Appendix

See Fig. A.1 and Tables A.1, A.2, A.3, A.4, A.5, A.6, A.7, A.8, A.9, A.10, A.11 and A.12.

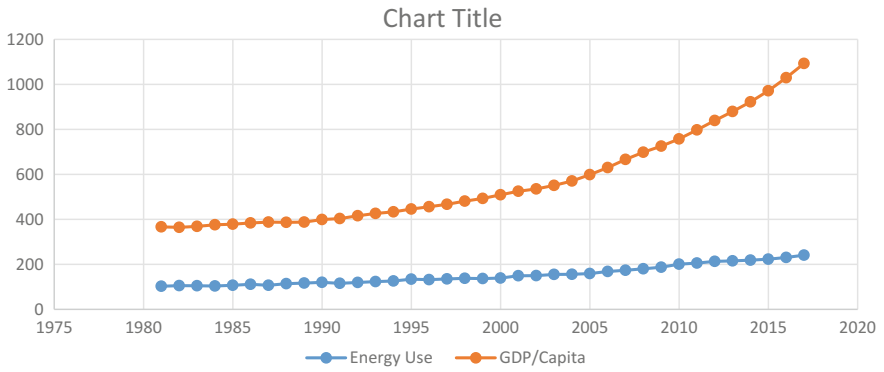

Fig. A.1 Relation between energy use and GDP in Bangladesh. *Source* World Development Indicator 2017

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Table A.1 A comparison of key statistics of energy indicators between 2009 and 2017

	2009–2010	2016–2017
Installed capacity (MW)	6639	13,555
Maximum peak generation (MW)	4606	9479
Total Net energy generation (GW)	29,247	50,193
Per capita generation (kWh)	200	324
Distribution system loss (%)	13.10	11.01

Source Bangladesh Power Development Board, 2018

Table A.2 Renewable energy potentials in Bangladesh

Technology	Resource	Capacity (MW)
Solar park	Solar	1400
Solar rooftop	Solar	635
Solar home systems (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, microgrid	Hybrid	3
Total		3666

Source Bangladesh Power Development Board, 2018

Table A.3 Projects for the improvements of energy efficiency in Bangladesh by JICA

Power generation	Power generation with the integrated coal gasification combined cycle, etc.
Improvement and rehabilitation of power generation facilities	Renewal of the facilities for the improvement of power generation efficiency
Power transmission and distribution	Establishment of power transmission and distribution facilities for the improvement of energy efficiency
Activities for reducing power transmission and distribution losses	Renewal of the existing facilities for the improvement of energy efficiency
Rural electrification	Conversion from the power generation with internal-combustion engines to more energy-efficient power generation, transmission and distribution facilities
Demand-side management (DSM) activities in the electric power industry	Introduction of energy-saving systems for the reduction of power consumption
Improvement of energy efficiency	Research for the improvement of energy efficiency and the development of energy-saving technologies

Source Bangladesh Power Development Board, 2018

Table A.4 Summary of EE&C programmes in action plan

Programme	Target
Energy management programme	Large industrial energy consumers
EE labelling programme	Residential consumers
EE building programme	Buildings
EE&C finance programme	Private companies
Government-own initiatives	Government
Energy consumption data collection	Government
Global warming countermeasure	All

Source Sustainable and Renewable Energy Development Authority, 2018

Table A.5 Electricity generation by fuel type in terms of percentage

Generation source	2013 (%)	2018 (as of August) (%)	2041 (planned) (%)
Natural gas	64.50	58.89	35
Diesel	6.69	9.95	–
Furnace oil	19.22	21.18	–
Coal	2.45	3.09	35
Renewables	2.25	2	10
Power import	4.90	3.89	11
Nuclear	–	–	6

Source Bangladesh Power Development Board (BPDB), 2018 and Amin (2015)

Table A.6 12 Transformative ICT-based innovations

1.	Platforms for the provision of energy as a service, i.e. charging for pumped water, lighting, battery charging or efficiency services instead of charging for the energy consumed
2.	Dematerialisation of billing processes and metering of energy services to operators
3.	New financing models for energy access with metering, and advanced demand and supply management
4.	Increased flexibility of existing electric grids with improved management of power flows
5.	Enhanced control of distributed generation systems, e.g. renewable energy sources
6.	Empowering individual and commercial users to identify and manage energy efficiency efforts
7.	Raising consumer awareness of energy efficiency and sustainable energy consumption
8.	Accelerating decision-making processes for energy infrastructure development
9.	Enhancing transparency in energy subsidy distribution, as part of growing e-government initiatives
10.	Providing a communication network to increase electricity supply quality and system resiliency
11.	Automation and unprecedented connectivity in transportation systems
12	Gathering data of energy indicators to assess progress and identify improvement needs

Source Modi and Figueroa (2015)

Table A.7 Main advantages of prepaid metering in Bangladesh

Power consumer's benefit	Power company's benefit
They can control their own consumption	Upfront payment
They can control their budget	Improved cash flow
No hassles with bill payment, disconnection or reconnection	Lower overhead expenses (no metre reading or billing)
There is no minimum charge	Decreased non-technical losses
Require no deposit; easy and transparent	Increased revenue
No more disputed bills	No outstanding
Users receive a 2% discount on the standard electricity billing rate	Tamper protection
Warning for low credit	Non-allowance of over sanctioned load
Emergency credit	Better load management
Automated record keeping	Better customer services
Abnormal voltage protection	Automated recordkeeping
Negative credit during friendly hours/holidays	Create power-saving attitude to the consumers

Source Power Division, 2018

Table A.8 List of subprojects under EECPF project

Sl.	Sector	Implementing financial institute (IFI)	Energy- efficient equipment (examples)	Energy-saving ratio (%)
1.	Ready-made garment	IDCOL	Direct drive sewing machine once-through boiler	25
2.	Cement manufacturing	IDCOL	Vertical roller cement mill	34
3.	Ready-made garment	BIFFL	Direct drive sewing machine VRF air conditioner	50
4.	Spinning	BIFFL	Automatic winder waste heat recovery and absorption chiller	50
5.	Spinning	BIFFL	PM motor-driven ring spinning frame pneuma-less roving frame	11
6.	Spinning	BIFFL	Air-jet spinning machine waste heat recovery and absorption chiller	22
7.	Home appliances assembly	BIFFL	Inverter-controlled air compressor	20

Source Sustainable and Renewable Energy Development Authority, Power Division, 2018

Table A.9 A comparison of electrification access in different countries (2016)

Country	Urban (%)	Rural (%)
Bangladesh	90	67
India	97	74
Nepal	97	72
Pakistan	90	63
Srilanka	100	100
China	100	100
Indonesia	99	82
Developing countries	94	70
Developing Asia	97	81
World	96	73

Source International Energy Agency, 2018

Table A.10 Selection of smart grid definitions

International Energy Agency (IEA)	A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users. Smart grids coordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimising costs and environmental impacts while maximising system reliability, resilience and stability
European Commission (EC)	Smart grids are energy networks that can automatically monitor energy flows and adjust to changes in energy supply and demand accordingly. When coupled with smart metering systems, smart grids reach consumers and suppliers by providing information on real-time consumption. With smart metres, consumers can adapt—in time and volume—their energy usage to different energy prices throughout the day, saving money on their energy bills by consuming more energy in lower price periods
US Office of Electricity Delivery & Energy Reliability (USA OE)	"Smart grid" generally refers to a class of technology that people are using to bring utility electricity delivery systems into the twenty-first century, using computer-based remote control and automation. These systems are made possible by two-way communication technology and computer processing that has been used for decades in other industries. They are beginning to be used on electricity networks, from the power plants and wind farms all the way to the consumers of electricity in homes and businesses. They offer many benefits to utilities and consumers—mostly seen in big improvements in energy efficiency on the electricity grid and in the energy users' homes and offices

(continued)

Table A.10 (continued)

International Electrotechnical Commission (IEC)	The general understanding is that the smart grid is the concept of modernising the electric grid. The smart grid comprises everything related to the electric system in between any point of generation and any point of consumption. Through the addition of smart grid technologies, the grid becomes more flexible, interactive and is able to provide real-time feedback
Japan Smart Community Alliance (JSCA)	In the context of smart communities, smart grids promote the greater use of renewable and unused energy and local generation of heat energy for local consumption and contribute to the improvement of energy self-sufficiency rates and reduction of CO_2 emissions. Smart grids provide stable power supply and optimise overall grid operations from power generation to the end-user

Source United Nations Economic Commission for Europe, UNECFE, 2015

Table A.11 The differences between traditional power grids and smart grids

Traditional power grids	Smart grids
Mechanisation	Digitisation
One-way communication	Two-way communication
Centralised power generation	Distributed power generation
Radial topology	Network topology
A small number of sensors	Sufficient sensors and monitors
No automatic monitoring	Automatic monitoring
Manual recovery	Semi-automatic and automatic recovery
Pay attention to failures and disruptions	Adaptive protection measures
Manual checking equipment	Remote supervisory controlling equipment
Handling emergencies through staff and telephone	Decision support system and reliable prediction
Finite control	Pervasive and intensive control system
Limited pricing information	Complete pricing information
Fewer user options	More user options

Source Yu et al. (2012)

Table A.12 Some examples of micro-enterprise activities

• Making and/or selling craftwork, e.g. carpentry, pottery, knitting, crocheting, weaving and clothes-making/tailoring
• Small-scale agricultural activities such as dairy processing, bee keeping, vegetable growing, poultry farming and goat keeping
• Food preparation and processing, such as bakeries, beer brewing, honey processing, edible oil/butter processing (e.g. palm oil/cassava), grain milling, fish smoking, ice-making and food kiosks
• Hospitality activities, such as guesthouses, hotels, restaurants and tea shops
• Medical services, such as traditional healers (sangomas/nyangas), homeopathic medicine production, herbal tea production
• Small-scale mining and processing activities, such as tinsmiths, blacksmiths and goldsmiths
• Energy-related enterprises that come into being because modern energy is available but are also essential to its availability. These include battery charging and distribution of components for PV systems, manufacturers and repairers of electrical appliances and machinery, wiring contractors, energy retailers such as LPG or oil fuel dealers and, increasingly, 'ESCOs' (electricity supply/service companies), which retail electricity from large-scale suppliers
• Technology generated business, especially relating to information and communication technology (ICT), e.g. internet cafes, faxing, emailing and telephone bureau
• Transportation activities for people and goods, including rickshaws, pushcarts, auto-rickshaws, taxis, ropeways, busses and lorries as well as related activities such as cycle hire, cycle and car repairs, and spare parts dealers
• Trading, including fixed and mobile hawkers or vendors, market stalls, small shops, peddlers, and home-based retailing activities
• Other specialist activities, such as leather treatment, candle wax manufacture, laundries, mechanical/electrical repair workshops, welding, soap-making, brick making, panel beating, hairdressing and furniture making/dealing

Source Meadows et al. (2003)

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