

TERI ENERGY & ENVIRONMENT DATA DIARY AND YEARBOOK 2020/21



TERI ENERGY & ENVIRONMENT DATA DIARY AND
YEARBOOK 2020/21

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**TERI
ENERGY &
ENVIRONMENT DATA
DIARY AND
YEARBOOK
2020/21**



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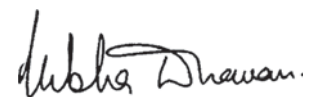
Preface

The world continues to steer through uncertain times with Covid-19 pandemic now nearing its end. Gradually economies are getting back on track by adapting to the new scenarios, in a world fighting the ongoing pandemic. During such times the need for energy planning is greater than ever before. The global economic output is expected to rebound substantially. In this regard, world's energy demand is projected to rise by 4.6% in 2021/22, pushing demand 0.5% above 2019/20 levels. Emerging markets and developing economies comprise almost 70% of the projected increase in global energy demand, as per the latest International Energy Agency (IEA) report. During the same time period, 6% increase in the global energy-related carbon dioxide emissions is expected. India's noteworthy growth record has been clouded by an increasingly degrading environment and a growing scarcity of natural resources. Emulating the size and diversity of the country's economy, the environmental risks are wide ranging and are driven by both prosperity and poverty. It is, therefore, imperative to ensure the optimization of the pathway for the development, transition, and monitoring of progress towards sustainable development.

The Energy and Resources Institute (TERI) takes pride in presenting the thirty-sixth edition of its flagship publication *TERI Energy & Environment Data Diary and Yearbook (TEDDY)*. It provides the latest information and statistics in the energy and environment sectors in India and serves as a ready reckoner for energy- and environment-related information and statistics sourced from government bodies, policy documents, and other secondary sources.

In *TEDDY 2020/21*, energy supply is discussed through chapters on coal and lignite, petroleum and natural gas, power, and renewable energy. The section on energy demand extensively covers the major energy-consuming sectors of the economy: agriculture, industry, transport, households, and buildings. The section on environment contains chapters on climate change along with air quality and pollution, solid waste management, water resource management, and land and forest resource management. The publication also provides a review of government policies with implications for the energy and environment sectors and contains data tables providing enhanced information on the sectors covered. An updated commercial energy flow in India with explanations prepared by TERI researchers is an important aspect of this publication as it predicts the flow of net available energy and its consumption by demand sectors in the future.

We strive to uphold the quality and comprehensiveness of the *TEDDY* as the go-to reference document for energy and environment data for India so that it can continue to be a trusted citation in government policy documents, scholarly articles, journals, and other peer-reviewed books in India and abroad. Consequently, we bring constant refinements to *TEDDY* with a view to enhancing its value to policymakers, business organizations, academic institutions, and research scholars. Comments and suggestions from readers shall be appreciated as they would help us improve subsequent issues of this publication.



Dr Vibha Dhawan
Director General
The Energy and Resources
Institute (TERI)

About TEDDY 2020/21

TERI Energy & Environment Data Diary and Yearbook (TEDDY) is an annual publication brought out by The Energy and Resources Institute (TERI) since 1986. It provides updated information on energy supply sectors (coal and lignite, petroleum and natural gas, power, and renewable energy sources), energy-consuming sectors (agriculture, industry, transport, residential, and commercial), and environment (local and global). Recent changes in energy sector and environment are depicted with the help of graphs, figures, maps, and tables, which makes the book an interesting read. The publication also provides a review of the government policies that have implications for energy and environment.

The data in the yearbook provides the latest available information at the time of compilation of the chapters. The analytical narrative supporting the data has been well researched by sector experts at TERI. Care has been taken to ensure that continuity of information is maintained so that the readers can understand and analyse the trends and patterns of change in energy and environment over a period of time.

The overall structure of this year's *TEDDY* follows the trend of last year's edition with some changes. For the reference of our readers, the chapters of the publication are listed in the following table.

Chapter 1: Energy and environment: an overview
Energy supply
Chapter 2: Coal and lignite
Chapter 3: Petroleum and natural gas
Chapter 4: Power
Chapter 5: Renewable energy

Energy demand
Chapter 6: Agriculture
Chapter 7: Industry
Chapter 8: Transport
Chapter 9: Household energy
Chapter 10: Buildings
Local and global environment
Chapter 11: Air quality and pollution
Chapter 12: Solid waste management
Chapter 13: Water resource management
Chapter 14: Land and forest resource management
Chapter 15: Climate change

The thirty-sixth edition of the publication, *TEDDY 2020/21*, comes with some interesting changes. Like the last year's edition, this year also *TEDDY* continues to remain less prose intensive. The publication includes more data represented with the help of infographics, thus making it more interactive and user-friendly.

We are hopeful that like all the previous editions of the publication, *TEDDY 2020/21* would be of immense value to our readers, including policy makers, business organizations, academic institutions, research scholars, and development practitioners. Suggestions and comments from the readers shall be highly appreciated as they would help us improve subsequent issues of this publication.

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Throughout the preparation of the publication, the team gained guidance and support from Dr Vibha Dhawan, Director General, TERI; without her leadership, this publication would not have been possible. We especially thank Mr Ajay Shankar, Distinguished Fellow, TERI, for his leadership and guidance in restructuring this publication.

We extend our gratitude to all the authors and reviewers of the publication who have done due fact-checking and put together research narratives for the chapters. We greatly acknowledge the colleagues at TERI Press for their constant support in bringing out the publication. We would also like to thank Ms Lakshmi Subramaniam for extending all possible executive support.

We are confident that *TEDDY 2020/21* meets the highest standards of scholarship and would be immensely useful to our readers, including policy makers, business organizations, academic institutions, and research scholars working in areas of energy and environment.

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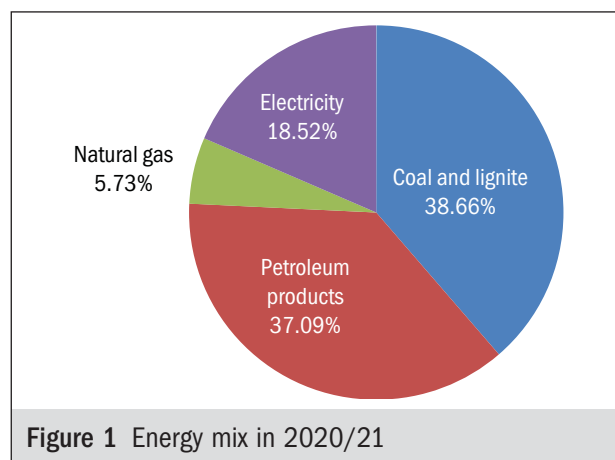
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ENERGY AND ENVIRONMENT: AN OVERVIEW

1

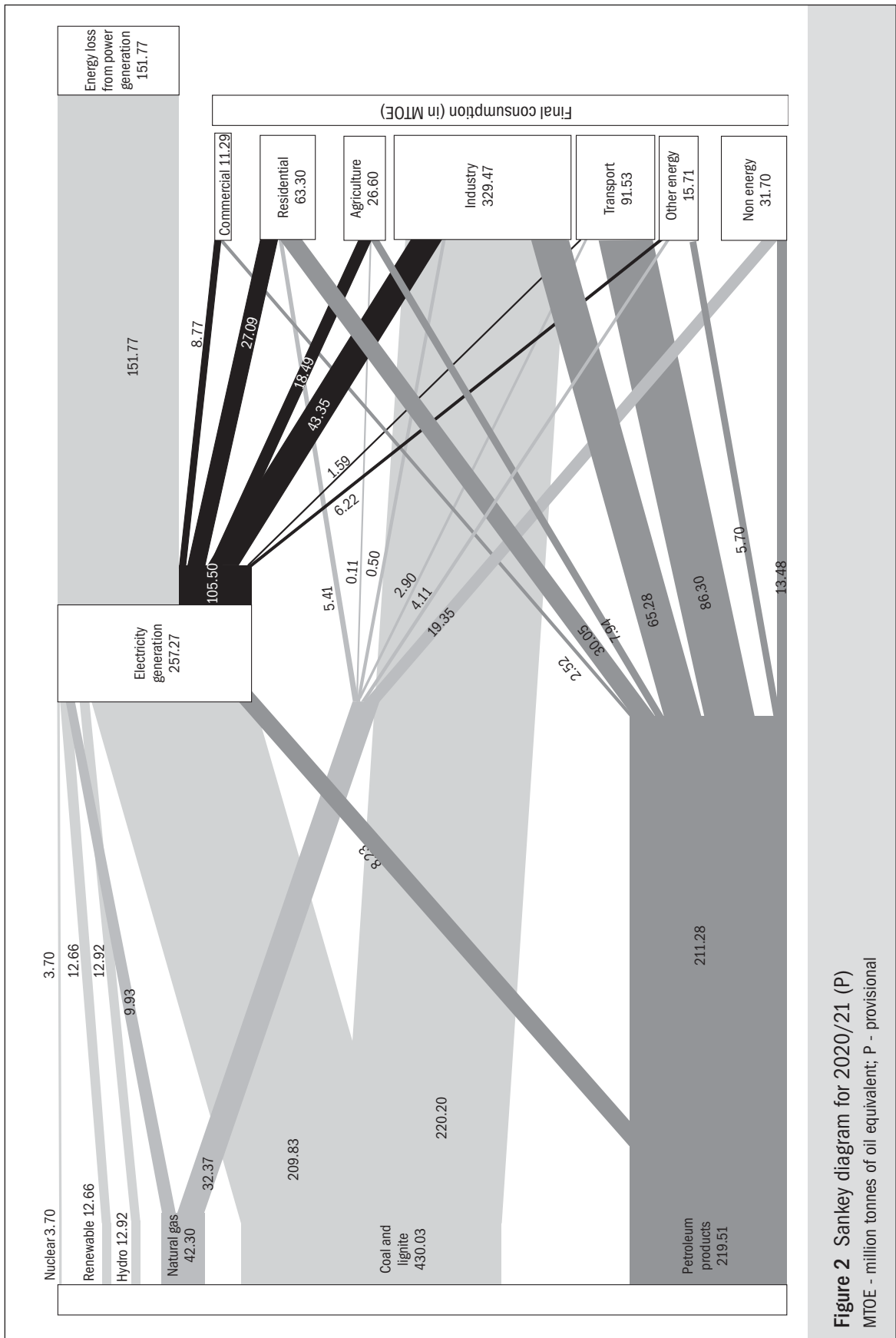
Overview of India's energy mix

- India is fuelled by primary (coal, lignite, and natural gas), secondary (electricity and petroleum products), and renewable energy sources.
- Consumption of coal and lignite increased by 7.1% between 2019/20 and 2020/21(P).
- The consumption of natural gas witness a slight decrease of 0.7% between 2019/20 and 2020/21(P).
- Figure 1 shows the fuel-wise energy consumption in India for 2020/21(P).
- Petroleum products occupied the largest share in India's fuel mix followed by coal and lignite.
- The industry sector continues to be the highest consumer of energy among all the sectors in the economy.¹
- Petroleum products are majorly consumed by the transport sector, with high-speed diesel (HSD) accounting for 49% of the total fuel consumed in the sector.
- Electricity was majorly consumed by the industry sector (41%), which includes both utilities and non-utilities.²
- This is followed by the residential sector, accounting for 26% of the total power consumption.
- The overall energy supply and consumption in the country for 2020/21(P) is represented by the Sankey diagram (Figure 2).
- Electricity generation in 2020/21 was 257.27 million tonnes of oil equivalent (MTOE), of which 82% was contributed by coal, 4% by natural gas, 5% by renewables, and 6% by nuclear and hydro.



¹ The share of industrial sector is 58% in the total energy consumption for 2020/21(P), followed by transport (16%) and residential sectors (11%).

² Utilities – power derived from the grid; non-utilities – captive power



- The transport sector was the major consumer of petroleum products as it accounted for ~41% of the total consumption.

Energy supply

Coal

- In 2020, coal constituted 54.8% of the total primary energy consumption (BP 2021).
- India has the fifth largest coal reserves in the world after the USA, Russia, China, and Australia. In 2020/21, India's overall coal production was 716.084 million tonnes (MT) while that of lignite was 42.1 MT (MoC 2019).
- The overall consumption/actual supply of coal during 2020/21 was 602.851 MT (up to December 2020).
- Industry-wise estimates of consumption of coal show that during 2020/21, electricity-generating units consumed 580.558 MT of coal, while the steel, sponge iron and cement industries consumed 8.934, 9.572 and 6.751 MT respectively (MoC 2021) (8.934 MT), sponge iron industries (12.23 MT), and cement industries (8.82 MT) (MoC 2019). Industry-wise consumption is indicated in Figure 3.
- The Indian Railways accounted for more than half (53.46%) of the total share of raw coal dispatched from pitheads to the centres of consumption in the year 2020/21 (MoC 2021). While in the same year road accounted for 24.84%, followed by merrygo-rounds (MGRs) at 16.47%. Rope, belt, and other categories together transported close to 5% of raw coal in 2020/21 (Figure 4).
- Coal and lignite imports during 2020/21 decreased by 13.5% to 215.01 MT, in comparison to 248.59 MT imported in 2019/20 (MoC 2021).
- The import of coking coal saw a decline of 1.05% in 2020/21 at 51.288 MT as compared to 2019/20. Import of non-coking coal was 163.707 MT in 2020/21 which indicated a decline of 16.78% over 2019/20.

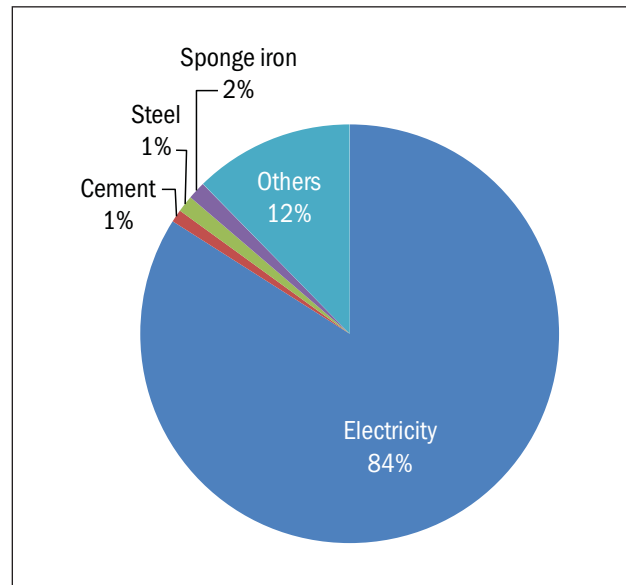


Figure 3 Industry-wise consumption of raw coal

Note Others include colliery consumption, jute, paper, textile, bricks, coal for soft coke, fertilizers and chemicals, and other industries consumption.

Source CCO (2021)

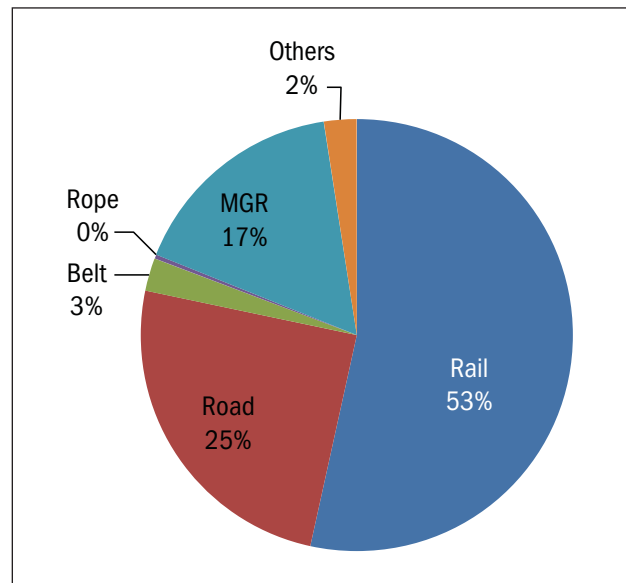


Figure 4 Coal transportation by various modes for 2020/21

MGR - merry-go-round

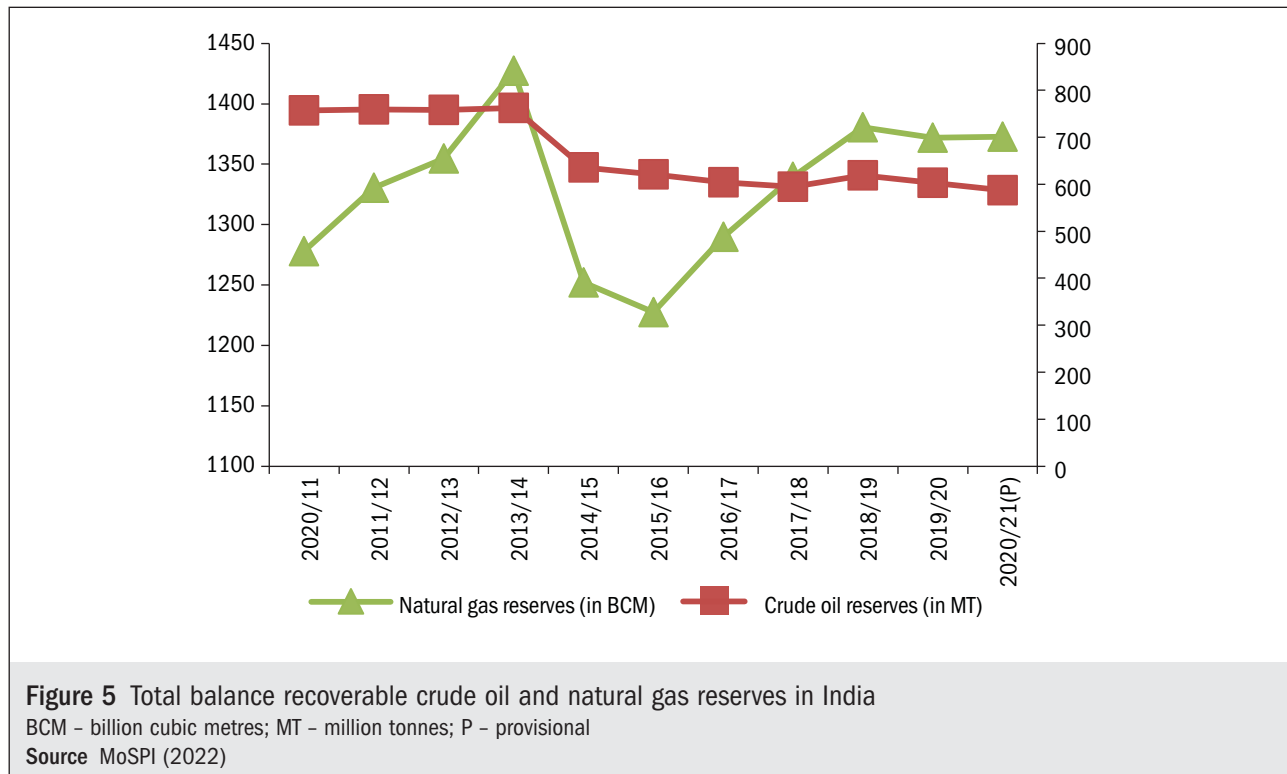
Source CCO (2021)

Petroleum and natural gas

- In India, as on 1 April 2020, the estimated balance recoverable reserves for crude oil and natural gas were 493 million tonnes (MT) and 1080 billion cubic metres (BCM), respectively (PIB 2021) (Figure 5).
- The crude oil imports witnessed a decline of 12.71% from 226.95 MT in 2019/20 to 198.11 MT 2020/21(P) (Figure 7). This is attributed to slow down of economic growth and impact of Covid on demand for petroleum products.
- Natural gas imports have decreased by 3% from 33.88 BCM in 2019/20 to 32.86 BCM in 2020/21(P) (PPAC 2021) (Figure 8).
- During 2020/21, the crude oil production in the country came down by 4.6% from 30.5 Mt in 2019/20 to 29.1 MT 2020/21(P) (excluding condensates). On the other hand, natural gas production declined by 8% from 31.18 BCM in 2019/20 to 28.67 BCM in 2020/21(P) (PPAC 2021) (Figure 6).

Power

- Electricity generation from conventional sources was 1234440 MU from April 2020 to March 2021 against the target of 1330000 MU for the 2020/21 (CEA 2021a).
- The per capita electricity consumption of 2019/20 was 1208 (provisional) kilowatt hour or kWh (a growth of 2.3% from 2018/19) (CEA 2020b).
- Installed generation capacity in India (utilities) was 382151.22 MW as on 31 March 2021 (CEA 2020), with an increase of 7.3% compared to the previous year.
- As on 31 March 2020, the share of renewable energy in the total installed capacity was 25%*, the share of coal-based thermal plants was 53%, while the installed capacities of gas, nuclear, and hydropower were 6%, 2%, and 12%, respectively (Figure 9) (CEA 2021a).
- Figure 10 shows mode-wise gross electricity generation in India.



*Data till 28 February 2021

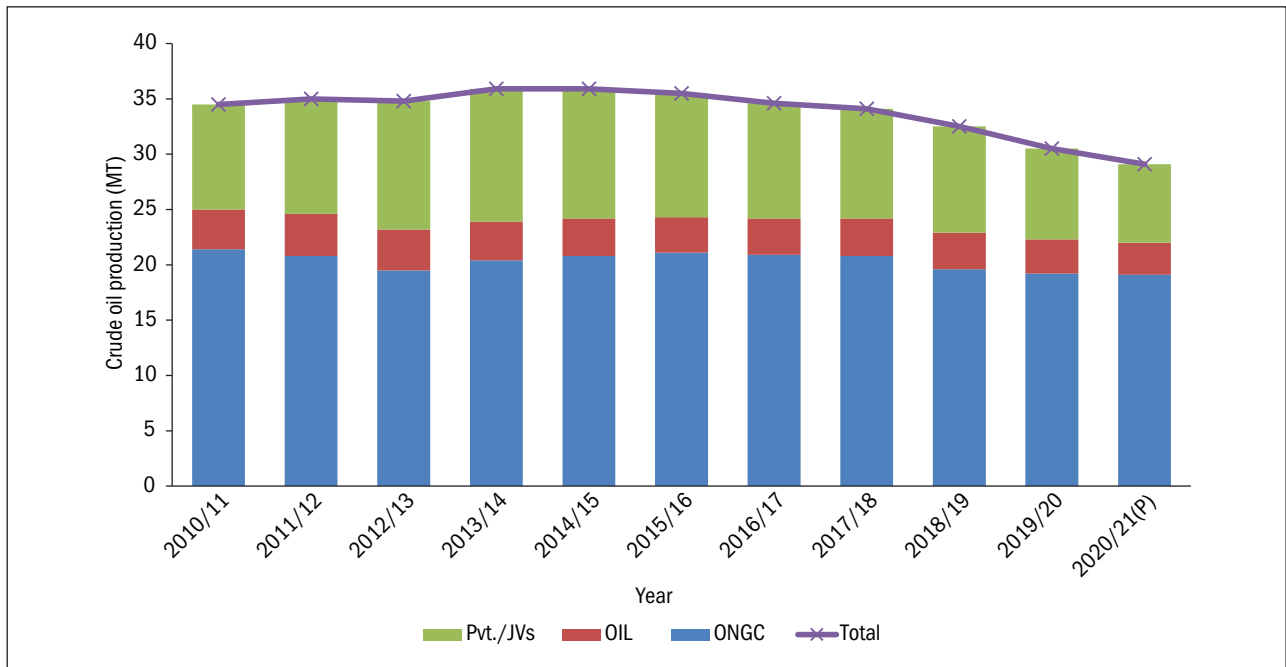


Figure 6 Trend in domestic crude oil production

JV – joint venture; MT – million tonnes; OIL – Oil India Limited; ONGC – Oil and Natural Gas Corporation Limited; P – provisional; Pvt. – private

Source PPAC (2021)

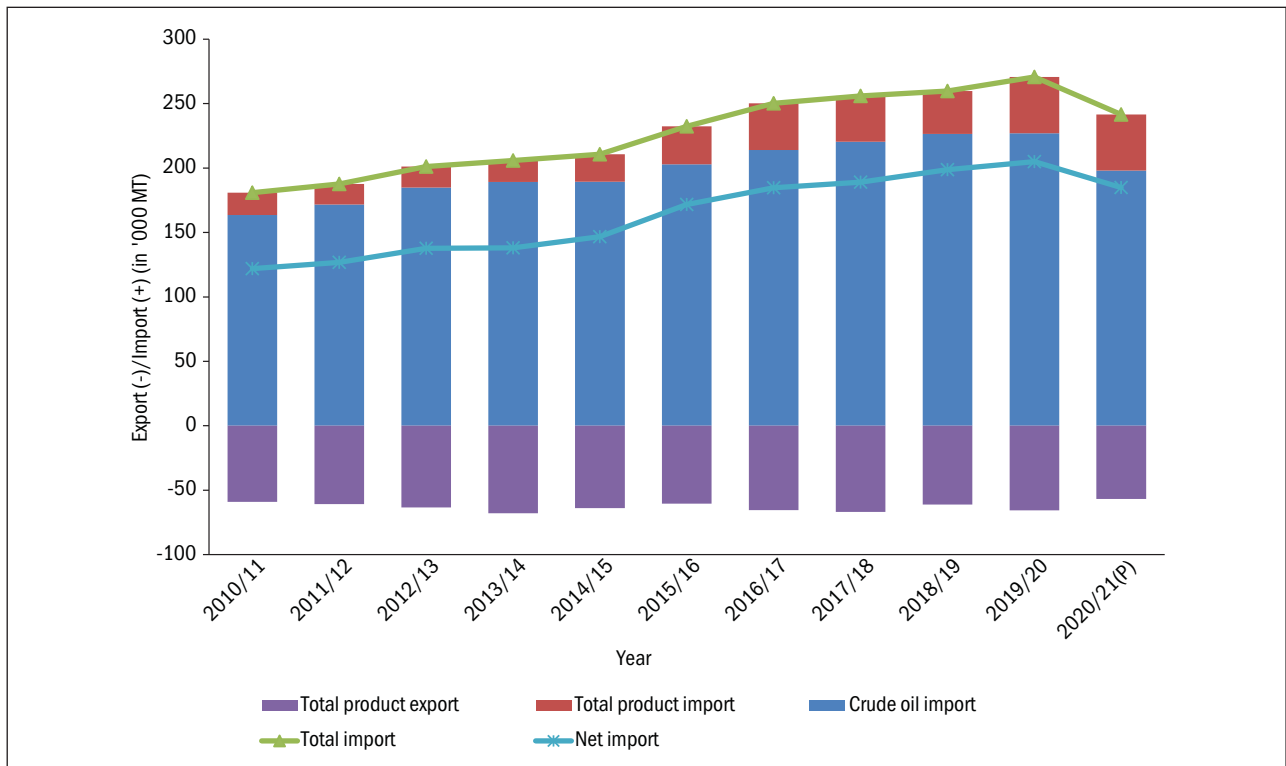


Figure 7 Crude import, product imports, and total imports (in '000 MT)

MT – million tonnes; P – provisional

Source PPAC (2021)

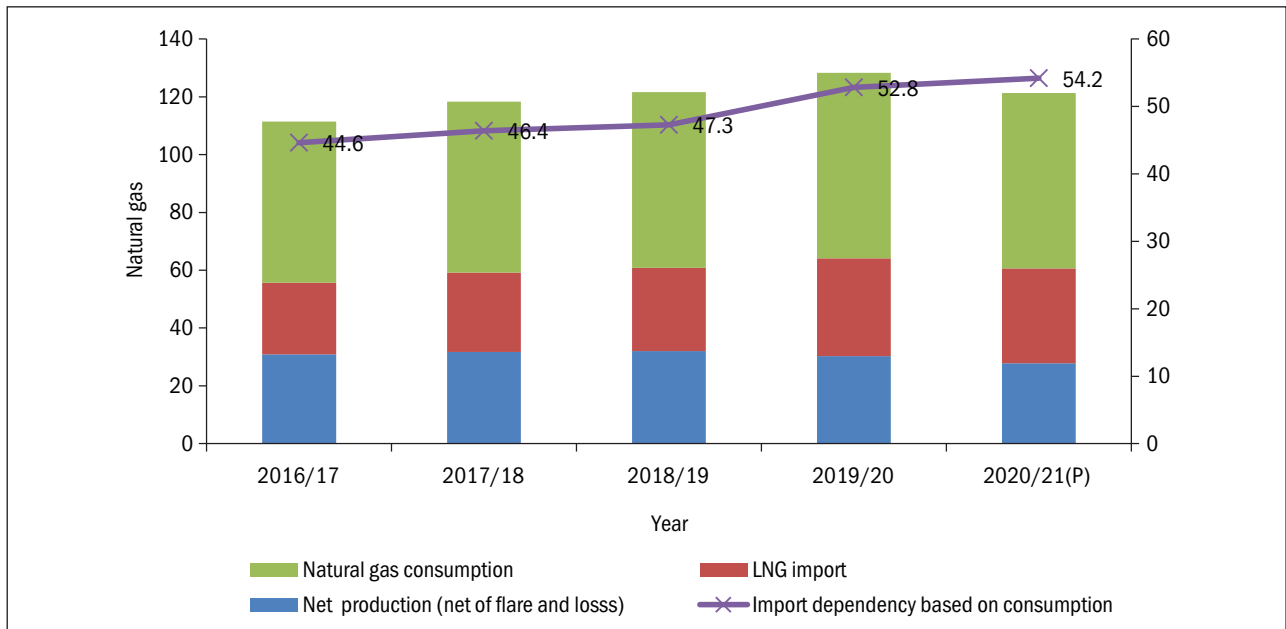


Figure 8 Trend in natural gas production, imports, consumption and import dependency

BCM - billion cubic metres; LNG - liquefied natural gas; P - provisional

Source PPAC (2021)

Renewable energy

- In India, the cumulative installed capacity of renewable sources was 94.43 gigawatt (GW) as of March 2021, approximately 25% of the total installed capacity of 382.15 GW. Figure 11 shows the trends in India's installed capacity from renewable energy sources.
- The installed capacity of India's solar power reached 40.08 GW by March 2021. As on 31 March 2021, solar rooftop systems of 4439.74 MW capacity have been installed (CEA 2021c).
- India ranks fourth in the world in terms of installed capacity of wind, with installed wind capacity as on 31 March 2021 being 39.25 GW. Wind energy accounts for 41.56% of the renewable energy capacity in India.
- Cumulatively, 10.17 GW of biopower projects, including biomass power (bagasse and non-bagasse cogeneration) and waste-to-power, were installed in India till March 2021.

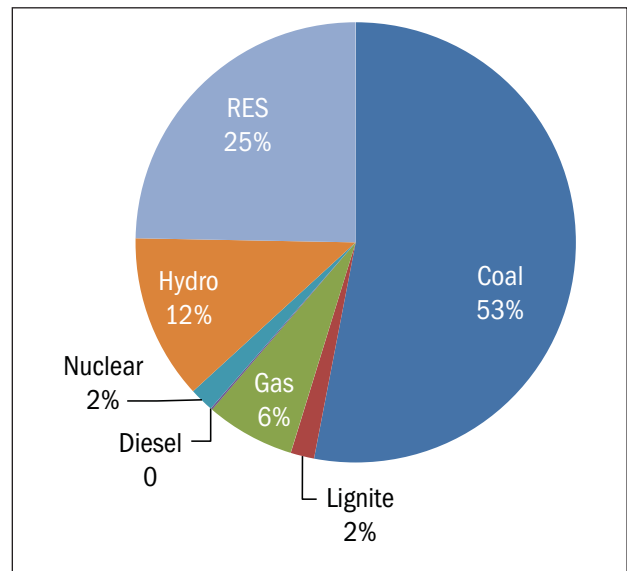


Figure 9 Installed generating capacity in India by mode (utilities)

RES - renewable energy sources

Source CEA (2021a)

Energy consumption

The total energy consumption in India has almost tripled since 2002/03.

Agriculture

- The total electricity consumption by the agriculture sector increased from 84 729 gigawatt hour (GWh) in 2000/01 (accounting for nearly

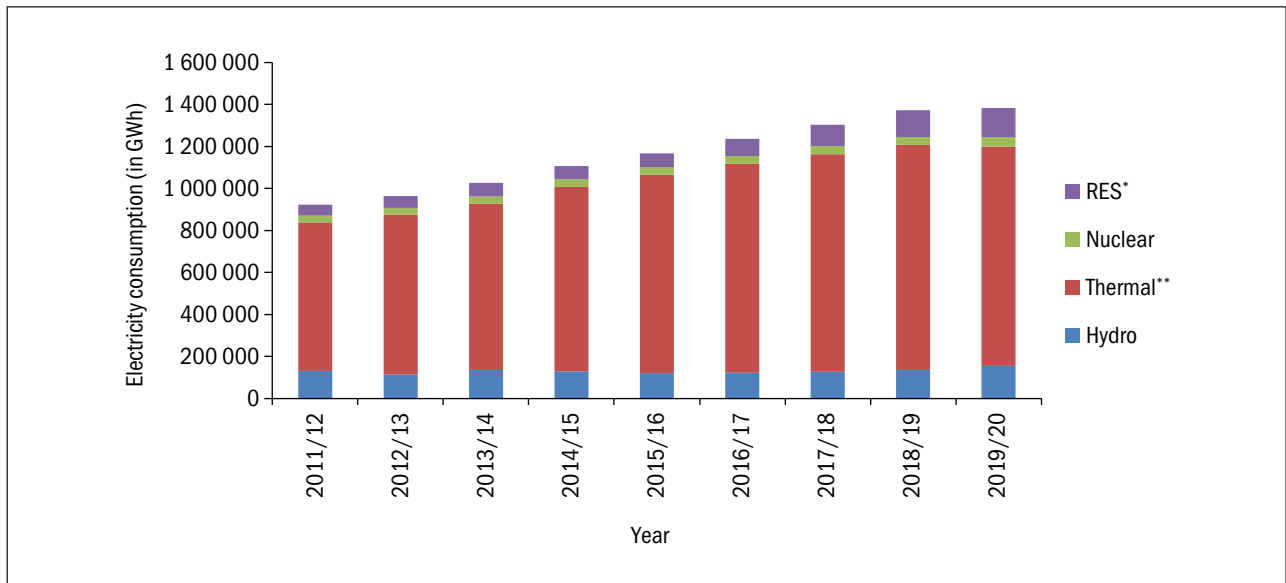


Figure 10 Growth of gross electricity generation in India by mode

*Renewable energy sources

**Including steam, gas, and diesel

GWh - gigawatt hour; MU - million units; RES - renewable energy sources

Source CEA (2021b)

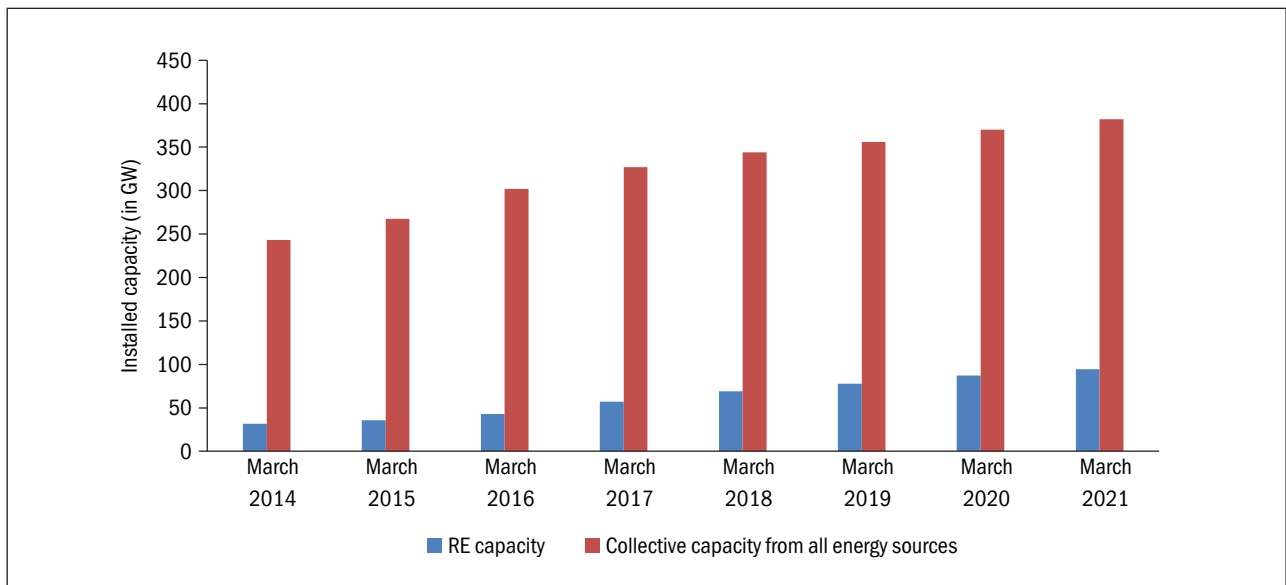


Figure 11 Growth of renewable energy sources

GW - gigawatt; RE - renewable energy

Source CEA (2021b)

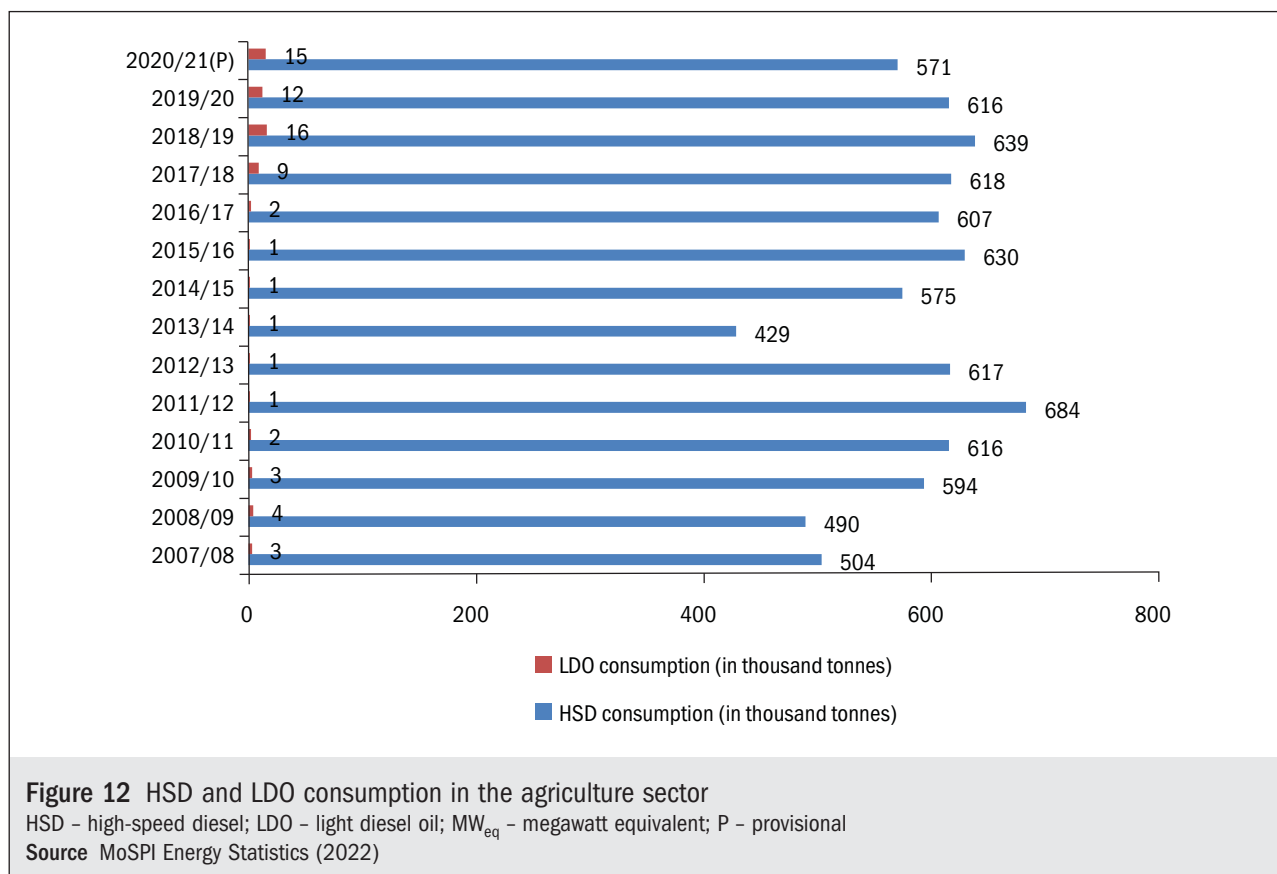
26.76% of the total electricity consumption in that year) to 215 000 GWh in 2020/21(P) (17.52% of the total consumption of electricity during that year) (MoSPI 2022). This increase was primarily driven by higher irrigation demand for new crop varieties and the huge levels of subsidies extended to this sector.

- HSD, which is used in tractors and tube wells, was estimated at 0.571 MT in 2020/21(P) (Figure 12). This represents around 0.78% of the total HSD consumption in India during 2020/21.
- India is one of the few countries that produces light diesel oil (LDO), which is a distillate fuel with a small proportion of residual fuel. It is used in agricultural pump sets by small industries and as start-up fuel in power generators. The consumption of LDO in the agriculture sector has

increased from 12 000 tonnes in 2019/20 to 15 000 tonnes in 2020/21(P) (MoSPI 2022). However, LDO consumption in agriculture increased to 9 000 tonnes in 2017/18 and is estimated to increase to 16 000 tonnes in 2018/19 (MoSPI 2020). The ban of furnace oil in some regions has led to an increase in LDO consumption.

Industry

- Of the total electricity consumption in 2020/21(P), industry accounted for the largest share (41.09%) (MoSPI 2021).
- The consumption of electricity in the industrial sector registered a decline from 532 820 GWh in 2019/20 to 504 200 GWh in 2020/21(P) (Figure 13).



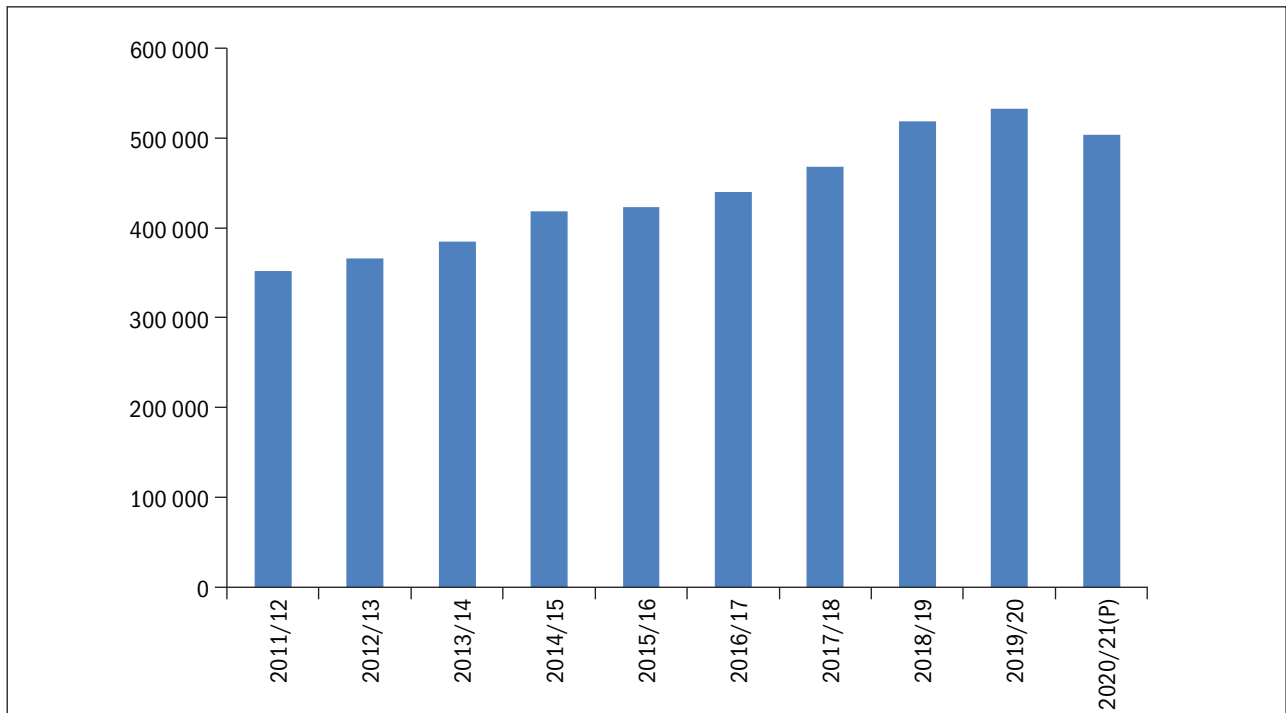


Figure 13 Trends in electricity consumption in the industry sector

P - provisional

Source MoSPI Energy Statistics (2022)

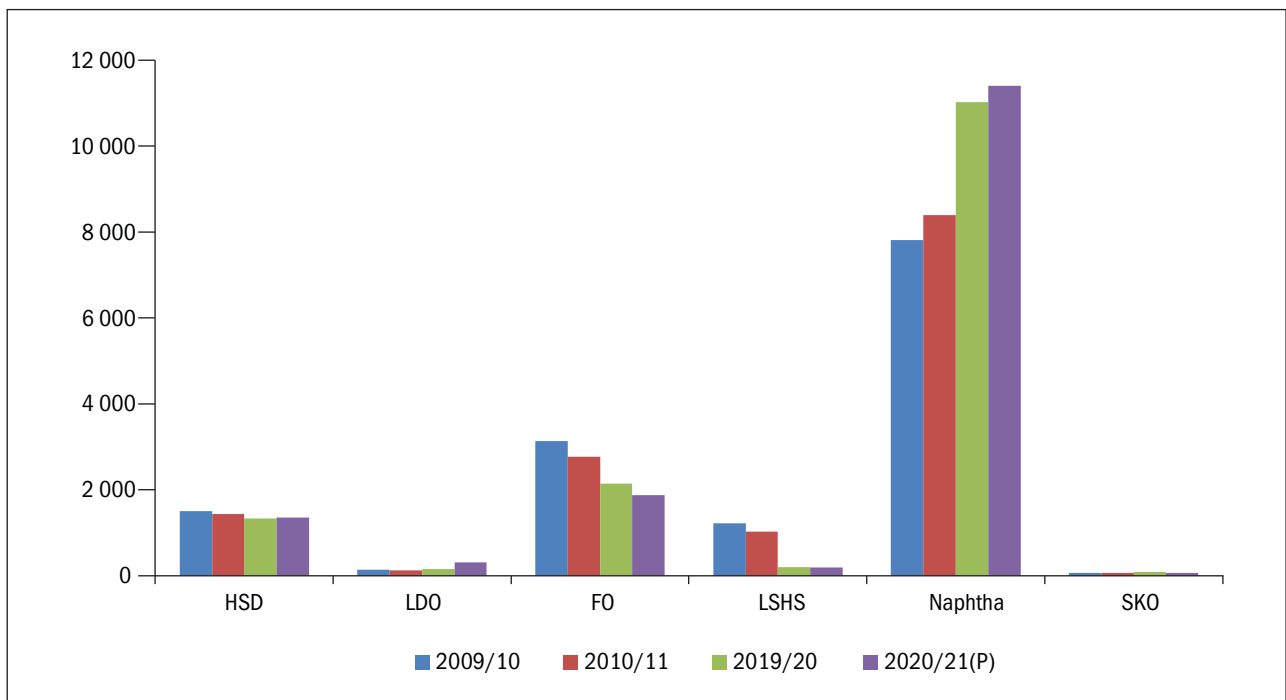


Figure 14 Consumption of selected petroleum products in the industry sector

FO - furnace oil; HSD - high-speed diesel; GWh - gigawatt hour; LDO - light diesel oil; LPG - liquefied petroleum gas; LSHS - low-sulphur heavy stock; P - provisional; SKO - superior kerosene oil

Source MoSPI Energy Statistics (2022)

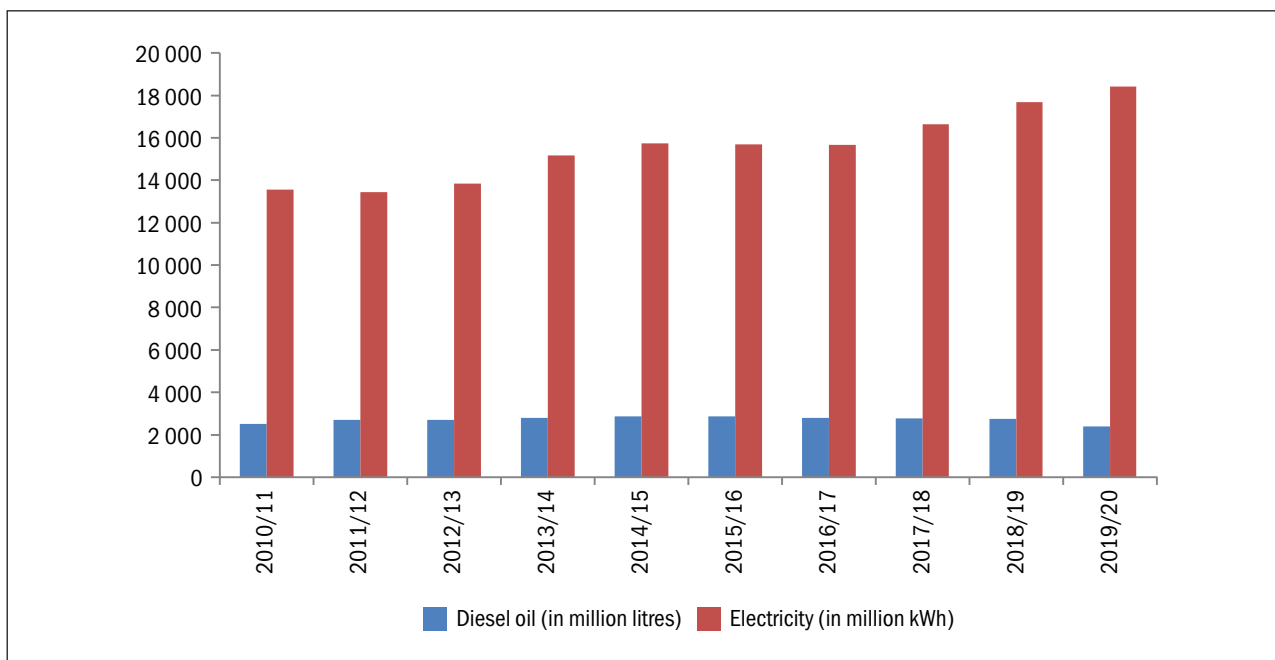


Figure 15 Trend in fuel consumption in the Indian Railways

HSD – high-speed diesel; kWh – kilowatt hours; LDO – light diesel oil; P – provisional

Source Indian Railways Yearbook (2019/20)

- Consumption of petroleum products in the industry sector registered a CAGR of 0.83% between 2009/10 and 2020/21 (provisional) (Figure 14).
- The share of naphtha consumption in the industry sector was the highest (74.99%) followed by Furnace oil (12.32).
- Different processes within the industrial sector consume different amounts of energy. However, there has been a transition towards adoption of energy-efficient techniques in production processes. For example, the cement industry in India is already one of the most energy efficient in the world, with relatively large production units using latest technologies.
- Specific energy consumption (SEC) in different industries in India is listed in Table 1.

Transport

- As per MoSPI (2022), in 2020/21(P), the transport sector accounted for 8.82% of the total final energy consumption; it was the second-largest energy-consuming sector in the country (after the industry sector).
- The transport sector was the third-largest user of natural gas with a share of 15% in 2020/21(P) (MoSPI 2022).
- The trend in consumption of selected petroleum products in the transport sector is listed in Table 2.

- Over the period of 2010/11 to 2019/20 the consumption of diesel by the railways declined at CAGR -0.6% while electricity consumption grew at CAGR 3.45% (Figure 15).

Household energy

- During 2020/21(P), estimated power consumption in the residential sector was 315 000 GWh. This sector consumed 25.67% of the total power produced in the country (MoSPI 2022).
- There has been a slight increase in the per capita electricity consumption between 2018/19 and 2019/20 (Figure 16).
- During 2020/21(P), the residential sector consumed 91.18% and 88.24% of the total LPG and kerosene in the country, respectively, across all consumer categories (Figure 17).
- The total numbers of active residential LPG consumers have increased from 1988 lakh in 2016/17 to 2932 lakh in September 2020/21. Between 2017 and 2020, the number of beneficiaries of the Pradhan Mantri Ujjwala Yojana in terms of access to residential LPG connection and LPG stove had more than doubled.
- The primary sources of cooking for residential households have been coke, coal, charcoal,

Table 1 SEC Indian industries

Industry	Unit	Value
Aluminium	kWh/tonne	14 400-18 000
Cement*	kWh/tonne	30
Chlor-alkali	kWh/tonne	3 062.71
Fertilizer	Urea	Gcal/MT
	Ammonia	Gcal/MT
Iron and steel	GJ/tonne	6.5
Pulp and paper	GJ/tonne	23-37

Gcal - gigacalories; GJ - gigajoules; kWh - kilowatt hour; MT - million tonnes; SEC - specific energy consumption

*Represents specific energy consumption of cement mill.

Sources IAI (2019); LBNL (2005); NPC (2017); DoF (2018); BEE (2019)

Table 2 Trend in consumption of select petroleum products in the transport sector in India (in MT)

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21(P)
High-speed diesel	64.8	69.1	68.4	69.4	74.6	76.0	81.1	83.5	82.6	72.7
Motor spirit	15.0	15.7	17.1	19.1	21.8	23.8	26.2	28.3	30.0	28.0
Aviation turbine fuel	5.5	5.3	5.5	5.7	6.3	7.0	7.6	8.3	8.0	3.7

MT - million tonnes; P - provisional

Source PPAC (2021)

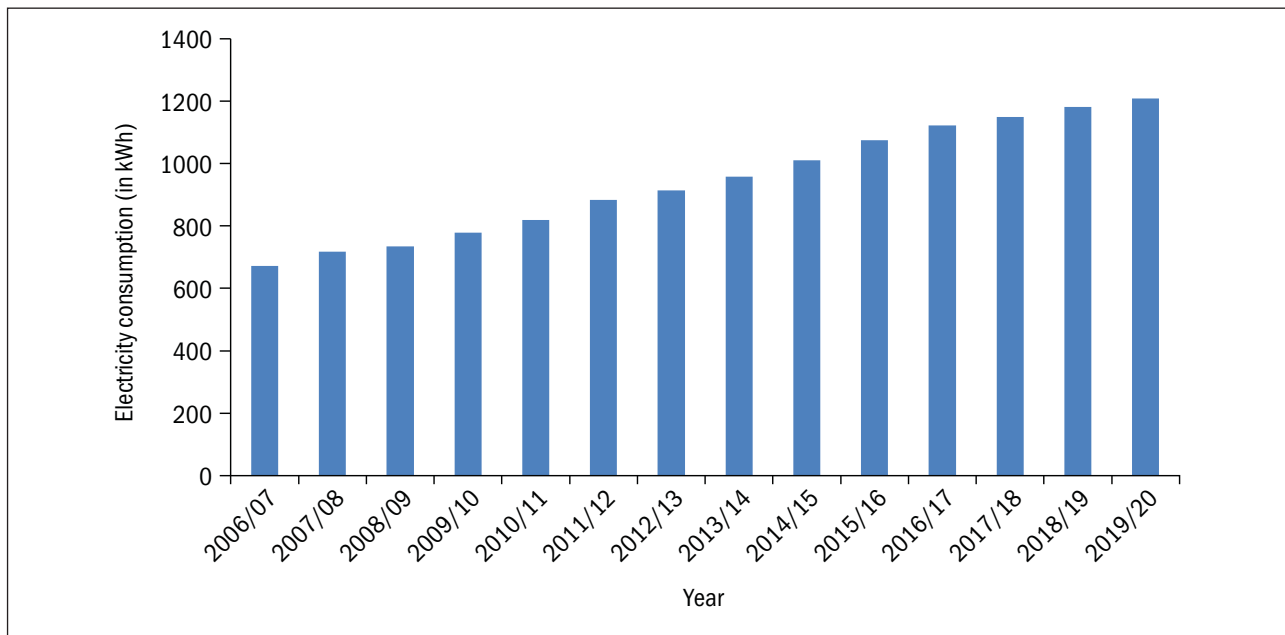


Figure 16 All-India annual per capita consumption of electricity since 2006

kWh – kilowatt hour; P – provisional

Sources CEA General Review (2021); CEA Executive Summary December (2021)

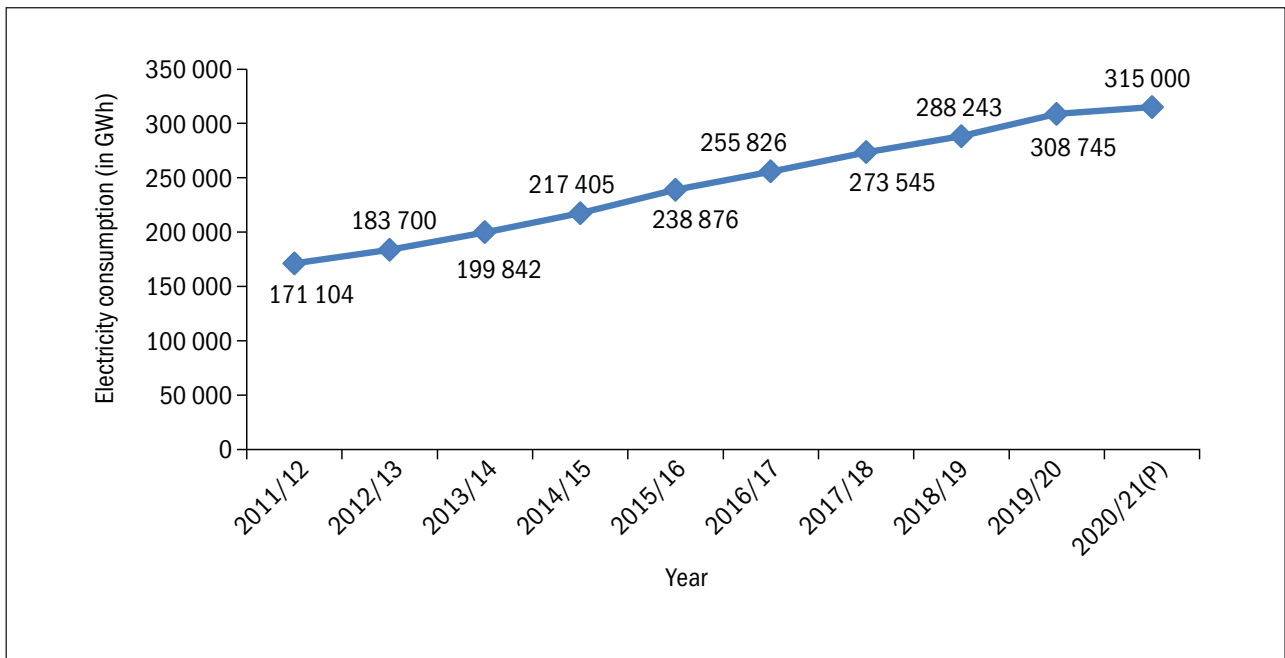


Figure 17 Consumption of electricity by the domestic sector from 2011/12 to 2020/21(P)

GWh – gigawatt hour; P – provisional

Source MoSPI (2022)

firewood and chips, LPG, dung cake, and kerosene. The change in distribution of fuel sources in households in rural and urban areas has shown a decline in the use of firewood and chips, and an increase in the use of LPG as a cooking fuel (Figure 18).

Buildings

- Commercial buildings account for about 8.31% of the total energy consumed in India (MoSPI 2022).
- Residential buildings account for 25.67% of the total energy consumed in India (MoSPI 2022).
- Electricity consumption projected till 2027 and 2037 for the commercial building sector is about 134 billion units (BU) and 227 BU, respectively (Figure 19).
- Electricity consumption by end use for commercial and residential sectors is shown in Figure 20.
- The share of space cooling in peak electricity load is projected to rise sharply in many countries, with

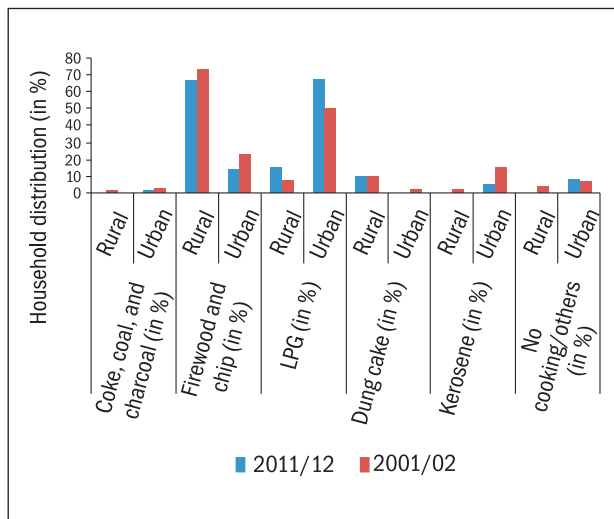


Figure 18 Percentage distribution of households by primary energy source for cooking (2001/02 and 2011/12)

LPG - liquefied petroleum gas

Note For 2011/12, the category 'coke, coal, and charcoal' does not include charcoal and the category 'no cooking/others' includes gobar gas, charcoal, electricity, and others.

Sources MoSPI (2001-02); MoSPI (2011-12); NSS rounds 57 and 68

the biggest increase occurring in hot countries such as India, where the share is expected to rise from 10% in 2016 to 45% in 2050.

Environment

Air

- Air pollution is reported as the second leading health risk factor in India and it reportedly costs 8.5% of the country's gross domestic product (GDP). Nearly 75% of deaths associated with air pollution in India are attributed to the emissions of pollutants during the burning of solid biomass fuels.
- Air pollution was the 4th leading risk factor for early death worldwide in 2019, surpassed only by high blood pressure, tobacco use, and poor diet. (SOGA 2020).

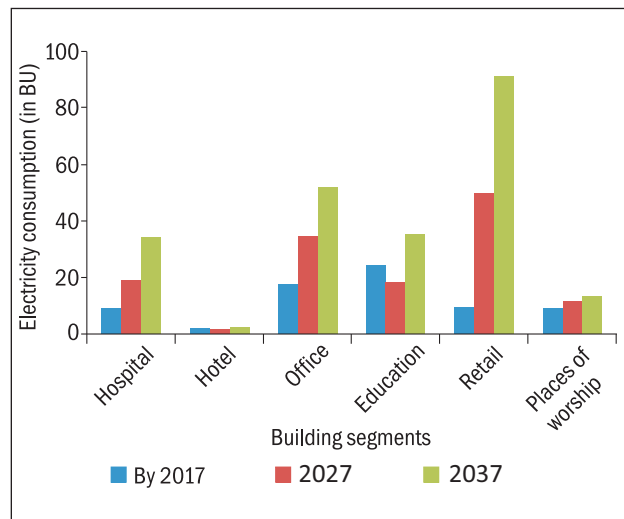
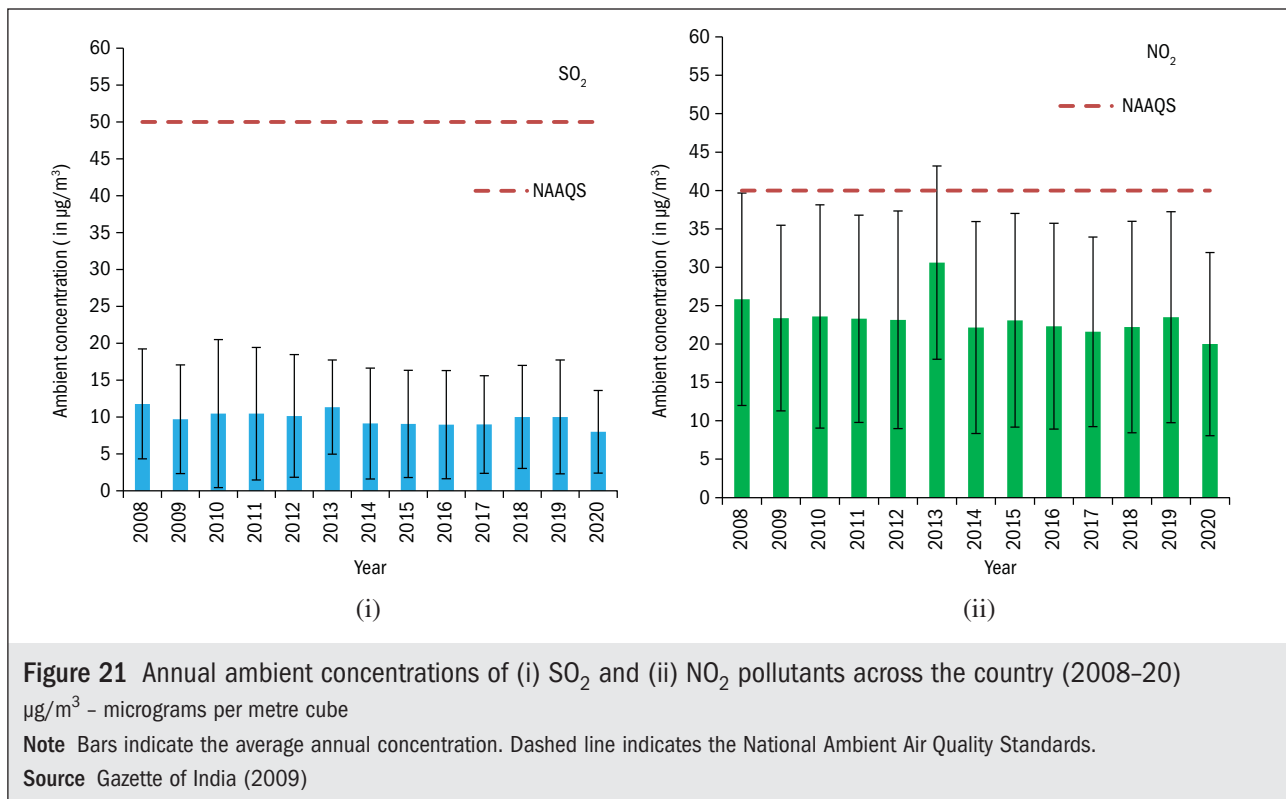
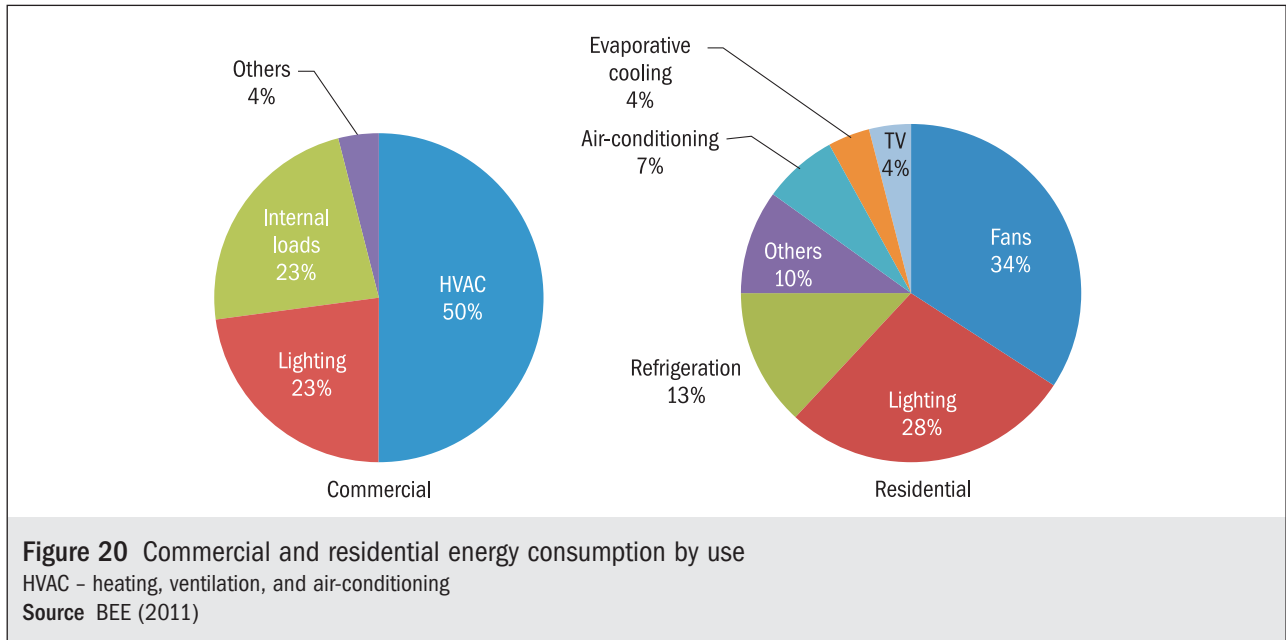


Figure 19 Electricity consumption (kWh) in BU for commercial building segments

BU - billion units

Source AEEE (2017)

- According to Global Burden Disease Study 2019, 1.7 million deaths were attributable to air pollution in India.
- The average annual ambient concentrations of SO₂ and NO₂ in India during 2008–20 remained within the National Ambient Air Quality Standards (NAAQS). The state-wise average concentrations for the period 2008-20 show that :
- all states complied with NAAQS for SO₂ and most of the states for NO₂ (except Delhi and West Bengal) (Figure 21).
- The National Ambient Air Quality Monitoring Programme (NAMP) monitoring stations started to report the PM_{2.5} concentration in 2014. The average annual concentration of



PM_{2.5} in 2020 at the national level was closer to the NAAQS (Figure 22). However, a majority of the states exceeded the NAAQS for PM_{2.5}, with the average being three to four times higher than the standard.

- The average annual concentration of PM₁₀ at national level remained much higher than the NAAQS during the period 2008–20 (Figure 23).
- Development and implementation of policies towards addressing 170 targets of the 17 SDGs can improve air quality. Policies towards improvement of ambient air quality from its present conditions can also address some of the SDG targets.

Waste

- The municipal solid waste (MSW) generated by urban India was about 59.56 million tonnes per annum (MTPA) in 2019 (CPCP 2019). The average collection rate was reported to be around 92% and only about 37% of the collected waste was treated (Figure 24).
- The estimated plastic consumption for 2019-20 is about 19.57 MT (Plastindia Foundation 2019).

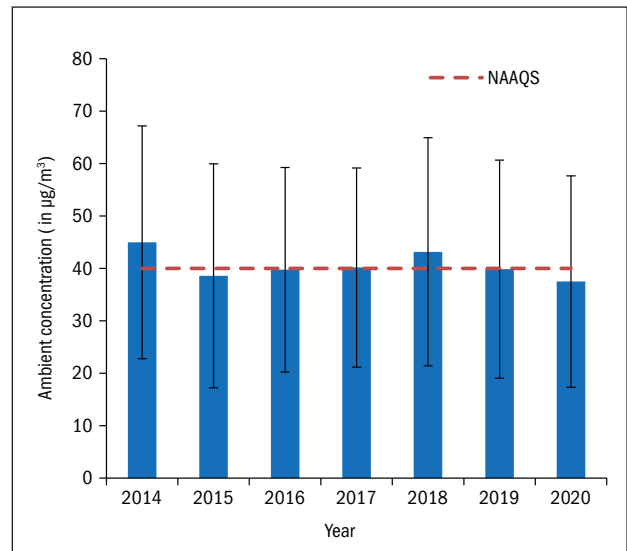


Figure 22 Annual ambient concentrations of PM_{2.5} across the country (2014–20)
 µg/m³ – micrograms per metre cube
Note Bars indicate the average annual concentration. Dashed line indicates the National Ambient Air Quality Standards.

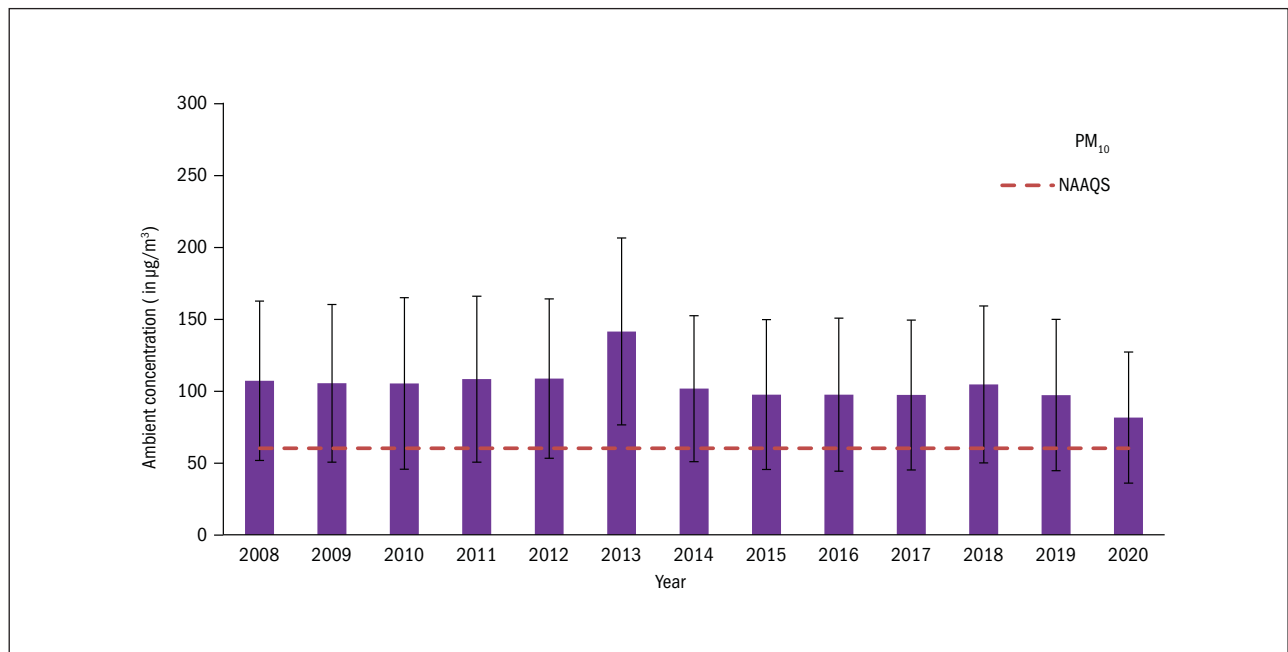
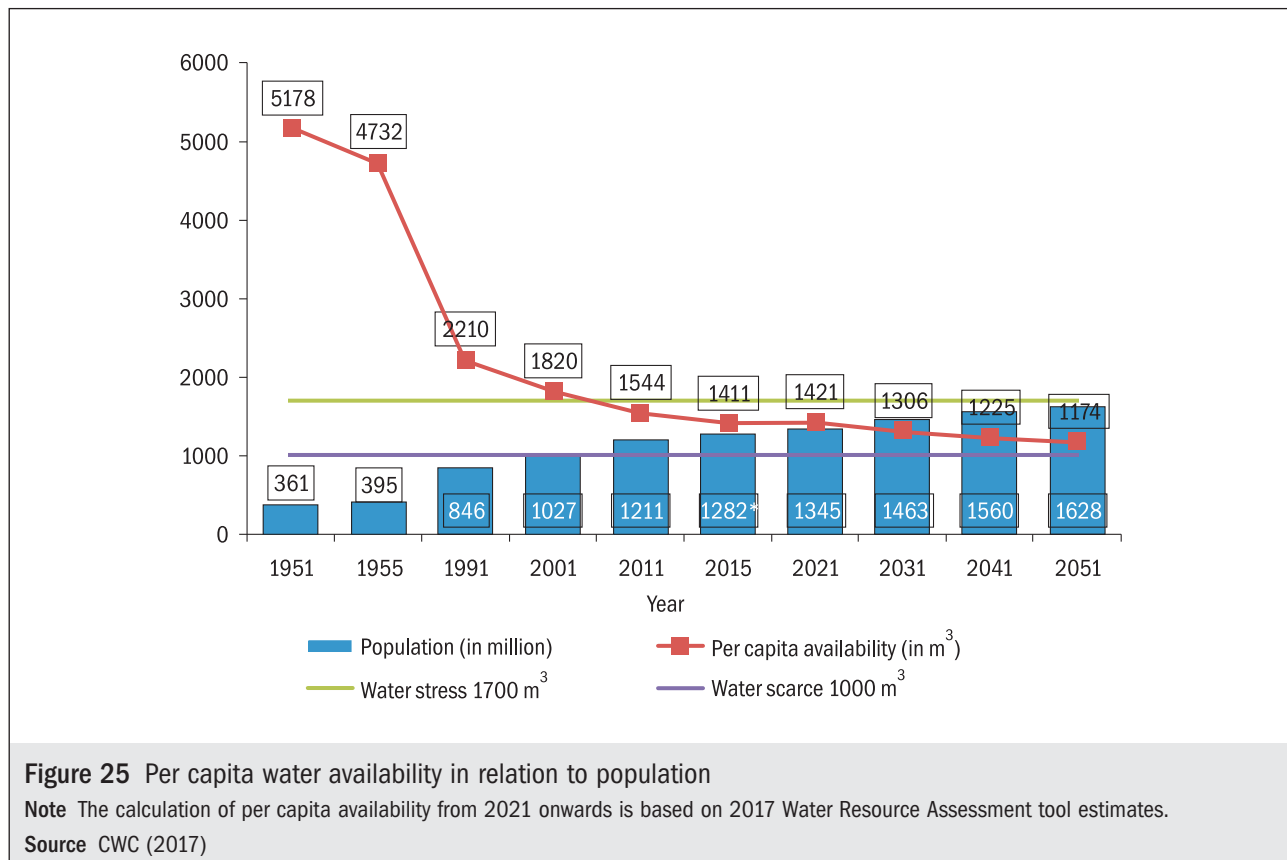
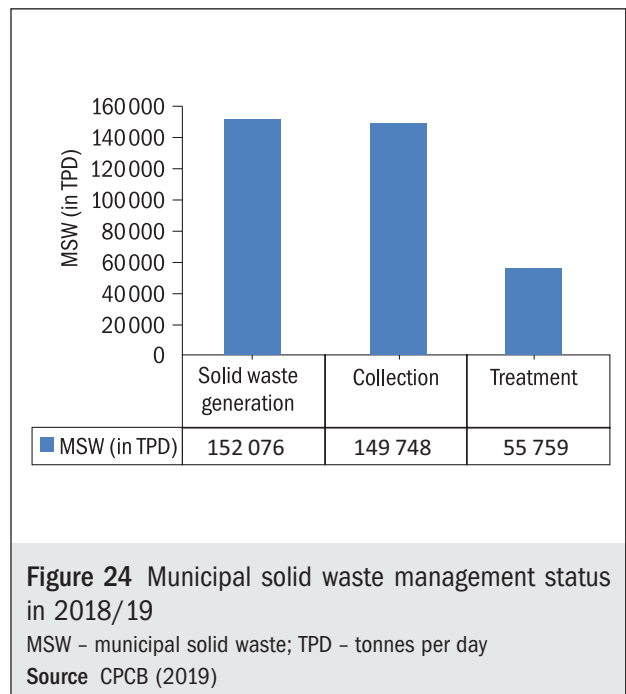


Figure 23 Annual ambient concentrations of PM₁₀ across the country (2008–20)
 µg/m³ – micrograms per metre cube
Note Bars indicate the average annual concentration. Dashed line indicates the National Ambient Air Quality Standards.

- India's plastic consumption is estimated to be 13.6 kg (virgin polymer)/capita/year (Plastindia Foundation 2019), with plastic waste ranging from 3% to 12.5% of MSW, varying from city to city.
- The plastic waste generation was reported to be about 9.468 MTPA in 2017 (CPCB 2017b).
- The estimated plastic consumption for 2019/20 is about 19.57 MT (Plastindia Foundation 2019).
- In early 2018, electronic waste (e-waste) generation in India was around 2 MTPA, and was expected to reach 3 MTPA by the end of 2018 (ASSOCHAM-NEC study 2018). Only 5% of the generated e-waste was recycled by the formal sector in India (Awasthi, Wang, Wang, *et al.* 2018). Construction and demolition waste rose to 530 MTPA in 2016 (PIB 2016).
- In 2016, MSW disposal contributed about 20% of the total greenhouse gas (GHG) emissions from the waste sector, which in turn accounted for 3% of the total GHG emissions in India (TERI 2016).



Water

- The per capita water availability has decreased from 1820 m³ (as per Census 2001) to 1545 m³ (as per Census 2011). The per capita availability of water registered a further decline to 1411 m³ in 2015. It is projected to be 1174 m³ by 2051, bringing the country ever closer to the ‘water scarce’ classification (CWC 2017) (Figure 25).
- A declining trend in the average water table across the country has also been observed (Figure 26).
- More than 82 lakh ha of inland water resources is available in the country (MoSPI 2020a).
- As of 2020, out of 6881 groundwater assessment units, 1186 were overexploited, 313 were critical, 972 were semi-critical, 100 were saline while 4310 were safe (CGWB 2020).
- In 2014, the Ministry of Jal Shakti (erstwhile Ministry of Water Resources, River Development and Ganga Rejuvenation) stated that industrial plants in India consume about 2–3.5 times more water per unit of production compared to similar plants operating in other countries. The National Water Mission strove to increase water-use efficiency in all the sectors of water use by 20% by 2017. However, the target has not yet been achieved.
- In order to improve water-use efficiency, the ‘More Crop per Drop’ scheme was launched under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). It aims at promoting the use of appropriate technological interventions such as drip and sprinkler irrigation technologies, and encourages farmers to use water saving and conservation technologies.
- The Government of India has been implementing a number of policies and programmes in the water and sanitation sector in order to achieve the SDG 6 target. The Swachh Bharat Mission with its ambitious goal of providing universal sanitation by 2019, is trying to address the gap in the sanitation sector.

Forest and biodiversity

- In India, the area covered by ‘very dense forest’ is 99 779 km², that with ‘moderately dense forest’ is 306 890 km², and by ‘open forest’ is 307 120 km², corresponding to 3.04%, 9.33% and 9.34%,

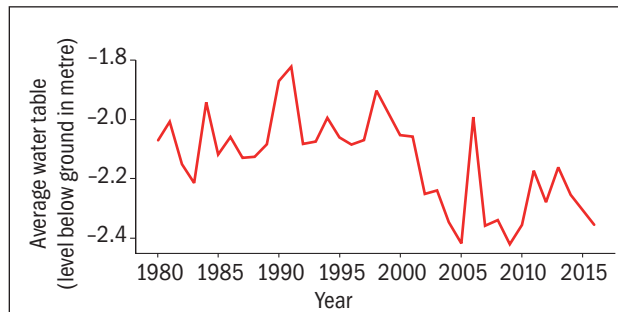


Figure 26 Trend of average water table in India from 1980 to 2015

Source MoSPI (2018b)

respectively, of the total geographical area of the country (FSI 2021).

- There are 14 major forest types in India, of which almost 38.2% constitute the tropical dry deciduous forests and 30.3% are tropical moist deciduous forests (Champion and Seth 2019).
- India, with 2.4% of the world’s land area, is home to 7%–8% of the recorded species of the world, which includes 47 485 species of plants (including fungi and lower plants) and 101 167 species of animals (MoEFCC 2019).

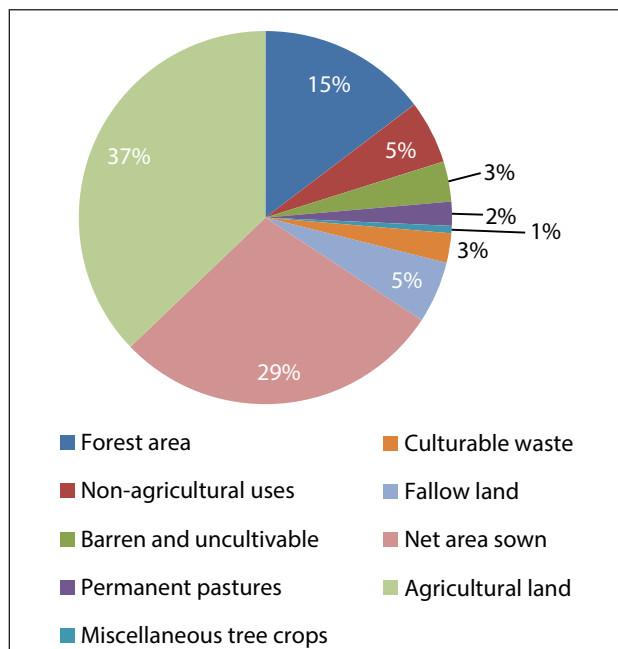


Figure 27 Percentage of land area under various uses in 2017

Source MoAFW (2017)

- There are 869 protected areas in India covering 165 158.54 km², which is 5.02% of the country's geographical area (WII 2019).
- In India, the total area under wetlands is 15.26 million hectares (Mha) out of which 4.14 Mha is under coastal wetlands, 10.56 Mha is under inland wetlands and 0.55 Mha of wetlands that are smaller than 2.25 ha (MoSPI 2020a).
- In the country, land use is classified into forest land, area under non-agricultural uses, barren and uncultivable land, permanent pastures and other grazing lands, land under miscellaneous tree crops, cultivable wasteland, fallow lands, current fallows, and net area sown (Figure 27).
- The net sown area has shown a decline of 1 Mha during 2010–15, in contrast to the other categories of land use which have shown an increase in the same time period (Figure 28).
- According to the National Remote Sensing Agency, about 16% of the geographical area of India is wasteland. This translates to 68.35 Mha of wasteland being present in India. Of this, approximately 50% is non-forest land, which can be made fertile again if it is treated properly (Balasubramanian 2015).
- Drylands cover approximately 34.9% of the earth's terrestrial surface and are home to about 34% of the world population (Adeel, Safriel, Niemeijer, *et al.* 2005). According to Space Applications Centre drylands in India comprise arid areas

covering 30.54 Mha (36.96%), semi-arid areas covering 35.4 Mha (42.84%), and dry sub-humid areas covering 16.7 Mha (20.21%) (SAC 2016). The area undergoing desertification from 2011 to 2013 was 82.64 Mha in these drylands, while it was 81.48 Mha between 2003 and 2005.

Climate change

- The annual mean temperature of India during 2019 was +0.36°C above the 1981–2010 average. The year 2019 was the seventh warmest year on record since 1901.
- Global mean temperature is projected to increase by 3–5.5°C (RCP 8.5) by 2100 relative to the 1986–2005 average (Hayhoe, Edmonds, Kopp, *et al.* 2017).
- India's per capita GHG emissions stood at 1.8 tonnes CO₂e for 2010 according to *Biennial Update Report II* (MoEFCC 2018). The report also highlighted a reduction in emission intensity of GDP by 21% between 2005 and 2014.
- CO₂ emissions trend in relation to GDP is shown in Figure 29.
- In terms of sectoral distribution, CO₂ emissions from the electricity and heat sectors for 2016 accounted for a little more than half of India's total CO₂ emissions (IEA 2018a). The transport sector emissions were dominated by road, followed by aviation and marine transportation (IEA 2017).

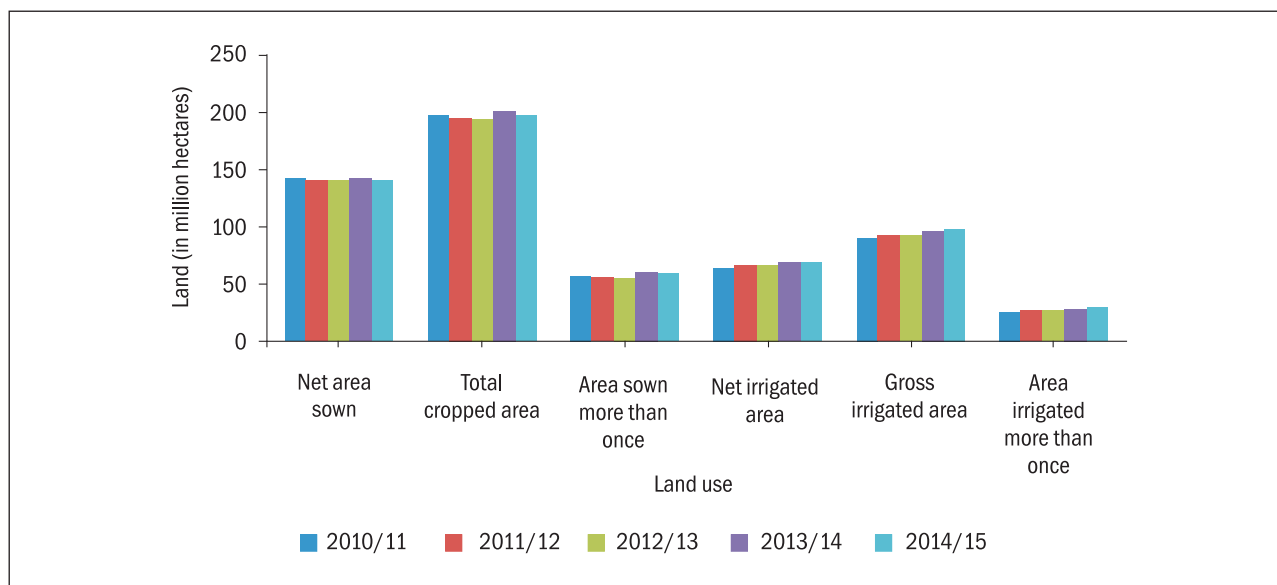


Figure 28 Land-use change from 2010/11 to 2014/15

Source MoAFW (2016)

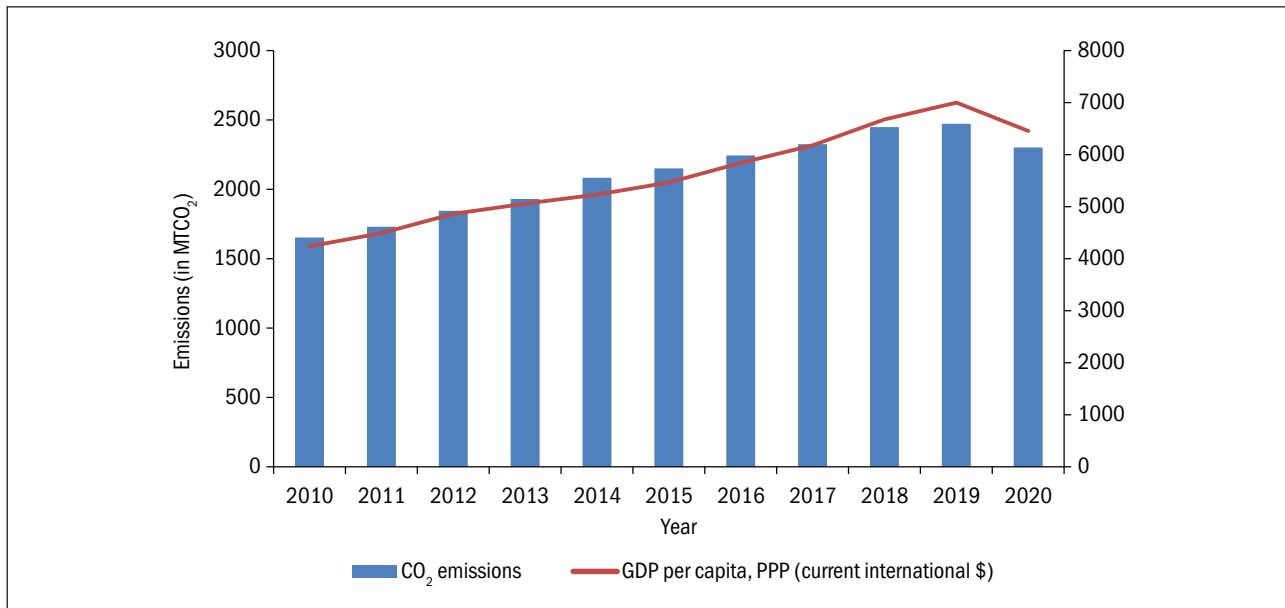


Figure 29 CO₂ emissions in India as compared to GDP (PPP)

GDP - gross domestic product; MTCO₂ - million tonnes of carbon dioxide; PPP - purchase power parity

Sources World Bank (2020); BP (2021)

The distributed share of carbon dioxide emissions across different sub-sectors for India is highlighted in Figure 30.

Moving ahead

TERI Energy & Environment Data Diary and Yearbook (TEDDY) is an annual publication, which presents the state-of-art information on energy supply, energy demand, and the environment. It seeks to support policy research and decision-making by providing policymakers and researchers with facts and data that can further be used to develop actionable solutions warranted by rigorous analysis. The data in *TEDDY* are compiled from various government sources, policy documents, and other secondary data. Each edition of *TEDDY* contains India's commercial energy balances that provide comprehensive information on energy flows within different sectors of the economy.

The data in the yearbook provide the latest available information at the time of compilation of the chapters, and is supported by well-researched analytical narratives. Energy supply is covered in chapters on coal and lignite, petroleum and natural gas, power, and renewable energy. Energy demand is explained in chapters on agriculture, industry,

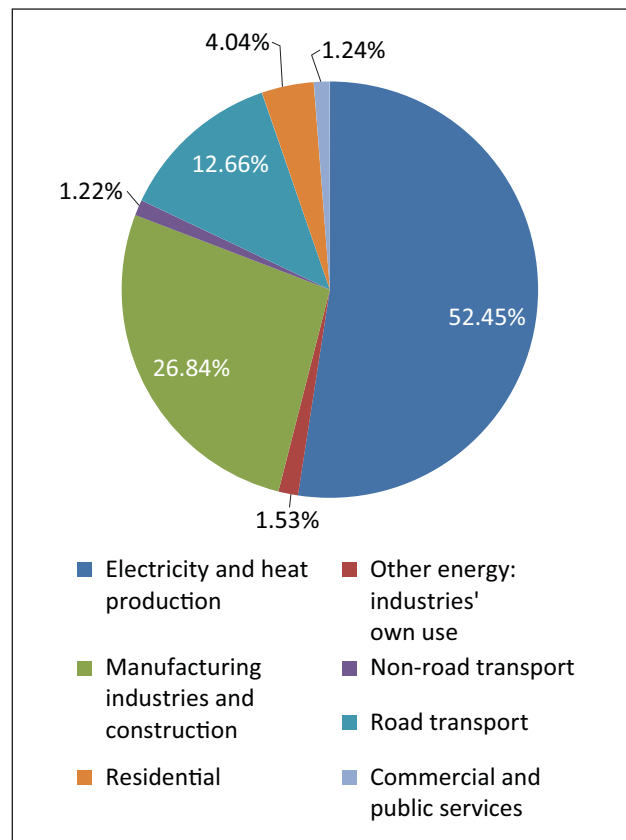


Figure 30 CO₂ emissions within sub-sectors in India

Source IEA (2019)

transport, household energy, and buildings. The section on local and global environment discusses the state of the environment in India, with chapters on air pollution, solid waste management, water resource management, land and forest resource management, and climate change. The publication also provides a review of government policies and analyses the latest policy discourse that has implications on the energy and environment sector of India. The interlinkages of various sectors with SDGs are also discussed.

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ANNEXURE

Annexure I

Availability of fuels

- Figure A1 shows the allocation of the net availability of fuels to different sectors of the economy for 2019/20. The energy flows are illustrated as bands. The width of the band is proportional to the size of the energy flow.

- The electricity generation in 2019/20 was 249.90 MTOE, of which ~84% was contributed by coal, ~4% by natural gas, ~5% by renewables, and ~7% by nuclear and hydro.
- The major consumer of petroleum products was the transport sector, which accounted for ~47% of the total, followed by industry (28%) and residential sectors (13%). The provisional commercial energy balance for 2020/21 is detailed in Table A2.

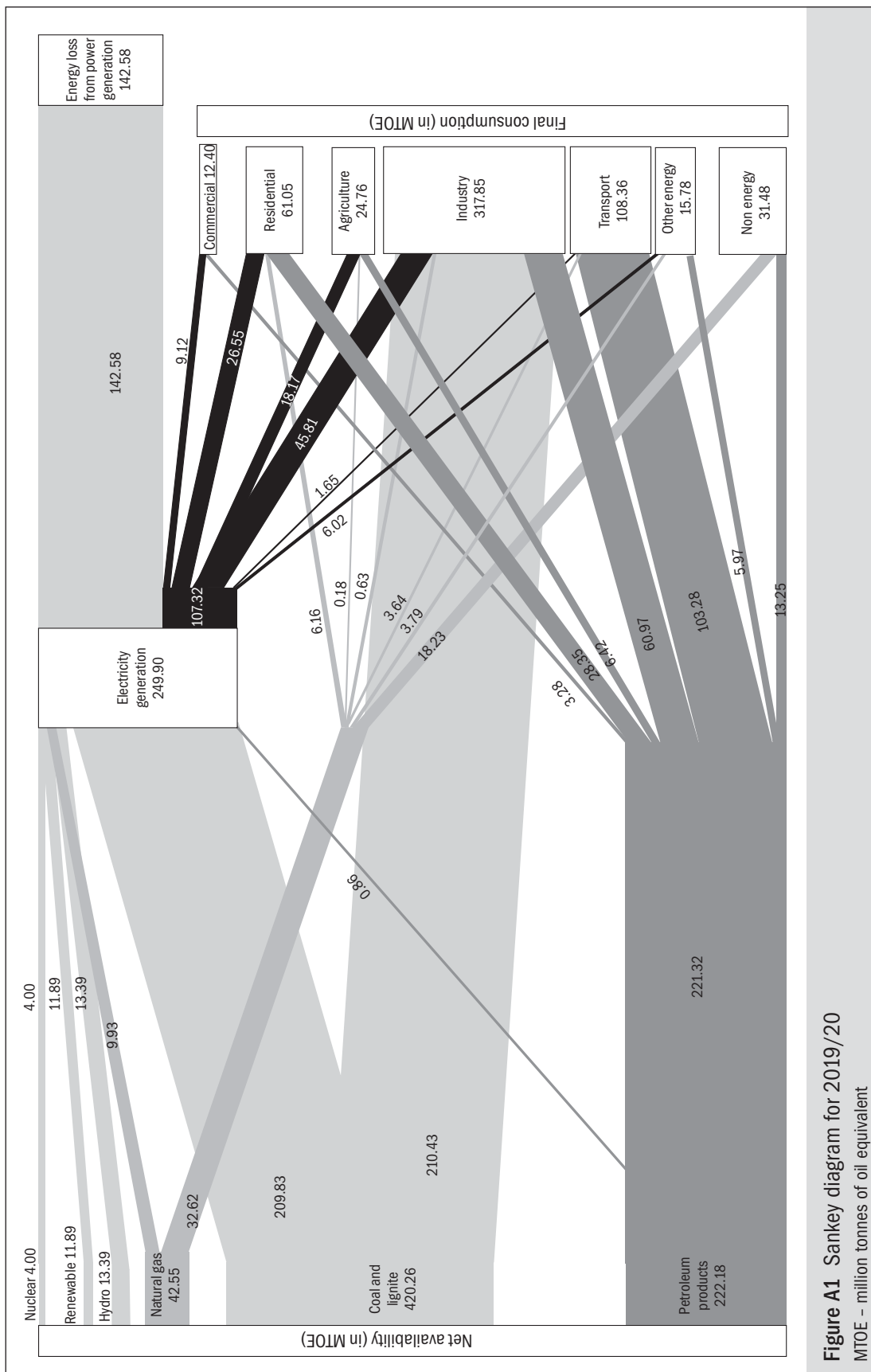


Figure A1 Sankey diagram for 2019/20
MTOE – million tonnes of oil equivalent

Table A1 Commercial energy balance (2019/20)

	Sources of secondary energy														Total energy				
	Coal and lignite	Hydro power	Nuclear power	Renewable energy sources	Natural gas	Crude oil	LPG	Naphtha	Motor gasoline	Aviation turbine fuel	Kerosene	High-speed diesel	Light diesel oil	Fuel oil		Other petroleum products	Total petroleum products	Thermal power	Total power
Supply																			
Production	323.51	13.39	4.00	11.89	28.07	32.17												57.35	413.03
Imports	161.54				30.50	227.00	16.72	1.83	2.25	0.11	0.00	2.90	0.00	4.42	16.99	45.21		0.55	464.25
Exports	0.65				0	0	0.57	9.57	13.59	7.35	0.21	32.81	0.00	1.44	3.30	68.83		0.82	69.48
Stock changes	0.05				0	0	-0.90	0.85	2.09	-0.47	-0.64	0.29	0.01	-5.23	-21.74	-25.74			-25.69
Availability	484.45	13.39	4.00	11.89	58.57	259.17	29.75	15.34	32.07	8.52	2.50	85.27	0.27	5.71	41.88	221.32			782.11
Petroleum refining					7.01	254.40	14.13	21.69	40.31	15.83	3.27	112.30	0.60	8.27	49.94	266.34			266.34
Own use	0.09				5.45	23.51										28.96			
LPG extraction					0.77		0.36	0.54	1.01	0.40	0.08	2.81				5.20			
Power generation	209.83	13.39	4.00	11.89	9.93		0	0				0.22	0.33	0.31		0.86	220.62	249.90	249.90
Conversion loss in power generation	134.26				5.80							0.16	0.24	0.23		0.63	140.69	140.69	140.69
Auxiliary consumption in power stations	16.03	0.11	0.38	0	0.37							0.01	0.01	0.01		0.03	16.43	16.92	16.92
Transmission and distribution losses																			
Flaring of natural gas					0.84											0		23.28	23.28
Coal washery rejects	14.96																14.96		14.96
Conversion	240.92				23.99	254.40	14.49	22.23	41.32	16.23	3.35	114.89	0.27	7.96	49.94	270.68	172.08	180.89	196.68
Net availability	243.53	13.28	3.62	11.89	34.58	4.77	29.75	15.34	32.07	8.52	2.50	85.27	0.27	5.71	41.88	221.32	63.50	126.10	625.53
Consumption	210.43				32.62		29.75	15.34	32.07	8.52	2.50	85.27	0.27	5.71	41.88	221.32		107.32	571.68
Agriculture					0.18		0.03	0			0	6.30	0.01	0.07		6.42		18.17	24.76
Industry	210.43				0.63		0.40				0.09	15.36	0.16	3.08	41.88	60.97		45.81	317.85
Transport					3.64		0.20	0.00	32.07	8.52	0.00	61.48	0.00	0.82		103.08		1.65	108.36
Residential					6.16		26.08	0.00			2.27	0.00	0.00	0.00		28.35		26.55	61.05
Commercial					0.00		2.95	0.00			0.00	0.00	0.04	0.29		3.28		9.12	12.40
Other Energy Uses					3.79		0.09	2.08			0.14	2.14	0.06	1.45		5.97		6.02	15.78
Non Energy Uses					18.23		0.00	13.25			0.00	0.00	0.00	0.00		13.25			31.48

Table A2 Commercial energy balance (2020/21) (P)

	Sources of secondary energy														Total power	Total energy			
	Coal and lignite	Hydro power	Nuclear power	Renewable energy sources	Natural gas	Crude oil	LPG	Naphtha	Motor gasoline	Aviation turbine fuel	Kerosene	High-speed diesel	Light diesel oil	Fuel oil			Other petroleum products	Total petroleum products	Thermal power
Supply																			
Production	315.66	12.92	3.70	12.66	25.80	30.49												55.09	401.24
Imports	139.73				29.57	198.10	18.65	1.51	1.39	0	0	0.72	0	6.62	15.94	44.83		0.80	412.23
Exports	0.52				0	0	0.57	6.99	12.41	3.73	0.02	31.67	0	1.15	2.80	59.34		0.81	59.86
Stock changes	0.18				0	0	-0.58	7.26	4.81	4.70	-0.60	2.25	0.11	-7.10	-17.78	-6.94			-6.76
Availability	455.05	12.92	3.70	12.66	55.38	228.59	31.14	15.08	32.07	8.52	1.88	75.05	0.57	5.09	41.88	211.28			746.85
Petroleum refining					7.01	221.80	13.26	20.27	37.22	7.34	2.43	101.06	0.70	6.95	46.53	235.76			235.76
Own use	0.09				5.45	23.51										28.96			
LPG extraction					0.77		0.38	0.58	1.07	0.21	0.07	2.89				5.20			
Power generation	209.83	12.92	3.70	12.66	9.93		0	7.55				0.21	0.24	0.23		8.23	227.99	257.27	257.27
Conversion loss in power generation	134.26				5.80							0.16	0.18	0.17		0.50	140.56	140.56	140.56
Auxiliary consumption in power stations	16.03	0.14	0.44	0.01	0.36							0.01	0.01	0.01	0.03	0.03	16.42	17.01	17.01
Transmission and distribution losses																0		22.99	22.99
Flaring of natural gas					0.84											0			0.84
Coal washery rejects	5.19																5.19		5.19
Conversion	231.15				23.99	221.80	13.64	13.31	38.28	7.55	2.50	103.74	0.46	6.72	46.53	232.73	162.17	180.56	186.58
Net availability	223.90	12.78	3.26	12.65	31.39	6.79	31.14	15.08	32.07	8.52	1.88	75.05	0.57	5.09	41.88	211.28	71.01	131.80	598.37

Contd...

Table A2 Contd...

Consumption	220.20					32.62	31.14	15.08	32.07	8.52	1.88	75.05	0.57	5.09	41.88	211.28	105.50	569.60
Agriculture						0.11	0.03	0			0	7.82	0.01	0.07		7.94	18.49	26.60
Industry	220.20					0.50	0.32				0.07	20.33	0.30	2.38	41.88	65.28	43.35	329.47
Transport						2.90	0.13	0	32.07	8.52	0	44.59	0	0.98		86.30	1.59	91.53
Residential						5.41	28.39	0			1.66	0	0	0		30.05	27.09	63.30
Commercial						0	2.13	0			0	0	0.12	0.27		2.52	8.77	11.29
Other energy uses						4.11	0.13	1.60			0.15	2.31	0.12	1.39		5.70	6.22	15.71
Non-energy uses						19.35	0	13.48			0	0	0	0		13.48		31.70

LPG - liquefied petroleum gas; MTOE - million tonnes of oil equivalent; P - provisional

TERI ENERGY & ENVIRONMENT DATA DIARY AND YEARBOOK 2020/21

TERI Energy & Environment Data Diary and Yearbook (TEDDY) is an annual publication brought out by TERI since 1986. It is the only comprehensive energy and environment yearbook in India that provides updated information on the energy supply sectors (coal and lignite, petroleum and natural gas, power, and renewable energy sources), energy demand sectors (agriculture, industry, transport, household, buildings), and environment (local and global). Recent changes in the energy sector and environment are depicted with the help of graphs, figures, maps, and tables. The publication also reviews government policies associated with energy and environment. *TEDDY 2020/21* gives an account of India's commercial energy balances, extensively covering energy flows within different sectors of the economy and how they have been changing over time. These energy balances and conversion factors are a valuable reference for researchers, scholars, and organizations engaged in energy and related sectors. Contents of the book are organized into three sections—Energy Supply, Energy Demand, and Local and Global Environment. Interlinkage of SDGs with energy and environment also forms the subject matter of *TEDDY 2020/21*. The thirty-sixth edition continues to remain less prose intensive with inclusion of more data, represented with the help of infographics, thus making the publication an authentic and interesting read.

