the formulation of policies and strategies for coal exploration, project approvals and other issues relating to the production, supply, distribution and pricing of coal in India.⁵³ The Ministry of Coal also sets production targets and other performance indicators for Coal India through a Memorandum of Understanding (MoU).

The Coal Controller: A subordinate office of the Ministry of Coal which sets standards and procedures for assessing coal quality, inspects coal quality, performs an arbitrator role in the event of quality disputes, issues project approvals, collects excise duties and manages coal-related statistics.⁵⁴

State governments: Approve mining licences and leases — which are required before the Ministry of Coal grants final project approval — and sets royalty rates.

Coal production in India is dominated by Coal India Limited, with smaller producers making up the balance. Key producers are:

- **Coal India Limited ('Coal India'):** Formed as a holding company in 1975, incorporating the state-owned companies that were created following the nationalisation of India's coal assets. The government owns a 75 per cent stake in Coal India, which continues to dominate coal production in India, accounting for over 80 per cent of India's total coal production (Figure 1.10).

Coal India is targeting coal production of 660 million tonnes in the 2019–20 financial year (April 2019 to March 2020), as laid out in the 2019 MoU with the Ministry of Coal. The target represents an increase in production of 8.7 per cent on the previous year's production of 607 million tonnes, which came in just below the 2018–19 target of 610 million tonnes.

Of the coal that Coal India supplies to power plants, around 80 per cent is through long-term fuel supply agreements (FSAs), and the rest is through e-auctions. FSA prices are generally much lower than those obtained through e-auctions.⁵⁶

- **Singareni Collieries Company Limited (SCCL):** Accounts for around 10 per cent of India's coal production, which is primarily supplied to southern India. The central government has a 49 per cent interest in SSCL, with the state government of Andhra Pradesh owning the other 51 per cent interest.
- **Captive producers:** Account for around 8 per cent of Indian production. The government allows privately-owned end-users (such as electricity generators and industrial sectors like cement production) to produce their own coal, through the auction of coal blocks. The producers are referred to as 'captive', as the coal can only be used in approved activities, and cannot be traded or exported, although any surplus production can be sold to Coal India. Recent reforms have sought to relax these restrictions (see Chapter 2).

Figure 1.10: India's thermal coal production by source



Notes: Production is for the Indian Financial Year, beginning in April

Source: IHS (2019) India coal data tables, July 2019.

Coal imports

Trends and policies

Prior to 2003, India was either at, or close to, total self-sufficiency in thermal coal. A combination of rapidly increasing consumption and stalling production underpinned a surge in India's coal imports from the mid-2000s onwards (Figure 1.11). In 2013, India overtook Japan to become the world's second largest thermal coal importer, and has increasingly become a driving force in international thermal coal markets.

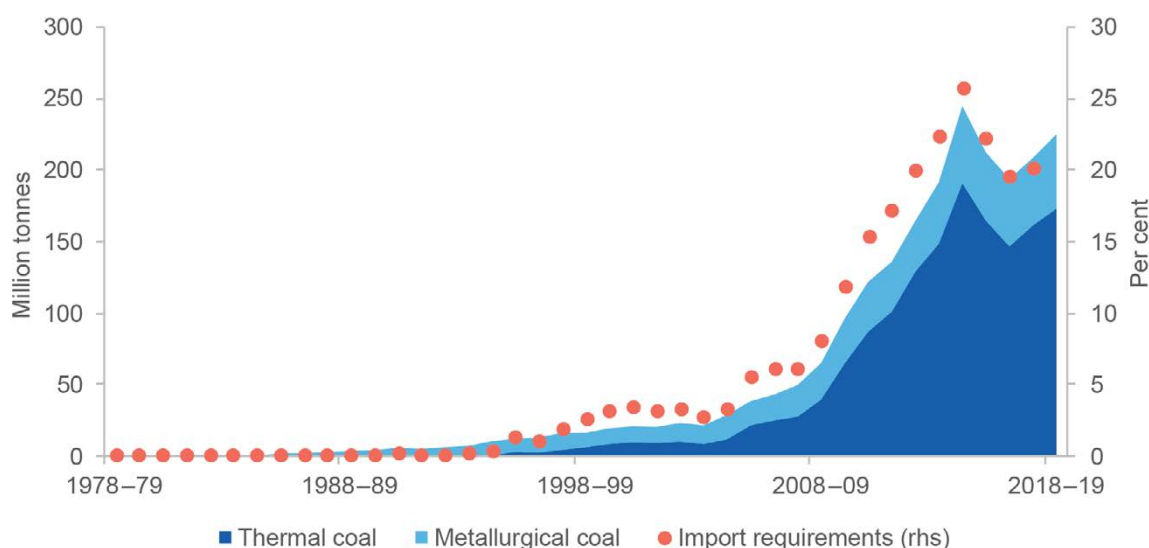
Imports declined for a couple of years beginning 2013–14, due to government efforts to boost production combined with slowing industrial production growth (which weighed on power demand). However imports bounced back in the subsequent years, as power demand rebounded. India now relies on imports for around a fifth of its thermal coal consumption.

Despite the ongoing government target of self-sufficiency, the power and industrial sectors have had to source thermal coal from the seaborne market, with domestic production and infrastructure capacity failing to keep pace with consumption. Coal India has missed its production target every year since 2011, although it came close in 2018–19. It is likely that achieving self-sufficiency in thermal coal will remain on the Indian government's agenda.⁵⁷

Import sources

Indonesia has been the primary source of thermal coal imports for India, driven by two key factors. The similar properties of Indonesian and Indian coal makes it easy to substitute Indonesian coal into India's coal-fired power generation fleet, which has largely been designed for low-energy, high-ash coal. The relatively low cost of Indonesian coal is also appealing to Indian buyers, who are relatively price sensitive.

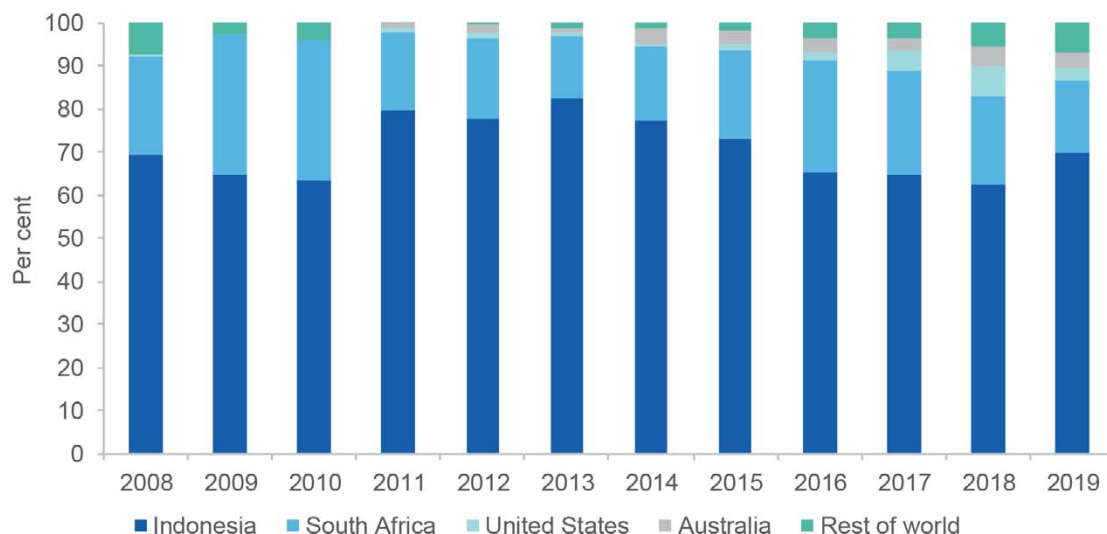
Figure 1.11: India's coal imports and thermal coal self-sufficiency



Notes: Import requirements are thermal coal imports as a share of total thermal coal consumption.

Source: IEA (2018) Coal Information 2018, IHS (2019) India coal data tables, June 2019, Indian Department of Commerce (2019) Export Import Data Bank

Figure 1.12: India's thermal coal imports by source



Notes: 2019 data is for January to May

Source: IHS (2019) India coal data tables, June 2019

India also imports smaller volumes of thermal coal from the US, Australia, South Africa, Colombia, and Russia (Figure 1.12). Imports from the US have increased in recent years, driven by a ban on petroleum coke (or 'petcoke') use in the three states surrounding New Delhi, to improve air quality. Petcoke is a refinery by-product used as a cheaper substitute for coal, and is more carbon and sulphur-intensive. As a result of the ban, buyers replaced local petcoke with coal from the US Northern Appalachia region — which has comparable costs on a per kilocalorie basis, but lower sulphur content.⁵⁸

Coal consumption

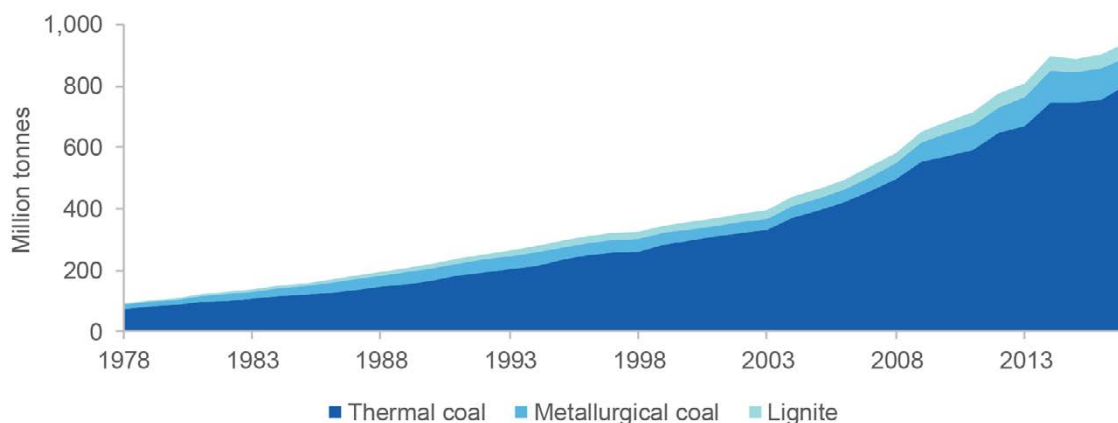
India is the world's second largest coal consumer, behind China, with coal consumption reaching 942 million tonnes in 2017:

- thermal coal accounts for 86 per cent (or 806 million tonnes) of India's coal consumption
- lignite (or brown coal) accounts for 5 per cent (or 47 million tonnes)
- metallurgical coal accounts for 9 per cent (or 89 million tonnes).⁵⁹

Coal consumption has grown rapidly in India over the last two decades, primarily driven by substantial growth in thermal coal use, which increased at an annual average rate of 6.3 per cent between 1978 and 2017 (Figure 1.13). The power sector accounts for almost 70 per cent of India's coal consumption⁶⁰ and thus remains central to the outlook for coal consumption in India.

In more recent years, metallurgical coal consumption has increased considerably, driven by India's rapidly expanding steel sector. The 2017 National Steel Policy⁶¹ contains an ambitious plan for India's steel capacity to reach 300 million tonnes by 2030. Other industrial sectors also use coal, including the cement industry and brick manufacturing.

Figure 1.13: India's coal consumption



Source: IEA (2018) Coal Information

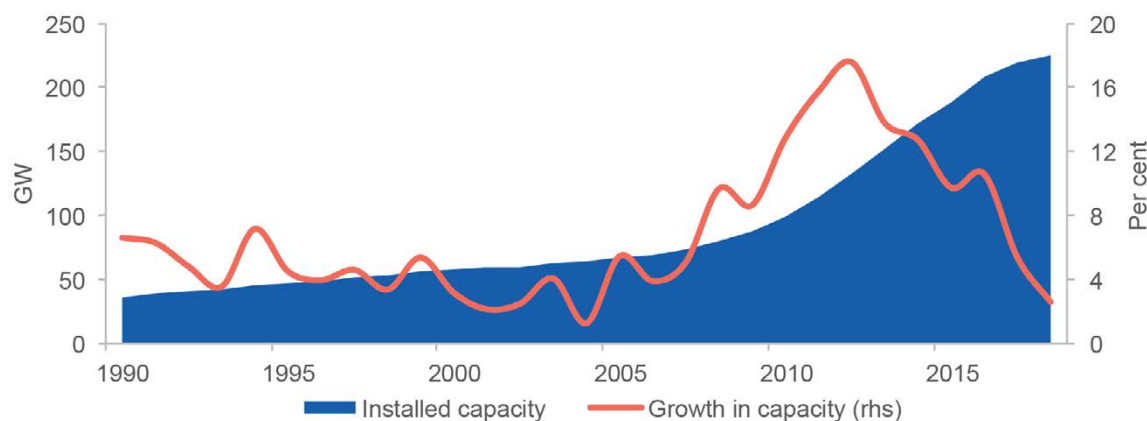
Coal-fired power generation

India has invested heavily in new coal-fired power generation over the past few decades, in response to rapid growth in electricity consumption and shortfalls in energy supply. In mid-2019, installed coal-fired power capacity totalled over 200 GW.⁶² The rate of growth in India's coal-fired power generation accelerated in the mid-2000s, with installed capacity more than doubling in just six years (Figure 1.14).

The pace of growth in power-generation capacity has declined sharply since 2012. In 2018, an

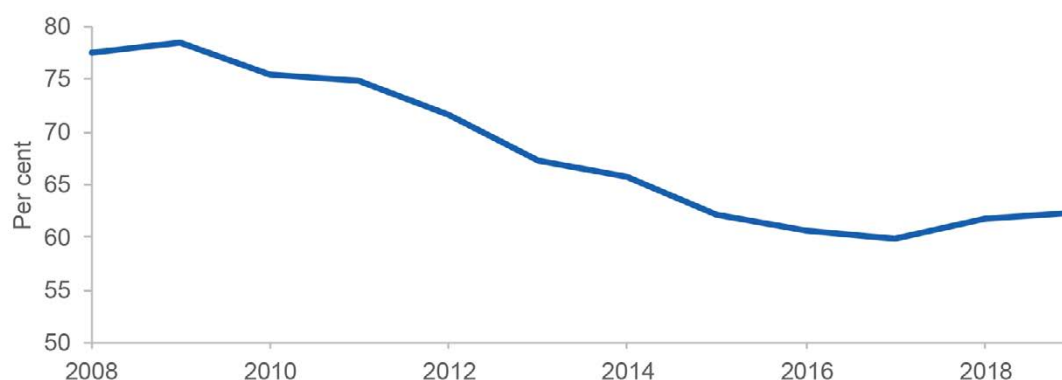
estimated 5.7 GW of coal-fired power capacity was added, the lowest rate of addition in more than a decade. The sharp decline has been driven by slowing investment and growing cancellations of coal-fired power projects, with the total stock of cancelled capacity reaching almost 300 GW.⁶³ The surge in project cancellations is a result of a glut in power supply and underutilisation of existing coal-fired power capacity. Utilisation rates for coal-fired power stations have steadily declined over the last decade and remain low at around 60 per cent (Figure 1.15).

Figure 1.14: India's installed coal-fired power capacity



Source Platts (2019) World Electric Power Plants database, March 2019.

Figure 1.15: Plant load factor at India's coal-fired power stations



Notes: 2019 data point is for the year average to May. A plant load factor (PLF) is a measure of average capacity utilisation.

Source: IHS Markit (2019) India coal data tables, June 2019, based on Central Electricity Authority data.

Coal-fired power plants have remained underutilised because power producers have struggled to sell all the electricity they produce from existing plants, due to weaker than expected electricity demand. India's energy demand has grown at a slower pace than original government forecasts, with industrial activity growing more slowly than anticipated. Further, state-owned distribution companies — which are the key buyers of electricity — have struggled to increase purchases amid large debts and financial losses, due to pricing, theft and other issues (discussed earlier in this chapter). An increase in renewable capacity — which has more than doubled in the past five years (see Figure 1.4) — and improvements in energy efficiency have weighed further on demand.⁶⁴

Nevertheless, with a large share of India's installed capacity relatively new, the existing fleet has another two decades or so of operational life remaining. Even with a subdued outlook for new additions to capacity, coal consumption is expected to continue to grow in the short-term. The outlook for India's coal-fired power capacity and coal consumption is discussed in Chapter 2.





Outlook for coal in India

India is one of the world's most rapidly expanding economies, and its population is expected to surpass China's in the late 2020s. As such, India's future energy requirements are expected to increase rapidly, and the country looks set to drive much of the growth in world energy demand.

The composition of India's future energy mix — and thus the outlook for coal in India — will depend on how India addresses the challenges faced in its energy, electricity and coal sectors, including balancing economic growth and improving access to energy while limiting air pollution and carbon emissions.

This chapter examines the IEA's 2018 World Energy Outlook (WEO) and other projections for India's future coal demand, and explores prospects for further growth in India's thermal coal imports.

2.1 India's energy mix

The IEA's WEO provides three scenarios for long-term energy use and the mix of sources that will supply this energy. The scenarios are not a forecast, but rather present pathways along which the world could travel if certain conditions are met. Box 2.1 describes the assumptions underpinning the IEA's three WEO scenarios.

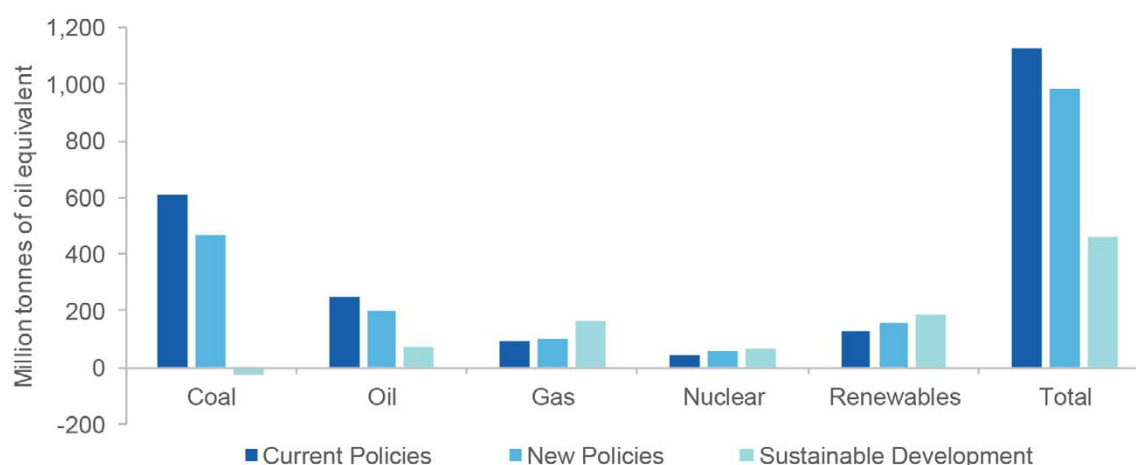
Under the IEA's New Policies Scenario, India would be the single largest source of new energy demand to 2040, with energy demand almost doubling. Even under the IEA's Sustainable Development Scenario — where energy demand growth is more subdued — India's energy requirements increase by over 50 per cent. India is expected to remain the world's third largest energy consumer, but will rapidly close the gap on China and the US.

Under both the Current Policies Scenario and the New Policies Scenario, coal (both thermal and metallurgical) account for the vast majority of the incremental increase in Indian energy

demand, with oil and renewables the next largest contributor. Under the Sustainable Development Scenario, where the goals of the Paris Agreement are met, renewables and gas would grow more rapidly, with coal consumption largely unchanged (Figure 2.1).

Under all three scenarios, coal (both thermal and metallurgical) is expected to remain an important part of India's energy mix (Figure 2.2). Under the Current Policies Scenario, coal would increase its share of India's energy mix to 50 per cent over the next two decades. Coal's share would drift lower in the New Policies Scenario but would fall more sharply under the Sustainable Development Scenario. However, even under the Sustainable Development Scenario — where growth in renewable energy is strongest — coal would still account for 28 per cent of India's total energy demand in 2040.

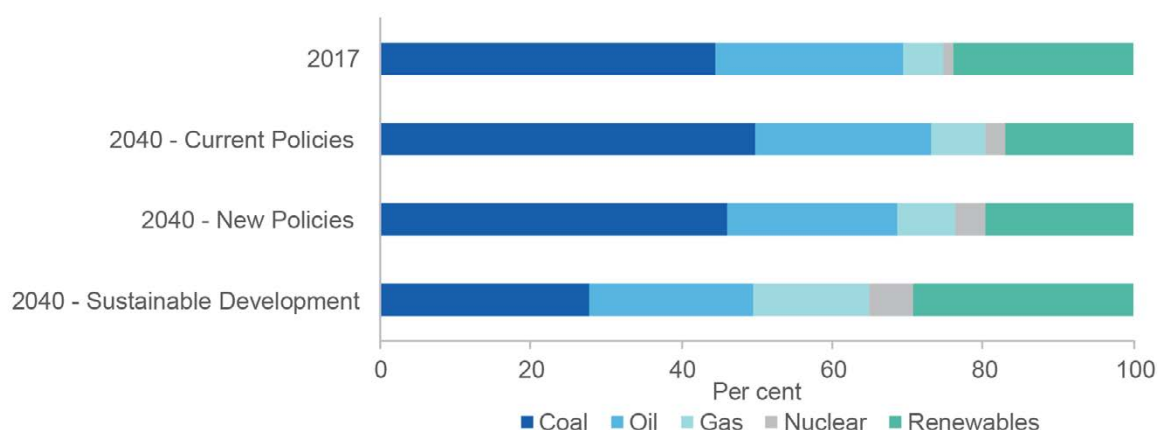
Figure 2.1: Change in India's energy use by source under different IEA scenarios



Notes: Renewables includes hydro, bioenergy and other renewables (wind, solar etc.)

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

Figure 2.2: India's energy mix under three different IEA scenarios



Notes: Renewables includes hydro, bioenergy and other renewables (wind, solar etc).

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

Box 2.1: IEA World Energy Outlook scenarios and assumptions

IEA WEO scenarios

The IEA WEO scenarios are primarily underpinned by different assumptions about the evolution of government policies on energy and climate.

The central **New Policies Scenario** incorporates policies and measures that governments have already put in place, and takes into account the effects of announced policies in official targets and plans. This includes the Nationally Determined Contributions of the Paris Agreement, although these may also be supplemented or superseded by more recent announcements.

The **Current Policies Scenario** considers the impact of only those policies and measures that are firmly enshrined in legislation as of mid-2018, and shows the lower bound estimate of any targeted range of outcomes. The Current Policies Scenario provides a conservative assessment of where existing policies might lead the energy sector in the absence of additional impetus from governments, and a reference case against which the impact of new policies can be measured.

The **Sustainable Development Scenario** starts from the objectives of the Sustainable Development Goals of the United Nations, and then works backwards to assess what combination of actions would deliver them. The objectives include:

- universal access to affordable, reliable and modern energy services by 2030
- a substantial reduction in air pollution
- effective action to combat climate change (aligned with the goal of the Paris Agreement to hold the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels).

IEA WEO assumptions for India

The IEA makes a number of key assumptions for India in its scenarios. GDP growth is assumed to average over 6.5 per cent a year to 2040, almost double the rate of average global growth, but slightly lower than India's 7.1 per cent growth in 2018.⁶⁵ India's population is assumed to grow by

250 million people, overtaking China to become the world's most populous country. The urbanisation rate is assumed to be almost half the population by 2040, up from around a third today.

Key policies in India included in the Current Policies Scenario are:

- the National Mission on Enhanced Energy Efficiency
- the National Clean Energy Fund to promote clean energy technologies based on a levy of 400 rupees (US\$6) per tonne of coal
- the Make in India campaign to increase the share of manufacturing in the national economy.

Key policies in India included in the New Policies Scenario are:

- a Nationally Determined Contribution greenhouse gas target: reduce emissions intensity of GDP to between 33 to 35 per cent below 2005 levels by 2030
- a Nationally Determined Contribution energy target: achieve about 40 per cent cumulative installed capacity from non-fossil fuel sources by 2030, with the help of technology transfer and low-cost international finance
- efforts to expedite environmental clearances and land acquisition for energy projects, and
- the opening of the coal, gas and oil sectors to private and foreign investors.

Table 2.1 sets out the IEA's macroeconomic and technology cost assumptions for India.

Table 2.1: Key IEA WEO assumptions for India

	Unit	2017	2040
Population	Million	1,339	1,605
— Compound annual growth rate	Per cent	1.0 (2017 to 2025)	0.8 (2017 to 2040)
— Urbanisation	Per cent	34	46
Economic growth			
— CAGR	Per cent	7.8 (2017 to 2025)	6.5 (2017 to 2040)
Selected technology costs (VALCOE)			
— Nuclear	\$/MWh	70	70
— Coal	\$/MWh	60	50
— Gas CCGT	\$/MWh	90	80
— Solar PV	\$/MWh	80	65
— Wind onshore	\$/MWh	65	55
— Wind offshore	\$/MWh	160	100

Source: IEA (2018) World Energy Outlook 2018, pp. 598, 605, International Energy Agency

2.2 India's coal consumption

Government policies

Indian government policies and plans all point to growing coal consumption — until at least the mid to late 2020s, and possibly beyond — to meet India's growing energy needs. A common theme emerges in these plans, with the emergence of renewables and storage flagged as a key uncertainty in the long-term outlook for coal consumption.

National energy policy

India's 2017 draft national energy policy (see Chapter 1) expects coal-fired capacity to grow to between 330 and 441 GW by 2040, translating into thermal coal demand of between 1.1 and 1.4 billion tonnes.⁶⁶ However, the draft national energy policy also notes the challenges in projecting coal demand, with the role of coal in India's energy future dependent on the evolution of renewables and storage technologies, especially in the longer term.

National electricity plan

The 2018 national electricity plan (see Chapter 1) models thermal coal requirements based on projections of coal-fired power capacity. Thermal coal demand for use in power generation is projected to increase from 630 million tonnes in 2017–18 to 735 million tonnes in 2021–22, and to 877 million tonnes in 2026–27 (Table 2.2).

Coal Vision 2030

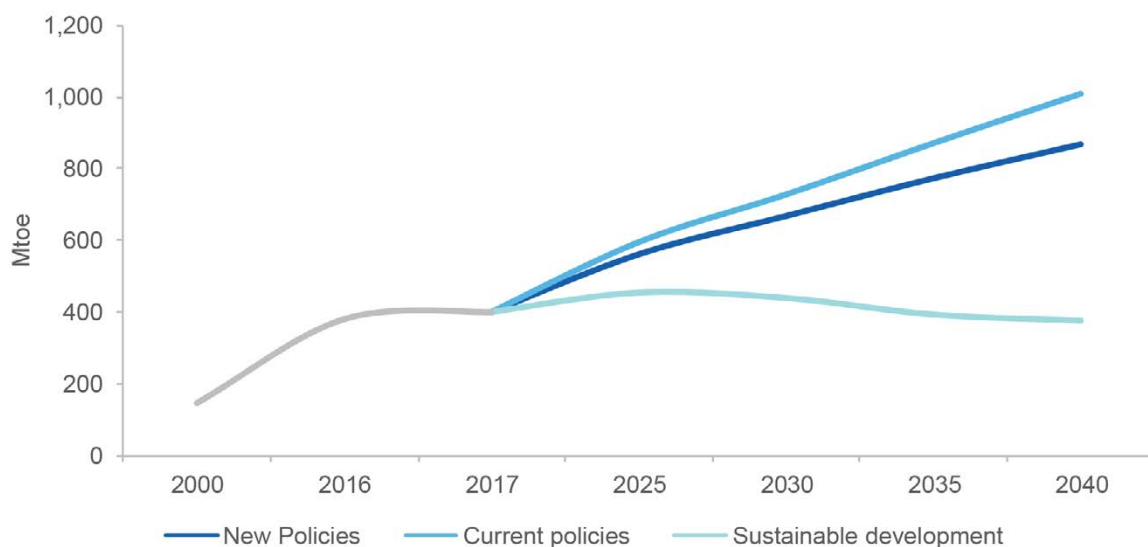
In 2018, Coal India commissioned a study — Coal Vision 2030 — to assess future demand scenarios for the coal sector in India.⁶⁷ The report finds that coal demand will continue to grow, until at least 2030, and perhaps beyond. The projections for India's thermal coal demand have a wide range, with projected demand ranging between 1.15 billion tonnes and 1.75 billion tonnes in 2030, reflecting the uncertainties underpinning the outlook for thermal coal.

Table 2.2: Projected coal requirements in India's National Electricity Plan

	Unit	2017–18	2021–22	2026–27
Renewable capacity	GW	69	175	275
Coal-fired power capacity	GW	197	217	238
Coal-fired power generation	TWh	958	1,119	1,336
Coal requirement	Mt	584	685	827
Coastal power plant imports	Mt	46	50	50
Total coal requirement	Mt	630	735	877

Source: CEA (2018) National Electricity Plan, January 2018, Central Electricity Authority.

Figure 2.3: India's coal demand under different IEA scenarios



Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

IEA World Energy Outlook

The role of policy and technology in determining India's future coal consumption is reflected in the IEA's WEO projections. The IEA's three scenarios produce widely divergent outcomes for India's coal consumption, highlighting both the dominant role of coal in India's power sector, and the fact that coal is one of the most emission-intensive fuels. Coal demand increases in all scenarios to 2025, but the pathways quickly diverge (Figure 2.3):

- in the New Policies Scenario, India's coal demand more than doubles between 2017 and 2040, increasing at an annual average rate of 3.4 per cent, to reach 868 mtoe.
- in the Current Policies Scenario, coal consumption rises at a more rapid pace of 4.1 per cent to reach 1,009 mtoe in 2040.
- in the Sustainable Development Scenario, coal consumption continues to grow to 2025 — although at a slower pace — before declining to 376 mtoe in 2040.

2.3 Coal-fired power capacity and generation

Understanding the Indian power sector — which accounts for almost 70 per cent of India's coal consumption⁶⁸ — is fundamental to understanding India's future thermal coal demand. There is a

divergence in the outlook for coal-fired power capacity and coal-fired power generation, although both will influence thermal coal consumption.

Coal-fired power capacity

Project pipeline and government plans

Growth in Indian coal-fired power capacity has slowed substantially in recent years (see Chapter 1) and will likely remain subdued, especially in the short term. There is almost 40 GW of capacity currently under construction (Table 2.3).

Despite another 45 GW of capacity in the planning phase, it is unlikely that much of this capacity will eventuate in the short term.

In its January 2018 national electricity plan (see Chapter 1), the Central Electricity Authority noted that beyond projects already under construction, no new coal-based capacity will be required before 2021–22 to meet energy demand.⁶⁹ Existing plants are currently running well below capacity, and there is considerable scope to ramp up capacity utilisation to meet growing demand. 26 GW of new coal-fired power capacity is expected to come online between 2022–23 and 2026–27 to meet growing electricity demand (Table 2.2).

Table 2.3: Coal-fired power station status in India

	Capacity (GW)	Number of units
Operating	230.6	1,333
Construction	39.0	75
Planned	45.1	89
Cancelled/deferred	310.6	580
Closed	8.9	195

Notes: The estimate for installed capacity differs from the Central Electricity Authority (CEA) estimates of 201 GW as at June 2019, due to time-dependent variations in unit capacity and operating status, and the inclusion of captive (non-utility) power capacity in the Platts World Electric Power Plants database. The most recent CEA estimates are provided in Chapter 1.

Source: Platts (2019) World Electric Power Plants database, March 2019

IEA World Energy Outlook

The outlook for coal-fired power capacity diverges substantially in the IEA's three scenarios. In the IEA's New Policies Scenario, coal-fired power capacity increases at an annual average rate of 2.8 per cent to reach 421 GW in 2040, up from 224 GW in 2017. In the Sustainable Development Scenario, coal-fired power capacity declines sharply to 166 GW in 2040. Achieving the Sustainable Development Scenario would be challenging for India, and would require a significant shift in government policy and the energy mix.

If India's future energy mix is to reflect the Sustainable Development Scenario, coal consumption would need to peak before 2030. However, the current fleet of coal-fired power plants in operation and under construction already

indicates that this is unlikely. A large share of India's installed capacity is relatively new — more than half of India's current coal capacity was installed in the last decade⁷⁰ — and have many years of operational life remaining. Relatively new coal-fired power capacity may need to close prematurely, which would further exacerbate economic costs. The Indian government's 2018–19 annual economic survey warned against abruptly halting coal-fired power stations before the end of their useful lives, due to the risks it presents to both the Indian banking sector and the stability of the electricity grid.⁷¹ The report notes that, 'considering the intermittency of renewable power supply, unless sufficient technological breakthrough in energy storage happens in the near future, it is unlikely that thermal power can be easily replaced as the main source of energy for a growing economy such as India.'

Gas capacity would need to grow by a factor of almost seven from its current capacity of 29 GW to reach 197 GW in 2040 — more than double than in the New Policies Scenario. India has considerable reserves of gas, but faces regulatory, social licence and cost challenges in developing them; gas exploration has remained low due to a lack of development incentives. Using imported LNG in electricity generation may be difficult for India's price-sensitive utilities.

Nuclear capacity would also need to grow by a factor of almost seven to reach 47 GW — beyond the already ambitious target of 39 GW — and hydro capacity would need to more than double to reach 130 GW by 2040. The availability of water and the distance of India's hydro schemes from key demand centres — in addition to the socioeconomic impacts — are likely to remain substantial barriers to growth in hydro capacity.

There would also need to be substantial and sustained investment in renewable technologies under the Sustainable Development Scenario. Solar PV capacity would need to grow by a factor of 34 to reach 651 GW by 2040, and produce 1,125 TWh in 2040 — 50 per cent higher than the New Policies Scenario projection. Wind would need to grow by a factor of over nine to reach 512 GW, and produce 749 TWh of power in 2040 — 50 per cent higher than the New Policies

Scenario projection. Renewables have surpassed expectations in India, with a faster than expected uptake and a sharper than expected decline in costs in recent years. The potential implications of a growing share of renewables is discussed in further detail in the next section.

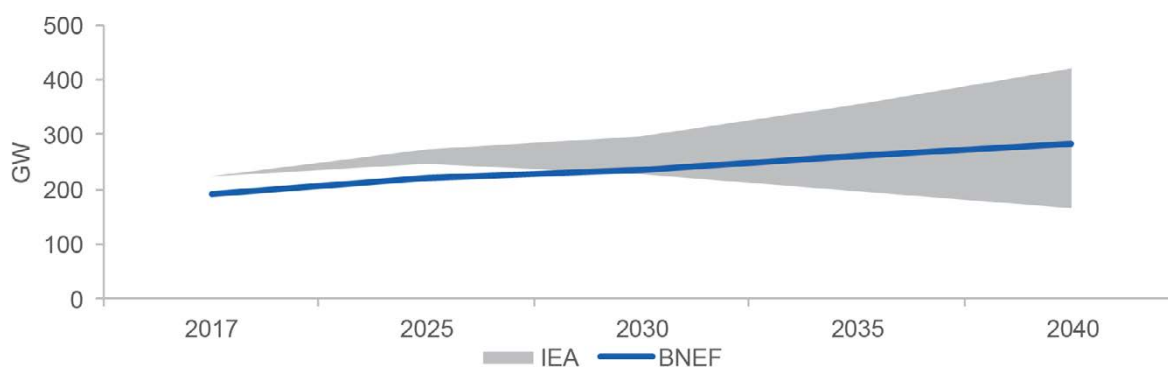
BNEF's New Energy Outlook

In contrast to the IEA's World Energy Outlook, which is largely driven by policy scenarios, Bloomberg New Energy Finance's (BNEF) New Energy Outlook projections emerge from least-cost optimisation modelling. This exercise is driven by the cost of building different power generation technologies to meet projected peak and total demand.

BNEF projections suggest that India's coal-fired power capacity is expected to grow for at least the next few decades, although at a slower pace than renewables. Projected coal capacity falls to somewhere between the IEA's New Policies and Sustainable Development scenarios (Figure 2.4). According to BNEF projections, coal capacity is not expected to peak until 2043 at 289 GW.

The BNEF projections also indicate that solar and wind will likely fall short of the levels needed in the Sustainable Development Scenario; solar PV capacity is projected to reach 586 GW, and wind capacity is projected to reach 226 GW in 2040.

Figure 2.4: India's projected coal-fired power capacity



Notes: The IEA projections represent the range between the Sustainable Development and Current Policies Scenarios.

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency; BNEF (2019) New Energy Outlook, Bloomberg New Energy Finance.

Coal-fired power generation

There is a divergence in the outlook for capacity and generation in the short term. While coal-fired power capacity growth will likely remain subdued in the near term — due to the factors outlined above — there is scope to substantially increase coal-fired power generation. Currently low utilisation rates and ongoing growth in energy demand could increase coal-fired generation and thus coal consumption.

IEA World Energy Outlook

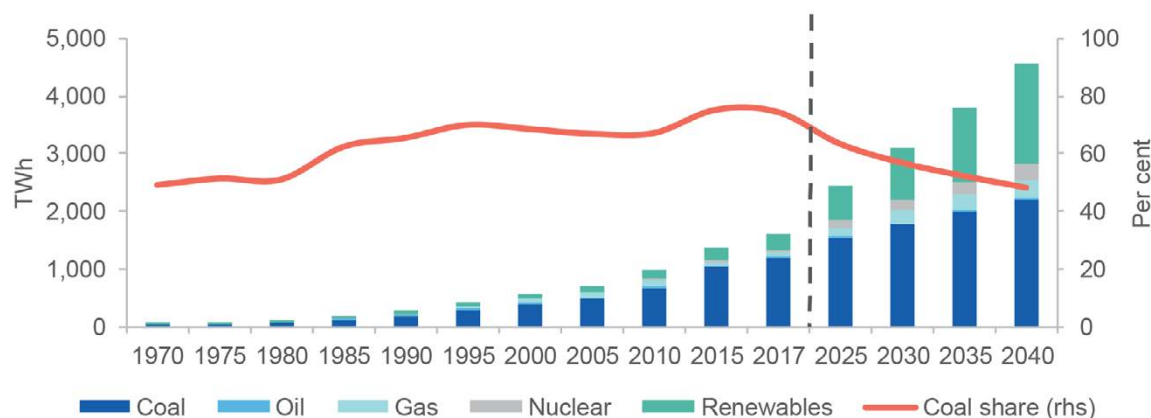
In the IEA's New Policies Scenario, electricity generation increases at an annual average rate of 4.6 per cent to 4,554 TWh in 2040. While coal's share of power generation declines from 74 per cent in 2017 to 48 per cent in 2040, coal-fired electricity generation increases in absolute terms — at an annual average rate of 2.7 per cent, to reach 2,195 TWh — and remains

the main fuel in power generation (Figure 2.5). Power demand is growing rapidly in India, and coal is expected to continue to play a key role in the energy mix. Coal consumption for power is likely to grow more slowly than generation — at an annual average rate of 2.5 per cent — as a result of higher efficiency in newer coal-fired power plants.

BNEF New Energy Outlook

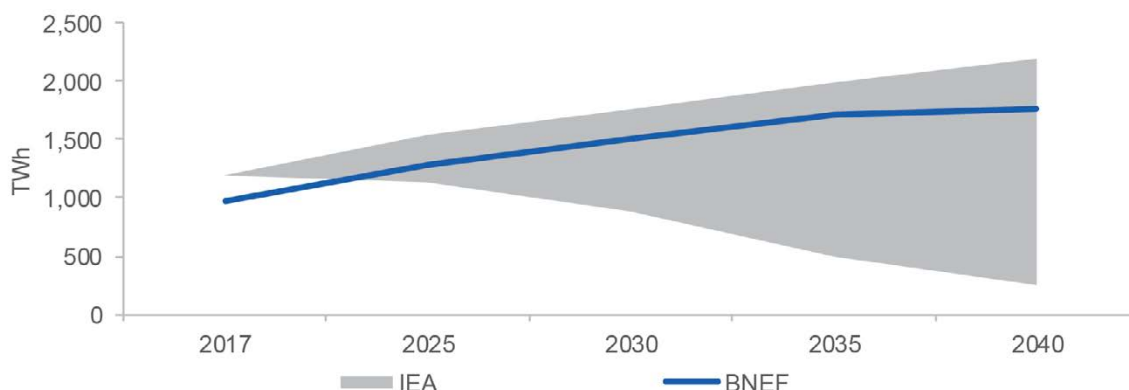
The expected growth in India's coal-fired power generation is echoed in BNEF New Energy Outlook projections (Figure 2.6). BNEF's projections show that coal-fired power generation could lie somewhere between the IEA's New Policies Scenario and Sustainable Development Scenario projections, but will likely lie closer to the former. Sustained electricity demand growth in India is expected to drive ongoing growth in coal-fired power generation up to the late 2030s, before declining (Figure 2.7).

Figure 2.5: India's electricity generation by source, and coal's share of electricity generation in the New Policy Scenario



Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

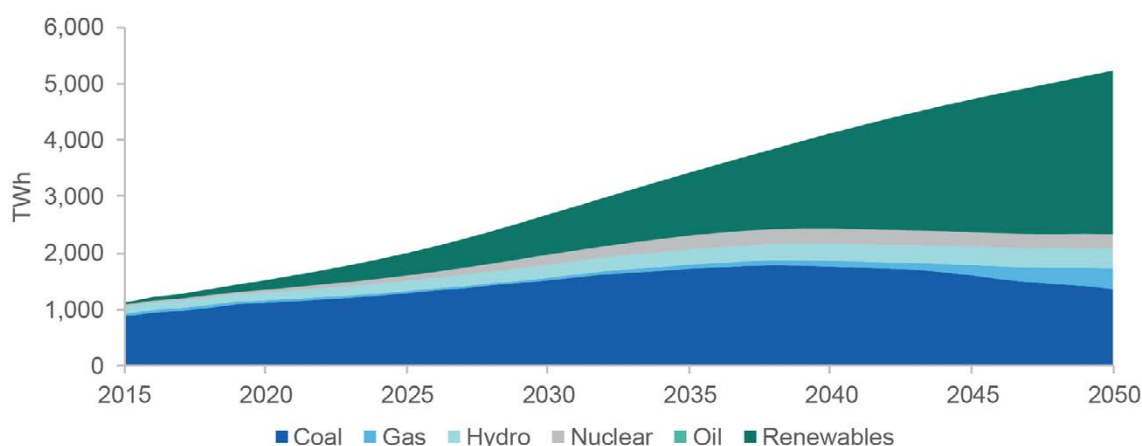
Figure 2.6: India's projected coal-fired power generation



Notes: The IEA projections represent the range between the Sustainable Development and Current Policies Scenarios.

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency; BNEF (2019) New Energy Outlook, Bloomberg New Energy Finance.

Figure 2.7: India's power generation by technology



Source: BNEF (2019) New Energy Outlook

Key factors influencing coal-fired power capacity and generation

A number of persistent challenges and other factors are expected to influence future coal-fired power generation and new investment in coal-fired power capacity in India.

Financial stress

Coal-fired power plants are one of the largest categories of stressed assets in India. In 2018, the Ministry of Power's Standing Committee on Energy reported that 34 coal-fired power stations, with a combined capacity of 40 GW (around 21 per cent of capacity at the time), were financially stressed. The 34 projects have been caught up in insolvency proceedings

through India's National Company Law Tribunal (NCLT).⁷² More recent estimates suggest that the amount of financially-stressed capacity has climbed even higher, to 75 GW.⁷³ As at March 2019, around 311 GW of planned projects had been cancelled or deferred (Table 2.3).

There are several key factors that have contributed to the financial stress of coal-fired power plants. Coal supply constraints are the primary driver. Domestic coal shortages and a lack of guaranteed coal supplies have resulted in some plants buying more expensive coal on the open market, or have left plants unable to procure enough coal to produce power and thus generate income to service their debts.⁷⁴ The financial challenges facing distribution companies

(see Chapter 1) have also impacted the coal-fired power sector, due to reduced purchases and delayed payments to power producers.

Overcapacity in thermal generation in India, coupled with the rapid expansion in renewables, has further added to financial pressure on coal power assets. However, issues around overcapacity of coal-fired power will likely be resolved over the next decade as power demand continues to grow.

The Indian Government implemented a series of policy measures in 2019 to alleviate the financial stress of the coal-fired power sector, which has revived an estimated 11 GW of capacity in the year to date.⁷⁵ These measures include debt-restructuring schemes, providing power procurement guarantees to projects, and improve coal linkages (under which private power producers will be provided with coal supply agreements through competitive e-auction bidding instead of by ministerial recommendations).

Nevertheless, India's coal power assets are facing growing difficulties attracting capital and insurance coverage due to the financial challenges facing the sector.⁷⁶ International financing for coal power projects has largely stalled, and the public sector banks and lenders which fuelled India's rapid growth in coal capacity a decade ago are facing financial stress due to the high levels of non-performing assets in the sector.⁷⁷

Technology

The IEA's 2018 WEO notes that technology choices are vital to the outlook for coal in power generation. Two potential technological game changers are carbon capture and sequestration (CCS), and increasing the flexibility of coal-fired plants to complement the variable nature of renewables.

While India showed strong interest in CCS through domestic research and development projects and international collaboration, momentum has recently slowed.⁷⁸ Beyond small scale government grants — released by the Indian Ministry of Science and Technology in

2018 to fund CCS research with partner countries⁷⁹ — there have been no new government-funded projects since 2015. CCS deployment in India has faced substantial barriers to date. Key challenges include the capital and operational costs, the inability to pass on the costs to distribution companies, and a lack of reliable geological storage data. Despite the slow progress in CCS deployment, India noted its interest in obtaining technological and financial support in implementing CCS in its latest submission to the United Nations Framework Convention on Climate Change (UNFCCC).⁸⁰

There are relatively stronger prospects for turning India's coal-fired fleet into a more flexible asset. Coal-fired power plants will remain important in India's power sector as the share of variable renewables grows, with neither gas nor hydro expected to play a major role in providing flexibility to the electricity system. India's national energy plan (see Chapter 1) notes that the flexible operation of coal-fired power plants has the potential to create a synergy between coal and renewables, rather than a dichotomy. The IEA's 2018 WEO notes that there is a currently a significant reserve margin in the system to allow for flexibility, provided that the right regulations, mechanisms and incentives are in place. However there are challenges to resolve. For example, some states in India have resisted the imposition of central government regulations on coal-fired power plants, due to costs and technical difficulties.⁸¹

Renewables

Over the last few years, renewables have surpassed expectations in India, with capacity rapidly expanding and costs falling dramatically (Box 2.2). The longer-term outlook for coal-fired power capacity depends heavily on the pace of expansion in renewable generation capacity.

The Indian government has set a goal of 500 GW of renewable capacity (excluding large-scale hydro) by 2028. However, the target is largely considered to be aspirational⁸², and India will need to overcome significant challenges to achieve its capacity targets for renewable energy generation (see Chapter 1).

Analysis by Brookings India⁸³ highlights the scale of the challenge. Reaching the target would require 42 GW of capacity additions yearly. This is in stark contrast to the 12 GW of renewables capacity that India added in 2017–18, and 9 GW added in 2018–19. If the 500 GW target is achieved, substantial deployment of grid-storage would be required to balance the system, which

would require a considerable increase in the cost of solar. India's 500 GW target is well above the projected 333 GW of renewables capacity in BNEF's New Energy Outlook projections. BNEF's analysis concludes that coal-fired power generation is unlikely to peak by 2030 due to these challenges.

Box 2.2: Electricity technology costs in India

The cost of renewable energy generation has fallen rapidly in recent years, and its price relative to coal-fired power generation has been the subject of much discussion. The cost of renewable generation compared to coal depends on the measure used, whether renewable generation is accompanied by storage, and whether the focus is on new or existing coal-fired power generation.

A key measure of the cost of different generation technologies is the levelised cost of electricity (LCOE). According to a 2018 Brookings study, the LCOE of new renewable generation without storage is lower than that of new coal-fired power generation in India.⁸⁴ The low LCOE of renewables without storage helps to explain their rapid uptake in India in recent times. However, when the cost of new renewable generation is compared to existing coal-fired power generation, the economics currently favour coal. The current economics suggests that renewable generation may have difficulty displacing existing coal assets, particularly those located near coal mines.

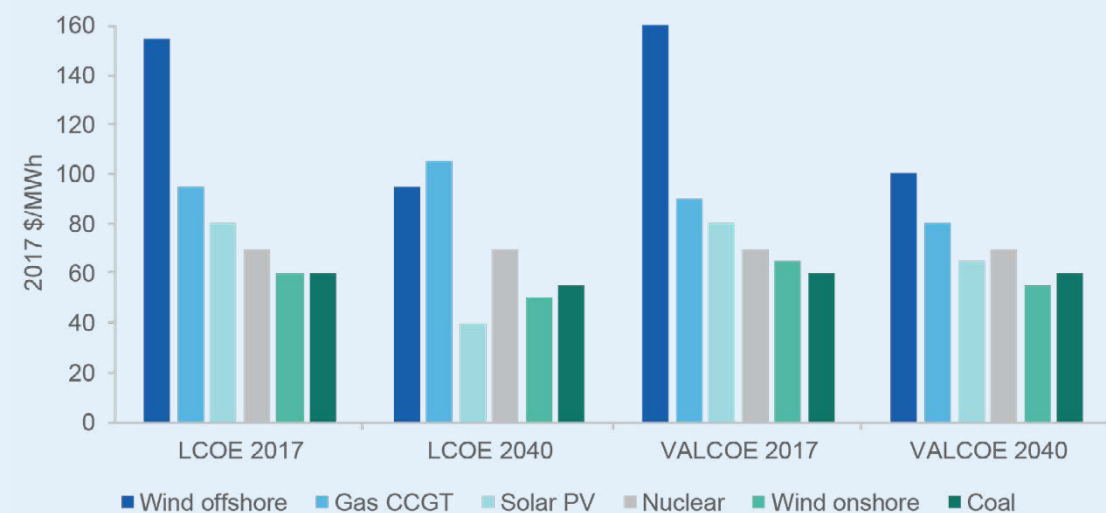
However, as the penetration of renewables increases, the electricity system will increasingly require storage solutions. Brookings' study suggests that renewable generation with battery storage may be competitive with new coal plants, but not with existing coal generation. When, and how much, storage will be required to support increasing renewable penetration is a difficult question, but it may be around 220 GW of capacity according to Brookings — slightly above India's 2022 target, but well below recent India's recently announced 2028 target of 500 GW. Overall, these findings suggest that renewable generation (with or without storage) could struggle to displace existing coal power, and that growing storage requirements for renewables could undermine any cost advantages they have to coal.

A key issue with the LCOE, however, is that the measure does not consider the system-level costs of renewable generation.⁸⁵ These system-level costs include the wear and tear on thermal generators due to the need to vary output to accommodate renewable generation, and the reduced efficiency of thermal generation operating at partial capacity as a result of increased renewable penetration. LCOE also does not capture the value that flexible generation brings to the electricity system. Peak demand in India is usually in the evening, which does not correspond with peak solar output and may not match wind's peak generation. The system-level costs of renewable power generation are likely to become more pronounced as renewable generation capacity in India rises.

The IEA has recently published a value-adjusted LCOE (VALCOE), which adjusts the LCOE by incorporating information on the value of different technologies to the system (specifically, energy, capacity and flexibility value). VALCOE provides a perspective that system planners and

policymakers (rather than investors) might take if they are seeking to minimise costs. Figure 2.8 shows the LCOE's and value-adjusted LCOE's in India for different generation technologies. In 2017, coal's VALCOE was lowest of any technology in India, followed by onshore wind, nuclear, solar PV and gas. Solar PV costs decline sharply on an LCOE basis between 2017 and 2040, but only approach the cost of coal on a value-adjusted LCOE basis. Existing coal power plants, in other words, make an important contribution to system flexibility and reliability.

Figure 2.8: LCOEs and value-adjusted LCOEs in India, 2017 and 2040



Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

2.4 India's coal production

Outlook for India's coal production

Government policies and plans

In order to meet the expected increase in India's coal consumption and reduce reliance on imports, the Indian Government set a target in late 2014 to roughly double Coal India's coal production to 1 billion tonnes by 2020, and to triple total domestic coal production to 1.5 billion tonnes over the same period. In 2018, Coal India's timeframe for the 1 billion tonne target was pushed back to 2025–26, and the Indian government stated that it was reviewing the 1.5 billion target in light of more recent developments.⁸⁶ Coal India cited a range of issues that contributed to the delay, including

changes to India's carbon emission targets, slow industrial growth and energy demand growth, a changing energy mix, environmental challenges and land acquisition difficulties.⁸⁷

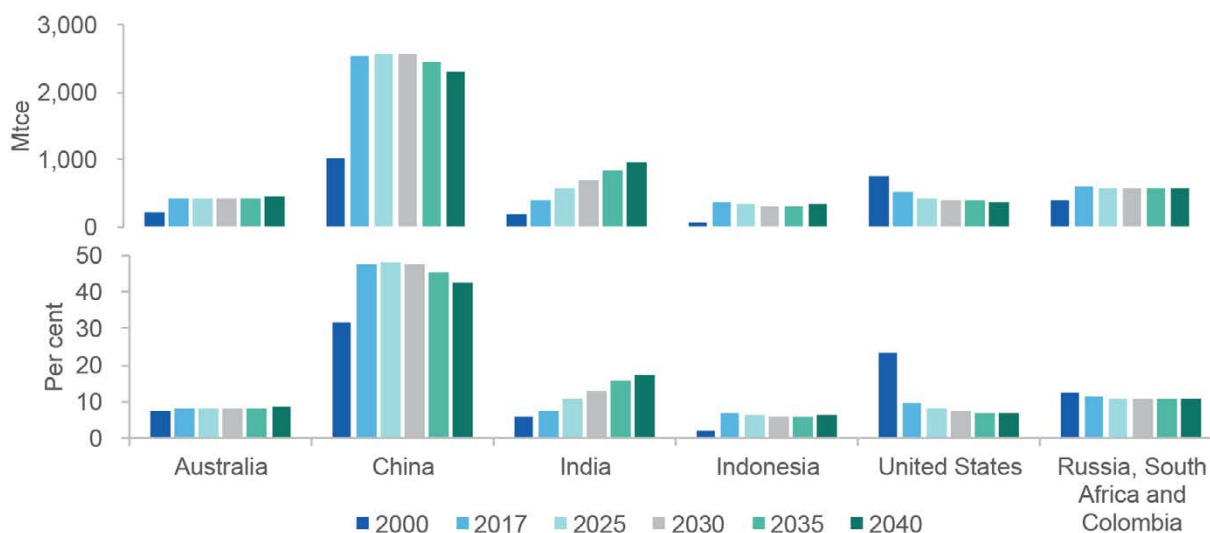
Despite an easing of the ambitious timeframe, production will still need to grow at an annual average rate of 8.5 per cent to achieve the 1 billion tonne target by 2025–26 — more than double the average pace of growth in the last decade. While India's production growth has accelerated in recent years (see Chapter 1), its coal sector continues to face substantial challenges. At the start of 2019, a third of Coal India projects were behind schedule, primarily due to delays in the approvals process.⁸⁸

IEA World Energy Outlook

In the IEA's New Policy Scenario, India's domestic coal production grows at an average annual rate of 5.0 per cent between 2017 and 2025, slower than required to achieve Indian government

targets. In the longer term, India's coal production is projected to increase at an annual average rate of 3.9 per cent to reach 955 mtce in 2040 (Figure 2.9).

Figure 2.9: World coal production, and share of world coal production, IEA New Policies Scenario



Note: The IEA does not provide projections for coal production for the Sustainable Development or Current Policies Scenarios.

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

India's coal production: challenges and recent reforms

While the Indian government has implemented and proposed a range of reforms in an attempt to increase coal production, substantial challenges remain. Approvals and land acquisition remain the primary factors weighing on production growth, with other issues — productivity, competition, investment, transport and domestic pricing schemes — further compounding the challenges. The Indian government will need to continue to pursue reforms and policy changes to address the remaining barriers to production growth.

Approvals, coordination and planning

Greenfield coal projects in India take an extensive amount of time and planning, and are subject to complex processes and bureaucracy. Coal India has identified approvals as a key bottleneck in

increasing production.⁸⁹ To develop a coal mine in India, project proponents need to acquire land, resettle or compensate local communities in some cases, obtain multiple clearances and environmental approvals, and develop supporting infrastructure. The process requires input from multiple agencies across various levels of government, reflecting the complex institutional structure (see Chapter 1). While the government has undertaken structural reforms in the last five years to support the faster development of coal mines⁹⁰, challenges remain. A recent report commissioned by Coal India highlighted that a simplification and streamlining of regulation, and reducing development risks were crucial to achieving its targets.⁹¹

Land acquisition

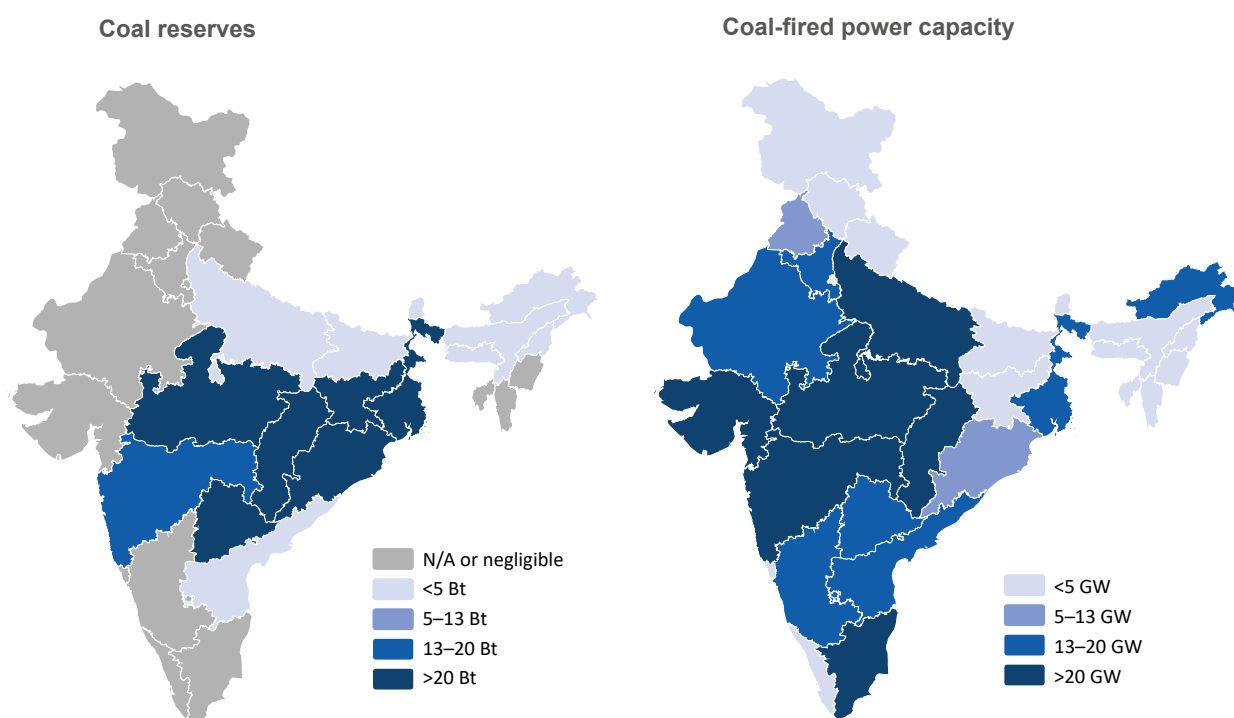
Land acquisition has been a substantial barrier to improving coal supply in India. With coal reserves, rail projects and prospective coal plants in, or near, areas that are privately or state owned, it can be challenging acquiring land for new projects. With India's economy still largely agricultural-based, and 44 per cent of India's workforce engaged in agriculture⁹², new coal projects can affect homes and livelihoods.⁹³ India's land laws are numerous, complex, and sometimes conflicting, with laws administered by various government ministries and departments at the central and state level.⁹⁴ Land reforms have been challenging to date.

The last attempt — in 2015 when the Modi Government attempted to pass a bill to reform aspects of land acquisition law — failed to pass the upper house. Land reforms will need to be progressed for projects to advance at a faster pace.

Transport and infrastructure

Logistics are another key constraint. The majority of India's coal-fired generation capacity is located in the northern and western regions of the country, while coal production is concentrated in the eastern region (Figure 2.10). As such, most of India's domestically-produced coal needs to be transported long distances, adding to costs.

Figure 2.10: India's coal reserves and coal-fired power capacity



Note: Map shows India's territorial claims.

Source: Central Electricity Authority (2019), Ministry of Coal (2019), Department of Science and Technology (2019) Survey of India

In the Indian 2018–19 financial year, almost 60 per cent of coal was transported by rail⁹⁵, and transport costs made up more than a third of the total fuel costs of an average non-pithead power plant in India.⁹⁶ Inadequate rail infrastructure and the cost of transportation have been key barriers to domestic supply growth. Key issues include bottlenecks — with coal stranded at mines because of inadequate rail lines and a shortage of railcars — and line congestion, with dedicated coal freight corridors not yet fully developed, and passenger services given priority over freight.

Coal freight rates are also very high, due to a cross-subsidy between passenger and freight users. Freight tariffs in India are among the highest in the world on a purchasing power parity basis, while its passenger tariffs are among the lowest.⁹⁷ The subsidy — which can distort locational choices for coal-fired power plants, and favours plants close to mines and those on the coast which use imported coal — will be very difficult to address given the political challenges of raising passenger fares.

However, some progress has been made since the 2015 *Coal in India* report. The Indian government has prioritised railway development, with two major railway infrastructure projects completed in the 2018–19 Indian financial year, and a further three projects underway.⁹⁸ The government has also made progress in allocating coal linkages (buying coal from mines close to power plants to save transport costs).⁹⁹

While inadequate rail infrastructure has contributed to the increased reliance on imports, imports also face transportation challenges. Coal imports have also been affected by port

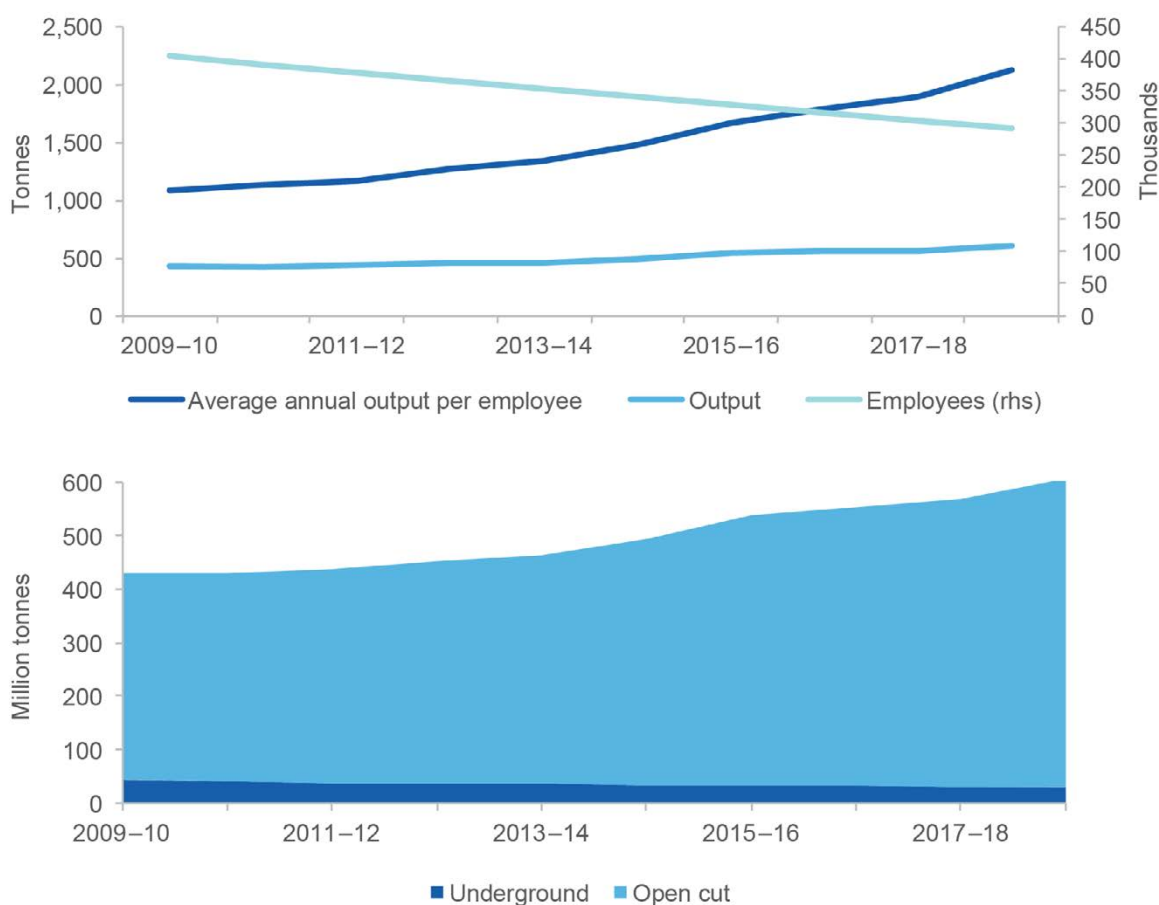
congestion, particularly on the east coast, and by inadequate rail infrastructure to transport coal from ports to utilities.

Productivity

Labour productivity in India's coal mining sector has been steadily improving over the last decade, with the average output per employee doubling between 2010 and 2019 (Figure 2.11).¹⁰⁰ To improve productivity and remain competitive against imports, Coal India increased mechanisation and the use of equipment, used natural attrition to cut its workforce, and opened mines at an accelerated pace. Nevertheless, labour productivity in India's coal sector remains low relative to other coal producing countries, with around double the employees needed to produce the same volume of coal as the world average.¹⁰¹ The lower productivity is largely the result of the use of older technologies and production methods.

Technology adoption in underground mining is particularly limited. In the 2018–19 financial year, 95 per cent of Coal India's production was from open cut mines (Figure 2.11).¹⁰² A push to increase profitability at Coal India's operations resulted in the closure of underground operations, which are high cost due to the limited use of advanced technology.¹⁰³ With a large proportion of India's coal reserves located at depths greater than 300 metres¹⁰⁴, increased adoption of underground mining and the use of more advanced technology could enhance access to its large coal reserves.

Figure 2.11: Coal India labour productivity and production methods



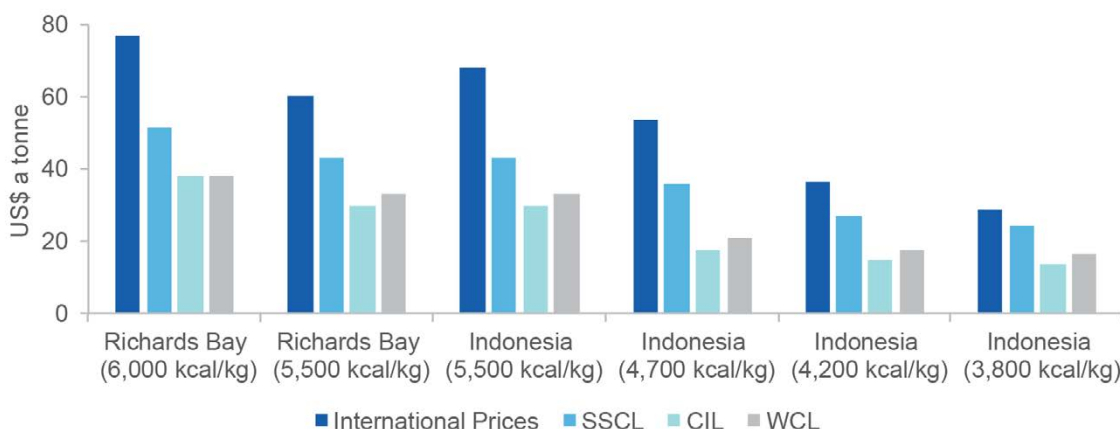
Source: Coal India (2019) Annual Report 2018–19

Coal pricing

Around 80 to 90 per cent of domestically produced coal in India is allocated through long-term agreements (called fuel supply agreements, or FSAs) to end-users at notified prices. The prices are set in consultation with the government, with the remaining coal sold via e-auctions. The pricing system had been subject to frequent disagreements between suppliers and end-users on a number of issues. These include coal ‘grade-slippage’ — where there is a difference between the stated dispatched and actual quality received of the coal — and a disconnect between domestic and international prices (Figure 2.12).

The pricing mechanism for coal has undergone several reforms over the last two decades. Most recently, Coal India adopted a new pricing system in April 2018 to address some of these issues, but ongoing challenges remain.¹⁰⁵ A recent World Bank report notes that, despite various pricing reforms, the price of coal for power generation has been kept low as a way to subsidise electricity in India.¹⁰⁶ Pricing reforms will be needed to both boost the quality and quantity of coal produced. World Bank analysis showed that raising the coal price to the market-clearing price could increase domestic coal production by an estimated 191 million tonnes a year.¹⁰⁷

Figure 2.12: Domestic and international coal prices



Notes: India's domestic prices are the average notified prices for the corresponding grade band. SSCL Singareni Collieries Company Limited, CIL Coal India Limited, WCL Western Coalfields Limited (a subsidiary of Coal India)

Source: IHS (2019) Indian coal data tables, June 2019

Competition and private investment

At present, coal production in India is effectively a monopoly, with production dominated by Coal India. In 1993, captive coal mining was allowed, but this did not provide the production growth that was envisaged. In more recent years, the government has approved two major policy changes, representing the biggest reforms to India's coal sector since its nationalisation in the 1970s. The policy changes aim to boost output, and improve productivity and coal quality in the sector, through facilitating greater competition and private investment. The two policy changes approved by the Indian Cabinet were:

- February 2018: Allow commercial coal mining, by changing coal mining auction rules to allow private companies to develop new mines and sell coal in the free market without price or end-use restrictions.
- February 2019: Allow captive producers to sell 25 per cent of their output in the open market.¹⁰⁸

Reforms to the coal sector have generally been politically difficult and faced resistance from trade unions in India, which have organised strikes and sought the Supreme Court's help to block policy changes.¹⁰⁹ Progress on implementing the latest

reforms to allow commercial mining stopped in the lead up to the Indian general elections after a trade union threatened to strike at Coal India's operations to protest the government's decision, and has not gained momentum since.¹¹⁰

The effectiveness of the reforms in boosting output will also depend on the response from private and foreign companies. An ongoing perception of excessive bureaucracy, lengthy approval processes and poor quality coal may continue to stifle interest. Commercial mining will not solve the fundamental challenges — of coordination and planning, land acquisition and obtaining approvals — that face India's coal sector.¹¹¹ Given the long lead times required for the approvals process, commercial production within the next five years is still highly uncertain.¹¹²

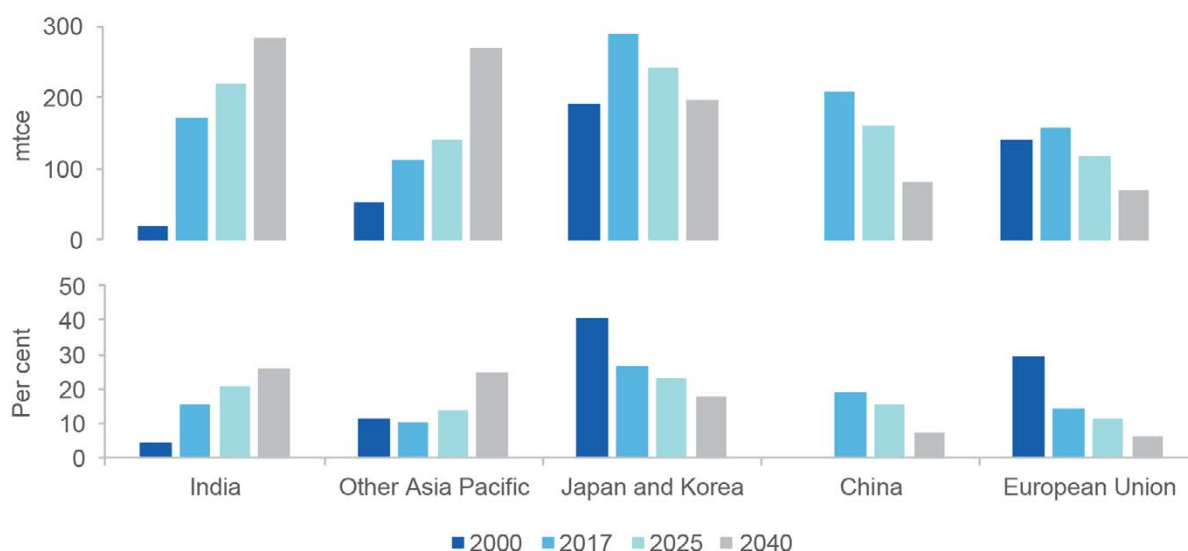
2.5 India's coal imports

IEA World Energy Outlook

Under the IEA's New Policies Scenario, India overtakes China as the world's largest coal importer by 2025, as total coal consumption continues to outpace production growth. Consumption will be driven by the country's

rapidly growing steel sector and coal-fired power generation requirements. In the New Policies Scenario, India's share of world trade in coal is projected to increase from 4 per cent in 2000 to over a quarter in 2040 (Figure 2.13).

Figure 2.13: IEA WEO New Policies Scenario world coal imports and share of world trade



Note: The IEA does not provide projections for coal production for the Sustainable Development or Current Policies Scenarios

Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

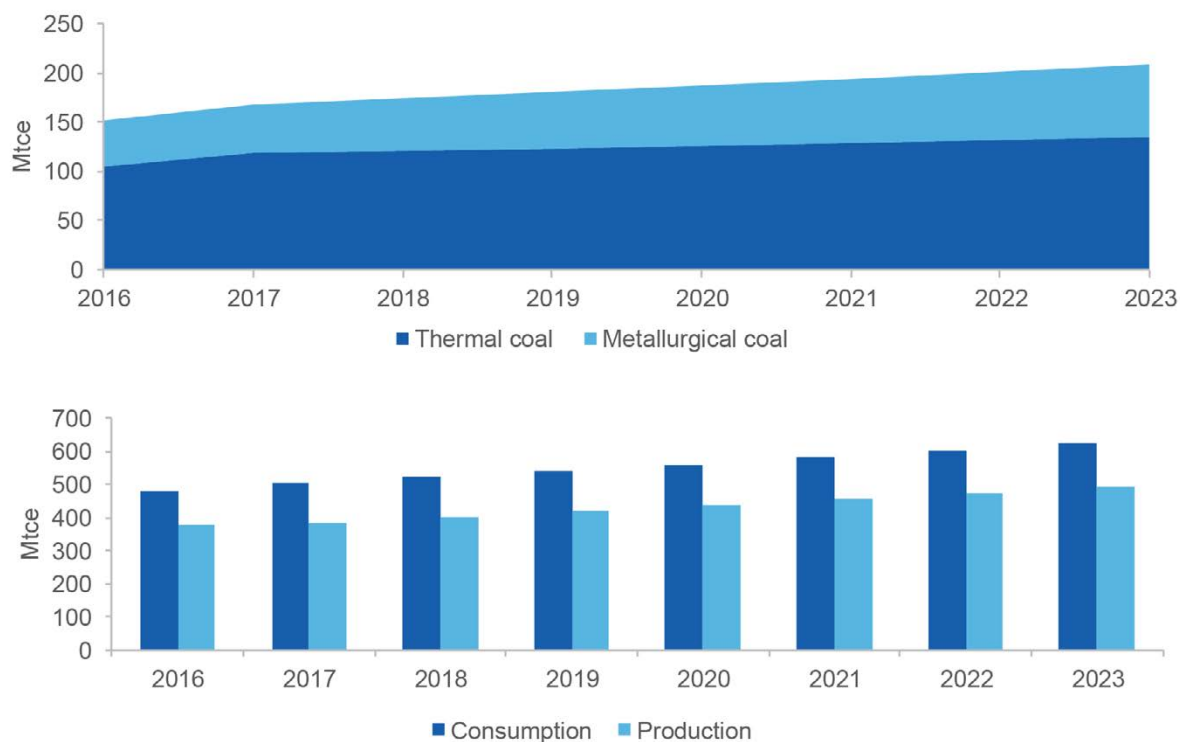
IEA Coal Market Report

In contrast to the World Energy Outlook — which is largely policy and scenario focused — the IEA's 2018 Coal Market Report aims to forecast the outlook for coal based on trade, demand and supply models, and makes projections of metallurgical and thermal coal imports.

The 2018 IEA Coal Market Report¹¹³ forecasts India's thermal coal imports to expand at an annual average rate of 2.2 per cent, from 119 mtce in 2017 to 135 mtce in 2023, with domestic production unable to keep pace with demand (Figure 2.14). Metallurgical coal imports grow at a faster annual average rate of 7.2 per cent, to meet growing demand from the rapidly expanding steel sector.

While the IEA's 2018 forecast for India's thermal coal demand was similar to the previous year, the forecast for imports was revised from declining imports in the 2017 forecast, to increasing imports in the 2018 forecast. The main factor driving the revision was that, despite favourable developments in India's domestic coal sector, it continued to face substantial challenges and noticeably undershoot initial expectations. The revision highlights the substantial uncertainties underpinning the outlook for India's thermal coal imports.

Figure 2.14: India's forecast thermal coal imports, consumption and production



Source: IEA (2018) Coal 2018: Analysis and forecasts to 2023, International Energy Agency

Key factors influencing India's thermal coal imports

Domestic production and consumption balance

India's future thermal coal import demand will be primarily driven by the gap between demand and domestic production. Some judgements can be made about the trajectories of each but, as highlighted, there are substantial uncertainties underpinning the outlook for both consumption and domestic production. These uncertainties grow further out into the future. Even small changes to either could swing the pendulum on whether India's thermal coal imports grow or shrink.

As discussed earlier in this chapter, India's thermal coal consumption is likely to increase, at least over the next decade — and potentially well beyond — as energy demand continues to rise. Despite the impressive ramp up of renewables and ambitious targets for new renewable capacity, increasing coal-fired power generation will likely be required over the next decade. India's thermal coal production is also expected to grow, but

likely at a slower pace than ambitious government targets. Substantial headwinds remain, and although reforms have moved in a positive direction, the pace of change remains slow, with India's complex bureaucracy, socioeconomic issues, and a financially-strained power sector all impacting.

The key question is if, and to what extent, production will continue to lag consumption growth, and thus drive import levels. As highlighted in the IEA's 2018 Coal Market Report, it is likely that production will not be able to keep pace with consumption growth in the next five years, resulting in growth in India's imports of thermal coal in the short term. However, in the longer term, the outlook for the scale — and even direction — of India's thermal coal imports is more uncertain.

Beyond the balance between production and consumption, there are a number of other factors that will influence the level of India's thermal coal imports, and these are outlined below.

Import-dependent power plants

A number of power plants have been designed and built to operate solely on the specifications of imported coal, which typically has higher calorific values and lower ash content than most domestic coals. Most of these plants employ supercritical technologies (see Box 3.1) and are located in coastal locations in the western states of Maharashtra and Gujarat.¹¹⁴ These power plants have signed long-term contracts with overseas suppliers, or rely on captive mines acquired overseas, largely in Indonesia. India's national electricity plan notes that import-dependent power plants will need to continue import around 50 million tonnes of coal out to 2026–27.

However, it is possible that these plants could turn to domestic coal in the long term, if higher quality coal (in terms of higher calorific content and low ash content) is produced in sufficient quantities, and if transportation bottlenecks are removed.¹¹⁵

Quality and efficiency regulations

In recent years, Indian government policies have favoured the use of higher quality coal to improve plant efficiency and air quality¹¹⁶ (see Chapter 1). The use of higher quality (high calorific value and low ash) coals improves efficiency by reducing the quantity of coal needed to generate the same amount of electricity compared to lower quality coals, and consequently reduces air pollution and carbon emissions. There have been several policies that could support the use of higher quality imported coal.

Coal quality requirements

A policy was introduced in 2016 which required power plants with a capacity greater than 100 MW and located more than 500 kilometres from mines — changed from a previous benchmark of 700 kilometres — to be supplied with coal with ash content no greater than 34 per cent. The obligation of meeting the target rests with the supplier of the coal.

The quality of coal can be improved either by:

- blending domestic coal with higher quality imported coal, or
- washing domestic coal to reduce the ash content and other impurities.

Despite supportive government policies, coal washing has not been adopted on a large scale by coal producers and end users. Coal India's thermal coal washing capacity was 16 million tonnes in 2018–19.¹¹⁷ Coal washing capacity did not grow as planned, due to delays in awarding contracts to establish washeries by Coal India.¹¹⁸ There are also ongoing challenges implementing coal washing due to the additional costs involved and incorporating the process into the existing coal supply and distribution system.¹¹⁹ In its latest annual report, Coal India stated plans for another nine washeries with a total capacity of 63 million tonnes by the end of 2020, which could support the supply of higher quality domestic coal.¹²⁰ In the meantime, beneficiation (washing) capacity in India remains limited and capacity utilisation is low.

Due to a lack of domestic supply of high quality coal, there has been an increase in imports to blend with domestic coal to meet quality requirements. Early in 2019, India's Power Ministry — in collaboration with Coal India — sought to make power plants reduce import volumes of high grade coal, with Coal India increasing high grade volumes offered to power plants and via e-auctions.

Coal-fired power plant efficiency standards

India's government released new power plant emissions standards in 2015, which aimed to reduce air pollution. Existing plants were assigned mandatory efficiency targets, which require retrofitting plants and the use of higher quality coal. With almost all plants missing the original deadline, the compliance period for these changes has been extended from 2017 to 2022.¹²¹ All new plants have also been mandated to use supercritical technology, which will also support the use of higher quality coal.

International and domestic coal prices

To date, the relative cost of domestic and imported coal has not been a major factor in influencing the volume of imports, because domestic coal prices are substantially lower than international prices, even after adjusting for quality.¹²² As a result, imports have largely been used in India to fill the gap between consumption and production, with domestic coal favoured where available. However, this situation depends on the evolution of domestic and international prices, and as the draft Coal Vision 2030 report highlights, the competitiveness of domestic coal may not hold forever.¹²³ Two trends could see the gap between the two narrow.

- International prices could decline. While coal prices, like other commodities, move in cycles, the average long-term price could drift lower as demand weakens relative to supply. The draft Coal Vision 2030 report notes that low international prices could drive as much as 200 million tonnes of coal demand towards imported coal.¹²⁴
- Domestic prices could increase. This could be driven by higher mining costs, higher taxes (with a review of the royalty rate currently underway), and ongoing high freight costs. Power plants closer to the coast are more likely to favour imports due to high domestic freight costs.

Regulatory changes

A number of recent regulatory changes could result in higher imports. In 2019, India's Central Electricity Regulatory Authority (CERC) passed two regulatory judgements affecting purchasing power agreements (PPAs) between power producers and state distribution companies.¹²⁵

In April 2019, the CERC allowed incremental fuel costs associated with importing coal at several import-based power plants to be passed-through to end consumers. In May 2019, the CERC approved a compensatory tariff for a domestic coal-based project — to compensate for high cost imports and high cost e-auction coal — where there were shortfalls in domestic coal availability.

Both verdicts are considered to be landmark judgements that could see an increase in thermal coal imports by up to 10 million tonnes a year, by allowing greater flexibility in sourcing and recovering the costs of imported coal.¹²⁶





Implications for Australia

Coal has been one of the key commodities that has underpinned Australia's latest mining boom. While the growth in Australia's coal exports has coincided with the substantial rise in India's coal imports, only exports of metallurgical coal to India have risen substantially — despite rapid growth in India's imports of thermal coal.

This chapter looks first at Australia's metallurgical coal exports to India, and then explores the trends and key barriers that have limited Australian exports of thermal coal to India to date, and future opportunities for the Australian mining and coal industry as some of these barriers fall away.

3.1 Australia's coal exports to India

Metallurgical coal

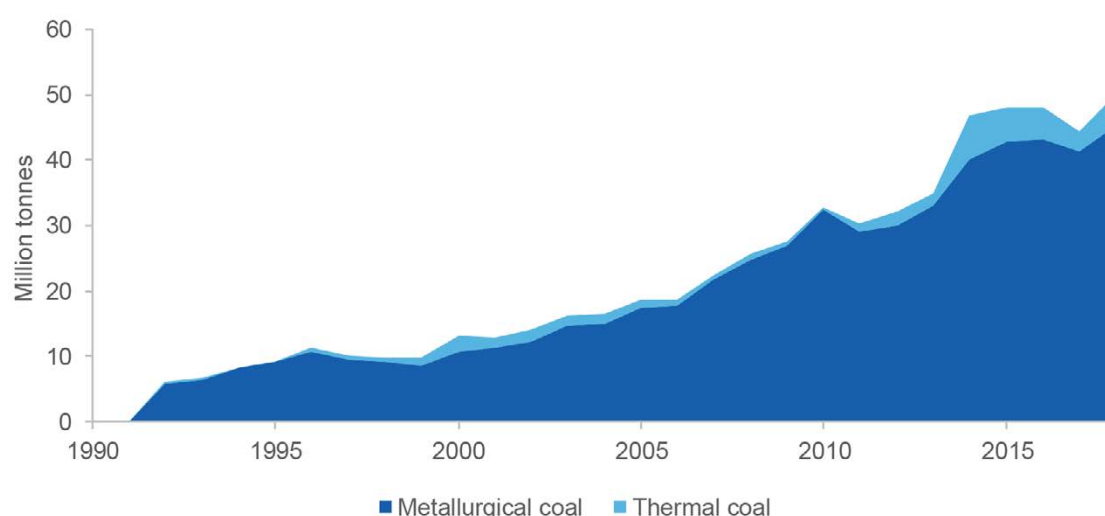
Australia's metallurgical coal exports to India have grown substantially over the last few decades, driven by India's rapidly expanding steel sector (Figure 3.1). India is Australia's largest export market for metallurgical coal, accounting for a quarter of total metallurgical coal exports in 2018 (Table 3.1). In recent years, India has sought to diversify the sources of its metallurgical coal imports, following supply disruptions in Queensland in the aftermath of Cyclone Debbie in 2016 (Table 3.2). Nevertheless, Australia is still the dominant supplier of metallurgical coal to India, accounting for over 70 per cent of its metallurgical coal imports.

India's low level of steel intensity — currently a third of the world average¹²⁷ — reflects the potential for ongoing strong growth in steel consumption and consequently metallurgical coal demand as India's economy continues to

grow (Figure 3.2). Even if India's steel demand follows a different, lower intensity trajectory than other major steel producing countries, India's metallurgical coal demand could still increase by a third between 2015 and 2035.¹²⁸ Steel demand in India will be driven by rapid urbanisation, rising household incomes and growing industrial activity.

India's 2017 National Steel Policy sets an ambitious steel capacity target of 300 million tonnes, and a consumption and production target of 255 million tonnes by 2030.¹²⁹ In 2018, India's crude steel production increased by 4.9 per cent to reach 106 million tonnes, more than double production levels a decade earlier. With limited domestic reserves of metallurgical coal, India is expected to continue to import the vast majority of its metallurgical coal needs to meet demand from its growing steel sector. Australia remains well-positioned to meet India's growing demand.

Figure 3.1: Australia's coal exports to India



Source: ABS (2019) International Trade in Goods and Services, Australia, cat. no. 5368.0

Table 3.1: Australia's metallurgical coal exports by destination (million tonnes)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
India	32.4	29.0	30.0	33.2	40.1	42.9	43.5	41.2	45.3
China	21.9	13.7	28.2	45.3	46.3	36.4	38.9	41.5	39.6
Japan	48.0	40.7	38.5	41.7	42.0	41.0	42.3	35.8	35.8
South Korea	17.4	16.2	15.8	17.0	20.4	21.5	19.5	17.8	17.8
Taiwan	8.2	7.8	8.0	9.1	9.4	9.3	9.7	8.5	10.0
Rest of world	31.1	25.2	24.2	23.6	28.2	35.1	35.4	27.9	30.3
Total metallurgical coal	159.0	132.7	144.6	170.0	186.4	186.1	189.2	172.7	178.9
India's share (per cent)	20.4	21.8	20.8	19.5	21.5	23.1	23.0	23.9	25.3

Source: ABS (2019) International Trade in Goods and Services, Australia, cat. no. 5368.0

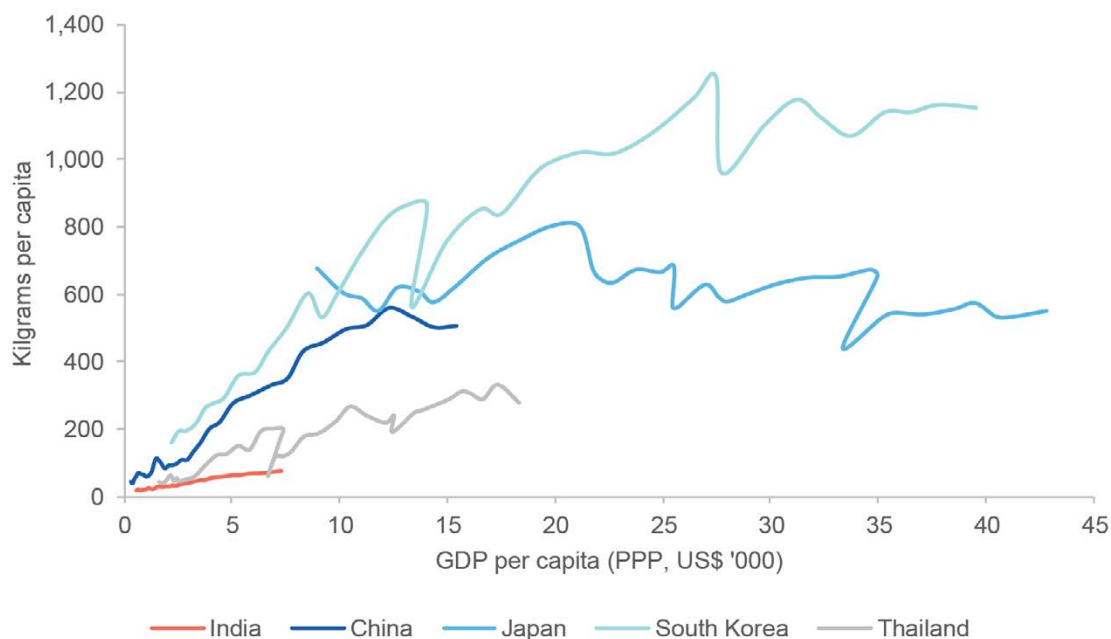
Table 3.2: India's metallurgical coal imports by destination (million tonnes)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Australia	15.9	25.7	27.5	29.8	37.5	39.0	36.5	35.8	36.9
United States	1.5	2.8	3.3	2.7	1.6	1.2	1.1	3.3	4.1
Canada	0.0	0.2	0.9	1.2	1.9	1.4	2.3	3.3	4.3
Mozambique	0.0	0.0	0.9	1.0	1.4	1.9	0.9	2.4	2.2
Rest of world	2.1	3.0	3.0	2.2	1.3	1.2	0.8	2.3	4.2
Total metallurgical coal imports	19.5	31.8	35.6	36.9	43.7	44.6	41.6	47.0	51.8
Australia's share (per cent)	81.9	80.8	77.3	80.8	85.8	87.5	87.7	76.1	71.2

Notes: Data is for the Indian financial year beginning in April of each specified year. Data for Australia's coal exports to India does not align with India's imports from Australia due to differences in the time periods, delays in shipping, and differences in customs classifications.

Source: Indian Department of Commerce (2019) Export Import Data Bank

Figure 3.2: Steel consumption intensity, 1980 to 2017



Notes: PPP is Purchasing Power Parity

Source: World Steel Association (2019) Steel Statistical Yearbook; Bloomberg (2019) IMF

Thermal coal

In contrast to metallurgical coal, Australia is not a significant supplier of thermal coal to India, despite India's rapid growth in thermal coal imports over the last decade. India accounted for just 2.3 per cent of Australia's thermal coal

exports in 2018 (Table 3.3). Indonesia has met most of India's import growth, with Australia accounting for just 4.8 per cent of Indian's thermal coal imports in 2018–19 (Table 3.4).

Table 3.3: Australia's thermal coal exports by destination (million tonnes)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Japan	69.8	65.4	75.2	82.3	77.7	84.7	79.6	81.7	81.0
China	15.3	20.3	34.7	42.7	47.1	35.0	36.4	42.0	49.8
South Korea	26.2	29.6	30.1	32.8	34.6	38.1	31.6	31.0	30.1
Taiwan	20.5	19.1	16.4	18.0	20.5	20.7	26.4	23.2	22.5
India	0.4	1.2	2.1	1.7	6.7	5.3	4.8	3.1	4.8
Rest of world	9.8	12.5	12.9	11.0	14.5	18.4	23.1	19.4	19.5
Total thermal coal	142.1	148.1	171.5	188.4	201.0	202.2	201.9	200.3	207.7
India's share (per cent)	0.3	0.8	1.2	0.9	3.3	2.6	2.4	1.6	2.3

Source: ABS (2019) International Trade in Goods and Services, Australia, cat. no. 5368.0

Table 3.4: India's thermal coal imports by destination (million tonnes)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Indonesia	49.0	77.2	103.0	120.5	140.5	115.8	90.8	94.6	112.0
South Africa	20.2	18.9	22.0	20.4	33.3	37.3	34.6	38.7	31.6
United States	0.2	0.8	1.5	1.2	1.2	2.1	2.9	8.8	10.3
Australia	0.2	1.2	2.3	1.7	7.1	5.8	4.5	3.6	8.3
Rest of world	4.8	0.1	0.5	2.0	2.4	3.9	5.3	5.6	11.0
Total thermal coal imports	74.4	98.3	129.4	145.9	184.6	165.0	138.1	151.3	173.2
Australia's share	0.2	1.2	1.8	1.2	3.9	3.5	3.3	2.4	4.8

Notes: Data is for the Indian financial year beginning in April of each specified year. Data for Australia's coal exports to India does not align with India's imports from Australia due to differences in the time periods, delays in shipping, and differences in customs classifications.

Source: IHS (2019) Indian coal data tables, June 2019

3.2 Australian thermal coal exports to India: opportunities and barriers

The 2015 *Coal in India report* identified three key factors that have limited Australian thermal coal exports to India: price, compatibility, and Indian investment in Australian mines. These factors have remained barriers to growth in Australian thermal coal exports to India to date.

However, there is potential for India to become a growing market for Australia's thermal coal as some of these barriers are reduced, and if India continues to import large volumes of thermal coal. The potential commissioning of Indian owned coal projects in Australia, growing compatibility between India's new coal-fired power plants and Australian thermal coal, and the potential for Indonesia and South Africa to divert supply from export markets to domestic use, could all open up opportunities for growth in Australian exports of thermal coal to India. Outside of thermal coal trade opportunities, the Australian mining

equipment, technology and services (METS) sector has, and will continue to benefit from growing coal production in India.

Australia's METS sector

Regardless of the trajectory that India's thermal coal imports take, the Australian METS sector will benefit from growing coal production in India. The India Economic Strategy highlights that India is one of the most important future markets for Australian METS companies.¹³⁰ Both state and privately-owned coal mines in India are seeking to lift productivity and production through effective mine planning, more efficient equipment, and meet global safety and work standards. India's desire to improve the productivity of domestic coal mines through advanced technology presents a considerable opportunity for Australia's METS sector.

As a recognised global leader in METS, Australian companies have a competitive edge as India grows and seeks to modernise and upgrade the technology employed in its coal sector, particularly in the coal value chain and the creation of beneficiation (washing) capacity.

India is currently host to more than 40 Australian METS companies, many with a longstanding presence in the country.¹³¹ For example, *SIMTARS* works with leading India's state-owned coal producers, CIL and SCCL, and has collaborated in numerous executive training programs. It has recently secured orders to supply, among other equipment, India's first virtual reality mine theatre to the Indian Institute of Technology-Indian School of Mines. Other examples include *Mine Excellence* (drilling and blasting software technology), *Ground Probe* (advanced hardware and software solutions) and *Valley Longwall International* (supplies and maintains specialist mining equipment and services). Orica-owned *Indian Explosives Pvt Ltd* operates a production facility in Jharkhand and Nagpur, and is one of the largest providers of commercial explosives and blasting systems in the country. *Cooee* has recently sold-in its dust suppression products and *Immersive Technologies* is setting up simulators for trucks and excavators.

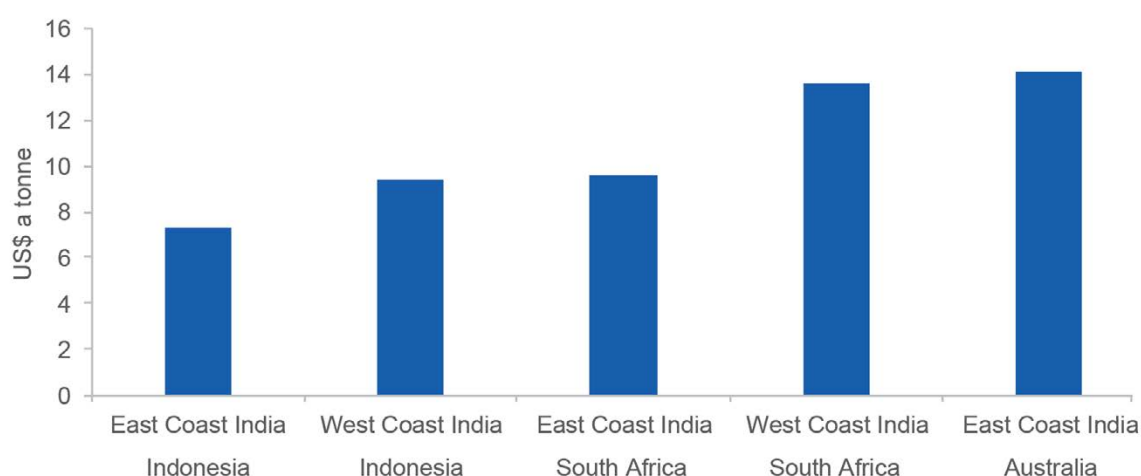
Price

Australian thermal coal prices and freight costs have typically been higher than other major exporting countries, particularly Indonesia and South Africa, due to the shorter distances they need to travel (Figure 3.3).

As a result, the cost of Australia's higher quality, more expensive thermal coal has generally exceeded the level that India's power utilities — which are subject to regulated prices (see Chapter 1) — could profitably pay. India's coal importers have primarily sourced supplies from low-cost producers in Indonesia, which supply lower energy content coal. In 2018, 74 per cent of India's thermal coal imports had a calorific value of 5,000kcal/kg NAR or lower. In contrast, all of Australia's thermal coal exports in 2018 had a calorific value of 5,000kcal/kg NAR or higher (Figure 3.4).

Despite recent policy and regulation changes, India's power utilities are expected to remain financially constrained and consequently relatively price sensitive in the years to come, restricting their ability to purchase more expensive and better quality Australian coal. Thus, Australian coal will likely continue to be less attractive for Indian buyers.

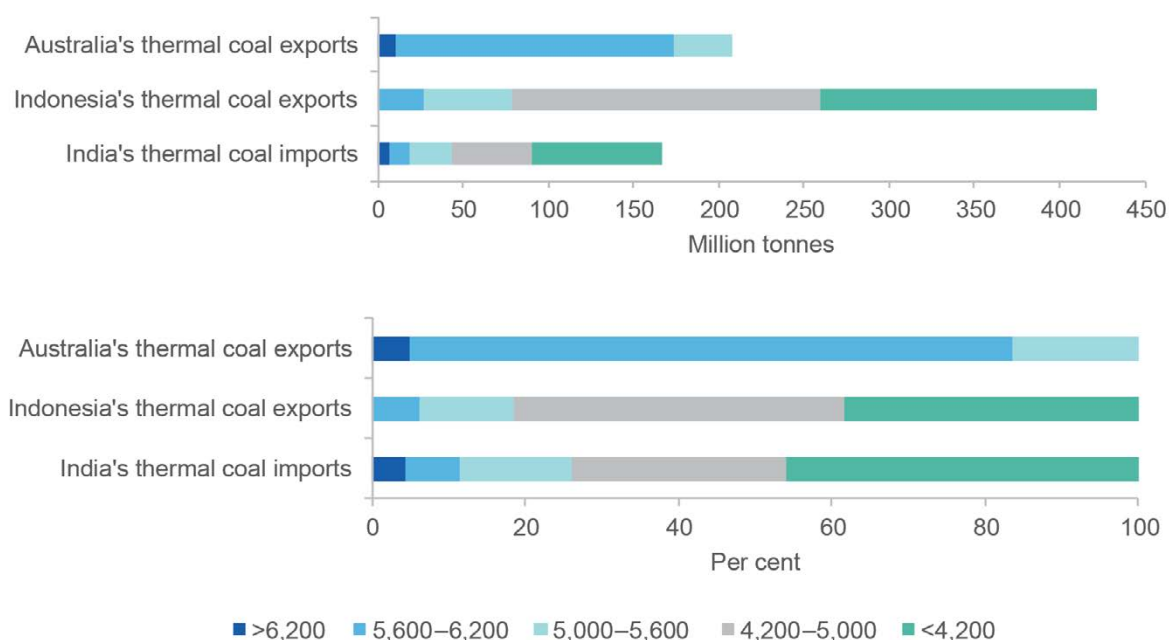
Figure 3.3: Average freight rates to India in 2018



Notes: Freight rates for Australia to India is for metallurgical coal, due to an absence of data for Australian thermal coal freight to India.

Source: Platts (2019) Steel Analyzer; IHS Markit (2019) India coal data, June 2019

Figure 3.4: Imports and exports by coal quality, India, Indonesia and Australia



Notes: Calorific values are in terms of kcal/kg Net as Received (NAR)

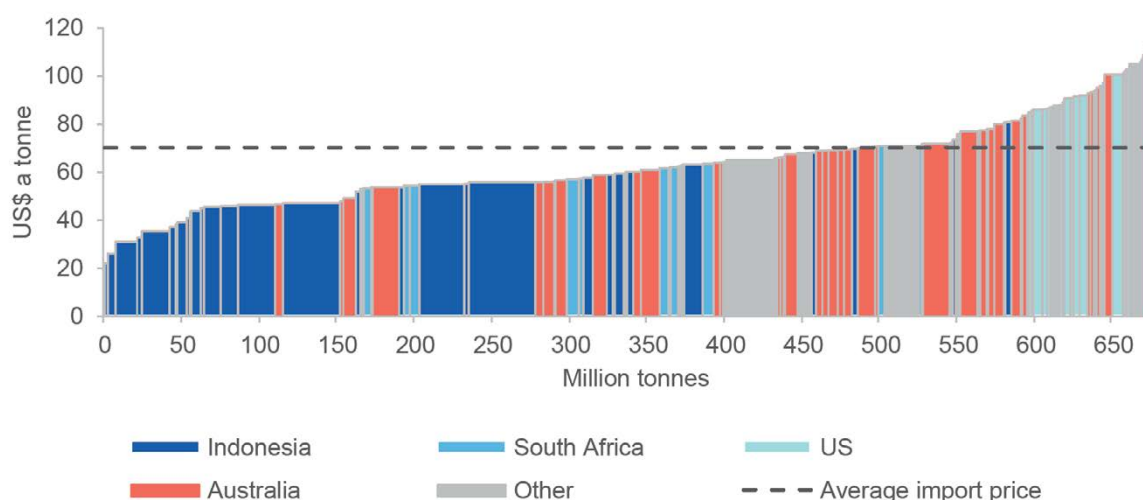
Source: IHS Markit (2019) Global coal imports and exports outlook by quality, July 2019

Outlook for thermal coal exports from Indonesia and South Africa

Thermal coal exports from Indonesia and South Africa may be more constrained in the future, with the possibility of either country diverting more coal to domestic markets. If Indonesia and South Africa are unable to meet all of India's future

thermal coal import needs, this could improve the prospects for exports of Australian thermal coal exports to India, particularly for low to mid-energy coal (Figure 3.5).

Figure 3.5: Estimated delivered costs of thermal coal to India, 2018



Notes: 170 million tonnes of supply from countries with no available estimates for coal freight costs to India has been excluded from the cost curve. Average import price is based on the import unit value for thermal coal in 2018.

Source: Department of Industry, Innovation and Science (2019) estimates, based on data from Indian Government trade data, AME Group, Platts Steel Analyzer, and IHS Markit

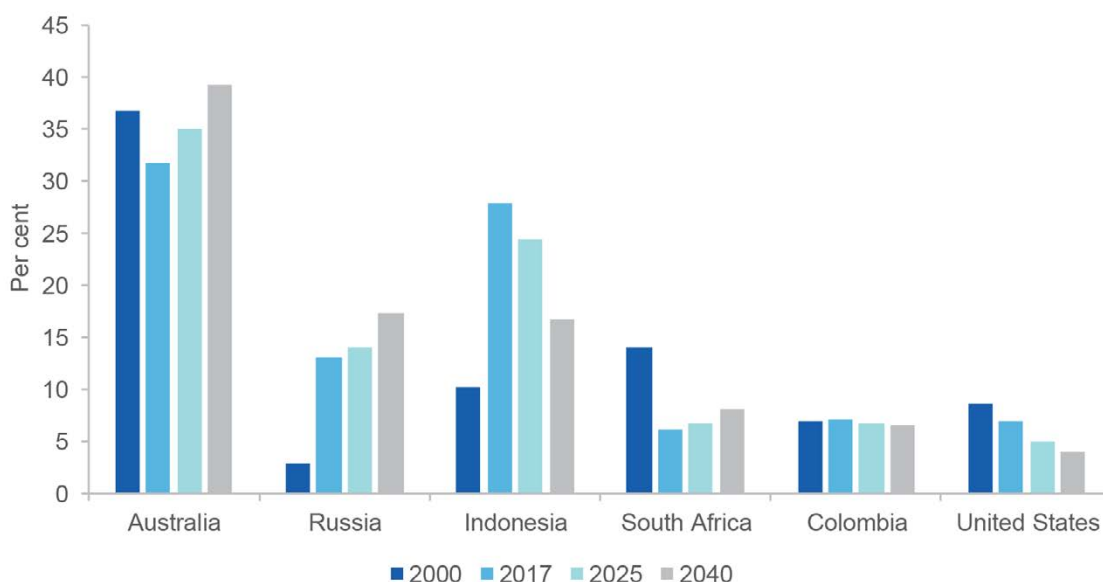
In particular, Indonesia's coal exports are expected to decline in the longer term. The IEA's Coal Market report forecasts Indonesia's thermal coal exports to decline at an annual average rate of 3.6 per cent between 2019 and 2023.¹³² Under the IEA's 2018 WEO New Policies Scenario, Indonesia's coal exports could decline at an annual average rate of 2.2 per cent between 2025 and 2040 (Figure 3.6).¹³³

The key driver of the projected decline in Indonesia's thermal coal exports is an expected increase in domestic consumption of thermal coal, driven by a strong increase in coal-fired power generation. Restrictive government policies may also affect future exports, although they have had little effect to date. The Indonesian government currently applies quotas to national coal production at capped levels, to both reserve coal for future use and to stabilise seaborne prices for Indonesian coal. The domestic market obligation (DMO), under which Indonesian producers are obliged to sell a share of production

in the domestic market at capped prices, will likely remain a feature of Indonesia's coal market for years to come. The DMO could be even more restrictive by 2030 if domestic coal-fired power stations are facing shortages.

Under the IEA WEO New Policies Scenario, South Africa's thermal coal exports grow at an annual average rate of 1.1 per cent between 2017 and 2040. However, this outlook is underpinned by considerable risks. South Africa's coal sector has faced infrastructure bottlenecks and subdued mining investment. The South African government has also occasionally mandated that thermal coal be redirected to the domestic market. Eskom, the national electricity utility, has recently been experiencing severe coal shortages. While the South African government is expected to improve the investment environment by changing regulations, addressing the ongoing problems at Eskom, and boosting rail capacity, it remains to be seen whether these measures will translate to higher production.¹³⁴

Figure 3.6: IEA World Energy Outlook New Policies Scenario coal exports



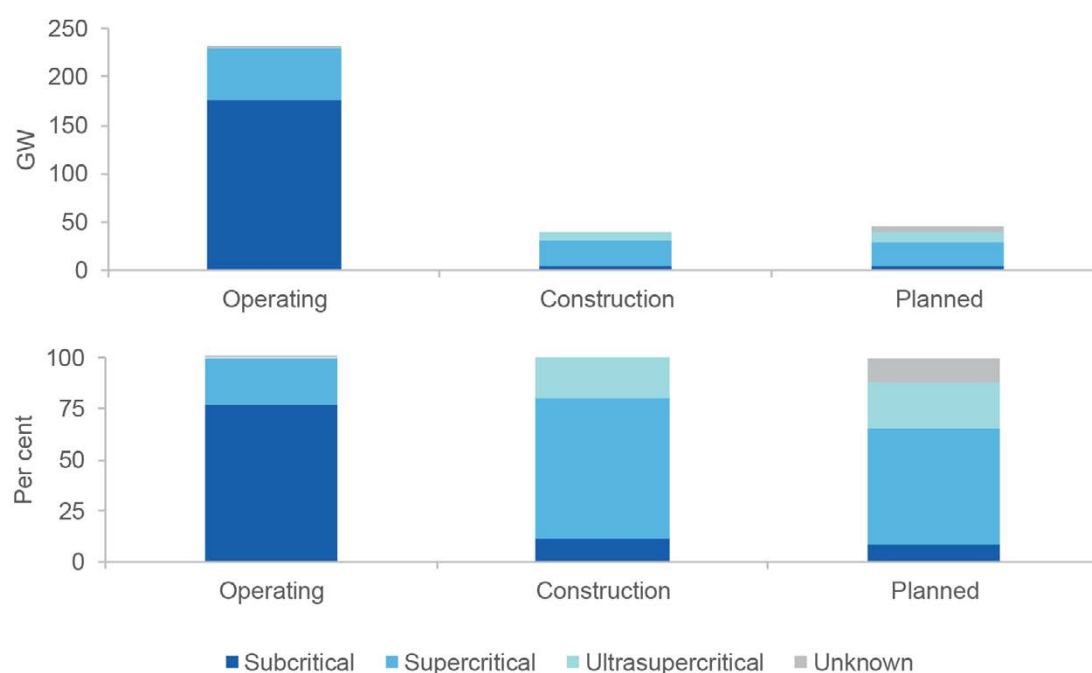
Source: IEA (2018) World Energy Outlook 2018, International Energy Agency

Compatibility

Much of India's coal-fired power generation fleet employs subcritical technology (see Box 3.1), for which Australian coal — with high energy content — will remain unsuitable for use. The specifications of the lower cost coal from Indonesia are closer to that of Indian coal, and are more compatible with the engineering requirements of power generators in India. The higher energy content and proportion of volatile matter in Australian produced coal makes it unsuitable for many older subcritical generators in India which are not designed to operate at higher temperatures.

However, India's investment in new generating capacity has a greater share of generators that employ supercritical technologies (Figure 3.7). Of the coal-fired power capacity currently under construction, 34 GW or 88 per cent of it employs supercritical technology or higher. The new power plants will provide better thermal efficiencies and lower carbon emissions per gigawatt hour of electricity produced, and their implementation has been supported by efficiency requirements for future coal-fired power plants. Electricity output from these generators could be optimised by using higher energy content and lower ash coal than most India's domestic mines currently produce.

Figure 3.7: India's coal-fired electricity capacity by technology



Source: Platts (2019) World Electric Power Plant database, March 2019.

Box 3.1: Coal-fired electricity generation technologies

Coal-fired power accounted for around a third of world electricity generation in 2017.¹³⁵ The technology is attractive because it is reliable, provides secure supply, and has relatively low fuel costs and competitive capital and operating costs.¹³⁶ However, coal-fired generation also presents challenges in terms of air pollution and CO₂ emissions.¹³⁷ The different technologies used for coal-fired power generation have markedly different efficiencies, costs, and pollution outcomes (Figure 3.8).

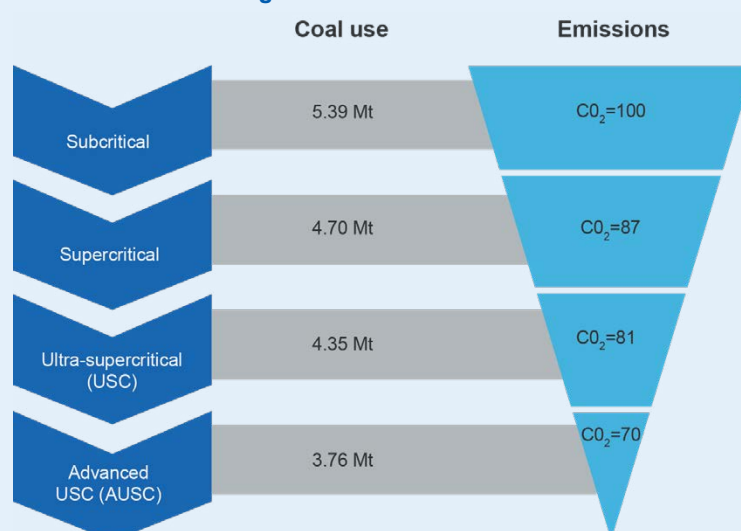
Pulverised Coal Combustion (PCC) is the most common coal-fired technology deployed worldwide. There are a number of PCC technologies being used that have markedly different efficiencies, costs and pollution outcomes. The efficiency of a plant refers to the electricity produced for a given heat input. In coal-fired power plants, this depends on the temperature and pressure of the steam generated in the boiler during combustion. The efficiency of a plant increases as both temperature and pressure are increased.

Subcritical technologies are the most common type of coal-fired plant. They have the lowest efficiency (around 30 per cent) of the available technologies. However, subcritical plants generally have low capital costs, which supports their large-scale uptake.

Supercritical technologies use less coal and generate less CO₂ than subcritical plants, and achieve efficiencies of around 40 per cent. The capital costs of supercritical plants are higher than for subcritical plants because they use materials with a greater heat tolerance in the boiler.

Ultra-supercritical and advanced ultra-supercritical plants operate at efficiencies between 45–50 per cent. The capital cost of these plants is high because they use advanced materials (with high nickel content) in the boiler. They use less coal and emit less CO₂ than supercritical plants. Plants that utilise supercritical technologies and above require higher energy coal with low ash content to operate optimally.

Figure 3.8: Effect of different technologies on coal use and carbon emissions



Notes: Based on an 800 MW power plant operating at a capacity factor of 80 per cent and generating 6 TWh a year. Emissions are relative to a subcritical plant. i.e. A supercritical plant generates 13 per cent less CO₂, an ultra-supercritical plant generates 19 per cent less CO₂ etc.

Source: IEA Clean Coal Centre (2014)

Table 3.5: Investment in Australian thermal coal projects by Indian companies

Project	Company	Capacity	Status	Investment	Approvals
Carmichael	Adani	10–27 mtpa (Stage 1)	Committed	\$2 billion	Mining Lease granted, EIS approved with conditions. Royalty agreement still to be finalised.
Alpha Coal	GVK Hancock	30 mtpa	Feasibility	\$10.8 billion (mine rail)	Mining lease application still under assessment. EIS approved with conditions.
Kevin's Corner	GVK Hancock	30 mtpa	Feasibility	\$6 billion	Mining Lease application still under assessment. EIS approved with conditions.

Notes: All three projects have received the Commonwealth Minister for the Environment's approval, subject to conditions; mtpa million tonnes per annum; EIS Environmental Impact Statement.

Source: AME Group (2019), Queensland Department of State Development, Manufacturing, Infrastructure and Planning (2019)

Indian investment in Australia

The limited investment by Indian companies in Australian thermal coal mines to date — beyond Adani's Carmichael project — has been another factor that has limited Australian thermal coal exports to India. In contrast, India has long invested in coal mines in Indonesia, which have provided power generators with a reliable source of coal. Ownership of assets reduces exposure to price and supply risks compared with buying on the open market. These are crucial considerations for electricity companies, which require reliable sources of fuel.

A key supporting factor that could drive up Australian exports of thermal coal to India is the development of Indian owned mines. Coal India has plans to invest in overseas metallurgical coal and high-grade, low-ash thermal coal projects for import into India, either through equity participation in working mines — on a production-sharing basis — or through the opening of new mines. In particular, Coal India has recently identified coal assets in Australia, for which it is interested in acquiring equity.¹³⁸

There has been substantial interest from Indian companies in developing thermal coal projects in the Galilee Basin in Queensland. There are three Indian-owned coal projects in the investment pipeline: Adani's Carmichael mine, and GVK Hancock's Alpha Coal and Kevin's Corner mines (Table 3.5). If these projects eventuate, most of the coal produced is expected to be destined for export markets, and could drive substantial growth in Australian thermal coal exports to India.

Adani's Carmichael project is the most advanced in the project pipeline, and could triple Australia's thermal coal imports to India — although from a low base of 5 million tonnes currently. The Carmichael project was scaled down from original plans for a 60 million tonne mine and a near-400 kilometre rail project after it was unable to source financing. The project now has a smaller proposed capacity of 10 to 27 million tonnes, and a 200 kilometre rail line to Aurizon's Newlands rail infrastructure, for which it still needs to negotiate access. The project is intended to be vertically integrated with Adani's power operations in India.

The other two projects are owned by GVK Hancock, a partnership between an Indian conglomerate, GVK Power and Infrastructure, and an Australian mining company, Hancock Prospecting. GVK Hancock was the first company to propose a Galilee Basin mine in 2008. The Alpha Coal project is a proposed 30 million tonne a year open-cut thermal coal mine with the potential to expand underground operations in the future. The project also includes proposed rail infrastructure to the Abbot Point port, owned by Adani. The rail would also be used by GVK Hancock's other adjacent project, Kevin's Corner, a proposed 30 million tonne a year open-cut and underground thermal coal mine.

As with all mining projects, there remain a range of regulatory, financial, technical, public relations and commodity price risks that, if realised, could result in delays, scope changes and cost overruns, and affect the commercial viability of the projects.

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