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Green Buildings Assessment Report for Bangladesh

Acknowledgement

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List of Abbreviations

ABs	Alternative Bricks
AFOLU	Agriculture, Forestry and Other Land Use
BAU	Business as Usual
BCCTF	Bangladesh Climate Change Trust Fund
BCPSAP	Bangladesh Climate Change Strategy and Action Plan
BEER	Building Energy and Environment Rating
BEEER	Building Energy Efficiency & Environment Rating
BELA	Bangladesh Environmental Lawyers Association
BHBFC	Bangladesh House Building Finance Corporation
BIFFL	Bangladesh Infrastructure Finance Fund Limited
BIM	Building Information Modeling
BNBC	Bangladesh National Building Code
BRAC	Bangladesh Rural Advancement Committee
BREEAM	Building Research Establishment's Environmental Assessment Method
BUET	Bangladesh University of Engineering and Technology
CAD	Computer-Aided Design
CCC	Clean Clothes Campaign
CIPL	Cosmopolitan Industries Pvt. Ltd.
CO2e	Carbon dioxide equivalent
CSE	Centre for Science and Environment
CSEB	Compressed Stabilised Earth Blocks
CSR	Corporate Social Responsibility
CVF	Climate Appropriate Forum
DWWT	Decentralised Wastewater Treatment
EDGE	Excellence in Design for Greater Efficiencies
EECMP	Energy Efficiency and Conservation Master Plan up to 2030
EEGIRE	Energy Efficiency and Grid Integration of Renewable Energy
EU	European Union
EUI	Energy Use Intensity
GB	Green Building
GBC	Green Building Code
GBIG	Green Building Information Gateway
GCF	Green Climate Fund
GHG	Greenhouse Gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GrACe	Green Architecture Cell
HBRI	Housing and Building Research Institute
HBHC	Centre for Housing and Building Research

HVACR	Heating Ventilation Air Conditioning and Refrigeration
IAP	Indoor Air Pollution
IDCOL	Infrastructure Development Company Limited
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
JCF	Jagorani Chakra Foundation
JCM	Joint Crediting Mechanism
KI	Key Informant
LCA	Life Cycle Assessment
LDCF	Least Developed Countries Fund
LEED	Leadership in Energy and Environmental Design
MoEFCC	Ministry of Environment, Forests, and Climate Change
MoPEMR	Ministry of Power, Energy and Mineral Resources
MRV	Monitoring, Reporting and Verification
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Actions
NBR	National Board of Revenue
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NGO	Non-Government Organisation
NHA	National Housing Authority
NZEB	Net Zero Energy Building
nZEBC	nearly Zero Energy Building Code
PKSF	Palli Karma Sahayak Foundation
PWD	Public Works Department
REEEP	Renewable Energy and Energy Efficiency Programme
RMG	Ready-Made Garments
SDG	Sustainable Development Goals
SCP	Sustainable Consumption and Production
SCPF	Sustainable Consumption and Production Facility
SDGs	Sustainable Development Goals
SHS	Solar Home System
SREDA	Sustainable and Renewable Energy Development Authority
T&D	Transmission & Distribution
TC	Technical Cooperation
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
VAT	Value Added Tax
WAB	Water Aid Bangladesh
WGBC	World Green Building Council

1. Introduction

In 2018 the second phase of the SWITCH-Asia Sustainable Consumption and Production Facility (SCPF) was launched with European Union (EU) funding. The programme aims at providing a platform to promote sustainable consumption and production (SCP) policies and principles in Asia and enhance the awareness and dialogue of local stakeholders on the theme. To achieve these goals, the SCPF fosters exchange through platforms, key experts, entities and stakeholders who share the interest for impactful actions to further enable sustainable housing, a top priority for Asia and Asian countries, through relevant and responsible consumption and production patterns, and to discuss ideas and lessons learned, and consequently, to identify and develop joint actions.

This report aims to support the integration of SCP principles in an Action Plan for Green Buildings (GB) in Bangladesh by providing an initial assessment of the constraints, gaps and opportunities that arise in this context. It explores the current status of GB with regard to energy efficiency, water conservation, waste management, use of sustainable construction materials and financing environment as well as the sustainable building techniques and methods already commonly used in Bangladesh in a building's life cycle (see Figure 1). Finally, it clarifies challenges for GB in Bangladesh, highlights gaps, constraints and opportunities, and investigates the next steps for integrating GB concepts into future policies.

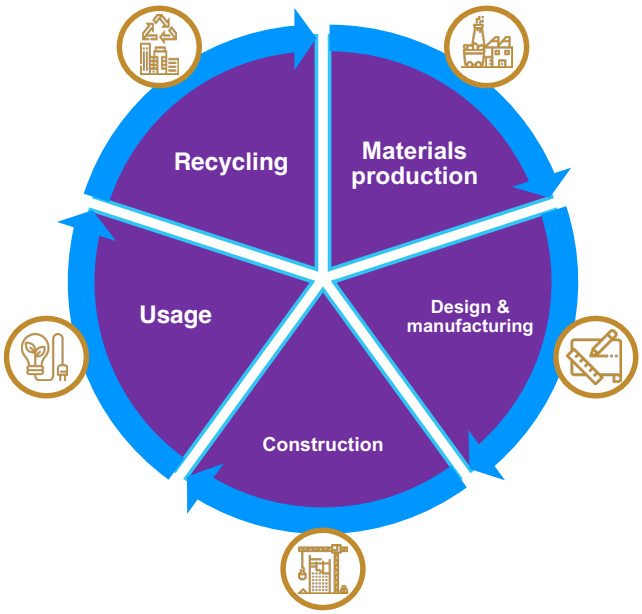


Figure 1: Building life cycle

Source: EU, 2019

Bangladesh is one of the countries most vulnerable to the impacts of climate change (Bhattacharjee, 2021). Climate change poses a significant threat to sustainable development in the country due to increased risk of extreme weather events in populated areas. With a population of 169.81 million in 2020, Bangladesh is the eighth most-populous country in the world (Ministry of Environment, Forest and Climate Change [MoEFCC], 2021). Of its total population, 35.7% live in urban areas, and more than half the total population is young (under 25 in 2016) (World Bank, 2017). **The demand for residential buildings is expected to experience the maximum growth until 2030**, with multi-unit buildings projected to be built, and an emphasis on affordable housing being the primary area of growth (IFC, 2018). At the same time, the available infrastructure of the country is unable to keep pace with the population and economic growth. Although every year an estimated 500,000 houses are built in urban areas and 3.5 million in rural areas, there remains an annual shortfall of about 5 million houses (IFC, 2017). The government meets only 7% of the annual housing demand and

relies on the private sector to fill the gap (EU, 2019), leaving 55.1% of the urban population living in informal settlements (Climate CoLab, 2014). In the last couple of years, to catch up with the rate of urbanisation, Bangladesh's major cities underwent significant transformation; one of the outcomes was a boom in the real estate, construction and housing industry. However, according to a survey conducted from January-July 2018, slightly more than 66% of the buildings in Dhaka were constructed illegally. Furthermore, of 195,376 buildings, 131,583 were found to be defective, putting them at high risk during earthquakes (Dhaka Tribune, 2019). **Ideas and solutions are needed to address informal housing, building safety and affordable housing, while keeping in mind sustainable building methods.**

Some promising advancements have been made to address the need for better quality, affordable housing. Multiple community-led, sustainable low-income urban housing projects have been piloted in Bangladesh. Three main housing programmes are Grameen Bank Housing Programme; Housing for the Urban Poor - Bangladesh Rural Advancement Committee (BRAC) initiative; and Reimagining Slums: Innovative Solutions to Urban Housing (Haque, 2008). The Ashrayan project, implemented by the government of Bangladesh, is further accomplishing shelter for landless and homeless people. Under this project 260,000 houses have been constructed in over 20,000 barracks (large canopies), housing almost half a million families. A housing project in Khuruskul, in Cox's Bazar district, houses more than 4,000 climate-refugee families. The project integrates rainwater harvesting, solar home systems and other sustainable features (MoEFCC, 2021). The National Housing Authority (NHA) of Bangladesh further developed a National Housing Policy in 2016 that directly addresses homelessness. While these programmes are helping to address key issues, **further action is needed to achieve widespread affordable, safe, resilient and sustainable housing throughout Bangladesh.**

Commercial building growth, primarily driven by the garment industry, is expected to reach a total market value of approximately 8.5 billion EUR by 2025, with only 10% anticipated to be built in the so-called "green market" (IFC, 2018). Despite the obvious advantages of GB, the concept is still developing in Bangladesh, and currently there is no official national GB policy, rating system or code. However, there is a high demand especially for green commercial buildings. While there are no BREEAM (Building Research Establishment's Environmental Assessment Method) and only a handful of EDGE (Excellence in Design for Greater Efficiencies) certified buildings, there are more than 150 LEED (Leadership in Energy and Environmental Design) certified buildings in Bangladesh, of which more than 130 are commercial buildings. A huge potential exists to address the country's specific construction challenges; however, **the process of finalising a regional GB system has been delayed**. Figure 2 depicts the chronology of the development and implementation of GB standards in the country.

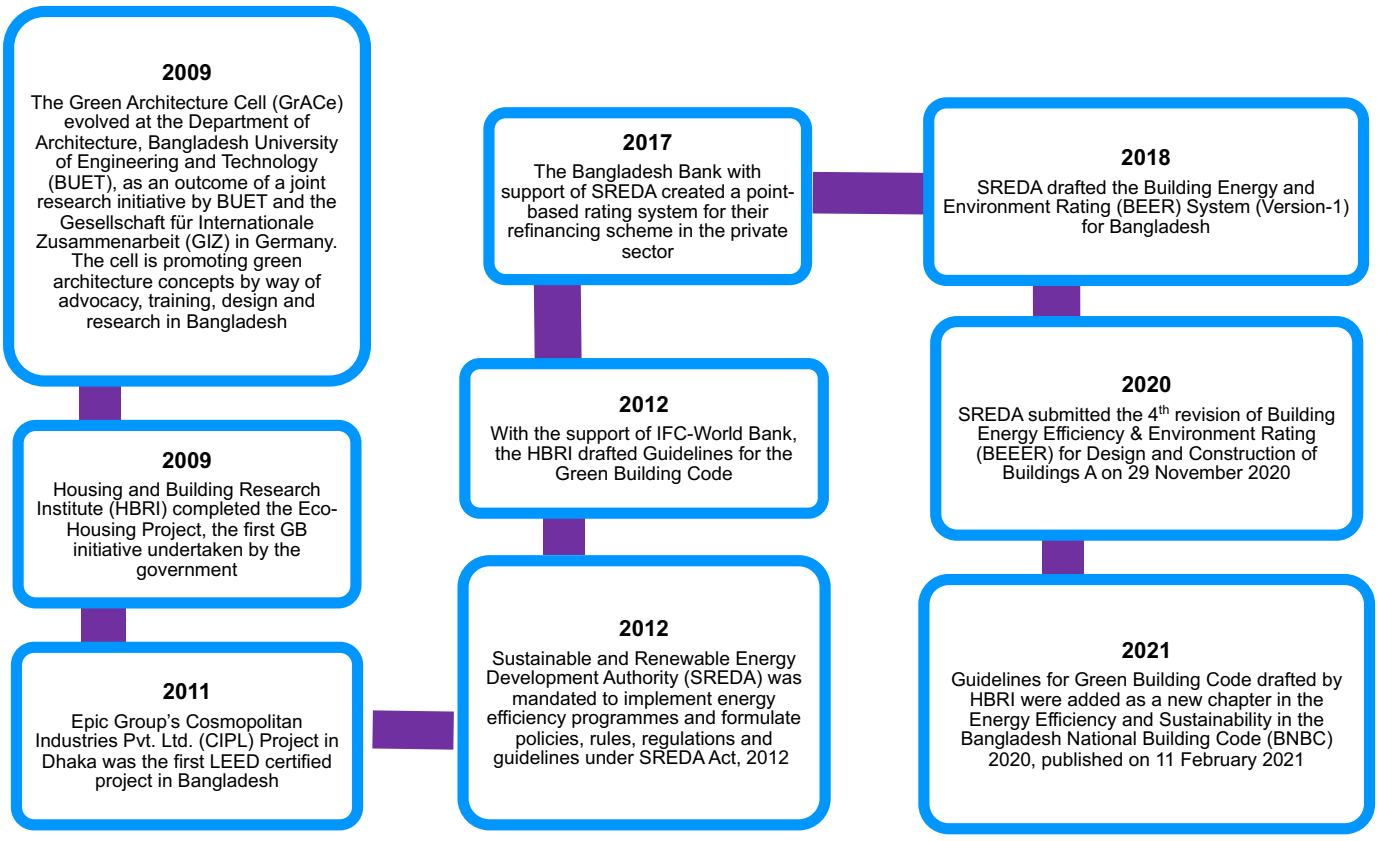


Figure 2: Timeline of development and implementation of GB standards in Bangladesh

Considering the huge growth potential for a GB market in Bangladesh, it is especially important to understand the opportunities that exist to **fill the current construction needs of the country in a sustainable way, while addressing the need for widespread capacity building.**

This report focuses on the key overarching issues for the development of a strong GB market in Bangladesh:

1. The need for a regional GB strategy specific to Bangladesh;
2. Safety and adaptation to climate change;
3. Overcoming the challenges of informal housing;
4. The need to improve specific financing targeting GB projects;
5. Differentiation between commercial and residential GB needs; and
6. The need for capacity building across all stakeholder groups.

2. Current status

2.1 Overarching strategies including provisions for green buildings

2.1.1 Policy and regulation

Bangladesh has adopted a two-fold strategy to meet the challenges of climate change: first, by increasing resilience to the impacts of climate change, and second, by reducing its greenhouse gas (GHG) emissions. This balanced approach is reflected in the Nationally Determined Contributions (NDCs) of Bangladesh registered on the United Nations Framework Convention on Climate Change (UNFCCC) NDC Registry in September of 2016 (MoEFCC, 2018). The country is committed to an unconditional reduction in GHG emissions of 12 million tonnes (5%) from the business-as-usual (BAU) scenario by 2030 and a further 24 million tonnes (10%) of conditional reductions in GHG emission for its three key sectors -- power, industry and transport. The NDC is updated over time with the addition of new sectors and targets, as required. The most recent update in September 2021 has been adapted to include: 1) Energy (power; transport; energy use in industry, in residential, commercial and agriculture sectors, and in brick manufacturing); 2) F-gases and fugitive emissions, industrial processes and product use (IPPU); 3) Agriculture, forestry and other land use (AFOLU); and 4) Waste sector. In this respect, the NDC is incorporating additional sectors according to the Intergovernmental Panel on Climate Change (IPCC) guidelines to ensure comprehensive coverage.

The latest update to the NDC additionally included provisions for residential buildings by considering possible mitigation actions through enhanced use of energy efficient appliances by households. Other NDC targets relevant to SCP in the building sector include Implementation of renewable energy projects by installation of prepaid meters and bringing down total transmission and distribution (T&D) losses to a single digit by 2030; enforcement and use of improved technology by banning fixed chimney kilns, encouraging advanced technology and non-fired brick use to reduce emissions; improved municipal solid waste management, along with ensuring that the 3R (reduce, reuse and recycle) principle for waste management is used by regional integrated landfill and resource recovery facilities, and improvement of sewage treatment and expansion of regional integrated landfill and resource recovery facilities. While no direct GHG emission reduction is committed for the IPPU sector, potential measures include switching to more efficient industrial processes in cement manufacturing. For example, cement factories should consider switching to technologies such as vertical roller mills that result in energy savings (MoEFCC, 2021).

Other overarching strategies or regulations with general provisions related to GB include the country's draft Green Building Guidelines, the Guidelines for a Green Building Code created by the Housing and Buidling Research Institute (HBRI) and the International Finance Corporation (IFC) in 2012, the Bangladesh National Building Code, and the Environment Conservation Act.

2.1.2 Voluntary green building strategies

Misconceptions about the cost and benefits of GB design and construction remain a barrier to the GB market in Bangladesh. EDGE and LEED are two of the major global building standards that can be applied to both new and existing buildings in commercial as well as residential sectors. However, due to the perceived high costs of the certification systems, and their incompatibility with local passive design (e.g., low cost, naturally lit and ventilated buildings), they are not feasible in the context of Bangladesh to cover the needs of the residential sector (Mahmud, 2011).

2.1.2.1 Excellence in Design for Greater Efficiencies

EDGE is an innovation of the IFC, a member of the World Bank Group. Considering that current rating systems are focused on top-tier clients, EDGE was created to respond to markets that need a simple, quick and affordable rating system for market transformation, and to make GB accessible to a larger share of the building industry (EDGE, 2021). Although this system is geared towards emerging GB markets, at present there are only two EDGE projects in Bangladesh.

2.1.2.2 World Green Building Council

The World Green Building Council (WGBC) catalyses the implementation of sustainable buildings globally. At present, there are 70 Green Building Councils around the world. There are three membership levels for Green Building Councils: Established, Emerging and Prospective. Bangladesh is not yet a member of WGBC at any of these levels (WBGC, 2021).

2.1.2.3 Leadership in Energy and Environmental Design

LEED is the most widely used green building rating system in Bangladesh. At present, there are 157 LEED certified buildings in Bangladesh (GBIG, 2022). More than 130 of these are readymade garment (RMG) factories in the apparel sector and hundreds more have registered in the LEED certification system. Bangladesh has the highest number of LEED RMG factories certified by the United States Green Building Council (USGBC), with seven of the top 10 in the world located in Bangladesh (Mirdha, 2018).

Figure 3: Cumulative LEED activity in Bangladesh

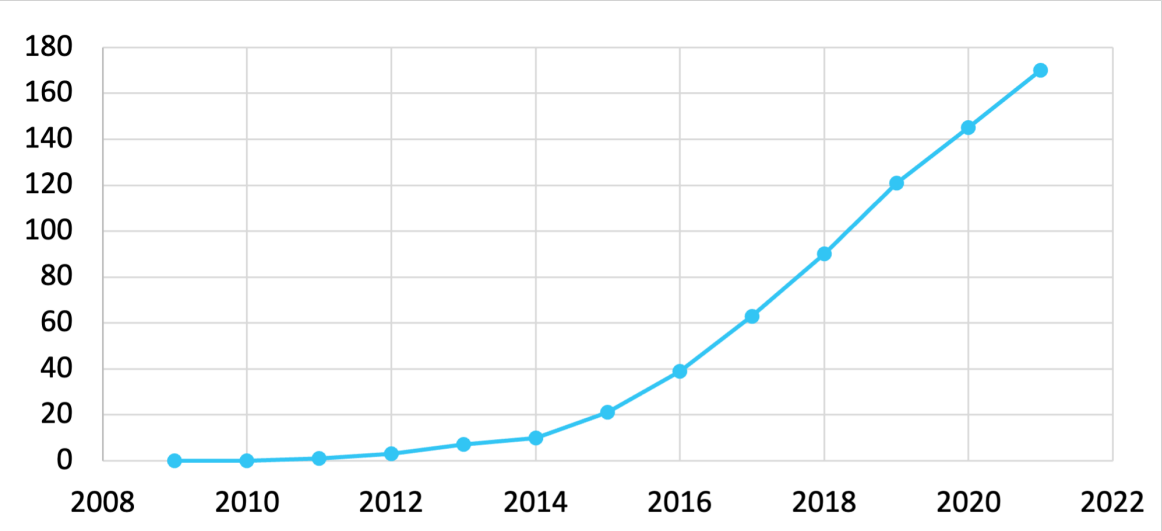


Image Source: LEED website

LEED gained momentum in Bangladesh after 2013 (see Figures 3 and 4) when the Rana Plaza factory building in Dhaka collapsed in April 2013. With 1,134 deaths and approximately 2,500 injured, it was the deadliest non-deliberate structural failure accident in modern human history and the deadliest garment factory disaster in history (Hoskins, 2015; British Broadcasting Corporation [BBC], 2013; Alam & Hossain, 2013a & b). The issue of workplace safety and building standards in the Ready-Made Garments (RMG) sector was brought to worldwide attention. Ground-breaking approaches were initiated to prevent and remedy hazardous workplaces within the RMG industry as a result of public interest and media attention (Clean Clothes Campaigns [CCC], 2021). LEED certification was marketed to garment factory owners as a way to improve worker health and safety alongside other benefits, including increased demand for goods made in these "green" factories. The US-based international rating system was widely adopted for new construction in the RMG sector and many building owners invested to achieve certification. While following the certification did allow for improvement of overall building safety, especially through the assessment of site hazards, quality control of construction materials and use of construction standards, owners were left frustrated with the results, questioning if the LEED system was useful in the context of Bangladesh.

> *"Green garment factory owners, who have spent billions of dollars for setting up the units, are left frustrated as the international retailers are not rewarding them with higher prices for the initiative. The factories cost 20 to 30 percent more to construct than the regular ones for their special design units,"* (Mirdha, 2018).

Figure 4: Rana Plaza disaster

Image Sources: http://www.thedailystar.net/beta2/wp-content/uploads/2013/06/Rana-Plaza2.jpg; 20 May 2021

Although LEED has come under scrutiny in Bangladesh due to its incompatibility for the region, some successes have been achieved. For example, Remi Holdings Ltd. is the highest rated LEED RMG factory in Bangladesh, earning a platinum rating under LEED for new construction in July 2016. This building boasts a 40% improvement on baseline building energy performance, 75% diversion of construction and demolition debris from landfills, and 100% reduction in potable water use for landscaping. Another standout project is the Plummy Fashions Ltd. knitwear manufacturing unit located in Narayanganj. It received the platinum LEED rating for new construction in September 2015. It used 20% recycled building materials and 20% regionally extracted, harvested, recovered or manufactured materials.

2.1.3 Summary and key findings

Overarching strategies or regulations with general provisions related to GB are generally underdeveloped in Bangladesh. No national policies exist to provide comprehensive regulations or standards for GBs. The common practice of dependence on western systems that are often outdated, energy inefficient, expensive, inappropriate and inadequate for local climatic conditions directs attention to the importance of learning from traditional vernacular architecture practices to develop effective sustainable solutions. GBs in tropical climate zones, such as Bangladesh, should focus on efficient energy systems to reduce cooling loads, and on passive design elements in architectural design.

Bangladesh needs to start the process of developing a GB rating system in the regional context considering environmental aspects (e.g., geography, topography, site, climate, local building materials, labour experience and building techniques), the use of resources available on-site, traditional technologies and the involvement of the community.

2.2 Energy efficiency

2.2.1 Policy and regulation

A number of policies and regulations have been developed to address energy efficiency in the building sector, including the BNBC 2020, the Green Buildings Guidelines, the Renewable Energy Policy for Bangladesh, and the SREDA Act of 2012. The SREDA Act includes provisions to assist the government in implementing an energy efficient building code, and for the voluntary Building Energy Efficiency & Environment Rating (BEEER) system for Bangladesh, which is continually updated.

2.2.1.1 Energy Efficiency and Conservation Master Plan up to 2030

In 2016, SREDA along with the Power Division of the Ministry of Power, Energy and Mineral Resources (MoPEMR) developed the Energy Efficiency and Conservation Master Plan up to 2030 (EECMP) to address demand-side energy efficiency and conservation in the country. The plan focuses on the need for adaptation to climate change and discusses the urgency with which energy topics need to be approached in Bangladesh. It especially facilitates implementation of energy efficiency and conservation programmes at a national scale and highlights the need to promote energy saving activities. The EECMP targets include a 15% improvement of Primary Energy Consumption per GDP by 2021 (compared to baseline 2013), and a 20% improvement by 2030. To frame a long-term vision, the National Solar Energy Roadmap, 2021 - 2041 was drafted, which defines general, specific and time-bound measures for the country's solar energy initiative target by the year 2041 (MoEFCC, 2021).

2.2.2 Existing practices

Many energy efficiency practices are in place in Bangladesh. For example, the development of the Cool Roof Programs for Urban Heat Island Mitigation in Dhaka is a collaboration between the German GIZ and SREDA. It uses highly reflective paints, tiles or shingles to conserve energy. Lighting is the main target for energy efficiency; there is efficient use of natural lighting in industrial buildings in addition to the use of energy efficient LED lighting, which is especially popular in the garment industry.

2.2.2.1 Compact Fluorescent Lamps

Figure 5: Installation of CFL bulbs

Image Source: https://blogs.worldbank.org/endpovertyinsouthasia/bangladesh-sets-world-record-%E2%80%93-5-million-cfls-day-one-bulb-time

Compact Fluorescent Lamps (CFLs) are four to five times more energy efficient than incandescent bulbs and last much longer. In the context of Bangladesh, peak electricity demands can be significantly reduced by the large-scale installation of CFLs. In early 2009, the MoPEMR, the Rural Electrification Board, and the World Bank came up with the Efficient Lighting Initiatives of Bangladesh programme to balance the supply and demand in the power sector (Sarkar, 2010). At a cost of 38 million USD, with support of the World Bank, the MoPEMR distributed 26.5 million CFL bulbs in 2010 through the Rural Electrification Programme, with assistance from the Power Development Board, Dhaka Power Distribution Company and West Zone Power Distribution Company (Global Times, 2009; bdnews24.com, 2010). In June of that year, MoPEMR distributed 5.5 million CFLs free of charge in 27 districts of Bangladesh under the first phase, which broke the record for the largest number of CFL bulbs distributed in a single day (Sarkar, 2010). The government's plan to provide two energy-saving light bulbs to each family in the country resulted in savings of about 350 megawatts (MW) of electricity across the country. In 2009, the country's power generation was around 3,700 MW against the demand for over 5,500 MW during peak hours (Global Times, 2009).

2.2.2.2 Photovoltaic Panels

In 2008, the generation of renewable energy was less than 1% of total electricity generation. The Renewable Energy Policy for Bangladesh was released in 2008 by the MoPEMR with the target to meet 10% of its power demand from renewable energy resources by 2020. In 2021, the renewable energy installed capacity reached 776 MW (SREDA, 2021), achieving only 4% within the overall energy mix. At the same time, an estimated 65 million people in Bangladesh still cannot access a central power grid (IFC, 2017). The government is in the process of scaling-up solar technologies such as roof-top, solar mini- and micro-grid, utility-scale solar etc., with a combination of suitable incentive mechanisms such as feed-in tariffs, net metering, or renewable portfolio obligation, benchmarking of the tariff based on market and movement of the economy.

To address land availability constraints across the country, more than 6 million solar-home systems (SHSs) have been installed on the rooftops of government and private buildings producing 66 MW, used by more than 18 million (11%) people (MOEFCC, 2021). According to the World Bank, Bangladesh has the fastest growing solar home systems programme in the world. SHSs in rural areas are economically viable solutions where electricity grids are too expensive to build and can replace diesel irrigation pumps with solar pumps. The government-owned Infrastructure Development Company Limited (IDCOL) and non-government organisations such as Grameen Shakti, Rural Services Foundation, and many others have partnered in the effort of supplying and giving technical support for the installation of SHS (Daily Star, 2013).

Figure 6: NWPGCL 7.8 MWp grid tied solar PV project, Saidabad, Sirajganj

Image Source: Shahriar Ahmed Chowdhury, 2021

2.2.2.3 Clean Cook Stoves

Indoor air pollution (IAP) from traditional wood-fired stoves causes more than 107,000 deaths in Bangladesh each year (World Bank, 2018). Under the National Action Plan for Clean Cook Stoves 2013, nearly 4.5 million improved cook stoves were distributed (Figure 7), and the government has formulated a new National Action Plan for Clean Cooking in Bangladesh, 2020-2030 (CAP, 2013; MOEFCC, 2021). This would reduce indoor air pollution radically with health benefits especially impacting women and children. Compared to traditional firewood and dung stoves, the improved cook stoves are more energy efficient and cheaper in terms of fuel costs.

Figure 7: Improved cook stove

Image Source: https://www.worldbank.org/en/results/2018/11/01/bangladesh-healthier-homes-through-improved-cookstoves

2.2.3 Summary and key findings

With regard to policy and regulation, the different building codes throughout the country, constant revisions, lack of differentiation between building types, and implementation of building codes and regulations remains a challenge (SREDA, 2020b). Whereas the concept of energy efficiency is generally understood in Bangladesh, key stakeholders in the industrial sector still lack the technical support, capacity building and experience to deal with it properly (USAID, 2018). The increased demand for power in the last decade due to the industrial and economic growth in the country, resulting in power outages, led to many using gas engines for power backup. This highlighted the need for efficient energy use and demand-focused solutions (ibid.). While some programmes are in place to improve energy efficiency in Bangladesh's building sector, a consolidated approach is needed for differentiation between residential and commercial buildings, and a clear rating system.

2.3 Water use efficiency and water recycling

2.3.1 Policy and regulation

The most important and recent water policy in Bangladesh is the 2013 Water Act. The Act, however, addresses water pollution and drinking water provisions only broadly, and in contradictions with other policies. Often it remains unclear which agencies have the overall responsibility for implementing water saving activities. Additional water-related policies include the Disaster Management Act 2012, Integrated Small-Scale Irrigation Policy 2011, National Policy for Safe Water Supply & Sanitation 1998, Environment Conservation Act 1995, and the Groundwater Management Ordinance 1985. None of these policies directly relate to water use efficiency or water recycling in the context of buildings.

2.3.2 Existing practices

A few practices for water-use efficiency and water recycling exist in Bangladesh. For example, under Bangladesh's Public Works Department (PWD), a manual was developed for the installation and operation of rainwater harvesting systems (PWD, 2016). Treatment of effluent water is also gaining recognition, especially in the textile industry. In 2014, the Centre for Science and Environment (CSE) and Water Aid Bangladesh (WAB) provided capacity-building training for academia, government officials and practitioners from Bangladesh to mainstream affordable and sustainable Decentralised Wastewater Treatment (DWWT) (CSE, 2014). The training strengthened technical understanding of designing DWWT systems, and in addition covered needs and recommendations for a future water policy for Bangladesh (ibid).

2.3.3 Summary and key findings

Generally, water-use efficiency and water recycling are relatively new concepts in Bangladesh. There is a massive opportunity for improvement in this regard, especially in the context of GBs.

2.4 Waste recycling and resource recovery

2.4.1 Policy and regulation

Waste management regulation in Bangladesh is by and large outdated. The current Waste Management Policy does not include any targets for waste-to-energy recovery, recycling or reuse. Additionally, waste minimisation is not incentivised (Shams et al., 2017). Other relevant policies that touch on the subject of waste management include the Environmental Policy, National 3R Strategy, National Clean Development Mechanism Strategy, E-Waste Management Rules 2020, Solid Waste Rules 2021 (draft under review) and the Medical Waste Management Rules 2008.

2.4.2 Existing practices

Currently, the majority of the country's organic waste is still dumped in the open or burned (UNCRD, 2020). Households do not commonly segregate waste, companies have not introduced voluntary environmental evaluations or reporting of waste, wastage of crops and agricultural produce from farms to consumers is high, and eco-industrial parks or zones have been designated. Eco-industrial parks or zones will be operated in line with environmental rules and regulations including national 3R strategy for waste management 2010 (ibid.). Further, awareness about the 3Rs and waste separation is low, waste collection and disposal are far behind current technologies and processes, waste management costs are increasing due to privatisation, and increasing amounts of land are used for landfills (ibid.). A positive trend emerging is the increase in use of biogas technology, with Guidelines for Bio Gas to Energy/Electricity already drafted in 2018.

2.4.3 Summary and key findings

With approximately 68-81% of Bangladesh's urban waste still containing organic matter, the resulting emissions equate to more than 250 million tonnes of carbon dioxide equivalent (CO_2e) annually (Shams et al., 2017). Especially in the context of GB, the country lacks sufficient waste management. Households do not commonly segregate domestic waste. Currently, the majority of the country's organic waste is still dumped in the open or burned (ibid.).

2.5 Use of sustainable and environmentally friendly construction and materials

2.5.1 Policy and regulation

Notably, the Brick Manufacturing and Brick Kiln Establishment (Control) Act 2019 seeks to minimise air pollution by banning brick production systems that are polluting or hazardous. The Bangladesh National Building Code (BNBC 2020) and Building Construction Regulations 2008 are the two most widely used standards in Bangladesh. Other existing codes in Bangladesh that need to be considered for GB design include the Building Construction Act, 1952; Revised Brick Manufacturing Act,2019; National Housing Policy, 2016 and National Environment Policy, 2018.

2.5.2 Existing practices

A return to vernacular architecture is a current trend in Bangladesh, focusing on the use of natural lighting and passive cooling. While these methods of construction are more sustainable, many new materials are also being developed. For example, some common alternative building materials in Bangladesh include compressed stabilised earth blocks, which use compacted soil as a material to build walls, alternative bricks (ABs), and more recently, the use of roof insulation and green roofs. However, capacity building and awareness raising are needed to increase the popularity of such materials.

2.5.2.1 Alternative Bricks and Building Materials

Instead of using agricultural topsoil, alternative bricks and blocks are made from dredged river sand, stone dust and a small percentage of cement. They do not need coal or wood to dry, therefore, they reduce air pollution and energy use from traditional brick kilns and also reduce overall construction cost. ABs and blocks are lightweight and easier to transport (Hosseini et al., 2014). Under the Promoting Sustainable Building in Bangladesh (SusBuild) project, alternative bricks and blocks were developed by the EU-funded SWITCH-Asia programme from 2016 to 2019. The total budget of the project was 2 million EUR. A wide range of stakeholders were involved throughout the project. Judicial experts and policymakers reviewed the existing policy gaps in the building code and in the brick manufacturing Act, and these were shared with stakeholders under the project's awareness raising activities (EC, 2020). Other sustainable materials used extensively in the construction of buildings in rural areas are treated bamboo and jute composite tin corrugated iron sheets (SWITCH-Asia SCPF, 2019).

Figure 8: Alternative bricks in use

Image Source: https://www.switch-asia.eu/project/bangladesh-susbuild/

2.5.2.2 Roof insulation and "green" roof

The roof of a building contributes to significant heat gain for the top floors if not treated appropriately. Roof gardens, which are gaining popularity in Dhaka, are an effective option for roof insulation and to enhance the quality of outdoor environment as a garden can lower the temperature of a rooftop by up to eight degrees Celsius. The floor immediately below the roof enjoys two degrees less than the usual room temperature. As a result, the flat remains cooler, naturally (Seraj, 2019). On a Bangla satellite TV channel (Channel i), hundreds of episodes outlining strategies for rooftop farming have been aired on the *Chhad Krishi* programme.

Figure 9: Green roofs in Bangladesh

Image Source: https://img.thedailystar.net/sites/default/files/styles/social_share/public/feature/images/green_city_rooftop_gardenning.jpg?itok=dJrPcNpm

2.5.3 Summary and key findings

Brick-making is one of the largest emitters of GHG in Bangladesh, contributing approximately 8.75 million tonnes of GHG annually. The processes consume approximately 2.2 million tonnes of coal and 1.9 million tonnes of firewood (SWITCH-Asia SCP Facility, 2019). The use of sustainable and environmentally friendly construction materials and the planting of green roofs therefore has great potential to reduce GHG emissions in the country. However, there is currently no GB code in practice or appropriate green building materials rating system. Capacity building activities and raising awareness would greatly increase the use of and create a market for sustainable building materials and technologies in Bangladesh.

2.6 Financing environment

2.6.1 Policies and regulations

2.6.1.1 Bangladesh Bank

The National Bangladesh Bank has instructed banks and financial institutions of the country for green banking and green credit through policy guidelines. Bangladesh Bank has mandated that all commercial banks must provide a discounted financing rate of 9% for the extra cost of green measures applied to light industry buildings. In 2016, the Bank set a fixed 5% mandatory credit quota for green finance in the total loan disbursement of banks and financial institutions (Bhattacharjee, 2021). To support environment-friendly technology, Bangladesh Bank has additionally established a refinance project focused on 50 products under 11 categories: renewable energy, energy efficiency, solid-waste management, liquid-waste management, alternative energy, fire burnt brick, non-fired block brick, recycling and recyclable products, and ensuring safety in the work environment of factories, to name a few. A participation agreement with Bangladesh Bank has been signed by 39 banks and 19 financial institutions to avail finance from this scheme (MOEFCC, 2021).

2.6.1.2 National Board of Revenue, Bangladesh

The National Board of Revenue (NBR) is the authority for tax administration in Bangladesh, which is responsible for the formulation and continuous re-appraisal of tax-policies and tax laws (NBR, 2021). To integrate the issue of environment in the tax policy, during the budget for the fiscal year 2017-18, the corporate tax rate was reduced from 20% to 14% for garment companies whose factories have internationally recognised green building certifications (Fibre2Fashion, 2017; Independent, 2017).

2.6.1.3 Bangladesh House Building Finance Corporation

Bangladesh House Building Finance Corporation (BHBFC) is an essential part of the housing delivery system (Haque, 2008). It is the only state-owned specialised financial institution of its kind, whose primary objective is to alleviate the acute housing problem in the country. For the last six decades it has been the major source of housing credit for middle and lower-middle-income groups (BHBFC, 2021).

2.6.1.4 Infrastructure Development Company Limited

Infrastructure Development Company Limited (IDCOL) plays a major role in developing and financing infrastructure, renewable energy and energy efficiency projects in Bangladesh. The company stands as the market leader in private sector energy and infrastructure financing in the country. IDCOL offers soft loans and grants for renewable energy projects (BCES, 2019). The government has extended a refinancing scheme through IDCOL to finance alternative energy generation projects, such as small-scale solar and microgrids, to improve energy access to those living in off-grid areas. IDCOL's target was to finance 6 million SHS by 2021, with an estimated generation capacity of 220 MW of electricity (MOEFCC, 2021).

2.6.1.5 Bangladesh Infrastructure Finance Fund Limited

Bangladesh Infrastructure Finance Fund Limited (BIFFL) is the largest non-banking financial institution in Bangladesh owned by the government. BIFFL aims to promote an attractive environment for sustainable private investment, addressing the importance of infrastructure development. BIFFL is also committed to protect the environment and adopt eco-friendly measures as its foremost priority while considering any investment transaction (BIFFL, 2017).

2.6.1.6 Mujib Climate Prosperity Plan up to 2030

Through international cooperation, the Mujib Climate Prosperity Plan in Bangladesh will be the first of 48-nation Climate Vulnerable Forum (CVF) plans, with a strategic investment framework to mobilise financing for implementing renewable energy and climate resilience initiatives, including training and skills development for the future (MOEFCC, 2021).

2.6.1.7 Bangladesh Climate Change Trust Fund

To implement strategic actions of the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 800 projects with an investment of 449.3 million USD have been taken under the Bangladesh Climate Change Trust Fund (BCCTF) from the national budget, which mainly focuses on adaptation, mitigation and climate change research (MOEFCC, 2021). To enhance adaptation capacity, 66% of the funds are aimed at a large number of small-scale projects across the country.

2.6.1.8 Green Climate Fund

The target of the Green Climate Fund (GCF) is to support mitigation and adaptation actions. In Bangladesh, the National Designated Authority (NDA) for GCF is the Economic Relations Division of the Ministry of Finance. Transformational investment opportunities in line with GCF's Investment Framework and Result Management Framework have already been identified. The total allocation for climate-resilient infrastructure mainstreaming in Bangladesh is 80 million USD: 40 million USD from the GCF; 25 million USD from the Bangladesh government; and 15 million USD in co-financing from the KfW of Germany (GCF, 2015; MoEFCC, 2018).

2.6.2 Existing practices

2.6.2.1 Nationally Appropriate Mitigation Actions

The Nationally Appropriate Mitigation Actions (NAMA) Facility was set up by the United Kingdom and German governments, and was supported by the Danish Government and the European Commission. In addition to financing from GCF, Least Developed Countries Fund (LDCF), Adaptation Fund under the Kyoto Protocol, and other bilateral and multilateral sources, NAMA offer an effective route to access international support for both mitigation and adaptation projects. To get available funding from international donors, NAMA need to be submitted to the UNFCCC's NAMA Registry. The type of support that is most suitable depends on the nature

of the barriers to carrying out the mitigation action (Würtenberger, 2012). The Bangladesh Government is currently working on five NAMA concepts: efficient lighting, solar renewable energy, waste heat recovery, waste management to lower GHG emission, and fertiliser (MoEFCC, 2018).

2.6.2.2 Joint Crediting Mechanism

To encourage Japanese and Bangladeshi private sector joint investment for developing low-carbon green projects in Bangladesh with incentives from the Japanese Government, a bilateral agreement for Joint Crediting Mechanism (JCM) was signed. As of December 2017, five JCM projects were implemented. Japanese bilateral funds are routed directly to government agencies via the coordination of the Economic Relations Division of the Ministry of Finance (MoEFCC, 2018).

2.6.2.3 Deutsche Gesellschaft für Internationale Zusammenarbeit

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, is currently working with the Power Division and other cooperation partners in implementing various technical cooperation projects. At the same time, they have a number of programmes for which financing is available to Bangladesh in the field of GB, for example, under the Renewable Energy and Energy Efficiency Programme (REEEP), which focuses on measures such as retained-heat cookers, waste-heat recovery for operating cold storage, solar water-pumping, efficient use of natural lighting, biogas technologies, energy efficient lighting, and waste to energy (GIZ, 2017). Other programmes include:

- Skills Development for Sustainable Energy 2022-2025, 5 million EUR
- Energising Development (EnDev) IV, 2021-2023, 2 million EUR
- REEEP II 2018-2022, 4 million EUR
- Energy Efficiency in Public Buildings 2019-2021
- Energy Efficiency and Grid Integration of Renewable Energy (EEGIRE) II, 2021-2024, 3 million EUR

As part of the continued support to the energy sector from the German Government, GIZ introduced the new Technical Cooperation (TC) project, Skill Development for Sustainable Energy Solutions (Skill4SE). The project has been approved in the 2020 bilateral TC Agreement between Government of the Federal Republic of Germany and Government of the People's Republic of Bangladesh. Under the preliminary scope of the project, existing political, technical and organisational framework conditions, and how to derive different options for the proposed TC measures in line with Bangladesh Government priorities have been assessed.

2.6.3 Summary and Key Findings

One of the major challenges in the implementation of green building design and construction is financing concerns that are often caused by high initial costs of the investment, long payback time and associated risks, discount rate lower than expectations of borrowers, conditions of lending, and lack of awareness on the part of the financier about the anticipation of customers.

The private sector and NGOs can contribute significantly to sustainable development activities through public-private partnerships. In Bangladesh, commercial banks offer concessional loans and refinancing, guided by the policy guidelines for green banking through the Central Bank (Bangladesh Bank, 2011). International funding for climate activities comes from a range of sources: Adaptation Fund under the Kyoto Protocol; Least Developed Countries Fund under the UNFCCC; Global Environment Facility's Trust Fund; and the Pilot Program for Climate Resilience via various mechanisms. GB-related investments can be effectively facilitated by ensuring access to low-cost and long-term finance. In the condition of lending, environmental criteria should be explicitly explained so that the impact of the investment activity on the environment is understood by both technical and non-technical stakeholders.

So far, the government, other policymakers and financial institutions have taken several initiatives in Bangladesh but they are lagging behind in implementing the policies (IFC, 2017). Full implementation of the strategic mitigation actions is conditional on the support of international stakeholders (MOEFCC, 2021).

3. Stakeholder mapping

The stakeholders in Table 1 have been identified as crucial for the development of a GBC in Bangladesh, and for their expert input regarding SCP implementation in the building sector. The ones in **bold** were consulted during this assignment and they suggested others to be added to the list. Many of them have already been involved in promoting SCP in the building sector or have worked on the topic to some extent.

Table 1: Matrix for mapping of stakeholders

Stakeholders	STATE	PRIVATE SECTOR	CIVIL SOCIETY
KEY	**Ministries and government agencies** • **Ministry of Environment, Forests & Climate Change (MoEFCC)** • Ministry of Housing and Public Works (MoHPW) • Ministry of Power, Energy & Mineral Resources (MoPEMR) • Ministry of Road Transport and Bridges • **Sustainable and Renewable Energy Development Authority (SREDA)** • Public Works Department (PWD) • **Department of Architecture (DOA)** • Department of Environment (DOE) • Power Division • Local Government Division • Economic Relations Divisions • Ministry of Industries • Road Transport and Highways Division • Capital Development Authority of the Government of Bangladesh (RJAUK) • Regional Authorities	**Professional Institutions** • **Institute of Architects Bangladesh (IAB)** • Institution of Engineers, Bangladesh (IEB) • **Bangladesh Institute of Planners (BIP)**	**Associations of sustainability** • Bangladesh Environmental Lawyers Association (BELA) • **RAiN Forum** (for sustainable water management) • **ASHRAE Bangladesh Chapter**
PRIMARY	**Financial institutions** • Bangladesh Bank • Bangladesh House Building Finance Corporation (HBFC) • Bangladesh Infrastructure Finance Fund Limited (BIFFL) • **Infrastructure Development Company Limited (IDCOL)**	**Private and development banks** • **World Bank** • **French Development Agency (AFD)** • **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)** • European Investment Bank (EIB) • Entrepreneurial Development Bank (FMO) • KfW Development Bank	**NGOs** • **Oxfam** • **Jagorani Chakra Foundation (JCF)** • Palli Karma Sahayak Foundation (PKSF)
SECONDARY	**State Universities and research institutions** • **Bangladesh University of Engineering and Technology (BUET)** • **University of Dhaka (DU)** • **Housing and Building Research Institute (HBRI)**	**Private Universities and Research institutes** • Ahsanullah University of Science and Technology (AUST) • **Center for Housing and Building Research (HBRC)**	**Developers** **Assure Group** (leading real estate company)

4. Gaps, constraints and opportunities for green building policy development and adoption

This section provides an overview of the gaps, constraints and opportunities for GB policy development and adoption in Bangladesh based on the current status and findings from key informant (KI) interviews. As a summary, a SWOT analysis is presented in Figure 10. The **strengths** for implementing GB in Bangladesh are that the guidelines and frameworks are already established, and technologies and methods for design and construction of GB/nZEB are available from traditional architecture, and could be used for selection of materials and development of concepts. The **weaknesses** are that knowledge is often not accessible to the stakeholders working in the existing building sector; there is a need for capacity building and training of experts, and sensitisation of the populace; there is a lack of coordination and collaboration among relevant organisations making it hard to take collaborative actions; financing frameworks are in early stages of development and not up to the expectation of the clients or owners; and there is currently no national strategy or action plan, leaving the construction sector directionless with regard to implementation of the GB/nZEB. **Threats** to GB include absence of research to develop a GB rating system based on the local context, therefore western approaches are currently governing the market; reluctance of the building sector to change causing it to lag behind other rapidly advancing sectors of the country; occurrence of natural calamities such as floods and tropical storms (whose frequency is increasing due to climate change) as a result of which buildings are often affected most, or are expected to be affected. Finally, the **opportunities** include increasing global awareness of GB/nZEB, while at the same time the cost for construction of GB/nZEB is decreasing; foreign investors are available and ready to invest, therefore, development opportunities are wide open; and there are many internationally successful good practices from which to learn and to exchange knowledge.

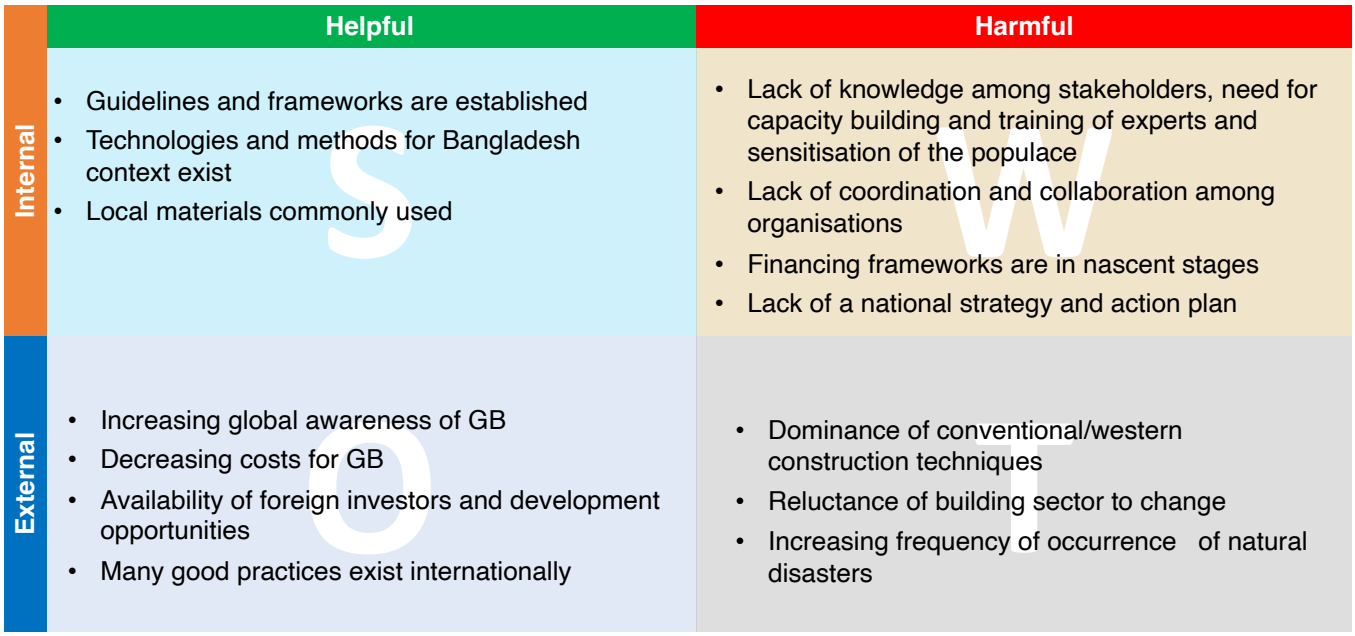


Figure 10: SWOT analysis of Green Buildings sector in Bangladesh

4.1 Gaps and constraints

4.1.1 Policy

The obvious policy gap is the provision of a complete and implemented GBC for Bangladesh. Furthermore, the existing policies for water, energy, buildings and waste are insufficient to produce results in the context of buildings as they all lack the provisions necessary to make progress in GB. There is also no existing GB rating system for Bangladesh that can be implemented and used for either commercial or residential buildings, in part due to the lack of research-based guidelines for the country's specific climate and geography. Gaps in data and monitoring further accentuate the circumstances for a GB policy to be put in place, or for further pilot projects to be developed as benchmarks and thresholds still need to be determined. Policy documents in Bangladesh need to be updated, be inclusive, and have stipulations for compliance.

The setting up of Technical Committees, Agencies and Bodies responsible for GB policy is still required to clarify authority and leadership. Coordination is lacking among Ministries, organisations, NGOs, civil society, professional associations and practitioners, which would contribute to the development of a successful GBC and Action Plan.

4.1.2 Financing

Financing remains a huge obstacle in the widespread uptake of GB. While many potential financial support instruments and plans for the implementation of GB exist in Bangladesh, their use is limited, and is reliant on donor entities, such as large banks or international funding agencies. Investments need to be facilitated to achieve the government's ambitious targets (IFC, 2017). Financial institutions focusing on GB would be beneficial in mitigating financing issues in the context of GB.

4.1.3 Application

Whereas several technologies exist that are fitting for GB in Bangladesh, many of them are not widely used. Awareness is low, and there remains a perception that GB methodologies cost much more than conventional ones. The application of GB measures is generally low and the market is not yet prepared for sustainable building material. The lack of data for GBs also adds to the issue of using the latest technologies, such as Building Information Modelling (BIM), Computer-Aided Design (CAD), 3D printing, etc.

4.2 Opportunities

Bangladesh Government and international development partners can facilitate the opportunities to increase practical understanding, working knowledge and implementation capacity through technical cooperation with other countries to share best practices and experiences. The IFC (2017) recommended launching and enforcing comprehensive green building codes, complemented by a policy on voluntary certifications for all new constructions. Academics and professionals should come forward to promote green building design. It is also important to raise awareness among developers about the long-term benefits of GB, for example that a 2% upfront investment in green building design can result in life cycle savings of 20% of the total construction costs (IFC, 2017). It is the sole responsibility of government authorities to collaborate with all relevant stakeholders in this regard (Climate CoLab, 2014).

The Government of Bangladesh is somewhat active in generating ambitious policies to respond to environmental issues, including on GB. At the same time, the private sector and NGOs consider environment and climate change adaptation as a potential sector to make profits and are ready to develop new business models and technologies, accessing new markets and taking advantage of cost savings from efficient technologies (MoEFCC, 2021).

The current government GB policies targeted at SDGs will ensure compliance with the Paris Agreement. The government target to reduce energy intensity per unit of GDP by 15% by 2021 and 20% by 2030 compared to 2013 is well underway. Building energy efficiency improvement is one of the interventions that can help to ensure achievement of this target. The government has already developed different policy documents starting from the 7th Five Year Plan and in the 8th Five Year Plan targeted to achieve SDGs, and can easily incorporate provisions for GB in future renditions. The Perspective Plan 2021-2041, Delta Plan, Power System

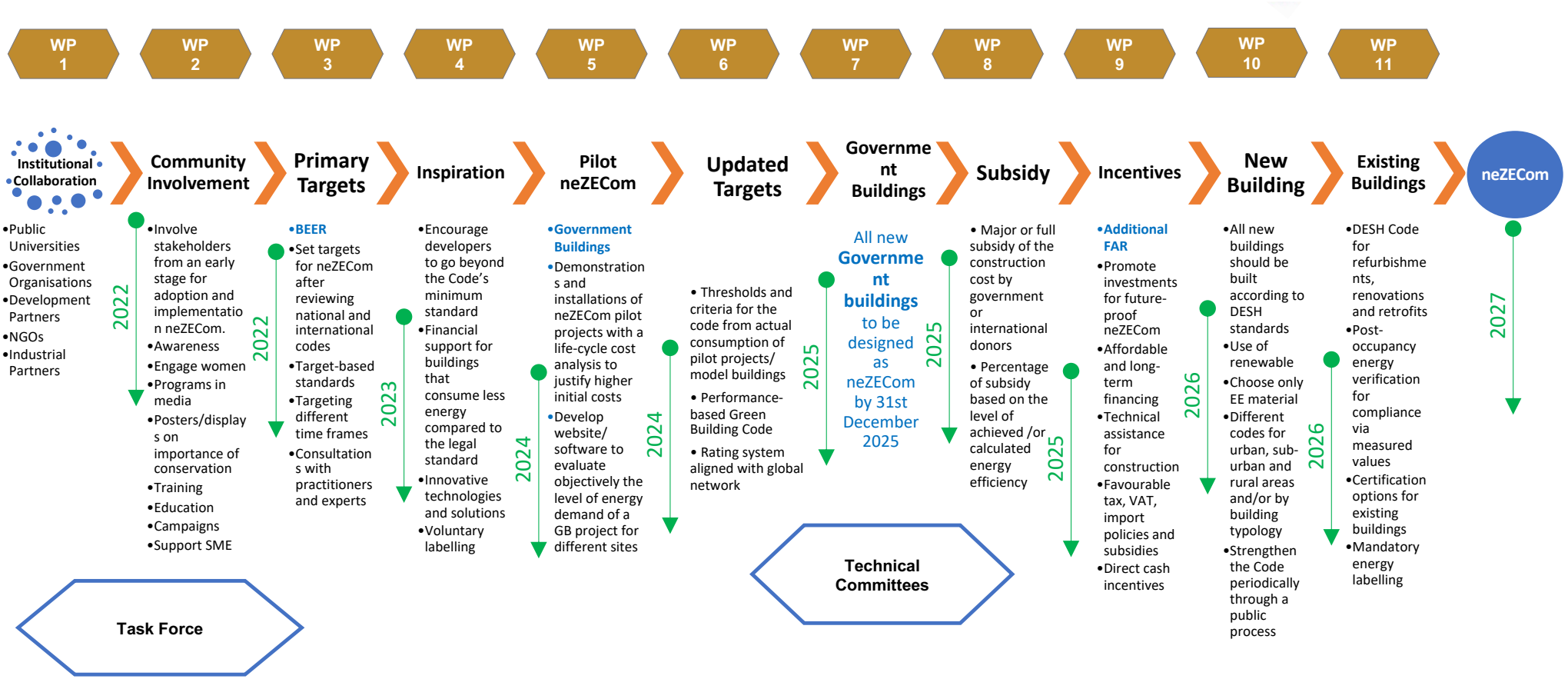
Master Plan 2016, Renewable Energy Policy 2008, Energy Efficiency and Conservation Master Plan up to 2030, Country Action Plan for Clean Cooking -- all have the potential to incorporate measures that relate to GB and the topics explored in this report. Updated Nationally Determined Contributions 2021 can also support GB implementation by promoting a GB policy under different SDGs, including ending poverty (SDG 1); access to affordable, clean energy (SDG 7); safe, resilient and sustainable human settlements (SDG 11); and sustainable consumption and production (SDG 12). Supplementary Roadmaps and Action Plans with necessary capacity development and financing support, along with a monitoring, reporting and verification (MRV) system can further ensure timely implementation of a GBC. Moreover, international communities and development partners create further opportunities by supporting the government in this regard.

Learning from international best practices can greatly support policymakers in Bangladesh in the context of GB and for the development of a GBC or related GB policies. Training, workshops, pilot projects and demonstration activities can all help builders and developers to learn more about GB, raise awareness among the general public and advance the topic in Bangladesh. Programmes with specific, measurable and visible outcomes can be developed to build the capacities of stakeholders across the country.

4.3 Lessons learnt and the way forward

Considering the analysis of the current status, gaps, constraints and opportunities for GB in Bangladesh, the first draft of a roadmap towards its widespread implementation is presented in Figure 11. This roadmap will gain actions along the course of this assignment.

Figure 11: Roadmap towards GB implementation in Bangladesh



References

Alam, J. and F. Hossain. 2013a. Bangladesh building collapse death toll tops 500: Engineer Whistleblower Arrested. *HuffPost*, 3 May 2013.

Alam, J. and F. Hossain. 2013b. Bangladesh collapse search over; death toll 1,127. *Yahoo News*, 13 May 2013.

BCES. 2019. Accelerating green buildings transition in Bangladesh. Bangladesh Clean Energy Summit, 2019.

BIFFL. 2017. *About BIFFL*. Bangladesh Infrastructure Finance Fund Limited. https://biffl.org.bd/

BHBFC. 2021. *Corporation introduction*. Bangladesh House Building Finance Corporation. http://www.bhbfc.gov.bd/site/page/41991621-ee4e-41bf-99f7-32edb585af58/-

bdnews24.com, 2010. Free CFL distribution on Saturday. 21 October 2010. https://bdnews24.com/bangladesh/2010/10/21/free-cfl-distribution-on-saturday

Bhattacharjee, A. 2021. Energy efficiency and green building pathways. *The New Age*, 23 February 2021. https://www.newagebd.net/article/130872/energy-efficiency-and-green-building-pathways

BBC. 2013. Bangladesh building collapse death toll passes 500. *BBC News*, 3 May 2013.

CSE. 2014. Training on decentralized waste water treatment at Dhaka, Bangladesh. Centre for Science and Environment. https://www.cseindia.org/training-on-decentralized-waste-water-treatment-at-dhaka-bangladesh--5563

CCC. 2021. Rana Plaza. Clean Clothes Campaign. https://cleanclothes.org/campaigns/past/rana-plaza

Climate CoLab. 2014. Promoting green buildings in Bangladesh. https://www.climatecolab.org/contests/2014/creating-public-demand-for-green-buildings/c/proposal/1309012

Daily Star. 2013. Solar home systems growing fastest in Bangladesh: WB. *The Daily Star*, 26 February 2013. https://www.thedailystar.net/news-detail-270559

GIZ. 2017. Renewable Energy and Energy Efficiency Programme (REEEP). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). https://www.giz.de/de/downloads/giz2017-en-reneable-energy-bangladesh.pdf

Dhaka Tribune. 2019. Two-thirds of Dhaka houses illegally built. 30 March 2019. https://archive.dhakatribune.com/opinion/special/2019/03/31/two-thirds-of-dhaka-houses-illegally-built

EDGE. 2021. *What is EDGE?* Excellence in Design for Greater Efficiencies, International finance Corporation. https://edgebuildings.com/about/about-edge/

EC. 2020. *Building greener - sustainable building in Bangladesh*. European Commission. https://ec.europa.eu/international-partnerships/stories/building-greener-sustainable-building-bangladesh_en

SWITCH-Asia SCPF. 2019. *Sustainable housing – Addressing SCP in the housing sector: Scoping study*. SWITCH-Asia Sustainable Consumption and Production Facility. https://www.switch-asia.eu/resource/addressing-scp-in-the-housing-sector/

Fibre2Fashion. 2017. Bangladesh lowers corporate tax to 15% in Budget FY18. https://www.fibre2fashion.com/news/apparel-clothing-policy-news/bangladesh-lowers-corporate-tax-to-15-in-budget-fy18-206133-newsdetails.htm?amp=true;;;&amp=true

Global Times. 2009. Bangladesh to distribute 26.5 mln free energy-saving bulbs. *Global Times*, 3 September 2009. https://www.globaltimes.cn/content/463774.shtml

GBIG. 2022. Bangladesh. Green Building Information Gateway. http://www.gbig.org/places/77

GCF. 2015. Readiness Proposal, with UNDP for the People's Republic of Bangladesh. October 2015. https://www.greenclimate.fund/sites/default/files/document/readiness-proposals-bangladesh-undp-country-programming.pdf

Haque, M. S. 2008. Bangladesh's experience with low-income housing finance. https://center4affordablehousing.org/wp-content/uploads/2019/05/Bangladesh-Bangladesh%E2%80%99s-Experience-with-Low-income-Housing-Finance.pdf

Hopkins, T. 2015. Reliving the Rana Plaza factory collapse: a history of cities in 50 buildings, day 22. *The Observer*, 23 April 2015.

Hosseini, E., G. Mursib, R. Nafida and B. Shahedi. 2014. Malay vernacular architecture: Mirror of the past, lessons for the future. https://www.researchgate.net/publication/263580553_Malay_Vernacular_Architecture_Mirror_Of_The_Past_Lessons_For_The_Future

Independent. 2017. Reduced tax rate for recognised green RMG factories. *The Independent*, 1 May 2017. https://www.theindependentbd.com/post/97347

IFC. 2017. *Climate investment opportunities in South Asia - An IFC analysis.* International Finance Corporation, World Bank Group. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/climate+business/resources/final+climate+investment+opportunities+in+south+asia+-+an+ifc+analysis

IFC. 2018. *Green buildings market intelligence: Bangladesh country profile*. International Finance Corporation. https://edgebuildings.com/wp-content/uploads/2022/04/Bangladesh-Green-Building-Market-Intelligence.pdf

MoEFCC. 2018. *Roadmap and Action Plan for implementing Bangladesh NDC: Transport, power and industry sectors*. Ministry of Environment, Forest and Climate Change. Government of Bangladesh. Dhaka.

MoEFCC. 2021. Nationally Determined Contributions (NDCs) 2021, Bangladesh. Updated on 26 August 2021. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bangladesh%20First/NDC_submission_20210826revised.pdf

NBR. 2021. *About National Board of Revenue (NBR).* National Board of Revenue, Bangladesh. https://nbr.gov.bd/about-us/about-us/eng

PWD. 2016. *Environment and PWD*. Public Works Department. Government of Bangladesh. http://old.pwd.gov.bd/about/environment

Sarkar, A. 2010. Bangladesh sets a world record – 5 million CFLs in a day, one bulb at a time! *World Bank Blogs*. https://blogs.worldbank.org/endpovertyinsouthasia/bangladesh-sets-world-record-%E2%80%93-5-million-cfls-day-one-bulb-time

Seraj, S. 2019. Let's make the cities green. *The Daily Star*, 4 April 2019. https://www.thedailystar.net/country/news/lets-make-the-cities-green-1724662

Shams, S., J.N. Sahu, S.M. Shamimur Rahman and A. Ahsan. 2017. Sustainable waste management policy in Bangladesh for reduction of greenhouse gases. *Sustainable Cities and Society*. Vol. 33, 18-26. https://doi.org/10.1016/j.scs.2017.05.008

SREDA. 2016. *Energy efficiency and conservation Master Plan up to 2030*. Sustainable and Renewable Energy Development Authority. Dhaka. https://elibrary.sreda.gov.bd/public/admin/files/books_202104281990004944.pdf

SREDA. 2020a. *DRAFT Building Energy Efficiency and Environment Rating (BEEER) for design and construction of buildings: Version-1, rev-4*. Sustainable and Renewable Energy Development Authority. Dhaka.

SREDA. 2020b. *Bangladesh experience in buildings energy efficiency - Building Energy Efficiency & Environment Rating (BEEER) System for Bangladesh*. Sustainable and Renewable Energy Development Authority. Dhaka. https://globalabc.org/sites/default/files/inline-files/Bangladesh%20Experience%20in%20Buildings.pdf

SREDA. 2021. *National database of renewable energy*. Sustainable and Renewable Energy Development Authority. Dhaka. http://www.renewableenergy.gov.bd/

SWITCH-Asia SCP Facility. 2019. *IMPACT SHEET: Promoting sustainable building in Bangladesh (SUSBUILD Bangladesh) – Resilience through construction*. https://www.switchasia.eu/site/assets/files/2660/susbuild_bangladesh_impact_sheet.pdf

UNCRD. 2020. *Country Report: Bangladesh*. Prepared by the Government of Bangladesh as an input for the 10th Regional 3R and Circular Economy Forum in Asia and the Pacific (Series of Webinars) of the United Nations Centre for Regional Development. https://sdgs.un.org/sites/default/files/2020-11/UNCRD_10th%203R%20Forum_Country%20Report_Bangladesh.pdf

USAID. 2018. *Promoting energy efficiency in Bangladesh*. United States Agency for International Development. https://www.usaid.gov/energy/efficiency/examples/bangladesh

World Bank. 2018. *Bangladesh: Healthier homes through improved cookstoves*. https://www.worldbank.org/en/results/2018/11/01/bangladesh-healthier-homes-through-improved-cookstoves

World Bank. 2017. Urban population (% of total population). https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

WBGC. 2021. *Members Directory*. World Green Building Council. https://www.worldgbc.org/member-directory

Würtenberger, L. 2012. *Financing supported NAMAs (Nationally appropriate mitigation actions)*. Discussion paper, ECN Policy Studies. http://resolver.tudelft.nl/uuid:c5b1fa4e-d963-425e-9a9d-fb1853b5eb66

Annex: Examples of National and International Organisational Structures for Collaborative Work

Organisational Context:
Environmental Sustainability in Textile Industries (ESTex), BUET, Bangladesh

Environmental Sustainability in Textile Industries (ESTex) aims to meet the demand and simultaneously maintain a sustainable sectoral growth in the textile sector in Bangladesh. ESTex intends to undertake comprehensive survey work on chemical sustainability and capacity building in chemical use and waste management. The team of ESTex is led by a Project Manager from BUET with six faculty members from the Department of Chemical Engineering, BUET; one professor from the Institute of Water and Flood Management, BUET; one faculty member from the Institute of Appropriate Technology (IAT), BUET; one faculty member from the Department of Dyes and Chemicals Engineering, Bangladesh University of Textiles; and 8 research and administration staff.[1]

National Context:
Building 4.0 CRC, Australia

Building 4.0 CRC is an industry-led research initiative co-funded by the Australian Government. The CRC aims to develop an internationally competitive, dynamic and thriving Australian advanced manufacturing sector, delivering better buildings at lower cost and with the human capacity to lead the future industry. The CRC has a collaborative structure to share new thinking and to integrate innovative practices in the market. It has three research partners (Monash University, University of Melbourne and Queensland University of Technology); one vocational education and training partner (Holmesglen Institute); three government partners (Victoria State Government; Jobs, Precincts and Regions; and Victorian Building Authority); four peak industry partners and associations (Master Builders Association Victoria, Green Building Council of Australia, PrefabAUS, and Standards Australia); and 17 commercial industry partners (Lendlease, BlueScope, Sumitomo Forestry, uTecture, Donovan Group, Bentley Homes, Salesforce, A.G.Coombs, Coresteel Buildings, Ultimate Windows, Hyne Timber, M-Modular, Fleetwood Australia, Amazon Web Services, Schiavello, Ynomia, and Taronga Group). The board of CRC is composed of a Chair, a CEO, a Director, three Independent Directors and a Professor from the University of Melbourne, Australia. The Executive Team is led by the CEO and includes 13 Members with different responsibilities.[2]

1 Environmental Sustainability in Textile Industries (ESTex) , https://www.estexbd.com/
2 Building 4.0 CRC, https://building4pointzero.org

National Context:
The Research Centre on Zero Emission Buildings (ZEB), Norway

https://slideplayer.com/slide/10276367/

The main objective of the Research Centre on Zero Emission Buildings (ZEB) is to develop competitive products and solutions for existing and new buildings that will lead to market penetration of buildings that have zero emissions of greenhouse gases related to their construction, operation and demolition. This national research centre will place Norway at the forefront of research, innovation and implementation within the field of energy efficient zero-emission buildings. The Research Centre is hosted by the Norwegian University of Science and Technology (NTNU) and is organised as a joint NTNU/SINTEF (one of the Europe's largest independent research organisations) unit. The Centre's leadership is thus shared by the two organisations. The Centre has an Executive Board and a General Assembly. The Executive Board is composed of the Centre's management and partner representatives, and the General Assembly includes all partners. There are nine members in the ZEB Executive Board from NTNU (2 members); SINTE Byggforsk, Skanska, SAPA Group, Statsbygg, Snøhetta, Caverion and Weber AS. There are eight members in ZEB's reference group from Lavenergiprogrammet, NBBL, NVE, Forbrukerrådet, NAL, Norsk VVS og Miljøteknisk Forening, Arkitektbedriftene and BNL.

Global Context:
Zero Energy Mass Custom Home (ZEMCH)

Zero Energy Mass Custom Home (ZEMCH) is planned to achieve lower-cost and higher-performance sustainable housing development through a proper organisational design decision-making process with a series of actions. ZEMCH Network was established after a number of international industry-academia collaborative study tours. The Network aims to enhance industry-academia research and development (R&D) collaborations on the delivery of zero energy mass custom homes in developed and developing countries. At present, the organising partners of ZEMCH Network are 13 educational institutes (The University of Melbourne, Australia; United Arab Emirates University, Abu Dhabi; Kongju National University, South Korea; University of Technology, Sydney; State University of Londrina, Brazil; University of Trento, Italy; University of Notre Dame, Indiana; Arkin University of Creative Arts and Design, Northern Cyprus; BMS School of Architecture, Bangalore; University of East London, UK; Vellore Institute of Technology, India; Thiagarajar College of Engineering, India); and four industrial partners (NRG Style, Canada; Gruppo Polo Le Ville Plus, Italy; ECOXIA, France; and CubiCon, Brazil). Anyone related to the construction business and research can join the network.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