Energy and Economic Growth
Applied Research Programme

Electricity in Bangladesh

Energy Insight

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Introduction

Bangladesh is the 92nd largest country in the world, the 8th most populous (population 163 million), and the 12th most densely populated. Gross domestic product (GDP) in Bangladesh was $274.03 billion in 2018[1], making it the world's 39th largest economy. GDP growth has increased year on year, from 6.0% in 2013 to 7.9% in 2018 (placing it in the top five fastest-growing globally) and is forecast to remain above 7.0% in the near term.

The country's development objectives are set out in Vision 2021 and the Perspective Plan of Bangladesh 2010–2021. They set the goal of becoming a middle-income nation by 2021 (the 50th anniversary of independence), with progress to be reflected in higher living standards as well as improvement in a wide range of human development indicators. Implementation of the Perspective Plan began with the Sixth Five-Year Plan (2011–2015) and is continuing with the Seventh Five-Year Plan (2016–2020). Beyond 2021, Bangladesh aims to progress from being a least-developed country by 2024, and Vision 2041 sets the goal of achieving high-income status by 2041.

In terms of the power sector, the plans set the following objectives for 2021:

- achieve universal access (from generation capacity of 20,000 megawatts (MW));
- ensure the sector is financially viable;
- increase the sector's efficiency;
- improve the reliability and quality of electricity supply; and
- promote the efficient use of natural gas, coal, and oil as the primary fuels for electricity generation.

The Seventh Five-Year Plan identifies two main (related) shortcomings in the electricity sector: the increased cost of electricity generation and the sector's continuing financial losses.

Beyond development plans and international commitments, the Government of Bangladesh (GoB) has put a number of specific energy policies in place[2]:

- National Energy Policy (2004): sets overall energy sector objectives and strategies. The primary aims are to achieve 100% electrification through engagement with the public and private sectors, and to develop the regional energy market.
- Renewable Energy Policy of Bangladesh (2008): set targets for renewable energy to meet 5% of the total power demand by 2015 and 10% by 2020 – both of these have been missed.
- Power Sector Master Plan (2010): positions coal as the dominant primary fuel out to 2030 (50% of supply). Annual GDP growth of 8% over this period results in demand of 34,000 MW.
- Power System Master Plan (2016; updated 2018): supported by Japan International Cooperation Agency and sets a detailed power development plan out to 2041. The plan covers the country's energy balance, power balance, and tariff strategies, set against expected decreases in gas availability. Various (coal) mega projects are included and the forecast reserve margin reaches 69% by 2026, not returning to a more reasonable (but still high) 20–25% until the late 2030s.
- Electricity Act (2018): updated the previous Act and specifically dealt with the development and reform of power generation, transmission, and distribution, the delivery of better service to consumers, and the growing demand for electricity.
- Bangladesh Energy Regulatory Commission Rule (2003): passed in order to establish the role of an independent regulator.
- Energy Efficiency and Conservation Rule (2016): developed by the Sustainable and Renewable Energy Development Authority (SREDA) and addresses the efficient use of electricity.

The country has committed to achieving the Sustainable Development Goals (SDGs) by 2030, including SDG 7, covering universal 'access to affordable, reliable, sustainable and modern

[1] https://data.worldbank.org/country/bangladesh .
[2] Adapted from Ministry of Power, Energy and Mineral Resources (MPEMR) 2019.

energy', and SDG 13, relating to climate change (as a low-lying, coastal country, Bangladesh is particularly susceptible to the impacts of climate change). A commitment is in place to reduce greenhouse gas emissions by 5% from business-as-usual levels by 2030 using only domestic resources, to be extended up to 15% if external funding is received.

The Energy and Economic Growth (EEG) applied research programme aims to address pressing policy questions in low-income countries to help shift energy systems towards a more sustainable, efficient, reliable, and equal paradigm. EEG's current 25 research projects derive from one general and two country-specific (Ethiopia and Sierra Leone) calls for proposals. The UK Department for International Development (DFID) is considering the possibility of future additional energy research investments and, alongside its ongoing research projects, EEG is carrying out scoping studies on behalf of DFID in several countries, including Bangladesh.

The aim of the Bangladesh scoping study was to identify potential research questions around large-scale electricity infrastructure of use to decision makers and practitioners in the energy sector, and to explore the extent of research capability in the country. The scoping study was conducted through two visits to the capital, Dhaka. The first consisted of one-to-one meetings with key energy sector stakeholders, and the second combined further one-to-one meetings with a half-day workshop. Workshop attendees discussed and prioritised research questions and areas, which were then discussed with the wider EEG team and developed into specific research questions.

This paper provides background on Bangladesh's energy sector and lays out the key issues and challenges identified during the scoping exercise.

Institutional structure of Bangladesh's electricity sector and key players

Several GoB ministries and institutions directly influence the power sector in Bangladesh. Within the central GoB, the Ministry of Finance sets sector budgets and wider taxation and economic policies. These policies are overseen by the Industry and Energy Division of the Ministry of Planning.

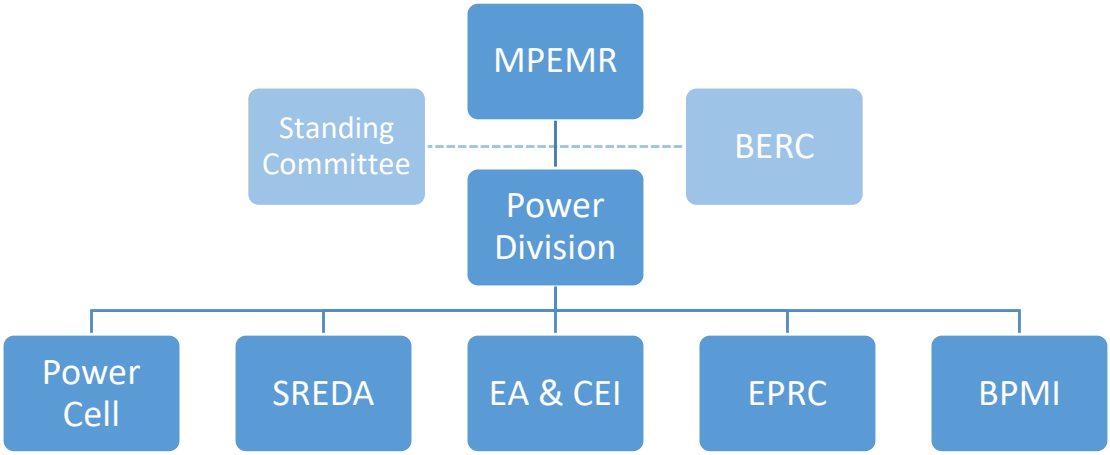
Specific energy sector institutions are presented in Table 1 and Figure 1.

Table 1 – Specific energy sector institutions

Institution	Role /activities
Ministry of Power, Energy and Mineral Resources (MPEMR)	Responsible for all policies and matters relating to electricity generation, transmission, and distribution from conventional and non-conventional energy sources. Also deals with policies related to primary fuels (import, distribution, exploration, extraction, and pricing). The MPEMR is split into two divisions headed by two secretaries: the Power Division, and Energy and Mineral Resources.
Parliamentary Standing Committee on MPEMR	The committee evaluates legislative proposals and scrutinises activities of GoB.
Bangladesh Energy Regulatory Commission (BERC)	Established in 2003 as an independent regulator and has the mandate to regulate electricity, gas, and petroleum products for the whole of Bangladesh. Aims to ensure energy is used efficiently and services provided are of appropriate quality, sets tariffs, and enhances safety across all energy supply chains.
Power Division	Works under MPEMR and is responsible for setting policy for, and monitoring the progress of, the electric power industry of Bangladesh. It coordinates the activities of the institutions that sit under it and develops plans to ensure generation capacity meets economic growth.

Power Cell	Established in 1995, the Power Cell develops and implements reform programmes that improve sector performance, increase consumer satisfaction, and maintain sector viability. It oversees the corporatisation of sector entities and the development of supporting management information systems and IT systems, among other activities.
SREDA	Dedicated to the propagation of sustainable and renewable energy, including efficiency, in Bangladesh. It provides policy, advisory, and technical support to GoB at all levels, including local governments, municipalities, and state utilities, and works with a range of partner organisations. It also maintains a technical library on sustainable energy.
Office of the Electrical Adviser and Chief Electric Inspector (EA&CI)	Created to ensure safety and equipment standards are in place and enforced, and to issue licences to workers in the electricity industry. The Electrical Adviser has the rank of minister and directly advises the Prime Minister of Bangladesh.
Energy and Power Research Council (EPRC)	Formed in 2015 and focuses on research and development in the energy and power sector through innovation, incubation and entrepreneurship (I^2E). EPRC's main purpose is to coordinate practical and implementable research works in the power and energy sector.
Bangladesh Power Management Institute (BPMI)	Formed in 2018 with the aim of upgrading technical knowledge within the sector through hosting training sessions and establishing international-standard institutes.

Figure 1 – Organogram of GoB power sector institutions and divisions



Further, a number of state-owned companies are responsible for the delivery of power across Bangladesh:

- Bangladesh Power Development Board (BPDB): responsible for the majority of electricity generation and distribution in urban areas, planning and developing the power infrastructure of the country, and operating most of its power generation facilities. Further, it purchases electricity from public and private generation entities and sells bulk electricity to the distribution utilities. As well as its own four distributions zones, BPDB sells electricity to the following distribution entities:
  - Bangladesh Rural Electrification Board – responsible for the electrification of rural areas in Bangladesh;
  - Dhaka Power Distribution Company Limited – commenced operations in 2008 and manages the distribution of electricity in Dhaka City Corporation area;
  - Dhaka Electric Supply Company Limited – created in 1996 and responsible for the distribution of electricity in the Northern parts of Dhaka;
  - West Zone Power Distribution Company Limited – established in 2002 and responsible for the Western Zone of

Bangladesh (covering the Khulna and Barisal divisions, and Faridpur region);

- Northern Electricity Supply Company Limited – responsible for the North-West Zone, including the Rajshahi and Rangpur divisions.; and
- Power Grid Company of Bangladesh – a subsidiary of BPDB and the only entity responsible for the transmission grid.

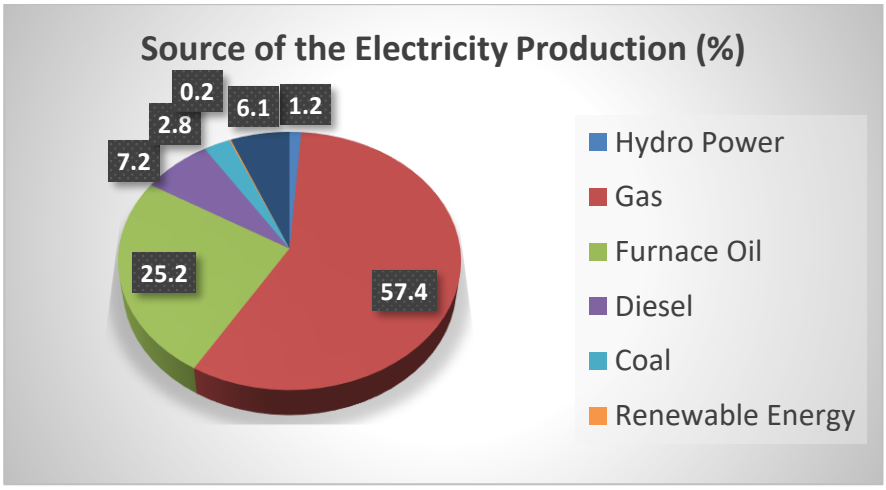
Finally, although not specifically energy-focused, Infrastructure Development Company Limited (IDCOL) is a state-owned non-banking financial institution. It provides finance for renewable infrastructure projects and has had significant involvement in solar home systems (SHS), rooftop solar, and solar irrigation.

Electricity supply and demand

Supply/generation

As shown in Figure 2, Bangladesh's electricity generation mix remains dominated by gas (57.4%) and furnace oil (25.2%). Overall, 92.6% of energy generated is thermal. Though capacity and production are increasing, non-hydro renewable energy makes up only 0.2% of total energy. This is significantly short of the 10% target set for 2021.

Figure 2 – Electricity mix of Bangladesh (source: Power Division Annual Report, 2018/19)



Generation capacity as at January 2020 was 22,787 megawatts (MW), including power imported from India (1,160 MW). This is a significant increase from 1975, when the figure was 667 MW, and 2009, when it was 5,000 MW. Table 2 presents some key supply figures, illustrating progress since 2009.

Table 2 – Key energy sector supply figures (source: Power Cell 2020)

Category	2009	2020
Number of power plants	27	137
Electricity production capacity (MW)	5,000	22,787
Maximum electricity production (MW)	3288	12,893
Per capita electricity production (kWh)	220	510
Transmission line (km)	8,000	12,068
Distribution line (km)	260,000	553,000
System loss in electricity distribution (%)	16.85	9.35

Total system losses are at 9.35% according to official figures (some interviewees involved in the scoping exercise believe the true figure is higher).

Electricity theft is believed to be concentrated in slums and is considered a sensitive political problem.

GoB has set out policies to promote private investment and independent power producers, and approximately 46% of capacity (8,284 MW) is now privately owned (9,507 MW is publicly owned). A significant proportion of new capacity added in the past decade is privately owned oil-fired quick rental. This was introduced as a temporary response to the 2010 power crisis (demand for electricity was greater than supply by an average of 2,000 MW between 2000 and 2009[3], and, in 2010, protests took place in response to the increased implementation of daily load-shedding).

Looking forward, capacity will continue to increase, with planned additions of 2,811 MW (2020) and 3,812 MW (2021). Further out, in line with national development planning, capacity targets are in place for 24,000 MW by 2021, 40,000 MW by 2030, and 60,000 MW by 2041. The total cost of achieving this is estimated at $80 billion.

The country's gas reserves, which have traditionally fuelled electricity generation, are depleting. As such, increasing installed capacity and diversifying away from gas have been key GoB priorities over the past decade.

The majority of new capacity will be coal-based, fuelled by both coal imports and the estimated 3 billion tonnes of reserves available in Bangladesh (Power Division, 2018). Targets exist for a total of 6,000 MW of coal to be installed by 2021, and for coal to provide 50% of the energy mix by 2030 (from 2.8% today). Much of the planned coal capacity will be delivered through mega projects (greater than 1,000 MW).

Bangladesh's limited land availability increases the requirement for innovative and space-saving electricity generation options. As such, rooftop solar has been promoted and GoB policies are in place requiring rooftop solar on new buildings.

GoB plans for 10% of the energy mix to be generated by nuclear by 2030 (from 0% currently). Two 1,200 MW nuclear units (forming the Rooppur Nuclear Power Plant) are in development, with operations expected to start in 2024 and 2025, respectively. The introduction of nuclear power into the energy mix will require significant capacity improvements. Rooppur is behind schedule and opposed by some environmental groups, and international experience suggests that even the revised timescales and costs are far from certain.

Although domestic gas reserves are forecast to be depleted by as early as 2031, 39 unexplored gas blocks remain (17 onshore and 22 offshore). Further, investments are being made in liquefied natural gas (LNG). Two floating storage and regasification units (FSRUs) have been established and a land-based terminal is being built – to be completed within five years. GoB plans to generate 11% of electricity from LNG by 2041, although the price of LNG is currently significantly higher than domestic natural gas.

The Seventh Five-Year Plan prioritises regional integration-based imports as an economically rational alternative to domestic generation. In fact, current total imports of 1,160 MW – all from India – are above the 2020 target of 600 MW. The potential to import from Bhutan, Nepal, and Myanmar is being explored and GoB has set targets of 3,500 MW by 2021, and 6,500 by 2030.

The potential for renewables is unclear. Studies have been carried out but there is potential for further detailed analysis of technologies – and an overall plan for development and grid integration.

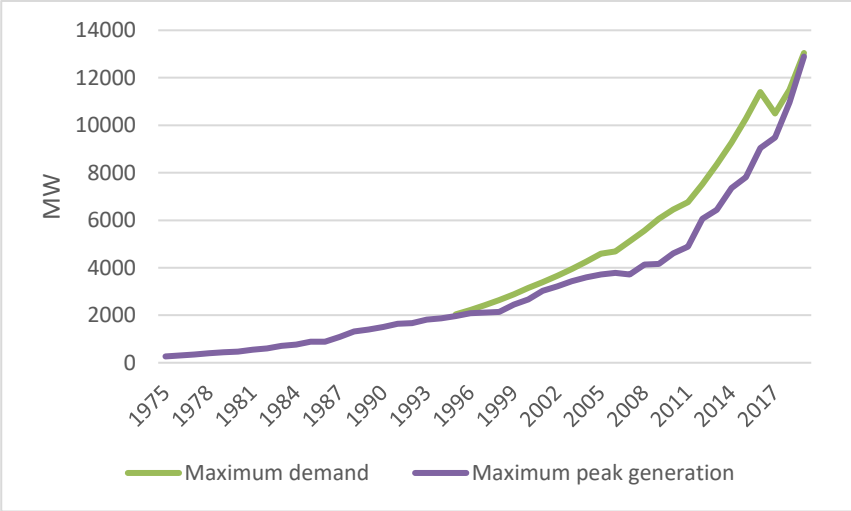
This is a critical point in the development of Bangladesh's energy system. Investment decisions to be taken in the coming years may lock in an uneconomical, environmentally damaging future energy mix.

Demand

Although limited (accurate) data are available relating to electricity demand in Bangladesh, it can be seen that peak demand has increased steadily year on year[4] over the past decade. This is illustrated in Figure 3, which also plots peak generation.

[3] Bin Amin, S., Marsilani, L. and Renstrom, T. I. (2019) 'Energy Options for Electricity Generation in Bangladesh'.
[4] The dip in 2017 is due to a realignment of calculations carried out as part of the 2016 Power System Master Plan process.

Figure 3 – Annual maximum peak demand and peak generation (source: adapted from Power Division Annual Report, 2019)



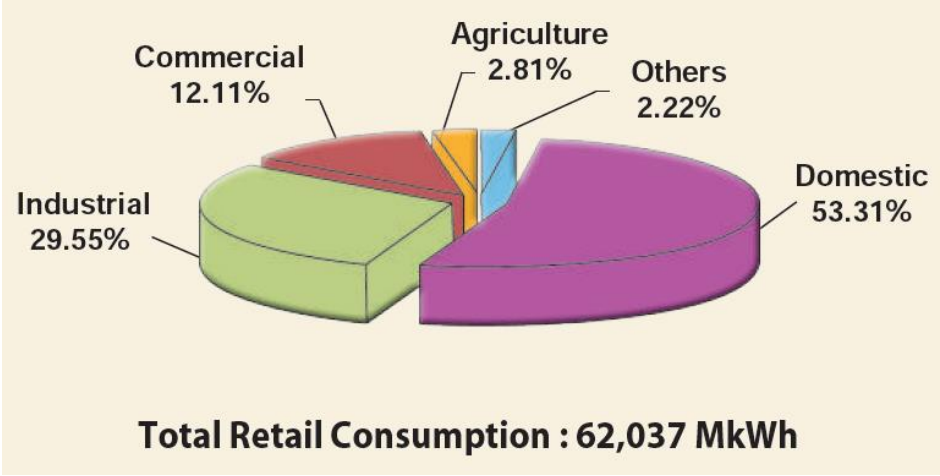
Bangladesh's daily demand profile includes a pronounced evening peak and, during warmer months in particular, a build-up of air conditioning demand through the afternoon. Peak demand of >12,000 MW covers only around six hours out of the day, meaning suitable peak supply (in terms of contractual and operational parameters) is required.

According to the latest available figures, per capita electricity consumption in 2014 was 320 kilowatts per hour (kWh), compared to 805 kWh in India, 531 kWh in Sri Lanka, and 448 kWh in Pakistan. Nepal's consumption was lower, at 146 kWh[5].

The industrial and agricultural sectors have been major sources of demand, and consumed around 45% of total electricity between 1995 and 2010. These sectors are growing in size and now contribute 50.3% of GDP.

Demand from households has grown significantly over the past decade as access has been extended. Figure 4 shows that 53.3% of consumption is domestic. (Diesel pumps used in agriculture and captive generation are not included in these calculations.)

Figure 4 – Grid electricity consumption in 2018/19 (source: Power Division Annual Report, 2019)



[5] No figures are available for Bhutan, and Myanmar was at 215 kWh.

Household access to electricity increased significantly from around 3% in 1971 (just after independence) to 59.6% in 2012[6] and is now at 95% according to the latest available data[7] – but, as in many developing countries, there is debate among stakeholders around the accuracy of access figures. As previously mentioned, a target of 100% access by 2021 is in place under the Perspective Plan 2010–2021.

Reflecting the increase in coverage, the number of consumers has more than trebled over the past decade, from 10.08 million in 2009 to 36.00 million in 2020.

Awareness and uptake of energy efficiency is limited, both by residential and commercial consumers. As household electricity consumption continues to rise, increasing the efficiency of appliances and behaviours will be increasingly important. In terms of the country's wider economic ambitions, efficiency can directly improve the competitiveness and productivity of industry – especially textiles, which accounts for 81% of Bangladesh's aggregated gross domestic income.

Challenges

The following challenges emerged during the scoping study.

Tariffs

Tariffs are highly subsidised, with electricity sold to consumers at prices below the real cost of supply[8]. Speaking in September 2019 at the inauguration of generation and transmission infrastructure, Prime Minister Sheikh Hasina acknowledged: 'We're providing subsidy. Please, don't waste electricity. We're giving electricity at the half price of its production cost. This is not right to provide subsidy this way, but we're giving it for the welfare of people and their benefits.'[9] In fact, 'half price' may be an underestimate, with cited costs thought by many interviewees to largely exclude transmission.

Generation costs are as high as Bangladeshi taka (BDT) 10+ per kWh (not including the cost of transmission and distribution, which is often excluded from consideration). The tariffs charged differ significantly by sector, with electricity supplied to agriculture sold at BDT 4–5 ($0.06) and that sold to industry at BDT 9–10 ($0.12). A ~10% increase in tariffs is expected from March 2020.[10]

Tariff structures in Bangladesh are complex, with limited transparency or understanding among stakeholders of the processes and calculations used. As in many countries, lobbying and political sensitivities are thought to play a significant role.

Ageing grid infrastructure

Much of the grid is ageing and poorly maintained. In part, this is a result of the lack of private investment in grid infrastructure (for example, when compared with the introduction of independent power producers) and the prioritisation of capacity and access by government. As a result, the unreliability of supply is now largely due to transmission and distribution weaknesses, rather than insufficient installed capacity. A key issue resulting from this is uncertainty around how the grid will cope with the increased presence of renewables.

Uncertain large-scale renewables potential

According to BPDB (2018), total renewables potential is only 3,666 MW, as outlined in Table 3.

[6] Islam and Khan (2017) 'A Review of Energy Sector of Bangladesh'.
[7] Power Cell, 2020.
[8] Limited data are available on the cost of supply.
[9] https://tbsnews.net/bangladesh/energy/bangladesh-talks-neighbours-electricity-import-pm.
[10] http://m.theindependentbd.com/post/236048.

Table 3 – Renewable energy potential in Bangladesh (Source: BPDB, 2018)

Technology	Resource	Capacity (MW)
Solar park	Solar	1,400
Solar rooftop	Solar	635
SHS	Solar	100
Solar irrigation	Solar	545
Wind park	Wind	637
Biomass generation	Rice husk	275
Biogas generation	Animal waste	10
Waste to energy	Municipal waste	1
Small hydro power plants	Hydropower	60
Mini grid, micro grid	Hybrid	3
Total		**3,666**

Bangladesh's renewables potential is constrained by: land availability (with laws in place to protect land allocated for agriculture), which makes the development of large-scale solar PV relatively expensive; the regularity of hurricanes along the coast (which can damage wind turbines); and other geographic factors. Many interviewees involved in the scoping study also believe lobbying and corruption are to blame.

As such, the development of renewables in Bangladesh is largely focused on small-scale technologies, such as rooftop solar, SHS, and solar irrigation. Also, there is interest in newer technologies, such as floating solar and bifacial solar. The overall potential, including the use of these innovative technologies, is uncertain.

Grid versus off-grid access

Around two-thirds of households are thought to be connected to the grid, but off-grid access has played a major role in Bangladesh's access increases and the country is often cited as an off-grid success story[11].

Over 5 million SHS have been deployed, through direct development-backed programmes or commercial sales (supported by development finance), although it is not clear how many are currently in use – with significant double-counting suspected. Institutionally, this progress has been backed by IDCOL. However, as the grid continues to expand, large numbers of people are switching to grid supply, often simply stopping payments for their SHS. As a result, SHS suppliers and IDCOL are incurring financial losses. Without sufficient planning, SHS may be disposed of in an environmentally damaging manner, and significant losses may be incurred by companies and organisations operating in the off-grid space.

There are questions over where and how the grid should continue to be expanded, and what the impact of this will be on current off-grid areas. The potential future role of SHS as the grid is expanded and micro-/mini-grids are developed is a key issue.

Inefficient use of rooftop solar

Rooftop panels are a requirement on new buildings, net-metering guidelines are in place (allowing the power produced to be sold on to the grid), and GoB is providing concessionary loans for installations. However, progress to date has been slow and it is understood that much of rooftop solar is underutilised or not connected to the grid, largely due to a combination of insufficient incentives/unsupportive pricing policies, poor maintenance, and difficult conditions (dust quickly builds up and reduces output).

Non-renewable and inefficient irrigation

Across Bangladesh, irrigation consumes a large proportion of energy – mainly through an estimated 1.5 million diesel pumps. Increasing the efficiency of irrigation could have significant environmental and economic benefits. IDCOL is supporting the deployment of solar alternatives and several

[11] https://cleanenergysolutions.org/sites/default/files/documents/Islam-Sharif-SKJ-Bangladesh-UN.pdf

universities are working on developing more efficient pumps.

However, irrigation use covers only three to four months per year. For investments in solar irrigation to be sustainable, year-round consumption of electricity is required, either through on-site productive uses or supply back to the grid. However, the feasibility of these options is not known. Further, the efficiency of irrigation could be improved through new technologies.

Demand uncertainty

GDP growth has averaged 7% in recent years, but this has been driven by large, public sector projects. Jobs growth has been slow and industrial demand for electricity has levelled off over the last three years. There is now a supply surplus and demand projections under GoB's Vision 2030 and 2041 targets are highly ambitious, risking significant future financial liabilities under take-or-pay contracts.

Conclusion

Overall, there is substantial interest in an EEG Bangladesh research programme, a relatively high level of local research capacity, and a number of viable research opportunities. The identified research themes were: developing a renewable energy pathway; establishing the role of energy efficiency; assessing the potential for electric cooking; maximising the utilisation of rooftop solar; increasing irrigation efficiency; linking the grid with off-grid; forecasting and utilising electric vehicle grid charging; improving demand forecasting; and assessing subsidies and tariffs.

About the authors

Jamie Stewart is a senior consultant in Oxford Policy Management's (OPM's) Natural Resources and Energy team.

Previously, Jamie was based in Africa, with the Tony Blair Institute. He was an adviser to the Ministry of Infrastructure in Rwanda, where he supported the Government of Rwanda on investment planning and implementation of off-grid electricity access and led the development of a five-year sector strategic plan. He was a Power Africa regional advisor in Ethiopia, where he modelled the benefits of regional power trade and identified potential cross-border transactions.

He has also worked in management at Drax, a UK utility, optimising governance and commercial arrangements between business units, and as a consultant at WSP, where he managed a number of projects in the UK and internationally, including regulatory reviews and asset valuations, covering transmission, distribution, and generation. He began his career as a power trader at Engie, trading the output of a 2 GW pumped storage station and delivering short-term response services to the system operator.

Solaiman Muhit is an assistant consultant for OPM, contributing research and analysis to development projects in support of GoB, donor partners, and international non-governmental organisations.

Prior to joining OPM Solaiman contributed to a number of research and development projects, with national and international partners, including the United Nations Development Programme, Saga University, Sheltech Consulting, University Grant Commission, Bangladesh Institute of Planners, DDC, and the LGED, where he contributed to project design, implementation, and evaluation.

Solaiman is an urban and regional planner. His work has been focused on the link between governance, sustainable urban development, and climate change with human development outcomes.

Front cover image: Susan Liebold / Alamy

The views expressed in this Energy Insight do not necessarily reflect the UK government's official policies.