The Spending Challenge of Achieving the SDGs in South Asia: Lessons from India

Garcia-Escribano, Mercedes and Mogues, Tewodaj and Moszoro, Marian and Soto, Mauricio

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SOUTH ASIA'S PATH TO RESILIENT GROWTH

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CHAPTER 2

The Spending Challenge of Achieving the SDGs in South Asia: Lessons from India

Mercedes García-Escribano, Tewodaj Mogues, Mariano Moszoro, and Mauricio Soto

South Asia has experienced significant progress in improving human and physical capital over the past few decades. Within the region, India has become a global economic powerhouse with enormous development potential ahead. To foster human and economic development, India has shown a strong commitment to the Sustainable Development Goals Agenda. This chapter focuses on the medium-term development challenges that South Asia, and in particular India, faces to ensure substantial progress along the Sustainable Development Goals by 2030. We estimate the additional spending needed in critical areas of human capital (health and education) and physical capital (water and sanitation, electricity, and roads). We document progress on these five sectors for India relative to other South Asian countries and discuss implications for policy and reform.

The authors express their sincere appreciation for the close cooperation and support given by officials and staff of the various organizations met on December 4–17, 2019, in Delhi, India, when this work was initiated. These include Indian government agencies: NITI Aayog (National Institute for Transforming India), the Department of Expenditure at Ministry of Finance, the Department of Drinking Water and Sanitation at Ministry of Jal Shakti, the Ministry of Statistics and Programme Implementation, the Ministry of Human Resource Development, the Ministry of Health and Family Welfare, the Ministry of Road Transport and Highways, the Ministry of Power, and the Ministry of Housing and Urban Affairs. The team is especially grateful to NITI Aayog staff members Sanyukta Samaddar and Alen John and the staff of the SDG Division. The team also benefited from meetings with Renata Lok-Dessallien (United Nations) Henk Bekedam (World Health Organization), Sabyasachi Mitra (Asian Development Bank), Jorge Coarasa (Human Development, World Bank), and staff of development partners. The authors are also thankful for comments and suggestions from participants during the IMF Asia and Pacific Department's South Asia seminar in January 2020, an event "Regional Forum on Fostering Growth in South Asia" in Delhi in February 2020, and an IMF Fiscal Affairs Department seminar in August 2021.

INTRODUCTION

South Asia has experienced significant progress in improving human development over the past few decades. With sustained income growth and strong policy efforts, the region, which accounts for one-fifth of the world's population, has contributed to more than 200 million people exiting poverty in the course of the last three decades (Goretti and others 2019). Nonetheless, some South Asian countries' human capital index is lower than what their GDP per capita would predict. And South Asia, on average, still lags East Asia and the Pacific as well as Latin America and the Caribbean in access to key infrastructure such as electricity, water, sanitation, and telecommunication (Jha and Arao 2018).

Within the region, India has become a global economic powerhouse with enormous development potential ahead. Unlocking this potential requires investments in human and physical capital. In this regard, India has made astonishing progress along several dimensions. Hundreds of millions have lifted themselves out of poverty over the past decades. Education enrollment is now nearly universal for primary school. Infant mortality rates have been halved since 2000. Access to water and sanitation, electricity, and roads has greatly improved. Nonetheless, to further capitalize on economic growth, India should continue to close gaps in human and physical capital—gaps that have recently widened as a result of the pandemic. Indeed, after years of steady progress, during the COVID-19 pandemic health and education systems have been disrupted, poverty has increased, and the prevalence of undernourishment has risen (Food and Agriculture Organization 2021; UN 2021). However, South Asia is projected to have the strongest improvement in poverty reduction of any region in 2021, with only a minor deterioration relative to prepandemic projections (Mahler and others 2021).

To foster human and economic development, India has shown a strong commitment to the Sustainable Development Goals (SDG) Agenda. The government has aligned its development priorities with the SDG framework. India recently underwent two Voluntary National Reviews (Government of India, NITI Aayog 2017, 2020), and carried out a third round of stocktaking of progress in meeting the SDGs (Government of India, NITI Aayog 2021) providing SDG metrics, including at the state level. Numerous national flagship programs that seek to connect villages to roads, launch initiatives to provide universal health coverage and sanitation, and aim at other ambitious development objectives are intimately linked to the SDGs. States and union territories are taking proactive steps to implement the goals, underpinned by national and regional consultations, although more can be done to reduce wide subnational disparities (Government of India, NITI Aayog 2021).[1]

This chapter focuses on the medium-term development challenges that South Asia, and in particular India, faces, namely, the additional spending—public and

[1] For example, based on government calculations, states and Union territories range in their SDG index from 52 to 75.

private—needed to ensure substantial progress along the SDGs by 2030. The focus of the chapter is on critical areas of human capital (health and education) and physical capital (water and sanitation, electricity, and roads), following the methodology developed by Gaspar and others (2019).[2] We find that an additional 6.2 percent of GDP per year will have to be spent in India in these five areas to achieve a high SDG performance in 2030, and preliminary desk estimates for the other South Asian countries combined point to an additional spending need of 11.3 percent of GDP in the year 2030.

The next section of the chapter documents progress on these five sectors for India relative to South Asian countries and other large emerging markets. Section 3 reports the estimate of the additional spending that would be required to make substantial progress toward the SDGs in India. The data collection and validation, carried out in New Delhi in 2019, and the analysis presented in this chapter use 2019 as the base year for the analysis—thus, the available data does not enable accounting for the potential effects of COVID-19. Section 4 briefly discusses comparable additional spending estimates for the region, and Section 5 concludes and reflects on the potential implications of the pandemic for the SDGs in South Asia.

BACKGROUND AND CONTEXT

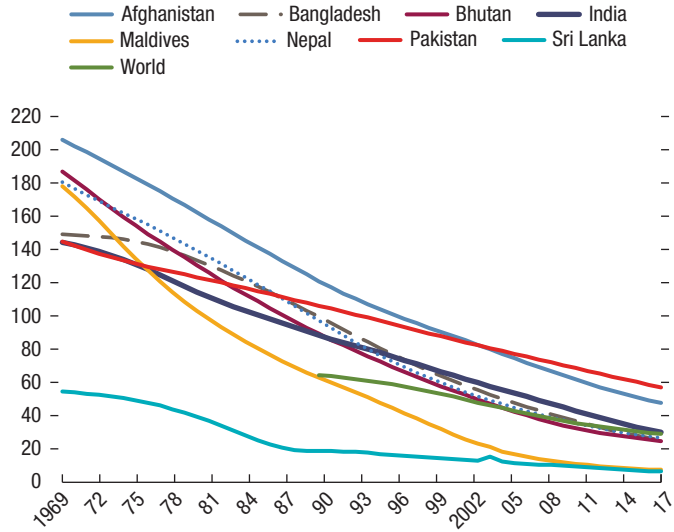
Health

All countries in South Asia have seen a steady improvement in health outcomes over the past 50 years. Sri Lanka and Maldives outperform other South Asian countries as well as the world's average in health outcomes, with Sri Lanka having the lowest under-1-year-old infant mortality in South Asia since the early 1970s (Figure 2.1), and Maldives catching up with Sri Lanka in recent years. Other countries—in particular, Pakistan since the 1990s, and Afghanistan—lag peers and, albeit exhibiting continued improvement, have infant mortality levels that double the current world average.

India has also made noteworthy strides in health outcomes. Infant mortality stands at around 30 deaths per 1,000 live births, similar to the world average, compared with about 140 deaths per 1,000 live births in the early 1970s. Mortality rates of children under 5 years old dropped from 95 to 37 deaths per 1,000 live births in 2000–18, and 2018 infant mortality is also less than half the rate of 25 years ago. Significant progress has also been made in maternal mortality, which declined by 77 percent from 1990 to 2016 (Government of India, Ministry of Health and Family Welfare 2018).

[2] Similar studies have been carried for Benin and Rwanda (Prady and Sy 2019), Nigeria (Soto, Moszoro, and Pico 2020), and Pakistan (Brollo and Hanedar 2021); however, this is the first in-depth costing exercise presented along with its regional comparators.

Figure 2.1. Evolution of the Infant Mortality Rate in South Asia
(Per 1,000 live births)

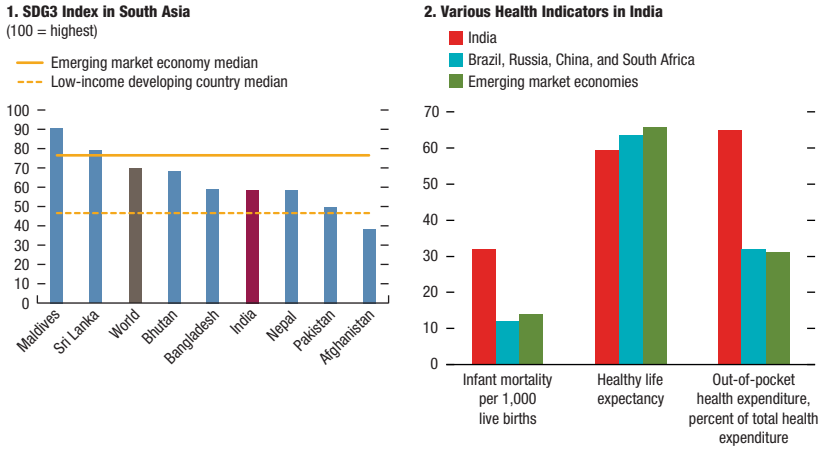


Source: World Bank 2020.
Note: The rate refers to the mortality of children under 1 year of age. "World" is the simple average across all countries in the world for which the index is available.

Yet, most countries in the South Asia region have a long way to go toward the health SDG. To assess this, we examine performance in terms of an index published in the annual Sustainable Development Report (for example, Sachs and others 2019) for each of the 17 goals, where index values of 0 and 100 indicate worst- and best-possible performance, respectively. We also assess India's health outcomes against those in emerging markets and in particular against other BRICS (Brazil, Russia, India, China, and South Africa) countries, deemed emerging economic powerhouses. As panel 1 in Figure 2.2 shows, only Maldives and Sri Lanka have an SDG3 index above the world average and above the median of emerging market economies.[3] In India, and despite past progress, health outcomes measured with the SDG3 index (or other indicators displayed in panel 2 in Figure 2.2) are below the median of emerging economies and still behind the country's own targets. For example, current under-five mortality, at 37 per 1,000 live births, is more than three times as large as the country's goal to have a mortality rate of 11 by 2030.

[3] The SDG3 index comprises 14 health variables relating, for example, to mortality rates, life expectancy, incidences of diseases, access to vaccines and other health services, and so on.

Figure 2.2. Health Outcomes in South Asia and India

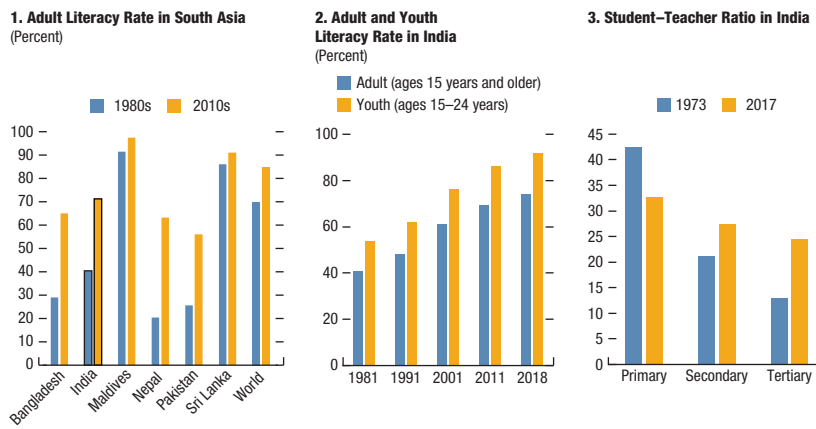


Sources: IMF staff calculations using Sachs and others (2019), IMF FAD Expenditure Assessment Tool (Garcia-Escribano and Liu 2017), and World Bank (2020).
Note: "World" is the simple average across all countries in the world for which the index is available. SDG3 = Sustainable Development Goal 3 (Good Health and Well-Being).

Education

In the past few decades, all countries in South Asia have improved their education outcomes. Since the 1980s, the adult literacy rate has doubled or tripled in Bangladesh, India, Nepal, and Pakistan (Figure 2.3, panel 1). At present, Sri Lanka and Maldives have literacy rates above 90 percent, whereas other countries lag the world's average.

Figure 2.3. Evolution of Education Outcomes

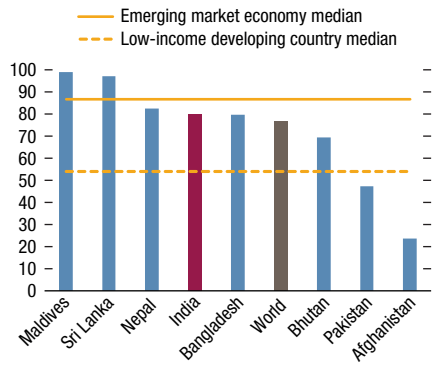


Source: IMF staff calculations using World Bank (2020).
Note: "World" is the simple average across all countries in the world for which the index is available.

India's growth into an emerging market economy has been accompanied by increased levels of education. The share of literacy among all adults increased from 41 percent in 1981 to 74 percent in 2018 (Figure 2.3, panel 2). The economic gains of past decades have gone hand in hand with better education service delivery, including through the reduction in the student–teacher ratio at the primary level (Figure 2.3, panel 3). Still, nearly 45 percent of the population has education only at or below the primary level (National Statistics Office 2019). While the expansion in the participation of youth in higher grade levels is welcome, it has put pressure on service delivery at the secondary and especially tertiary levels, resulting in rises in the student–teacher ratio.

Despite progress, educational outcomes in most South Asian countries lag emerging economy peers (Figure 2.4). South Asian countries span a wide spectrum in educational performance. Only Maldives and Sri Lanka are close to attaining an SDG4 index of 100 and well exceed the emerging economy median of 87.[4] At the same time, two countries—Pakistan and Afghanistan—even fall short of the low-income developing countries median index of 54. India's value at 80.2 falls short of the median index for emerging economies, which is likely related to the relatively large class sizes as well as gaps in preprimary and tertiary enrollment. The student–teacher ratio is higher than in Brazil and China, and the enrollment ratio for the population ages 3–23 years is also below that of Brazil and China. India's own goal is to achieve a 100 percent adjusted net enrollment for grades 1–10 by 2030 (Government of India, NITI Aayog 2018).

Figure 2.4. SDG4 (Education) Index for South Asia
(100 = highest)



Source: IMF staff calculations using Sachs and others (2019).
Note: "World" is the simple average across all countries in the world for which the index is available. SDG = Sustainable Development Goal.

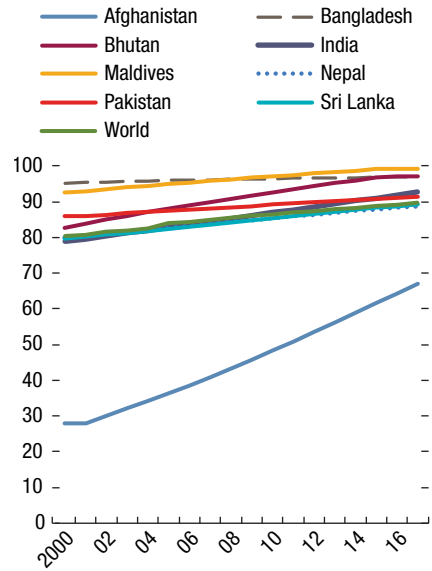
[4] The SDG4 index for non-OECD countries is based on three measures: youth literacy, primary enrollment, and secondary completion rates.

Water and Sanitation

South Asia is rapidly improving access to water and sanitation. South Asian countries have gradually expanded access to basic drinking water, with several of them reaching almost universal access (Figure 2.5). In India, almost 90 percent of its rural population and all its urban population had access to basic water in 2019, a substantial improvement from below 80 percent in both categories in 2000, especially considering the population growth in the past two decades. Likewise, in basic sanitation, India has also seen impressive improvements, with 97 and 98 percent of the rural and urban population, respectively, being served in 2019. Meanwhile, access to safely managed water services in rural areas increased from 40 percent in 2010 to 56 percent in 2019 and urban areas from 73.5 percent in 2010 to 75.1 percent in 2019. Another important achievement in India has been ending open defecation (Government of India, Ministry of Jal Shakti 2019).

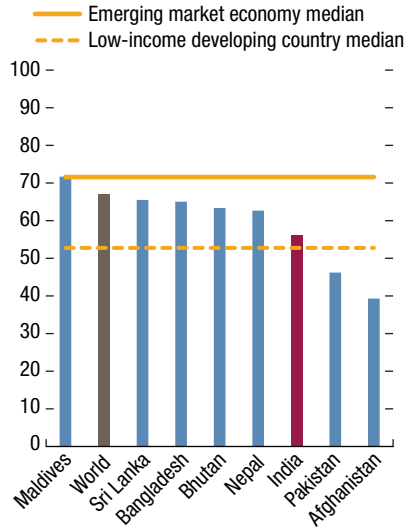
However, pockets of hygiene deprivation remain. Many households have only access to public sources of water, and exclusive access to drinking water in the home remains a privilege. The challenge in most South Asian countries is to improve the quality, accessibility, and safety of water and sanitation services (Figure 2.6). There is a persistent 30 to 60 percent gap in access to safely managed

Figure 2.5. Access to Basic Drinking Water in South Asia
(Percent of population)



Source: World Bank 2020.
Note: "World" is the simple average across all countries in the world for which the index is available.

Figure 2.6. SDG6 (Water and Sanitation) Index for South Asia
(100 = highest)



Source: IMF staff calculations using Sachs and others (2019).
Note: "World" is the simple average across all countries in the world for which the index is available. SDG = Sustainable Development Goal.

water and sanitation in the region.[5] In India, there is room for improvement even in basic sanitation, as 29 percent of the rural population and 15 percent of the urban population do not practice basic hygiene nor have access to such services. India lags peers in safely managed water and sanitation, especially in rural areas (Figure 2.7).[6]

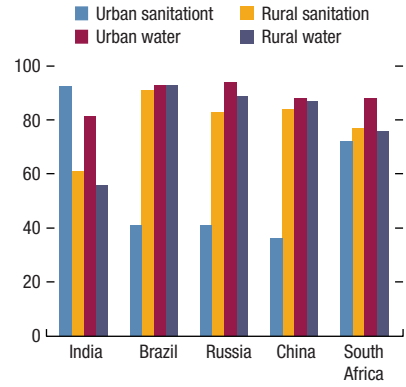
Electricity

Access to electricity, a key requirement for a modern economy, has been steadily increasing across South Asia during the past decade (Figure 2.8). During 2002–17, India tripled its installed capacity from 108 to 327 gigawatts. Most of the added installed capacity came from thermal and hydro power plants, with an increasing share of renewable energy sources in recent years. During the same period, the per capita energy consumption increased from 559 to 1,122 kilowatt-hours. Recently, the peak demand not met declined from 12,159 megawatts (9.0 percent of peak demand) in 2012 to 2,608 megawatts (1.6 percent of peak

[5] The SDG6 index synthesizes variables on access to basic drinking water, access to basic sanitation, freshwater withdrawal, groundwater depletion, and treated wastewater. See Sachs and others (2019) for further details.

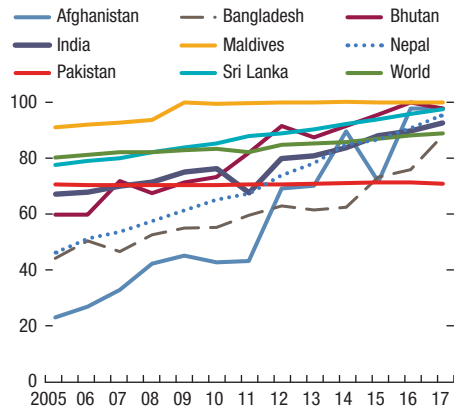
[6] The fact that the figure for safely managed sanitation is high for India may be related to different definitions used for classification between the Indian authorities and the United Nations.

Figure 2.7. Safely Managed Water and Sanitation in BRICS, 2016
(Percent of population)



Source: IMF staff calculations based on data from the World Bank (2020).
Note: BRICS = Brazil, Russia, India, China, and South Africa.

Figure 2.8. Access to Electricity in South Asia
(Percent of population with access)



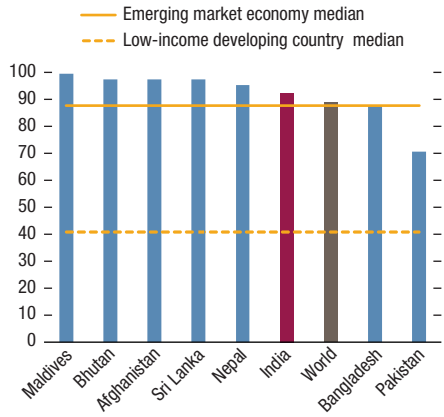
Source: World Bank 2020.
Note: "World" is the simple average across all countries in the world for which the index is available.

demand) in 2017, reflecting a substantial improvement in the quality of electricity service (Government of India, Ministry of Power 2018).

Several South Asian countries display high achievement in the electricity SDG subindex (Figure 2.9). In only one country—Pakistan—is electricity access below 80 percent as well as below the median for emerging market economies. There remains room for most South Asian countries to increase capacity, reliability, and

Figure 2.9. SDG7 (Electricity) Index in South Asia

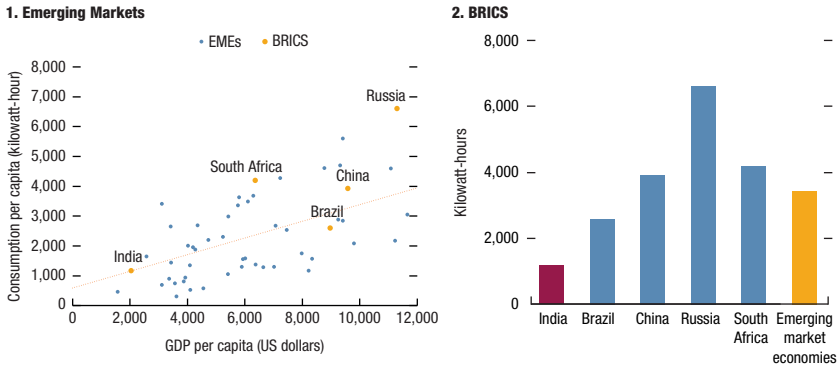
(Percent of population with access)



Source: World Bank 2020.

Note: The figure reflects only the subindex of SDG7 capturing the percentage of the population with access to electricity. "World" is the simple average across all countries in the world for which the index is available. SDG = Sustainable Development Goal.

Figure 2.10. GDP and Electricity Consumption Per Capita, 2018 or Latest Year



Source: IMF staff calculations based on data from World Bank (2020).

Note: In panel 1, the dotted line represents the fitted line of the relationship between electricity consumption per capita and GDP per capita, calculated using ordinary least squares regression. Data for India are from 2018; data for Brazil, Russia, China, and South Africa are from 2016. BRICS = Brazil, Russia, India, China, and South Africa.

sustainability of electricity provision. For instance, India's electricity consumption per capita falls behind peers. With per capita consumption of 1,181 kilowatt-hours in 2019, India is in line with its expected provision of electricity given its GDP per capita (Figure 2.10, panel 1), but it lags other BRICS (Figure 2.10, panel 2).[7] While India has accomplished practically universal supply of electricity to its approximately 700,000 villages, universal and reliable access has yet to be extended

[7] BRICS include Brazil, Russia, India, China, and South Africa.

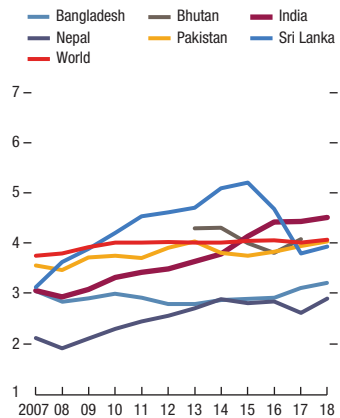
to every household, with ubiquitous blackouts being one of India's major electricity challenges (Jha, Preonas, and Burling 2021). In addition, India intends to become energy self-sufficient and independent from imported power inputs.

Roads

South Asian countries have undertaken a major effort in extending and upgrading their road systems over the past decade (Figure 2.11). India appears to have made the largest strides, currently exhibiting the world's third largest road network (Road Traffic Technology 2014). In the years 2011–17, India added on average more than 130,000 kilometers per year to its road network (Government of India, Ministry of Road Transport and Highways 2019) with notable efforts including developing roads around industrial corridors and the implementation of rural road programs.

Nevertheless, the quality of road infrastructure remains low across the South Asia region. The infrastructure index places South Asia, except for India, below the world average (World Economic Forum 2019; Figure 2.12).[8] Rural roads in India account for 71 percent of the total road length,[9] but only about 70 percent of the rural population have access to all-weather roads within two kilometers (Figure 2.13). Closing the rural road infrastructure gap and increasing rural access to at least 90 percent will be critical for further development in India as well as in the rest of the South Asian region.

Figure 2.11. South Asia Evolution of Road Infrastructure Index
(Road index score; 1 = lowest, 7 = highest)

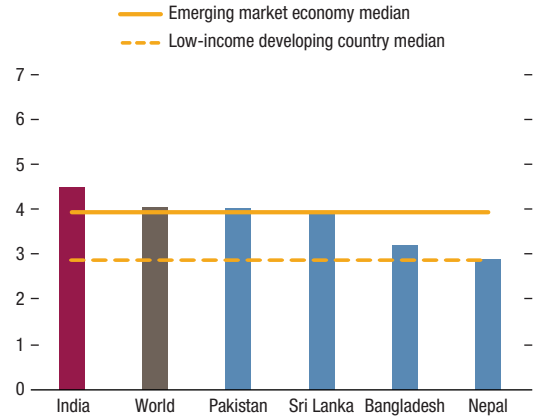


Source: World Economic Forum 2019. Data are not available for Afghanistan and Maldives.
Note: "World" is the simple average across all countries in the world for which the index is available.

[8] The survey-based infrastructure index obtains information from expert respondents on the quality of overall infrastructure in a country, and ranges from 1 (worst possible) to 7 (best possible).

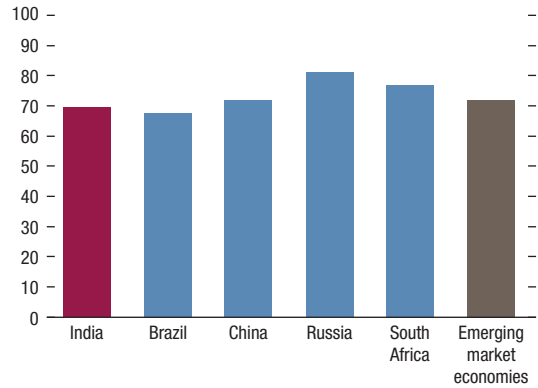
[9] Of total roads length, rural roads account for 71 percent, district roads for 10 percent, urban roads for 9 percent, project roads for 5 percent, state highways for 3 percent, and national highways for 2 percent (Government of India, Ministry of Road Transport and Highways 2019).

Figure 2.12. South Asia Road Infrastructure Index, 2019
(Road index score; 1 = lowest, 7 = highest)



Source: World Economic Forum 2019. Data are not available for Afghanistan, Bhutan, and Maldives.
Note: "World" is the simple average across all countries in the world for which the index is available.

Figure 2.13. Rural Access Index for BRICS and Emerging Market Economies
(percent of rural population within 2 kilometers of an all-weather road)



Source: IMF staff calculations using Government of India, Ministry of Road Transport and Highways (2018a); Mikou and others (2019); and World Bank (2020).
Note: BRICS = Brazil, Russia, India, China, and South Africa.

RESULTS ON ADDITIONAL SPENDING IN INDIA NEEDED TO MEET THE SDGS

This section presents the estimates of the additional public and private spending required to make substantial progress toward the SDGs in India following the methodology developed by Gaspar and others (2019). The methodology is based on an input-outcome approach, which assumes that development outcomes are a function of a mix of inputs. For each country, the methodology sets the levels of

key inputs and the associated unit costs at the values observed in countries with similar levels of GDP per capita that reach high development outcomes (Gaspar and others 2019). The costing approach used in the paper does not systematically account for cross-sectoral (and cross-country) interdependence and spillovers.[10]

For the health and education sectors, the additional spending is estimated using as a benchmark the input variables (for example, student to teacher ratio in the case of education) in peer countries that exhibit relatively good performance in these two sectors, and also taking into account India-specific factors such as demographics and the level and growth of GDP per capita. Peer countries for India in this analysis are emerging market economies (EMEs), including the other BRICS. The estimates, as indicated in Gaspar and others (2019), are consistent with increasing technical efficiency. Countries that perform well also tend to be among the most efficient. Thus, when assigning the input levels observed in countries that perform well today to India, our spending estimates for high performance assume better spending. Should improvements in efficiency not take place, the spending required to reach the SDGs would be larger.[11] Results are presented as the annual additional spending in 2030 in percentage points of GDP compared with the current level of spending as a share of GDP. For physical capital, additional spending in percentage points of GDP corresponds to the annualized spending required to close infrastructure gaps between 2019 and 2030. The costing estimates for electricity and roads assume a linear 5 percent depreciation and reinvestment rate; for water and sanitation, given its longer depreciation period, a one-off investment in capital stock is assumed. More methodological details for each sector are presented in the annexes.

Health

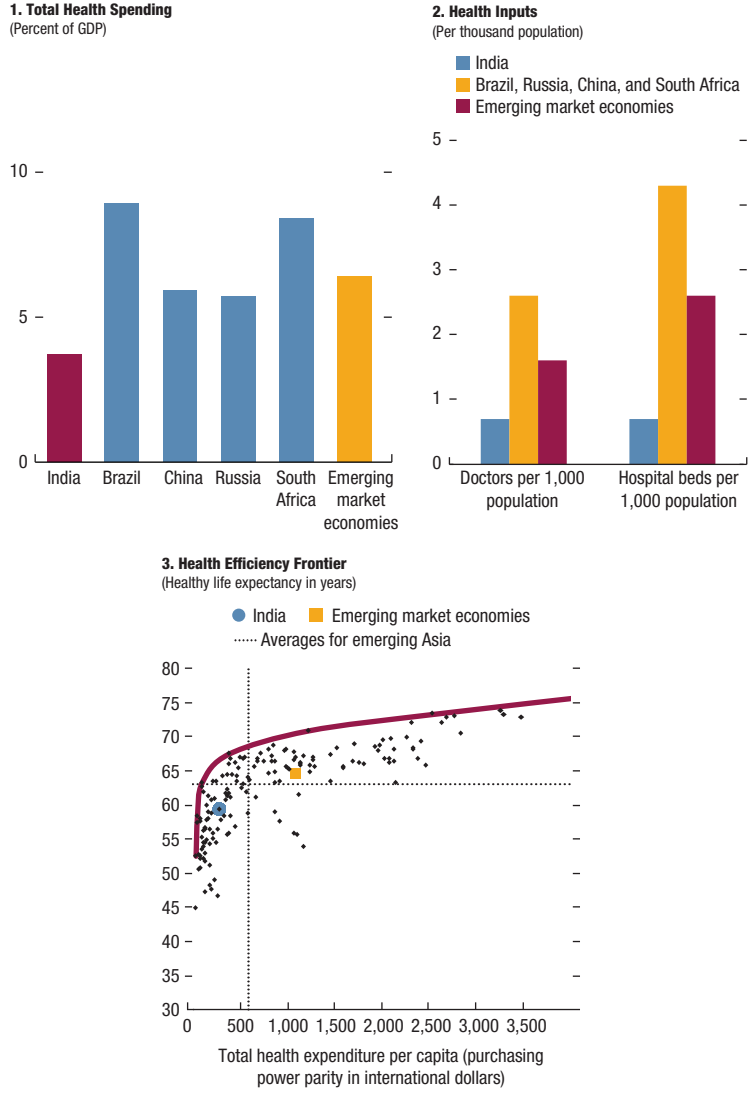
Enhancing health outcomes in India in line with achieving the health SDGs would require a sizable increase in health spending. Health spending in India currently stands at 3.7 percent of GDP and falls short of levels spent in BRICS and EMEs (Figure 2.14, panel 1). This level of spending reflects a lag in doctors and hospital beds per 1,000 inhabitants (Figure 2.14, panel 2). For India to achieve substantial progress toward the SDGs by 2030, it will need to more than double health sector spending relative to its GDP (Table 2.1). Such additional spending of 3.8 percent of GDP would allow India to expand the number of medical staff, while moderately slowing the growth of personnel compensation, containing the ratio of doctor salaries to GDP per capita from 7.8 to 6.6—the current ratio is higher than for economies in the same income group that are able to achieve strong health

[10] For instance, increasing health spending may be useful for school attendance, and increasing spending on physical infrastructure might be helpful for improving health outcomes, for example, through wider access to health facilities. The cross-sectoral and cross-country inter-dependence and spillovers should be addressed with a dynamic stochastic general equilibrium model, which goes beyond the scope of this chapter.

[11] Considering how different levels of allocative efficiency across sectors would affect our results goes beyond the scope of this study, and could be explored in future research.

outcomes.[12] Meanwhile, capital and recurrent spending other than on the health care workers' wage bill should increase as a percent of total health spending. The expansion in health spending would need to be undertaken mostly by the public

Figure 2.14. Performance in the Health SDG in Income Group and Regional Comparison



Source: IMF staff estimates using Sachs and others (2019) and IMF FAD Expenditure Assessment Tool.
Note: SDG = Sustainable Development Goal.

[12] A potential concern of brain drain resulting from slowing the growth of salaries of medical staff is mitigated by the fact that strong-performing peers in the same income group appear not to face this problem substantially.

TABLE 2.1.

Estimated Health Spending Needed for High Performance in India in Health SDG

	GDP Per Capita $3,000–$6,000			India	
	All	Low Performers	High Performers	2017	2030
Main factors					
Doctors per 1,000 population	1.2	0.8	1.7	0.7	1.6
Other medical personnel per 1,000 population	6.0	5.6	6.3	2.9	5.4
Share of population <1 year and 60+ years	12.0	10.9	19.0	11.4	14.1
Doctors per 1,000 population age 1–59 years	0.9	0.7	1.2	0.6	1.2
Other medical personnel per 1,000 population age 1–59 years	4.2	4.2	4.1	2.3	4.1
Doctor wages (ratio to GDP per capita)	7.1	7.1	6.6	7.8	6.6
Other current and capital spending (percent of total spending)	62.3	61.1	62.3	54.2	62.3
Results					
Health spending (percent of GDP)	6.9	6.6	7.0	3.7	7.5
Per capita spending (2018 US dollars)	285.6	258.6	350.2	68.9	315.1

Source: IMF staff estimates using Gaspar and others (2019) methodology.
Note: SDG = Sustainable Development Goal.

sector as the country currently relies heavily on private outlays (67 percent of total health spending). The spending increase could help cover an expansion of India's health protection scheme, Pradhan Mantri Jan Arogya Yojana, to prevent non included but vulnerable individuals from falling into poverty because of illness and private health costs[13] (see Annex 2.1 for methodological details).

As stated earlier and illustrated in panel 3 of Figure 2.14, India will need to not only spend more on its health system but also spend more efficiently. Institutional changes and strengthening public financial management could contribute to increasing the efficiency of outlays. Providing greater autonomy to facility managers could foster greater efficiency in the sector. Rigidities imposed on clinic and hospital managers limit their ability to allocate funding in their facility in the most appropriate way for service delivery (Barroy and others 2019). Strengthening budget preparation will also improve health units' absorptive capacity and mitigate the problem of these units often having to return unused funds.

Education

India can achieve better education outcomes by 2030 without increasing the share of GDP devoted to education expenditures. As the student-age population is expected to shrink, India can increase the spending per student even if expenditures as a percentage of GDP decline. Education spending in 2030 as a share of GDP at 4.1 percent (lower than the current expenditures of 5.6 percent) would allow spending per student to increase by 37 percent by 2030—to an annual

[13] Today India's health insurance scheme, at about 0.1 percent of GDP, remains small in size and scope.

TABLE 2.2.

Additional Education Spending for High Performance in India in Education SDG

	GDP Per Capita $3,000–$6,000			India	
	All	Low Performers	High Performers	2018	2030
Main factors					
Students per teacher ratio	19.0	20.6	16.5	26.9	16.5
Teacher wages (ratio to GDP per capita)	2.5	3.9	1.7	3.1	1.7
Other current and capital spending (percent of total spending)	38.9	39.0	35.7	52.1	35.7
Student-age population (percent of total population)	39.0	40.9	33.1	38.3	31.9
Enrollment rate (preprimary to tertiary)	68.4	64.3	69.8	59.9	80.1
Results					
Education spending (percent of GDP)	5.7	8.2	3.7	5.6	4.1
Spending per student (US dollars, 2018)	890.8	1,401.6	660.2	491.2	673.6
SDG4 Index	77.8	75.3	88.2	80.2	

Source: IMF staff estimates using Gaspar and others (2019) methodology.
Note: SDG = Sustainable Development Goal.

$674 per student from the current level of $491 (Table 2.2). Such expansion in spending per student might require a larger share of public sector in education, as private spending contributes 27 percent of overall spending—compared with peer countries with a strong sectoral record, with only 5 percent reliance on private spending (see Annex 2.1 for details on the methodology).

While there is no need to spend more in education relative to GDP, India needs to spend more efficiently. Reallocation of resources by reducing wage growth toward bringing on board more teachers will support higher enrollment and reduce class size. The student per teacher ratio is 16.5 in countries with strong education outcomes compared with 27 in India today. As strong economic growth continues, teachers' wages would have to increase at a slower pace than GDP per capita. India's teachers' wages are three times its GDP per capita, which is distinctly higher than teachers' wages in high-performing countries among India's peers that are less than twice the GDP per capita. More effort also needs to be exerted to reduce absenteeism of those teachers already employed if resources are to be used efficiently, for example, through more systematic monitoring—using both top-down (for example, through surprise inspections) and bottom up (through active parent–teacher associations) mechanisms (Muralidharan and others 2017).

Beyond countrywide levels, the geographic and socio-cultural distribution of educational opportunities requires greater attention. The SDG4 India Index across states/union territories ranges widely, from 36 to 87 (Government of India, NITI Aayog 2018). Discrepancies also prevail across social groups. For example, scheduled tribes' gross enrollment rate in higher education is 10 points lower than the overall average (Government of India, Ministry of Finance 2019). Important progress by the government needs to be acknowledged in bringing about gender equity in enrollment. In fact, gross enrollment rates are higher for girls than boys

at all levels other than higher education (Government of India, Ministry of Finance 2019). Being attentive to these distributional concerns will both improve targeting of spending for more efficient achievement of India-wide goals, as well as address crucial concerns of equity.

Water and Sanitation

India can achieve universal coverage of water and sanitation with large health externalities at a relatively low cost. Using the World Bank's water, sanitation, and hygiene (WASH) methodology in Hutton and Varughese (2016), we estimate the cost to provide universal safely managed access to water and sanitation at $106 billion over 2020–30, which on an annualized basis is equivalent to 0.17 percent of GDP in 2030, including depreciation. The bulk of the burden comes from sanitation in rural areas (see Annex 2.3 for the methodology).

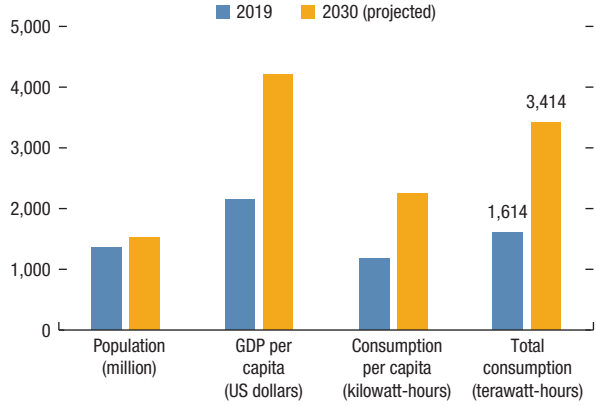
Beyond resources, institutional and technical capacity constraints need to be addressed. Subnational governments are responsible for water and sanitation, but often do not have the capacity to set the institutional framework, especially in rural areas. Other areas for improvement include enhancing the management of tariffs—unsystematic application of tariffs might be straining the finances of local governments—and improving the mapping of the existing network, which can bring efficiency gains as well as facilitate maintenance and network expansion. In addition, efforts should continue to improve wastewater treatment—only around 30 percent of wastewater is treated—to prevent the deterioration of the groundwater.

Electricity

Generation capacity needs to keep up with population and economic growth to grant full access to electricity (the SDG Indicator 7.1.1 measures the proportion of the population with access to electricity). To provide universal electricity access to a larger population of 1.5 billion and increase electricity per capita consumption to keep up with GDP growth, there will be a need to expand installed capacity (Figure 2.15). The cost of additional generation capacity is estimated at $1,140 per kilowatt (Table 2.3), plus markups of 50 percent for transmission and 50 percent for distribution.[14] The average investment cost per kilowatt of capacity is calculated as the weighted average of unit costs for the different types of energy sources, using the shares of projected installed capacity in the power mix as the weights. At an overall unit cost of $2,280 per kilowatt including generation, transmission, and distribution costs, India will have to invest an aggregate of $469 billion from public and private sources to meet electricity demand, which on an annual basis is equivalent to 1 percent of GDP in 2030, including replacement costs.

[14] Based on interviews with experts from India's Ministry of Power and the Central Electricity Authority, the costs in transmission and distribution costs are assumed to add 50 percent each to investment costs in capacity.

Figure 2.15. Electric Power Consumption in India, 2019 and 2030



Source: IMF staff calculations.
Note: The electricity consumption forecast of 2,257 kilowatt-hours per capita by 2030 is higher than India's Central Electricity Authority forecast of 1,717–1,777 kilowatt-hours because of our assumption of higher income demand elasticity.

India has embarked on an ambitious program to shift its power mix toward renewable energy. According to the National Electricity Plan (Government of India, Ministry of Power, Central Electricity Authority 2018), renewable energy sources will increase from 23 percent of total installed capacity in 2019 to 44 percent in 2027 (Table 2.3 and Figure 2.16). The major renewable energy sources include solar and wind, both of which will require an investment in battery storage of 136 gigawatt-hours because of their asynchronous (that is, weather-dependent and time-dependent) nature. India is the third-largest CO_2 emitter, after China and the United States (Fleming 2019), thus the environmental advantages of increasing the share of renewables in the energy mix will be substantial at the global level.

Roads

India will have to invest a significant share of its GDP to improve rural roads access. Gradually raising rural access to 90 percent by 2030 will require about 2.4 million additional kilometers of all-weather roads—an increase of 39 percent in road length (Figure 2.17). While construction costs vary by road characteristics (that is, number of lanes and type of surface) and region (for example, a third-tier all-weather road in the north may cost twice as much to build than in the south), we estimate an average cost per kilometer of about $509,000 (Annex 2.4). Thus, extending the road network by 2.4 million kilometers will require an aggregate investment of $1.2 trillion by 2030, which on an annualized basis is equivalent to 2.7 percent of GDP in 2030, including depreciation.

The estimated cost is a lower bound. First, India's goal is to achieve 100 percent of households connected by all-weather roads under the Pradhan Mantri

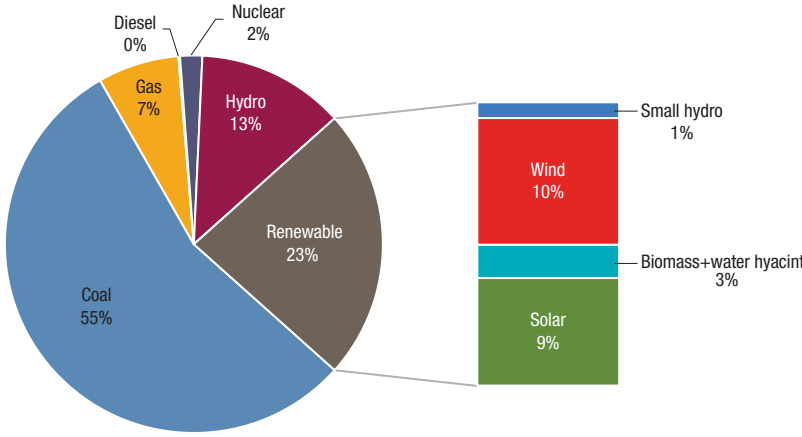
TABLE 2.3.

Current and Target Installed Capacity Mix in India

	2017			2022			2027		
Source	Megawatts	Percent	Investment Cost per Kilowatt (US dollars)	Megawatts	Percent	Investment Cost per Kilowatt (US dollars)	Megawatts	Percent	Investment Cost per Kilowatt (US dollars)
Conventional									
Coal + lignite	193,001	59	868	217,302	45	1,056	238,150	38	1,285
Gas	25,329	8	514	25,735	5	625	25,735	4	760
Hydro	44,478	14	1,335	51,301	11	1,625	63,301	10	1,977
Nuclear	6,780	2	1,335	10,080	2	1,625	16,880	3	1,977
Subtotal	269,588	82		304,418	63		344,066	56	
Renewable									
Solar power	12,289	4	764	100,000	21	764	150,000	24	764
Wind power	32,280	10	833	60,000	13	833	100,000	16	833
Biomass	8,296	3	792	10,000	2	792	17,000	3	792
Small hydro power	4,380	1	868	5,000	1	1,056	8,000	1	1,285
Subtotal	57,244	18		175,000	37		275,000	44	
Total	326,832	100	905	479,418	100	1,011	619,066	100	1,140

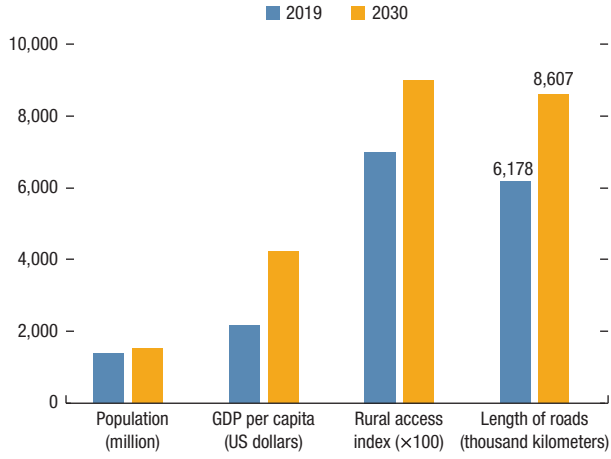
Source: IMF staff calculations based on Government of India, Ministry of Power, Central Electricity Authority (2018).

Figure 2.16. Installed Capacity in India, 2019



Source: Government of India, Ministry of Power, Central Electricity Authority 2018.
Note: Data correspond to October 2019.

Figure 2.17. Statistics of India's Main Roads, 2019 and Projections



Source: IMF staff calculations based on Government of India, Ministry of Road Transport and Highways (2019).
Note: Projections assume rural access increases to 90 percent.

Gram Sadak Yojana program by 2030 (Government of India, NITI Aayog 2018): that is, the government's goal is more ambitious than the target of 90 percent of the rural population with access, assumed in the IMF's additional spending estimations for EMEs by Gaspar and others (2019). Second, our analysis does not account for the additional investments to make infrastructure resilient to climate change (for example, to more severe floods). The Asian Development Bank has

estimated that climate-adjusted costs could add between 1.2 and 1.4 percent of GDP annually to their base estimations (Asian Development Bank 2017).

Land and financing reforms and strengthening subnational institutions are also essential to expedite road infrastructure development. Many infrastructure projects have stalled because of difficulties in land acquisition or the slow pace in obtaining government clearances (Rajan 2019). Addressing these weaknesses could include initiatives such as enhancing procurement practices (that is, increasing openness and transparency and limiting red tape) and improving risk allocation (that is, shifting some of the risks related to land acquisition to the government while maintaining the construction and commercial risks in the private sector). Subnational institutional and technical capacity requires build-up to cope with road network expansion, as about 90 percent of the road budget is administered at the subnational level. While central road agencies are well-equipped and staffed, many state and local level administrations need to increase institutional and technical capacity to accelerate road network development.

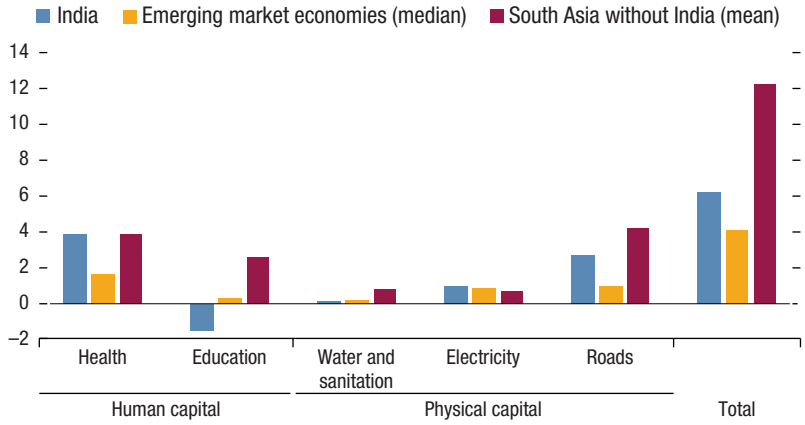
The private sector has emerged as a key player in the development of road infrastructure. Many private players are entering the business through the public-private partnership model. In addition, the National Infrastructure and Investment Fund was formed to facilitate international and domestic funding in infrastructure and attract equity capital from both international and domestic sources for infrastructure investments in commercially viable projects. Likewise, the latest budget for 2018–19 highlights the use of innovative monetizing structures such as Toll-Operate-Transfer (TOT) and Infrastructure Investment Trusts (InvITs) to monetize public sector assets, including roads.

RESULTS ON ADDITIONAL SPENDING REQUIRED TO MEET SDGS IN SOUTH ASIA

This section places the results on costs to meet the SDGs in India into a regional context. It compares them with the corresponding costs for other South Asian countries. The analysis for India presented in the previous section is based on an in-depth case study, involving extensive discussions with the authorities and based on the most up-to-date data. For other countries, the estimates follow the same methodology but have not been validated through discussions with and the latest data from the respective country counterparts. Given these estimates are preliminary in nature, Figure 2.18 presents the average for a group of countries including Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka.

Spending to meet the health and electricity goals in India are somewhat comparable to those in the rest of South Asia. The additional expenditures to perform well on the health SDG in India outstrip the corresponding costs associated with any of the other four selected SDGs. This estimate is quite similar to that of other South Asian countries, on average. India's additional spending to achieve a high

Figure 2.18. India: Spending in 2030 in Selected SDG Sectors
(Percent of 2030 GDP)



Sources: Gaspar and others 2019; and IMF staff calculations.
Note: South Asia without India consists of Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka. SDG = Sustainable Development Goal.

performance in the electricity sector is also proximate to (and only somewhat higher than) the average across South Asia.

Spending needed for the education, water and sanitation, and roads SDGs are distinctly lower in India than elsewhere in South Asia. On average, South Asian countries' additional costs to meet the education SDG is about 2 percent of GDP, with some countries facing additional costs of more than three times this average. This is higher than for India—which has a lower spending requirement in terms of GDP in 2030 than its current spending—and for the average emerging economy. Overall, additional spending in water and sanitation is relatively low when compared with the spending to meet most other selected goals. Additional spending on water and sanitation is also lower in India and South Asian countries relative to emerging economies. In contrast, the South Asian region will need to make the substantial investments in road infrastructure. The average annual additional spending in the region for roads is about 4.3 percent of GDP, 1.6 percent higher than the additional annual spending required to meet the road SDG estimated for India and more than four times that for emerging economies.

CONCLUSIONS

We estimate that making substantial progress in critical SDG sectors in India would require additional annual spending of about 6.2 percentage points of GDP in 2030. While this is significant in size, it appears moderate when compared with the estimated additional cost in other South Asian countries of about 11.3 percent of GDP. On the other hand, however, additional annual

spending in India is above that of the median emerging economy, at about 4 percentage points of GDP (Figure 2.18) as estimated by Gaspar and others (2019).

The estimates assume that India and South Asian countries would be able to combine different inputs efficiently to deliver across the analyzed sectors. This would require important reforms. For example, in education, expanding enrollment in preprimary and tertiary levels as well as reducing class sizes would require increasing the number of qualified teachers. In health, in addition to raising the number of qualified health care workers, it is critical to address the financial vulnerability to health care shocks. In infrastructure, raising institutional and technical capacity remains key, particularly in largely rural states. Broader public financial management reforms are also called for to strengthen the efficiency of spending. For example, while some states have begun to produce medium-term fiscal projections as part of the budget, the central government and all states could do so too, as well as strengthen the performance-orientation of budgeting and develop more forward-looking fiscal strategies.

Because the analysis for this chapter was undertaken before the COVID-19 pandemic, it does not incorporate its potential effect on the spending needed to reach the SDGs. Evidence is already mounting that COVID-19 will have ripple effects for years to come in economies throughout the world, including in South Asia, and, as such, it will also have implications for the SDG agenda. For the first time in more than 20 years, 2020 had an annual rise in the extreme poverty rate, with an estimated additional 119 to 124 million people pushed into poverty—60 percent of whom are in southern Asia (UN 2021). Countries could see a reduction in the available fiscal space to finance the SDGs because of the higher debt, a decline in revenues as economic activity stalls, and higher expenditures to fight the virus and its economic and social consequences, making the achievement of the SDGs in human capital development and infrastructure more challenging (IMF 2021).

Cost estimates for reaching the SDGs may increase because of progress being set back by the pandemic. For instance, school closures are likely to result in children falling behind in learning (especially since homeschooling cannot be done effectively in particular by households lacking skills, means, or time). In India, for example, an estimated 320 million children have been affected by pandemic-induced school closures (Sahni 2020). This will increase the costs to achieve the education SDG. Health personnel and supplies to fight the virus could be diverted from other health needs, and demand for health services could decline when the population fears the risk of contagion in medical facilities. Both factors may compromise progress on critical SDG health indicators. A study on 14 countries, among which six are in South Asia, found that such resource diversion has already shown detrimental effects on the maternal mortality rate (De Beni and Maurizio 2020). Electricity consumption could face a temporary sharp dip because of dropping demand emanating from the lockdowns and cascading effects on stalled economic activity. And the significant resource needs for the emergency health response to the pandemic, for social assistance, and for support

to firms, could be expected to temporarily hold back public investment, including in road infrastructure.

On the other hand, emergency financing, debt relief, and budget reallocations that are boosting health-related spending to fight the pandemic, if sustained over time, could accelerate the achievement of some SDG targets. Increases in health spending may improve indicators concerning access to vaccines, health personnel, and mitigating global health risks. Similarly, efforts to contain the virus may lead to advancing progress on the SDG related to water and sanitation by triggering increases in the proportion of the population using safely managed sanitation services, including handwashing facilities with soap and water (WHO 2020).

Future research could usefully update the analysis to account for the pandemic, drawing on additional collected data from 2020 onward on key cost drivers, inputs, and spending in the five sectors and other demographic and economic variables.

The analysis can be expanded in additional ways. Given the cooperative federal structure and the diversity across states and union territories, it would be insightful to review the challenges in achieving the SDGs at the subnational level. To this end, the authorities have taken important steps toward the localization of SDG efforts, including promoting convergent implementation structures and deploying regional monitoring systems. This chapter's analysis discussed qualitatively what reforms may be needed for India to achieve higher levels of efficiency in spending that underlies the costing method. Further work could estimate the effect on spending needs of relaxing assumptions on technical efficiency in spending, and quantify the increases in efficiency commensurate with the stated spending needs to reach the SDGs.

METHODOLOGY AND DATA, BY SECTOR

Annex 2.1. Health Care

Health expenditures (as a percent of GDP), E, can be expressed as an identity:[15]

$$E = 10w\frac{D + 0.5M}{100 - E_{other}},$$

where w refers to doctors' annual wages as a ratio to GDP per capita, D and M are the numbers of doctors and other medical personnel, respectively, per 1,000 population, and E_{other} pertains to all spending besides the health care workers' wage bill as a percent of total expenditures in education. The number 0.5 in the equation reflects an assumption that wages of other health service providers are about half that of doctors, based on cross-country data[16] on wages of specialists, general practitioners, and nurses (this assumption is also used in Gaspar and others 2019). The rationale behind this equation is that total expenditures are a function of the health service providers wage bill (that is, wages times the supply of personnel) divided by the share of the wage bill in total spending.

The spending needed in 2030 by India to perform well in the health SDG are derived as the level of expenditures that India would incur in light of its projected demographics (in particular, the projected population share of infants and elderly adults) in 2030 and today's levels for the health cost drivers observed in the high-performing countries in the health sector among India's peers (which include emerging markets, as noted in the main text). These cost drivers include doctors' wages, the number of doctors relative to the population size, the number of other medical personnel relative to the population size, and health spending other than the health care workers' wage bill (as a share of total health spending). The approach of matching India's 2030 cost drivers to today's level of the high performers is seen in the corresponding columns of Table 2.1. Annex Table 2.1.1 presents the data sources and computation of demographic factors and cost drivers for India today (latest available are from 2016 to 2017).

[15] This is a rearrangement of the equation in Gaspar and others (2019, page 27).

[16] Given limited data availability, this estimate is based on OECD data (OECD 2021), and reflects the average ratio across countries from 2000 to 2020 between specialists' and nurses' wages (0.46) and between general practitioners' and nurses' wages (0.58). The average of these two ratios is 0.52. On the one hand, the two ratios are likely to be lower for lower-income countries, but on the other hand there are usually many more general practitioners than specialists, biasing the simple average of the two ratios upward. The two biases are expected to at least partially cancel each other out.

ANNEX TABLE 2.1.1.

Computation and Data Sources for Variables Used in Health SDG Additional Spending Estimation in India

Variable	Computation or Data Source
D	0.9 * 1000 * number_of_doctors / population Assumption that only 90 percent of registered doctors are practicing because of emigration, incapacity, or other factors
No. of doctors	Government of India, Ministry of Health and Family Welfare 2018
Population	Population in 2017 from UN (2019)
M	1000 * (dentists + nurses + Ayush_practitioners) / population
No. of registered dentists	Government of India, Ministry of Health and Family Welfare 2018
Ayush registered practitioners	Government of India, Ministry of Health and Family Welfare 2018
Registered nurses	ANM + RN&RM + LHV Government of India, Ministry of Health and Family Welfare 2018
E_{other}	[total_spending – (compensation_of_employees_non_administrative + wage_bill_component_of_current_transfers_to_local_bodies_non_admin)] / total_spending Ministry of Statistics and Program Implementation 2019

Note: ANM = auxiliary nurse midwife; LHV = lady health visitor; RM = registered midwife; RN = registered nurse; SDG = Sustainable Development Goal.

Annex 2.2. Education

Education expenditures (as a percent of GDP), E, can be expressed as an identity:

$$E = \frac{w}{STR} e \frac{SAP}{100 - E_{other}},$$

where w refers to teachers' annual wages as a ratio to GDP per capita, STR is the student–teacher ratio, e signifies the enrollment rate (that is, the number of students as a percentage of the student-age population), SAP indicates the student-age population as a percent of total population, and E_{other} pertains to all education spending besides the teacher wage bill as a percent of total expenditures in education. Total education expenditure is therefore a function of the teachers' wage bill (that is, wages times the supply of teachers) divided by the share of the wage bill in total education spending. The supply of teachers, in turn, is derived as the number of students (enrollment rate times the student-age population) divided by the student–teacher ratio.

The spending needed in 2030 in India to perform well in the education SDG derived taking into account India's projected demographics (student-age population) in 2030 and today's levels of the education cost drivers of the high-performing countries among India's peers. These cost drivers include teachers' wages, the student–teacher ratio, the enrollment rate, and education spending other than the teacher wage bill as a share of total education spending. The approach of matching India's 2030 cost drivers to today's level of the high performers is shown in the corresponding columns of Table 2.2. Annex Table 2.2.1 gives the data sources and computation of demographic factors and cost drivers (latest available are for 2017–18).

ANNEX TABLE 2.2.1.

Computation and Data Sources for Variables Used in the Education SDG Additional Spending Estimation in India

Variable	Computation or Data Source
STR	number_of_students / number_of_teachers
No. of students	pre_primary_students + school_education_students + tertiary_students
No. of teachers	pre_primary_teachers + school_education_teachers + tertiary_teachers
Preprimary students	attendance_rate_of_population_aged_3to5 * population_aged_3to5
School education students	Received from authorities
Tertiary students	Received from authorities
Attendance rate of population ages 3–5 years	Ministry of Statistics and Program Implementation 2019; National Statistics Office 2019
Population ages 3–5 years	UN 2019
Preprimary teachers	Pre-primary_students / 25; 25 is the student–teacher ratio provided verbally by authorities as a rough estimate, in the absence of data
School education teachers	Received from authorities
Tertiary-level teachers	Received from authorities

(Annex Table 2.2.1 continues on the next page)

ANNEX TABLE 2.2.1.

Computation and Data Sources for Variables Used in the Education SDG Additional Spending Estimation in India *(Continued)*

Variable	Computation or Data Source
E_{other}	[total_spending – (compensation_of_employees_non_administrative + wage_bill_component_of_current_transfers_to_local_bodies_non_admin)] / total_spending Ministry of Statistics and Program Implementation 2019
Wage bill component of current transfers to local bodies, nonadministrative, that is, for direct service delivery (Rs.)	current_transfers_to_local_bodies_non_administrative * compensation_of_employees_non_admin / (total_spending_non_admin – current_transfers_to_local_bodies_non_admin) Ministry of Statistics and Program Implementation 2019
SAP	population_aged_3to23 / total_population
Population ages 3–23 years	UN 2019
Total population	Population in 2018 from UN (2019)
e	number_of_students / population_aged_3to23
E	In education: (public_spending + private_spending) / GDP
Public spending (Rs.)	total_spending Ministry of Statistics and Program Implementation 2019
Private spending (Rs.)	pre_primary + primary + upper_primary_middle + secondary + higher_secondary + post_higher_secondary
Private education spending, by level (Rs.)	By level: out_of_pocket_spending_per_student * number_of_students
Out-of-pocket spending per student, by level (Rs.)	NSO 2019
No. of public school students, by level	By level: number_of_students * %_of_students_attending_public_school
No. of private aided school students, by level	By level: number_of_students * %_of_students_attending_private_aided_school
No. of private unaided school students, by level	By level: number_of_students – number_of_public_school_students – number_of_private_aided_school_students
Students attending public, private aided, private unaided school (%)	NSO 2019
Total no. of students, by level	gross_enrollment * population_of_corresponding_age_group
Population of corresponding age group	UN 2019
Gross enrollment rate, by level (as %)	NSO 2019
w	Level of teacher wages (as ratio of GDP per capita) that satisfies

$$E = \frac{w}{STR} e \frac{SAP}{100 - E_{other}}$$

Source: IMF authors.
Note: Rs. = rupees; *SAP* = student-age population; *SDG* = Sustainable Development Goal; *STR* = student–teacher ratio.

Annex 2.3. Water and Sanitation

The percentage of served population in rural and urban areas and the cost per capita of providing the service is obtained from different sources and updated data, when available, are provided by government authorities. Annex Table 2.3.1 reports the reviewed statistics of coverage by type of water and sanitation service. The target population unserved in 2030 is extrapolated from the percentage of rural and urban population unserved in 2019, the additional population growth between 2019 and 2030, and the migration from rural to urban areas. This implies, ceteris paribus, an improvement in the coverage ratios by simple migration from unserved rural to served urban areas.

ANNEX TABLE 2.3.1.

Statistics of Coverage, by Type of Water and Sanitation Service in India

	Rural		Urban	
	Coverage (Percent)	Cost Per Capita (US Dollars)	Coverage (Percent)	Cost Per Capita (US Dollars)
End open defecation[1]	100.0	—	100.0	—
Basic water[2]	89.5	15.4	100.0	55.6
Basic sanitation[3]	97.4	37.4	98.5	145.0
Basic hygiene[4]	70.7	21.6	84.8	8.0
Safely managed water[5]	56.1	36.1	81.1	249.6
Safely managed sanitation[6]	61.1	168.5	35.1	122.3

Source: IMF staff calculations using data from UN (2021); World Bank (2020); Government of India, Ministry of Jal Shakti (2019); Government of India, Ministry of Statistics and Program Implementation (2018); and interviews with NITI Aayog officials.

Note: Statistics used for the computation of the Sustainable Development Goal (SDG) additional spending in water and sanitation.

[1] Ending open defecation refers to access to services that remove the need for open defecation—improved or unimproved toilet facility (for example, pit latrines without a slab/platform, hanging latrines, bucket latrines). NITI Aayog considers 100 percent coverage based on the provision of 114 million latrines.

[2] Basic water service is the access to an improved water source within 30 minutes round trip. NITI Aayog considers access to a river, stream, or pond as "basic water."

[3] Basic sanitation service is the access to improved sanitation facilities such as flush toilets or latrines with a slab on household premises.

[4] Basic hygiene service refers to the presence of handwashing stations in the household with soap and water. The actual practice of handwashing after defecation (with soap and water) is lower: 66.8 percent of rural population and 88.3 percent of urban population.

[5] Safely managed water service is the access to an improved water source on household premises. According to NITI Aayog, an urban population of 72.5 million individuals are envisaged to be provided with safely managed water by the government of India.

[6] Safely managed sanitation service is the access to improved sanitation facility on household premises where excreta are safely disposed of in situ or treated off-site. According to the Ministry of Drinking Water and Sanitation, there is no drainage (no formal system of carrying off household wastewater and liquid waste) reported for 38.9 percent of the rural population and 8 percent of the urban population. According to the Ministry of Housing and Urban Affairs and NITI Aayog, 133.5 million people are not covered in small towns (below class 1) and 106.9 million people are not covered in class 1 cities.

Because the goal in water and sanitation is full coverage in each service category (that is, basic water, sanitation and hygiene, safely managed water, and sanitation provision), the cost per type of service and population strata is computed as the product of the population unserved times the cost per capita of providing the service by type of service and population strata.

To avoid double counting and since the services are incremental (that is, populations with safely managed sanitation have access to more basic services such as

water and latrines), we compute the total population unserved as the maximum of rural population unserved by type of service plus the maximum of urban population unserved by type of service. Following the WASH methodology developed by the World Bank (Hutton and Varughese 2016), the total cost was calculated as the full cost of providing safely managed water and sanitation services plus half of the cost of providing the basic water and sanitation.

Annex 2.4. Roads

The cost per kilometer by type of road—highway, local, and rural—is taken from the Government of India, Ministry of Road Transport and Highways' (2018b) normative costs. The average cost of road construction was estimated at $509,000 per kilometer. This assumes that future roads are going to follow the same proportion as currently observed between share of highways, local (district, urban, and project) roads, and rural roads as a percent of total roads from the Government of India, Ministry of Road Transport and Highways (2019). Annex Table 2.4.1 provides the input data used for the estimation of the average cost per km of road.

The goal in roads for EMEs is to increase the Rural Access Index (RAI; that is, the share of the population that has access to a road within two kilometers) to at least 90 percent by 2030. Keeping roads constant, the migration from rural to urban areas—assuming a general migration pattern from not connected rural areas to connected rural areas and urban areas—mechanically increases the RAI. We account for population migration to calculate the migration-adjusted RAI in 2030 using the following equation:

$$RAI_{2030}^{migration-adjusted} = 1 - \underbrace{\frac{\overbrace{Rural_{2019} \times (1 - RAI_{2019}^{observed})}^{current\ rural\ population\ not\ connected} - \overbrace{(Rural_{2019} - Rural_{2030})}^{migration\ from\ rural\ to\ urban}}{Rural_{2030}}}_{migration\text{-}adjusted\ rural\ population\ witout\ access\ to\ roads},$$

where *Rural* is the actual share of rural population in 2019 and projected share of rural population in 2030. Consequently, India's RAI in 2019 increases from 70 to 77 when adjusted for migration dynamics.

We estimate the additional road density needed to increase in the RAI from its current level in India to at least 90 percent by 2030 by estimating the following ordinary least squares regression specification:

$$lg\_cia\_density = \alpha + \beta_1 \times lggdp\_cap + \beta_2 \times lgpop\_density + \beta_3 \times RAI + \beta_4 \times agg\_gdp + \beta_5 \times manu\_gdp + \beta_6 \times urban + \varepsilon,$$

where *lg_cia_density*, *lggdp_cap*, and *lgpop_density* are the natural logarithms of road density, GDP per capita, and population density, respectively, RAI is the Rural Access Index, *agg_gdp* is the aggregated GDP, *manu_gdp* is the ratio of manufacturing to GDP, urban is the share of the urban population in total

population, α is a constant, and ε is the error term. The regression is restricted to low-income and developing economies, and EMEs with medium-range road density (that is, for comparability it does not incorporate advanced economies, or countries with too low or too high road density). This approach assumes away contemporaneous reverse causality: that is, road density affects income per capita and population density with a substantial lag (Fay and Yepes 2003).

The additional road length needed to meet the SDG goal is estimated at 2.4 million kilometers. The total cost of the additional road network is computed by multiplying the additional kilometers by the unit cost of constructing 1 kilometer at $509,181 (Annex Table 2.4.1) and accounting for a 5 percent annual depreciation rate.

ANNEX TABLE 2.4.1.

Cost of Road Construction in India

Type	Share of Roads (Percent)	Cost per Kilometer (Indian Rupees, in Crores)	Cost per Kilometer[1] (US dollars)	Reference
National and state highways	4.91	10.87	1,509,722	Greenfield alignment 8-lane, 1.5 meters
District, urban, and project roads	24.44	4.26	591,667	Greenfield alignment 2-lane, 1.5 meters
Rural roads (including Jawahar Rozgar Yojana)	70.65	2.96	411,111	Service road with flexible pavement (10-meter carriageway)
Weighted average			509,181	

Source: IMF staff calculations based on data from the Government of India, Ministry of Road Transport and Highways (2018b).
[1] Costs were converted at a rate of 72 Indian rupees to 1 US dollar.

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