SECTOR ASSESSMENT (SUMMARY): ENERGY

A. Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. **Sector overview**. India witnessed strong economic expansion between FY2003 and FY2016, when the economy grew by an average of 7.2%. India is entering the most energy-intensive phase of its economic growth, driven by industrialization, infrastructure development, and transportation. India is one of the world's fastest growing economies. It accounts for about 5% of the world's total annual energy consumption and is the third largest consumer of energy in the world after the United States and the People's Republic of China (PRC).[1] However, the nation's per capita energy consumption is still substantially lower than that of most developed and some developing countries, predicating soaring energy demand.

2. **Oversight and regulatory bodies.** The Government of India's Ministry of Power governs the central power sector. Government of India established the Bureau of Energy Efficiency (BEE) in 2001 under the Ministry of Power with a mandate to develop policy and strategies on energy efficiency with a focus on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001. The Ministry of Power set up Energy Efficiency Services Limited (EESL) in December 2009 as a joint venture of four national public sector enterprises (NTPC Limited, Power Finance Corporation, Rural Electrification Corporation, and Powergrid Corporation of India Limited). EESL is a "super" energy service company, acting as a resource center for capacity building of state distribution companies, the Energy Regulatory Commission, state designated agencies, energy service companies, and financial institutions; and is implementing several energy efficiency projects in the country across sectors and subsectors.

3. **Electricity supply and demand.** As of end–FY2019, overall generation in the country had seen an increase of 3.56% over FY2018, from 1.20 billion megawatt hours (MWh) to 1.24 billion MWh. The overall installed capacity was 360 gigawatts (GW) as of July 2019, while the peak power demand deficit was 0.8% in 2018–2019.[2] The national average for transmission and distribution losses continued to average around 21%. Even though India has gradually been adding generation capacity every year with almost universal electrification coverage by mid–2019, there is a continuous challenge to improve the quality of supply, especially in the rural areas.[3]

4. **Sectoral electricity consumption and intensity.** Population growth is a strong driver of energy demand. India's population is projected to increase from 1.3 billion in 2016 to 1.7 billion by 2042. India can be expected to overtake PRC as the world's most populous country by 2025 (UNDP, 2015). Most of this growth in population will be absorbed in cities. Rapid urbanization will significantly impact energy consumption trends because urbanization drives energy demand from industries that require energy for construction and manufacturing. On the demand side, there are five broad areas of electricity demand: industry, agriculture, transport, cooking, and buildings. The growth trajectory of demand [for energy] is linked to the growth rate of gross domestic product (GDP); it is calculated by [dividing] elasticity of demand for energy to the GDP growth rate.

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1 Enerdata. Global Energy Statistical Yearbook 2019. (accessed 26 July 2019).
2 Ministry of Power. https://powermin.nic.in/en/content/power-sector-glance-all-india (accessed on 18 Oct 2019).
3 Central Electricity Authority. 2019. *Power Sector Report.* http://www.cea.nic.in/reports/monthly/executivesummary/2019/exe_summary-03.pdf.

5. Based on projected rates of population growth and GDP growth, the five areas noted above are projected to exhibit compound annual growth rates (CAGRs) in the range of 1.5% to 5.4% from 2017 to 2042, with the transport sector growing the fastest (Table 1).

Table 1: Compound Annual Growth Rate for Gross Domestic Product

Sector	CAGR (%)
1. Cooking	1.5
2. Agriculture	3.1
3. Buildings	3.9
4. Industry	4.1
5. Transport	5.4

Source: India's Energy and Emissions Outlook, Niti Aayog.[4]

6. **Overall energy-efficiency potential**. The BEE undertook a study on the potential of energy efficiency in India. The study found that implementing energy-efficiency measures in key demand areas would lead to overall energy savings of 86.9 million tons of oil equivalent by 2031 (Table 2). The study also indicated that the areas with the most potential for energy-efficiency measures are transport (through a switch toward rail-based movement and electric vehicles [e-vehicles] and improvement in vehicle efficiencies); agriculture (through improvement in irrigation efficiency); and electricity metering, billing, and collection.

Table 2: Electricity Savings Potential

Demand Area	Savings by 2031		Savings Investment by 2031
	Mtoe	%	₹ Cr.
1. Agriculture	5.7	9%	91,467
2. Transport	15.8	7%	81,154
3. Domestic	12.1	12%	120,233
4. Commercial	4.9	17%	14,822
4. Municipal	0.9	12%	307,137
5. Industries	47.5	11%	226,039
Total	**86.9**	**10%**	**840,852**

Mtoe = Million ton of oil equivalent.
Sources: Energy Efficiency Potential in India, Bureau of Energy Efficiency, 2019, New Delhi.[5]

7. **Power distribution.** The distribution segment is key to the entire energy sector value chain as distribution is responsible for supplying electricity to the end-user. However, this is an area of chronic concern on account of operational and technical inefficiencies. The financial health of distribution companies (DISCOMs) has degraded mainly because of inefficiencies in metering and billing and aging infrastructure causing high network losses, resulting in financial weakness and underinvestment in maintenance.

[4] India's Energy and Emissions Outlook, Niti Aayog. https://niti.gov.in/writereaddata/files/document_publication/India%E2%80%99s-Energy-and-Emissions-Outlook.pdf.
[5] Bureau of Energy Efficiency. Unlocking National Energy Efficiency Potential, https://beeindia.gov.in/sites/default/files/press_releases/UNNATEE%20Report.pdf Delhi.

Table 3: Transmission and Distribution Losses and Aggregate Technical and Commercial Losses

Period	T&D Losses (%)	AT&C Losses (%)
2012–2013	23.04	25.48
2013–2014	22.84	22.58
2014–2015	22.77	24.62
2015–2016	21.81	
2016–2017	21.42	

T&D = transmission and distribution, AT&C = aggregate technical and commercial losses; (…) = data not available.
Source: Executive Summary on Power Sector, Central Electricity Authority.[6]

8. **Barriers to energy-efficiency implementation**. The adoption of energy-efficiency measures and technologies remains limited because of:

(i) **Policy barriers.** Several voluntary energy efficiency regulations have been introduced in India, and national programs have been launched that focus on energy efficiency, such as the perform–achieve–trade (PAT) scheme[7]. However, implementation of these schemes and/or programs has not progressed as anticipated because they are voluntary in nature;
(ii) **Institutional barriers.** While the government has created an institutional structure for energy efficiency, bodies like the BEE are constrained in terms of their capacity to support implementation of energy efficiency projects at the scale envisaged under the National Mission on Enhanced Energy Efficiency (NMEEE). The capacity of local bodies also needs to be built up to support energy efficiency initiatives;
(iii) **Financial barriers.** Key barriers to financing energy efficiency projects include lack of awareness of energy efficiency among conventional lenders, high transaction costs relative to investment magnitude, high project development costs, lack of capacity in banks and financial institutions in evaluating energy-efficient projects, and limited financial capacity of energy-efficient service providers;
(iv) **Consumer awareness.** Despite some progress, understanding of energy-saving technologies and associated benefits remains limited, which in turn limits market penetration.

2. Government's Sector Strategy

9. **Energy efficient policy and regulatory framework.** The Electricity Act, 2003 is the legislative cornerstone for India's energy sector, providing a legal framework for sector development. The act's primary concerns are the unbundling of state electricity boards, open access, and competition. The most important policies from an energy-efficiency perspective are the Energy Conservation Act, 2001, and the NMEEE. India's overall energy policy is governed by the Integrated Energy Policy, which has a broad vision to reliably meet demand for energy services across all sectors.

10. **Energy-efficiency policies**. India's energy-efficiency policy framework was formally initiated upon the enactment of the Energy Conservation Act in October 2001. The act provides

[6] Central Electricity Authority. 2019. Executive Summary on Power Sector, http://www.cea.nic.in/reports/monthly/executivesummary/2019/exe_summary-03.pdf Delhi.
[7] PAT is a flagship market-based mechanism of BEE to enhance the cost effectiveness to reduce specificenergyconsumption in energy intensive industries through certification and trading of excess energy saving in the market.

for the efficient energy use and energy conservation. It also created the BEE at the national level, and the state-designated agencies at the state level. The act targets the following key schemes for energy efficiency in India: (i) appliance standards and labeling; (ii) energy efficiency in building new buildings; (iii) energy benchmarking in designated consumers; (iv) energy efficiency in small- and medium-sized enterprises; (v) certification of energy managers and auditors; and (v) energy conservation awards.

11. The NMEEE targets key programs for energy efficiency. Implementing the NMEEE would save about 23 million tons oil equivalent by 2025, avoiding about 19,000 megawatts of capacity addition. Initiatives under the NMEEE include the following:

(i) **Perform, Achieve and Trade.** This market-based mechanism enhances the cost effectiveness of improvements in energy efficiency in energy-intensive large industries by certifying energy savings that could be traded;
(ii) **Market Transformation for Energy Efficiency.** This initiative accelerates the shift to energy-efficient appliances in designated sectors through innovative measures to make products more affordable;
(iii) **Energy Efficiency Financing Platform.** This initiative creates mechanisms that help finance demand-side management programs by capturing future energy savings;
(iv) **Framework for Energy Efficient Economic Development.** This framework develops fiscal instruments to promote energy efficiency.

12. **Promotion of e-mobility**. The Government of India is promoting e-vehicle adoption and announced in February 2019 its target to reach 25% e-vehicle adoption by 2030.[8] The government announced the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India (FAME-II) scheme on 8 March 2019 and allocated about $1.5 billion to incentivize and promote e-vehicle adoption. Government provided support of around $50 million through various incentives under the FAME-I which started in April 2015. Lack of public charging infrastructure is one of the major barriers hindering e-vehicle adoption. On 14 December 2018, the Ministry of Power released guidelines for public charging infrastructure for e-vehicles.[9] The ministry has proposed covering 70 cities and 20% of highways with charging infrastructure by 2025 at a cost of about $750 million. EESL is supporting the development of an electric mobility ecosystem in the country through its National E-Mobility Programme, launched on 7 March 2018.

13. **Smart metering**. India is on the path to transforming its energy mix with innovation. Along with enhancing energy production, the nation also needs to cut aggregate technical and commercial losses (AT&C) losses to below 12% by 2022, and to below 10% by 2027. New smart meters can bring efficiency to the process of managing electricity in India by checking data-entry errors and billing efficiencies and cutting the costs of manual meter readings through web-based monitoring system and replace manual meter reading. Under the National Smart Grid Mission, the government is promoting smart grids that can offer affordability and other benefits to consumers.[10] The first step toward realizing smart grids is implementing the Advanced Metering Infrastructure. The Ministry of Power has come out with several transformational policy initiatives for reforming the energy sector in India, including the Smart Meter National Program, which aims to replace India's 250 million conventional meters with smart meters. EESL as key implementing partner will employ a proven model of bulk procurement, aggregation of demand, and

[8] Ministry of Housing and Urban Poverty Alleviation. http://pib.nic.in/newsite/PrintRelease.aspx?relid=188638.
[9] Charging Infrastructure for Electric Vehicles Guidelines and Standards. https://powermin.nic.in/sites/default/files/webform/notices/scan0016%20%281%29.pdf.
[10] National Smart Grid Mission. Ministry of Power, India. http://www.nsgm.gov.in/sites/default/files/NSGM-Framework-Final.pdf.

monetization of savings to roll out smart meters and has already installed 5 million smart meters towards this initiative.

14. **Distributed solar photovoltaic for agriculture**. DISCOMs in India are plagued by high AT&C losses that impact the viability of the energy sector. A key reason for high AT&C losses is low voltages in agricultural feeders and long distribution lines serving scattered loads in rural areas. Agriculture feeders experience the highest losses, and for most DISCOMs the cost of service to agriculture consumers in ₹6–₹7 per kilowatt-hour. The revenue realization for the DISCOM is very low and is a major source of energy and financial losses. "Tail-end" photo voltaic (PV) installations can be used effectively to meet agricultural power demand. Solar power installations at sub-stations can provide competitively-priced electricity (i.e., ₹3–₹4 per kilowatt-hour), reducing financial losses for DISCOMs and helping to achieve targets under the Bureau of Energy Efficiency's PAT Scheme. Furthermore, to ensure energy security along with financial and water security to farmers, the Ministry of New and Renewable Energy has launched the scheme to promote farmers energy security and development (KUSUM).[11] Under this scheme, farmers are connected with decentralized solar power capacity of 25,750 megawatts by 2022. The KUSUM scheme will comprise 10 GW of decentralized grid-connected solar or other renewable energy power plants; installation of 1.75 million stand-alone solar agriculture pumps; and solarization of 1 million grid-connected solar agriculture pumps.

15. **Other government energy efficiency initiatives**. There are several schemes driven by the government on promoting energy efficiency across sectors. These include the following: standards and labelling; agriculture demand-side management: municipal demand-side management; capacity building of DISCOMs; energy efficiency in small and medium-sized enterprises; strengthening of state-designated agencies; contribution to the state energy conservation fund scheme; and national energy conservation awards.

B. Major Development Partners: Strategic Focus and Key Activities

16. EESL is implementing projects supported by German development cooperation through KfW, Agence Française de Développement (AFD), ADB, and the World Bank. KfW signed a loan agreement in the amount of €200 million with EESL in 2017 for investment in energy-efficiency measures for private households, public buildings, light-emitting diode (LED) streetlights, water supply systems, agriculture (pump upgrades), and industry. AFD's assistance of €50 is being used in efficient lighting and other products. The World Bank signed a $220 million loan agreement and an $80 million guarantee agreement for the India Energy Efficiency Scale-Up Program in 2018. The program, to be implemented by EESL, helps scale up the deployment of energy-saving measures in residential and public sectors, strengthen EESL's institutional capacity, and enhance its access to commercial financing.[13] There are other technical assistance programs under implementation such as USAID supported Smart Power for Advancing Reliability and Connectivity of USAID and GEF supported Creating and Sustaining Markets for Energy Efficiency through United Nations Environment and ADB. Development partners regularly exchange information and experiences with each other. The table below shows major development partners supporting energy efficiency through EESL:

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[11] https://mnre.gov.in/sites/default/files/webform/notices/KUSUMguidelines.pdf

[13] Project Signing: Government of India, EESL and World Bank. https://www.worldbank.org/en/news/press-release/2018/08/28/agreement-scale-up-indias-energy-efficiency-program

Major Development Partners

Development Partner	Project Name	Duration	Amount
KfW	Energy Efficiency in Public Buildings Energy Efficiency in Energy Intensive Sectors	2014–2018 2017–2021	€50 million €200 million
AFD	Energy Efficiency in Public Infrastructure	2017–2021	€50 million
World Bank	India Scale Up Energy Efficiency Program	2018–2022	$220 million loan $80 million guarantee
ADB	Demand-Side Energy Efficiency Sector Project	2016–2021	$200 million loan $13 million grant from Global Environment Facility

ADB = Asian Development Bank, AFD = Agence Française de Développement
Sources: Asian Development Bank and Energy Efficiency Services Limited

C. Institutional Arrangements and Processes for Development Coordination

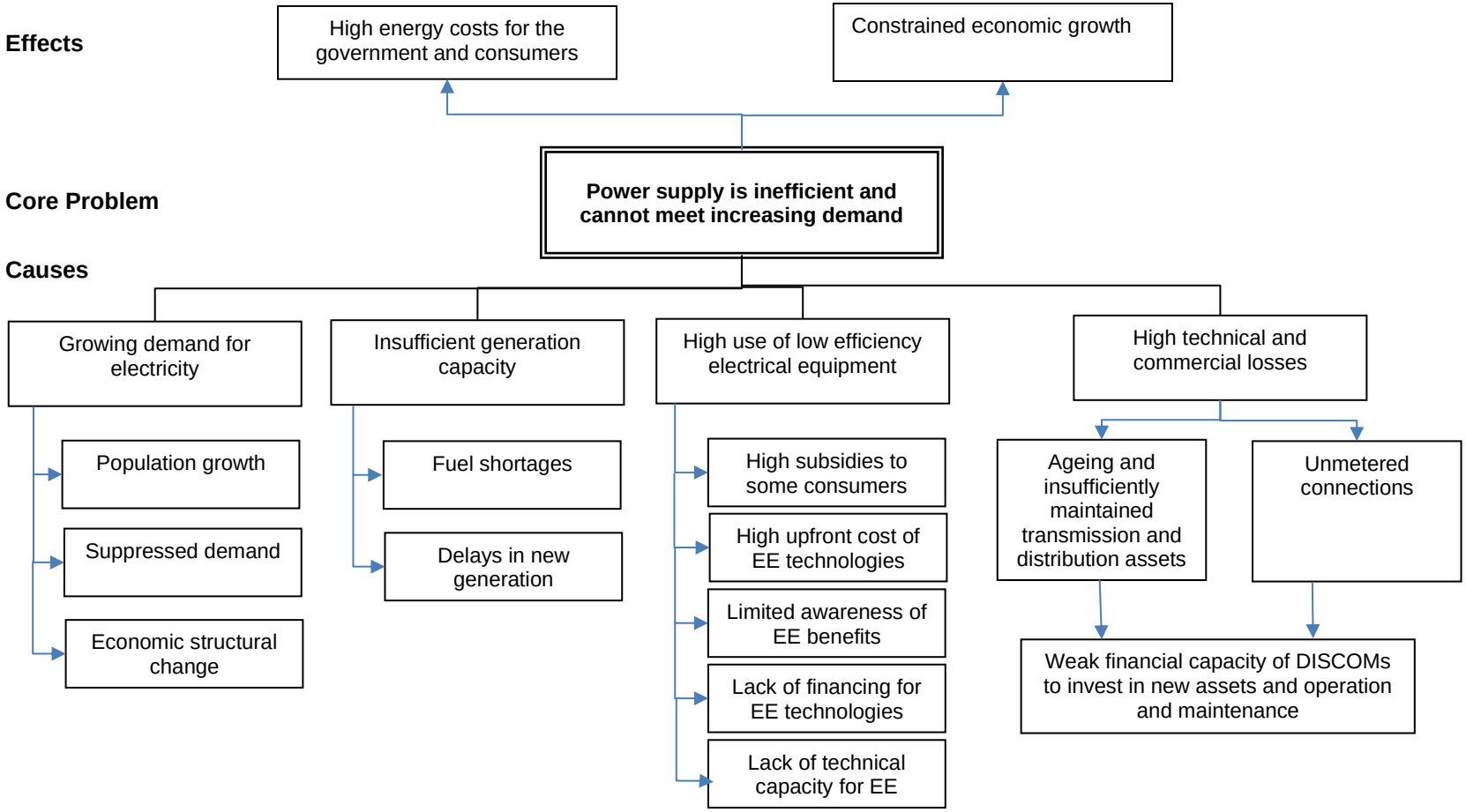
17. ADB's energy sector program will be closely aligned with the Government of India's emphasis on addressing structural weaknesses in electricity distribution and improving the quality and reliability of the electricity supply and improving the efficiency of energy use. ADB will continue participating in coordination meetings organized by the Government of India, especially the Department of Economic Affairs under the Ministry of Finance and the Ministry of Power and sharing experiences and planned activities to ensure there is proper coordination and avoid duplication. ADB engages with other development partners on a regular basis to share the updates, implementation challenges, and discuss areas for collaboration to support promotion of energy efficiency in India.

D. ADB Experience and Assistance Program

18. **ADB public sector operations in energy efficiency.** From 1994 to 2000, ADB was instrumental in initiating and funding the Industrial Energy Efficiency Project to promote efficient and environmentally sustainable industrialization in India. ADB provided a $150 million loan to the Industrial Development Bank of India for on-lending to industrial firms. The key objective of the project was to support investments in energy efficiency and related environmental improvement measures by energy-intensive industries in India. In 2016, ADB approved a $200 million loan for investment in more efficient LED municipal street lighting equipped with remote operating technology and other efficient appliances.[14] ADB approved an additional grant of $13 million from the Global Environment Facility to support the expansion of EESL's business to new energy-efficient technologies. These projects complement other energy supply investment in electricity generation, transmission and distribution in Madhya Pradesh, Bihar, Rajasthan and others.

[14] Project is on track in terms of implementation as of quarter ending June 2019. Current contracts award is about $165 million and disbursement is about $80 million as of end of September 2019.

Problem Tree



DISCOM = distribution company, EE = energy efficiency.
Source: Asian Development Bank.