Fast-Growing Developing Countries: Dilemma and Way Forward in a Carbon-Constrained World

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1 Introduction

The reporting and comparing national progress are still dominated by single metric of gross domestic product (GDP). In pre-COVID-19 period, countries like Bangladesh were experiencing ~ >7% annual GDP growth rate in this century, while many others experienced that in the past century (Mahmud & Roy, 2020). While China experienced high GDP growth of 8.26% annual average between 2009 and 2017, Costa Rica 3.47% annual average between 2009 and 2019, Finland 0.11% annual between 2009 and 2019 and some faced even negative growth rate (Greece—2. 81% annual average between 2009 and 2017), India’s average annual GDP growth rate was ~7% during 1995–2007. IPCC report clearly shows that income growth per capita is contributing more compared to population growth to decadal emissions growth (Fig. 1) (IPCC, 2014). Question is do people want more products? Or do people want a healthy,
Fig. 1  Decomposition of the change in total emissions from fossil fuel combustion. Source (IPCC, 2014) (adapted)

cohesive, equitable, peaceful life? Global debates about how Global South (a highly contested concept) (Hayward & Roy, 2019) might rise over the course of the next one, two and three decades and Global North manage their irresponsible consumption (Schor, 2005) by the time the global population growth will be peaking, need more deeper analysis and reflection. In reality, there is vast literature (Golley & Meng, 2012; Chancel & Piketty, 2015; Jorgenson et al., 2019) which is trying to see this debate in terms of reducing inequity in consumption and access to good life (Hayward & Roy, 2019). Roughly, 30% of human settlements in traditionally classified developing countries have already followed the path of economic progress of the now highly industrialized countries in the Post-World War II period and have proved successful in improving individual quality of life and are on the way to adopting solutions for improving social and environmental quality (Singer, 2018). If we talk of broader equity and justice, there can be no denial of progress for the remaining 70% who in fact as a group are true representation of the Global South following various definitions provided in the literature (Hayward & Roy, 2019; Rao et al., 2019; Rao & Pachauri, 2017).

Many believe that if these debates are emerging mostly due to changing climate and carbon-constrained world, they are going to delay the basic development process for the less developed world further and lead to more inequity while experts search for alternative development pathways. It is also well understood that fast-developing countries will need to maintain this initial phase of high economic growth rates merely for providing universal access to a decent living. This is seen by many as a threat to increasing impact on climate change. However, recent research shows otherwise. Decent living standards for everyone in developing countries can be met
with just 10% of the total energy consumption by the USA in 2020 (Rao et al., 2019; Millward-Hopkins et al., 2020).

Can fast-developing countries of this decade avoid what was known as the most efficient examples of land-use patterns in human settlement design, in which a strip of road provides space for multiple basic service delivery compatible infrastructure, including water supply pipelines, transport and mobility, telecommunications, drainage and sewerage, a grid-based electric supply, transmission and distribution network, street lighting and avenue plantation? What can be the options for human settlement design and living patterns for the half of the world? Today, when frustration is leading to social conflicts over lack of access to basic facilities, the first political step becomes adoption of the establishment of grid power connectivity, provision of public transport system and comfortable homes with basic service access. It is easy to see that lack of adequate infrastructure kills aspiration. Potatoes, tomatoes, garlic, onions, and other vegetables and fruits are left to rot in many villages in India and Bangladesh and in many less developed countries because of lack of on the farm cold storage facilities. Food processing industries are not able to move to the point of produce because of lack of reliable, adequate, productive power connections. Life therefore remains stuck at subsistence level, and the day ends with sunset. This has nothing to do with aspiration levels but with basic needs for a dignified living. Hot summer days of 40 °C and 98% humidity take a toll on life and labor productivity (NATCOM, 2018). It is not that hot tropical countries in South and South-East Asia do not want air-conditioned spaces. Nor can any ethical consideration be put forward to say that they should not aspire to have space cooling as they become affluent enough to afford it, on the grounds that it will mean increased global warming. These are the minimum aspirations for well-living and for productive thinking. What needs to be answered is how to provide these services with new innovative service delivery mechanisms. Today, thanks to improved irrigation facilities and advanced agricultural equipment, India produces no fewer than a dozen top-quality varieties of rice, cereals, mangoes and so on. If strategically managed, these resources would be able not only to feed India’s own population but also to feed large parts of the rest of the world. The much-bruited adverse impact on soil quality and water table levels are misrepresentations of the environmental concerns: they result from a lack of investment in natural capital, i.e. the environmental resources management. Experiences in the field give grounds for hope; when orchards are seen replacing paddy cultivation in some of the degraded lands of Punjab in India, drip irrigation is replacing flooded irrigation, and vegetables and horticulture are bringing in more cash and adding diversity to dietary habits. However, these changes are propagating but not at an exponential rate which deserve attention.

We present in the sections below how the two neighbouring developing countries are navigating on their own despite the climate change and GDP growth in early development phase dilemma and are raising ambitions in tandem: a way forward for development in a carbon constrained world. Indian progress so far has been on incremental path of energy efficiency with cumulative positive impact through relative decoupling renewable energy growth to show how it can in reality enhance ambition.
Indian agriculture also plays its role here. Adopting new activities that reduce non-energy-related emissions without reducing yield provides various other sustainable development-related co-benefits (Some, 2020) as well. These aid in achieving GDP growth in a sustainable way, as Indian agriculture contributes ~17% to India’s GDP. Bangladesh poised for fast economic growth to catch up with developed country status (Mahmud & Roy, 2020) is setting some new examples of social transformation unlike many past century predecessors and holds a promise for leapfrog in sustainable energy transitions.

2 India’s Achievements and Scope for Enhancing Contribution

2.1 In Energy Matters

Low-carbon strategies gained importance in Indian policy documents as well as a part of both environmental and developmental concerns. India is home to one-sixth of world’s population but accounts for only 6.8% of global energy use and consumes only 5.25% of electricity produced globally (Enerdata, 2018). Economic development without proportional expansion of carbon emissions has become one of the major challenges in today’s development strategy in India. Study shows that for both primary and secondary energy-related emissions, rising economic activity and fossil fuel intensity of these activities are the two dominant factors for increase in emission from various economic sectors in India (Dasgupta & Roy, 2002; Dasgupta & Roy, 2017). During the period 1990–91 to 2014–2015, the overall energy intensity in India declined from 0.007 Mtoe per billion INR of GDP to 0.004 Mtoe per billion INR of GDP with annual average decline of 2% (GoI, 2016). Industrial sector is found to be the highest contributing sector in CO2 mitigation by reducing its energy intensity (Dasgupta & Roy, 2017). Apart from industrial sector, service sector has also contributed positively in reducing CO2 emission by reducing energy intensity. This change is also boosted by the structural shift in the economic sectors. India is moving away from energy-intensive industries to relatively non-energy intensive industries (Das, 2019). Share of agriculture in GDP has gone down during 1990 and 2015, thereby reducing energy intensity by 5% (RBI, 2017). Share of service sector has also increased from 51 to 67% during study period (RBI, 2017). Service sector is less energy intensive with average energy intensity of 0.002 Mtoe/Rs billion of output compared to industry with average economy-wide energy intensity of 0.016 Mtoe/Rs billion. However, fuel mix with increasing share of non-fossil sources which has proved to be important mitigating factors for many countries is showing limited impact in Indian context across all the sectors. Primary reason is high domestic reserve of coal and socio-technical regime that influences the decisions towards maintaining the high share of coal in total energy use which is around 80%.
Power generation is still the most strategic sector in India from the perspective of economic and social development as well as from GHGs emissions (Das & Roy, 2020). When landscape-level pressures through global discourse are building stronger towards ending the use of coal in energy supply sector by 2050, it is becoming increasingly important for India to transform its energy supply sector towards a low-carbon one. Hence, the opportunity for low-carbon future of power sector in India lies in reducing energy intensity with introduction of more energy-efficient technology combined with low/no-carbon fuel mix at an exponential rate. Indian power sector is diversified in terms of different primary energy sources used in generation. Still dominant source is fossil fuels, mainly coal. Installed capacity categorized as thermal power, consists of coal, oil and natural gas accounts for nearly 67% of total installed capacity in India as on March, 2017 (CEA, 2017a).

Increase in share of variable renewables like solar and wind along with hydro and nuclear-based power generation is a very important part of Indian energy policy. Capacity of renewable electricity generation in India has annually grown by 38%, and its generation has shown even a higher annual growth rate of 45% during 1990–2015 which is highest among all the other sources (CEA, 2017a). India is running one of the largest committed renewable capacity expansion programmes in the world. India aims to achieve 175 GW of renewable energy capacities by 2022 (INDC, 2015) from 42.85 GW as on March 2016 (CEA, 2017b). At present, cumulative capacity of renewable energy sources contributes to almost 17.5% which is 57.25 GW of total installed capacity 326.83 GW in India (Fig. 2) (CEA, 2017a). The share of renewable grid capacity has increased over 13% between 2002 and 2015, and the installed capacity of grid-connected renewable energy has touched 38.1 GW in December 2015 with an increase of 18% from last year. Installed capacity of off-grid captive power from renewable sources has crossed 1.23GW (INDC, 2015). Though wind continues to dominate grid-connected power in India, solar power has shown the highest expansion of more than 100% increase. Untapped potential for overall non-fossil energy in India is more than 1000 GW which shows huge growth potential for renewable energy in India, and Government of India has set a target of more than 200 GW capacity by the year 2022 from all the non-fossil sources. Renewable sources contribute to almost 17.5% of total installed capacity in India (CEA, 2017a). The installed capacity of grid-connected renewable energy has touched 38.1 GW in December 2015 with an increase of 18% from the previous year. Installed capacity of off-grid captive power has crossed 1.2 GW. According to Indian Renewable Energy Status Report, 2014, total renewable energy potential from various sources in India is almost 250 GW. The untapped market potential for overall renewable energy in India is more than 200 GW that shows huge growth potential for renewable energy in India (NREL, 2014). This growth rate is particularly significant for solar energy.

Among other non-fossil sources, large hydropower is an important source of power generation in India. In 2015, hydropower share in total installed capacity was 17% (46.1 GW); out of that small hydro consists of 9% (4.1 GW) and large hydro is 91% (41.99 GW). (INDC, 2015). At the end of March 2017, installed capacity from hydro was 44.5 GW which comes second after thermal power, accounting for 14% of the
total installed power. Share of hydro in total capacity and also in generation started to decline since 1984–85 (CEA, 2017b). This falling capacity of hydro is mainly replaced by wind and solar. Nuclear-based capacity is given the foremost priority in India due to advantage of indigenous technology. The highest rate of annual growth from 2013–14 to 2014–15 in installed capacity was for nuclear power (20.92%) (GoI, 2016). With a 2% share in current installed capacity, total installed capacity of nuclear power in operation is 5.78 GW. In 2017–18, another 1.5 GW of capacity addition is expected to be happening. Additionally, six reactors with an installed capacity of 4.3 GW are at different stages of construction. It is expected to achieve 63 GW installed capacity by the year 2032. But this is highly dependent on the supply of the fuel (INDC, 2015) (Fig. 2).

Falling electricity intensity of the Indian economy at the end user point is one of the important contributors in the fall of CO$_2$ emission from power generation. It is estimated that during the study period (1990–191 to 2014–15), electricity-GDP elasticity in India is 0.85, and overall energy-GDP elasticity is 0.72 (CEA, 2017a; RBI, 2017). This implies that change in GDP is faster compared to change in energy and electricity. Cumulative effect of declining electricity intensity of the economy resulted in a decrease of 91.90 million tonne of CO$_2$ (Das, Low Carbon Growth: Alternative Pathways for India, 2019). During 1998–2015, falling electricity intensity acted as an inhibiting factor in CO$_2$ emission reduction by 35 and 76 million tonne, respectively (Das, Low Carbon Growth: Alternative Pathways for India, 2019). During this period, the ratio of change in electricity generation to change in GDP was below unity for a considerable period of time (Fig. 3). This implies that one unit of GDP can be increased by using less than one unit of expansion of electricity generation. This has
resulted from enhanced efficiency of electrical appliances and resulting reduction in consumption of electricity. Government of India has introduced several policies to promote efficient use of energy under the Energy Conservation Act 2001 (EC Act). Bureau of Energy Efficiency (BEE) was set up as the statutory body to facilitate the implementation of the EC Act and promote energy efficiency in all sectors of the economy (Das & Roy, 2020). Ministry of Power through BEE has initiated a number of measures for standards and labelling of equipment and appliances, energy conservation building codes for commercial buildings and energy consumption norms for energy-intensive industries (Ministry of Power, GoI, 2018). These initiatives have contributed in falling electricity intensity per unit of GDP in India (Roy et al., 2018).

Emission coefficient, a measure of energy efficiency in fossil-based power generation (Shrestha et al., 2009), is another important factor which acts as an inhibiting factor on CO₂ emission reduction. Since 1991, decline in emission coefficient led to a fall in emission of CO₂ by 11 million tonne. Plant load factor (PLF), which is the ratio of actual output to optimum output of thermal power plants, is another important parameter of operational efficiency of thermal power plant. In Indian thermal power plants, PLF is declining over time. A study of Central Electricity Authority has shown that the reason behind this falling PLF of thermal power plant is due to increasing capacity of renewables and hydro and any increase in renewable electricity generation is mostly replacing the thermal generation (CEA, 2017b).

Following the discussion, it is evident that targeted policy in combination with technology choice can change the level of emissions from the power generation sector. Such actions and policies in energy sector can help in managing emissions in desired direction along with economic growth. In the past decade, India has seen how
positive policy environment can foster effective change in case of use of LPG expansion. To improve the availability and access of clean cooking fuel, the Government of India adopted a policy package for the expansion of LPG connection comprising many complementary schemes which resulted in a shift from traditional biomass to the adoption of modern cooking fuel for 80 million households in rural India (Dabadge et al., 2018). According to a study of NITI Aayog of India, the demand of electricity in building and transport sector is going increase at a rate of 5.4–6.4% under different economic growths (NITI Aayog, 2016). The transition of cooking fuel from biomass to LPG has a scope for scale up and a significant potential for the transition towards an emission-free cooking with use of electricity as cooking fuel.

2.2 In Non-Energy Matters: Indian Agriculture

Indian agricultural sector has potential for adoption of new activities which not only increase yield but also help in mitigating GHG emissions. Indian agriculture offers the highest global mitigation potential from paddy cultivation (USEPA, 2019; Beach et al., 2015). India has adopted the National Mission for Sustainable Agriculture (NMSA) in 2010 which aims to reduce agricultural GHG emission. Other aims include improving food security, protecting natural resources like land, water, biodiversity and genetics and making agriculture climate resilient. All these objectives are related to Sustainable Development Goals (SDGs). There are several agricultural practices or mitigation options already in practice, but in smaller scale that can reduce non-energy-related GHG emission and provide SDG benefits. Here, we provide three such examples: changing paddy water management practices and planting practices; efficient use of nitrogenous fertilizer and climate-smart agriculture (CSA).

Adopting paddy cultivation practices like alternate wetting and drying (AWD), direct seeded rice (DSR) and system of rice intensification (SRI) can increase productivity by 35–40% (Deelstra et al., 2018; Kakumanu et al., 2018) depending on location. SRI provided a world record rice yield of 21.16 tons/ha (Kassam & Brammer, 2013) in Bihar. These practices help in reducing GHG, especially methane emission. Imbalanced used of nitrogenous fertilizer (urea) has increased nitrous oxide emission (Some et al., 2019). Studies (Basak, 2016; Datta et al., 2017) suggest that applying neem oil-coated urea reduces GHG emissions by 13% as compared to urea alone. Furthermore, efficient use of nitrogen fertilizer is possible by using smart technologies (e.g. optical sensors), as well as by changing the method of application (e.g. deep placement). Use of optical sensors in northern states of India has reported increasing wheat productivity by 0.20–0.53 t/ha, and nitrification inhibitors have increased maize production by 0.150–0.520 t (Basak, 2016). Climate-smart agriculture practices such as rice-shrimp cultivation, agroforestry and use of water management technologies ensure better livelihood security by increasing productivity, farm income and boosting employment opportunities (Sikka et al., 2018). A study based on Punjab reveals that CSA reduces GHG emission intensity by 34% (Groot et al., 2019).
Some (2020) has explicitly shown from extensive literature review that adoption of these new activities (mitigation actions) provide various SDGs-related co-benefits. For example, adoption of SRI requires less fertilizer (Kassam & Brammer, 2016), so it reduces water pollution through leakage of agro-chemicals (catering to SDG 6 and 14) (Rockström et al., 2017). Efficient use of nitrogenous fertilizers saves energy (SDG 7) due to reduction in application of fossil fuel-dependent synthetic fertilizer (Kritee et al., 2015) and also reduces leaching, thereby reducing water pollution (SDG 6 and 14), and hence aids in sustainable production (SDG 12). CSA practices sustain soil health (SDG 2 and 12) (Parihar et al., 2018), save water and increase water productivity (SDG 6) and improve energy use efficiency and energy productivity compared to traditional practices (SDG 7) (Groot et al., 2019). Therefore, to pave the path towards sustainable development of Indian agriculture, scaling up these new activities is a must.

There are few barriers (Table 1) that can impede this scaling up in India because of the economic background and landholding of Indian farmers. But the literature suggests that these barriers can be solved through expert consultation and multi-stakeholder partnerships. For instance, recently, farmers are opting out of the SRI practice mainly due to high initial cost and physical difficulties in using tiny seedlings along with the risk of seedling loss due to pest attack (Berkhout et al., 2015). But government initiatives like Joint Action Initiative on SRI (JaiSRI) in Telengana provide subsidies as guarantee against the risk of implementing these new SRI practices which incentivizes farmers to adopt SRI and also provide trainings to farmers.

Some et al. (2019) has shown link between fertilizer policy intervention and nitrous oxide emissions. Therefore, policy has a major role to play. Government of India (GoI) has mandated the production (both indigenously produced and imported) and use of neem-coated urea (as it reduced nitrous oxide emission) since 2016 but might need bigger push to ensure effective implementation. Besides policy, scaling up of new activities like efficient use of nitrogen fertilizer needs government intervention through a combination of appropriate financial incentives and awareness mechanisms. Community-based extension services and demonstration projects are also helpful to promote necessary knowledge required in adopting these new activities. Krishi Vikas Kendras (KVKs), the agricultural extension centres in India associated with the Indian Council of Agricultural Research (ICAR), are organizing short training programmes on balanced use of fertilizers for farmers and suppliers in various parts of India. The main impediment in upscaling CSA practices is high transaction cost (Westermann et al., 2015), high upfront costs of machinery, lack of site-specific scale-appropriate machinery in some locations, the traditional mindset on crop establishment and farm management of the farmers (Groot et al., 2019; Kakraliya et al., 2018; Sapkota et al., 2015). Government has started providing field-specific data to the farmers through mobiles or smart phones for better decision making related to amount of input use. But wide-scale scaling up of CSA in India needs data-driven technology generation process in Indian NARS (National Agricultural Research System) (Rao, 2018) so as to facilitate assimilation of field-specific
| New activities (mitigation options) | Productivity increase in India (per ha or %) | GHG emission mitigation (in % compared to conventional practices) | Barriers to widespread scaling up |
|-----------------------------------|---------------------------------------------|----------------------------------------------------------------|----------------------------------|
| Changing paddy water management practices and planting practices | 35–40%<sup>a</sup> | ~ 30%<sup>b</sup> | Lack of proper financial and market-driven incentive for adoption and scaling up of this practice<br>− Lack of capacity building of farmer |
| Efficient use of nitrogenous fertilizer | Wheat: 0.20–0.53 t/ha<sup>c</sup> | 10–15%<sup>b,c</sup> | High cost for small landholders. High upfront cost<br>− Access to information regarding such technologies |
| Climate-smart agricultural practices | Maize: 60–70%<sup>d</sup> | 34%<sup>e</sup> | Expensive for small landholders and small holdings do not generate adequate income to apply such technologies<br>− Farmers may find it unattractive because they may have lower yield in the first year of adoption due to in-expertise in handling new technologies<br>− Government extension agents have limited knowledge about the tools and techniques available for using CSA technologies in small land holding |

*Note* Compiled by authors using the following sources: <sup>a</sup>(Kakumanu et al., 2018; Deelstra et al., 2018), <sup>b</sup>(Pathak et al., 2014), <sup>c</sup>(Basak, 2016)-reported for optical sensors, <sup>*</sup>Site-specific N-use; <sup>d</sup>(Chan et al., 2017); <sup>e</sup>(Groot et al., 2019)-reported emission intensity
data, conveying data-driven agronomic knowledge to farmers and government extension agents for proper decision making. For this to be effective, joint participation of Government and private sectors plays pivotal role. Therefore, scaling up of these agricultural activities will help in achieving sustainability in agriculture and pave the path towards sustainable development.

3 Bangladesh

Bangladesh with ~160 million people has attained lower middle-income country status in 2015 with ~6.5% yearly GDP growth rate over the last decade and attained over 8% growth in the 2019 (WB, 2019). This remarkable progress is driven by export, remittance, private consumption and investment, agricultural development (Asian Development Bank, 2018; LR Global Research, 2017; Rahman, 2016). The country represents a unique success story of the development from 1990 to 2016 with significant progress in the social development indicators. Poverty (headcount ratio at $1.90 a day) reduced from 44.7 to 14.5% (Fig. 4a), fertility rate came down from 4.3 to 2.1 birth per woman (Fig. 4b), infant mortality rates declined from 95.9 to 28.3 per 1000 live births (Fig. 4c), maternal mortality ratio declined from 569 to 260 per 100,000 live births (Fig. 4d).

![Graphs showing trends in poverty, fertility, infant mortality, and maternal mortality](image.png)

**Fig. 4** Trend in **a** poverty, **b** fertility, **c** infant mortality and **d** maternal mortality rate of Bangladesh 1990–2016. *Source* (WB, 2019)
176 per 100,000 live births (Fig. 4d), achieved gender parity in school enrolment. (WB, 2019).

Analysis shows that the achievement of the export-oriented labor-based garments industry and the flow of remittance from labor migration are the drivers of social development in Bangladesh and ultimately raised the earnings and human capital at the grass-root level within the nation. The women-targeted microfinance programmes and the NGO-led social mobilization intensified this success (Al-Muti, 2014). Vision of digital Bangladesh by 2021 emerged in 2008 to enable Information and Communication Technology (ICT) penetration in all sectors of economic activity to act as powerful technology led disruption to advance the socioeconomic development. (Access to Information Program, 2009; Palak, 2015). For managing this disruptive economic transformation, multi-directional change has been planned, and policy push is supporting the growth of the power sector, social changes, especially women empowerment, girls education, children’s health improvements (life expectancy is now 72 years), population growth reduction, NGO participation in development sector and microcredit programme stimulating social interactions and involvement of rural women in economic activity (Basu, 2018; Mahmud et al., 2013).

Evidence clearly shows the rise of Asian economic power centres in the past century like Singapore, South Korea, Malaysia, China which fueled their growth by heavy dependence on fossil fuel. Bangladesh is although not a major exception but one advantage which the country enjoys over India and China is due to the domestic natural endowment of natural gas as opposed to coal which has so far been fueling the economic growth. Figure 5 shows the comparative analysis of energy and GDP growth rates of these countries in their fast economic growth phase (mentioned in

![Fig. 5 Energy and GDP growth rates in fast-growing phase of selected Asian countries. Source Adapted from Mahmud and Roy (2020)
the bracket the country name). Historically, Singapore full filled its primary energy demand from imported oil and China from both imported and locally produced coal, gas and oil. Again, Malaysian energy support comes from locally produced oil although with time it balances the consumption of oil, gas and coal. South Korea’s initial industrialization was supported by imported coal, and with time, energy mix has been diversified to oil, coal, gas and nuclear energy. Bangladesh as a late comer in the development process is supporting the fast growth phase with locally drilled natural gas and with some imported refined oil. Extraction, transportation infrastructure, manpower development and institutions, regulatory mechanisms and price subsidy were centred around increasing penetration of gas in total energy mix. With declining local gas reserve over time, the country started to import natural gas from 2018 to meet its growing demand. Coal share is increasing since 2005. The energy mix was changed from 71% gas, 25% oil, 3% coal and 1% hydro in 2005 to 69.3% gas, 22.69% oil, 7.09% coal, 0.71% hydro and 0.3% renewables in 2017 (BP 2018). Development context today in the world has moved to the goal of sustainable development, especially after adopting the agenda titled “Transforming our world: the 2030 Agenda for Sustainable Development” in 2015 UN general assembly. Around the same time, Paris agreement has been signed by the countries including Bangladesh. In the energy supply sector, Bangladesh is uniquely positioned in the region which can with global cooperation within Paris and Agreement and as an actively participating country in 2015 globally accepted common future defined by the Sustainable Development Goals (SDGs) framework. Through technology partnership, it can move away from natural gas at the end of its life to make a technically feasible transition to geothermal and hydrogen fuel economy and by strategically using the comparative advantage of the existing drilling and gas distribution network (Roy et al., 2020).

While Bangladesh adds new capacities in power sector and other energy service demands over next two decades, it can align to satisfy multiple goals under three broad categories: social, economic and environmental. In sustainable energy sector development, high target of energy supply growth is seen at the same level with high energy efficiency growth and energy security (UN, 2007, 2020; Vera & Langlois, 2007). Unless enhanced supply is simultaneously synergistic with social goals of equity in access, affordability and environmental goals of clean air, water, etc., twenty-first-century energy sector development will not be consistent with sustainability goal. These are also linked to high decent job creation goal. Bangladesh economy now is trying to catch up with the similar pattern and rate of economic growth as other fast-growing economic countries in the region during their rapid growth era of the past century. Therefore, significant growth in energy sector is inevitable and needs to be assured.

As the country’s domestic resource endowment of natural gas is depleting due to historical dependence and limited reserve, the country is currently struggling with the persistent problem of the gas-based energy system and how to make transition more sustainable in future (Broese & Grin, 2017). The major transition in energy sector to gas-based energy sector happened in 1975 in Bangladesh with nationalization of the gas fields (Petrobangla, 2016). From multilevel perspective landscape level changes through adoption of global collective actions towards sustainability where Bangladesh is also a party (MOEF, 2015), the pressure is building up for
change. However, this is also coinciding with national level need for diversification of almost monolithic natural gas-dominated sector. So, the past cheap fossil fuel-driven regime of Asian fast-developing countries of past century is an old narrative which is changing very fast and needs to be articulated to the decision maker and political level so as to break away from persistence of the problem from fossil fuel dependence. Wind and solar technologies are also becoming competitive now in global market place in terms of levelized cost of energy (Fig. 6).

In Bangladesh, besides supply-side transition, there is huge scope of transition in demand-side sectors for Bangladesh which can provide faster economic growth, job creation and emission reduction, and energy conservation is through enhancement of energy efficiency. While many countries could combine higher economic activity growth rate with relatively lower energy sector growth rate due to conscious choice of relative decoupling strategy mostly through energy efficiency programmes (Das & Roy, 2020), Bangladesh has not mainstreamed energy efficiency yet within sectoral policies, technologies and human capacity building. Bangladesh is in a much advantageous position than other fast-growing countries from the past century as only 15% of the future energy sector is currently locked-in on fossil fuel path (Roy et al., 2020). Increase in energy efficiency in end use sector and a variety of clean/renewable energy penetration for achieving SDG 7 target by 2030 provides enormous scope for Bangladesh. Bangladesh while taking off in next couple of decades can take advantage of multidimensional global developments in the energy sector.
4 Concluding Remarks

Fast economic growth in the next two decades and need for energy to fuel the growth are essential for providing basic decent living standards to people of Bangladesh and India. The current dominant fossil fuel path dependency is only for 25–30% of the economy. Major growth in energy sector will happen now through the next two decades. Both the countries are already breaking away from the past development precedents of Asian developed countries and embarking on sustainable development pathway, but exponential scaling up of efforts is needed both in supply and demand sectors. These potentials for energy sector growth provide unique opportunity for economic growth and employment generations. There is need for international cooperation in technology and investment in innovation and institution building for managing this sustainable transition in energy sector with global common goal. These growth rates are required for providing universal access to a decent living for all. India already enjoys low per capita emission due to dietary habits based on locally grown agricultural produce and low per capita meat consumption approximately 5 kg per capita a year, compared to 120 kg in the USA and 80 kg in Germany (Roy & Pal, 2009). India’s ~10% of urban households own a car; car sharing is a lifestyle in India, 42% still use a bicycle, and motorized two-wheelers are used by 35% of urban households, per capita CO₂ emissions are less than 2 metric tons (MT) (Roy et al., 2018). For Bangladesh, per capita emission is less than 1.3 MT, compared to 17 MT in the United States, 7 MT in the EU and 6.7 MT in China. India for very long time could manage to keep per capita emission at very low level due to its developmental choices. Industries have begun to adopt cleaner production to maintain global competitiveness in India (Roy, Dasgupta & Chakraborty, 2017; Roy, 2007). A five-fold increase in energy growth can now produce 20-fold activity growth thanks to energy-saving technology. Policies related to agriculture have started focusing on GHG emissions from agricultural practices and implement strategies like neem-coated urea, adopting climate-smart technologies that can help in reducing it. These examples can help in the global search for alternative sustainable development narratives for many fast-developing countries and developed countries who are locked in high emission trajectory from the past century.

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