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International Good Practices in Green Building and Housing: Lessons for Bangladesh

Acknowledgement

This study was prepared on behalf of the EU SWITCH-Asia Sustainable Consumption and Production Facility (SCP Facility) by green building expert Prof. Dr Md Ashikur Rahman Joarder with his team members, and by Jessica Weir and Anton Barckhausen from adelphi consult GmbH, under the supervision of Cosima Stahr, Key Expert of the SWITCH-Asia SCP Facility and Dr Zinaida Fadeeva, Team Leader, SWITCH-Asia SCP Facility.

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List of Abbreviations

ABs	Alternative Bricks
AFOLU	Agriculture, Forestry and other Land use
BBR18	Boverket's Building Regulations (Sweden)
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCTF	Bangladesh Climate Change Trust Fund
BEER	Building Energy and Environment Rating
BEEER	Building Energy Efficiency & Environment Rating
BHBFC	Bangladesh House Building Finance Corporation
BIFFL	Bangladesh Infrastructure Finance Fund Limited
BMI	Federal Ministry of the Interior, Building and Home Affairs (Germany)
BMS	Building Management System
BMU	Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (Germany)
BMWi	Federal Ministry for Economics and Energy (Germany)
BNBC	Bangladesh National Building Code [Revised]
BR10	Building Regulation 10 (Denmark)
CO2e	Carbon dioxide equivalent
CVF	Climate Vulnerable Forum
DESCO	Dhaka Electric Supply Company Limited
DGNB	German Sustainable Building Council
DIHK	German Association of Chambers of Commerce and Industry
DPDC	Dhaka Power Distribution Company
EC	European Commission
EDGE	Excellence in Design for Greater Efficiencies
EE	Energy Efficiency
EED	Energy Efficiency Directive (EU)
EEWärmeG	Renewable Energies Heating Act (Germany)
EnEG	Energy Savings Act (Germany)
EnEv	Energy Savings Ordinance (Germany)
EPBD	Energy Performance of Buildings Directive (EU)
EU	European Union
GB	Green Building
GBC	Green Building Code
GBPN	Green Buildings Performance Network
GCF	Green Climate Fund
GEG	Building Energy Act (Germany)
GHG	Greenhouse Gas

HVACR	Heating Ventilation Air Conditioning and Refrigeration
IDCOL	Infrastructure Development Company Limited
IEQ	Indoor environmental quality
IFC	International Finance Corporation
LEED	Leadership in Energy and Environmental Design
LED	Light Emitting Diode
MoEFCC	Ministry of Environment, Forests, and Climate Change (Bangladesh)
MoPEMR	Ministry of Power, Energy and Mineral Resources
NBR	National Board of Revenue
NDA	National Designated Authority
NDC	Nationally Determined Contribution.
NYECCC	New York Energy Conservation Construction Code (USA)
nZEB	Nearly Zero Emissions Building
nZEBC	Nearly Zero Emissions Building Code
PKSF	Palli Karma Sahayak Foundation
SCP	Sustainable Consumption and Production
SCPF	Sustainable Consumption and Production Facility
SECO	State Secretariat for Economic Affairs (Switzerland)
SEEF	SUSI Energy Efficient Fund
SMEs	Small and Medium Enterprises
SPEER	South-central Partnership for Energy Efficiency as a Resource (USA)
SREDA	Sustainable and Renewable Energy Development Authority (Bangladesh)
TECCC	Texas Energy Code Compliance Collaborative (USA)
USD	United States Dollars
USGBC	US Green Building Council
ZDH	Confederation of Skilled Crafts (Germany)

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 responsible consumption and production patterns. SCPF enables discussion of ideas and lessons learned, which consequently helps identify and develop joint actions.

Sustainable housing came out as the top priority for Asian countries from the study of the second phase of the SWITCH-Asia Sustainable Consumption and Production Facility's (SCPF) EU-funded project launched in 2018. As a follow-up, this study aims to assess the current status and demand of green buildings (GBs) in Bangladesh. It focuses on international and regional good practices for green buildings and housing that could be transferred to the Bangladeshi context. In addition, it aims to support the integration of SCP principles in an Action Plan for Green Buildings in the country. The international good practices were selected and analysed, in particular, based on their focus on the following areas:

- Finance. For example, house loan schemes for promoting GBs and fostering an ecosystem for their development;
- General guidelines on GB construction with an SCP approach;
- Strategies for converting existing buildings into GBs following an SCP approach; and
- Support for research on GB with an SCP approach.

Criteria were developed for the selection of good practices based on these topics, especially those that considered the entire life cycle of GBs -- from materials and production, design and engineering, construction, usage and end-of-use -- by integrating SCP into four key themes, namely, energy efficiency, water use efficiency and water recycling, waste recycling and resource recovery, and the use of sustainable and environmentally friendly construction and materials.

The report describes international and regional best practices to provide specific directions for Bangladesh. These examples show different aspects of the process of implementation of the code, including financial mechanisms, compliance methods, and strategies for stakeholder engagement. The methods and techniques presented have achieved outstanding results in their respective region or country; they are then assessed for their transferability to the Bangladesh context.

1.1 Background

Green building is an emerging market, particularly in Asia where there is a high demand for residential buildings. The maximum growth is expected in the Asia-Pacific region, where green buildings might contribute more than United States Dollars (USD) 20 trillion by 2030 to the economy. With a population of 169.81 million in 2020, Bangladesh is the eighth most populous country in the world (Ministry of Environment, Forests and Climate Change [MoEFCC], 2021). Among the population, 35.7% live in urban areas (World Bank, 2017). The available infrastructure of the country is currently unable to keep pace with the economic growth. In the last couple of years, to catch up with the rate of urbanisation, the cities underwent significant transformation. One of the outcomes is a boom in the real estate, construction and housing industry focused on residential buildings and apartments. At the same time, residential buildings consume 50% of the total energy of Dhaka (Dhaka Electric Supply Company Limited [DESCO], 2013). Analysis of household survey data by the World Bank suggests that 77% of the urban households in Dhaka consumed between 100 and 400 kWh of electricity

per month in 2010 (Ahmed et al., 2013). About 19% of the households in the richest quintile consumed more than 400 kWh per month and this accounts for almost 22% of total monthly electricity consumption (ibid.). Another study (Ahsan et al., 2014) found that in a typical summer month in Dhaka, apartment users' electricity consumption for cooling, lighting and appliances, on average, is about 42%, 41% and 17% respectively of the total electricity consumed. Research on the current status of GB in Bangladesh has further revealed that:

- Overarching strategies, regulations or policies for GB are non-existent, no regional rating system for buildings exists, and guidelines for regionally adequate GB measures are still under development;
- Energy policies and regulations need to be consolidated, key stakeholders in the energy sector need capacity building and technical support, and whereas some programmes are already in place, awareness raising of the general public with regard to efficient energy use needs to occur;
- Water use efficiency and water recycling are relatively new concepts in the country and need to be integrated into the building sector;
- Waste management remains a major issue in the country, creating more than 250 million tonnes of carbon dioxide equivalent (CO_2e) per year. Especially in the residential sector, sufficient waste management strategies are lacking and households do not normally segregate their waste; and
- While some programmes promote brick alternatives, sustainable and environmentally friendly construction materials are not commonly used, nor is there a materials rating system to identify better building materials.

A significant opportunity exists in Bangladesh to reduce the demand and use of energy and resources by applying the SCP approach. Learning from international best practices can support policymakers in achieving the integration of SCP in GB-related policies and in overcoming some of the identified challenges and constraints identified in the country, such as the lack of sufficient knowledge of GB provisions among stakeholders and the absence of financing instruments that support and facilitate GB.

2. Good practices in regulatory, financing and other instruments to support green building measures

Besides understanding the challenges and hurdles that can come up during the implementation of Green Building Codes (GBCs) and the possible mitigation measures to tackle them, it is important to look at case studies of methods and techniques that have achieved outstanding results in the field. These examples show different aspects of the process of implementation of the code, including financial mechanisms, compliance methods and strategies for stakeholder engagement.

2.1 Regulatory instruments and measures for code implementation

2.1.1 EU – Energy Performance of Buildings Directive

EU's Energy Performance of Buildings Directive (EPBD) outlines that from 31 December 2020 all new buildings should be built according to nearly Zero Energy Building (nZEB) standards. It promotes the decarbonisation of the building stock by 2050 in addition to creating stability for investment decisions and allowing consumers and developers to make better informed decisions for energy saving (EC, 2020).

Transferability to the Bangladeshi context

In Bangladesh, the term 'Green Building' is often misunderstood by common people and is symbolized as building with green roofs and facades. The term 'nearly Zero Energy Building' (nZEB) is more self-explanatory and thus easier to understand. In the future, setting targets for nZEB, instead of GB, can be helpful in communicating, disseminating and promoting the use of innovative technologies to achieve sustainable goals, in addition to promoting investments in future-proof buildings.

2.1.2 Denmark – Building Regulation 10

Since 2006, three performance levels have been outlined in the Danish building code: 1) the minimum requirements, 2) voluntary class 2015, and 3) voluntary class 2020. The classifications 2 and 3 directed developers to future requirements for the coming years. This approach helped the country to advance its long-term goals by providing realistic standards for different time frames as well as supporting policy packages allowing developers to go beyond the code's current minimum standards. The code was successful in engaging the construction industry in using innovative technologies and solutions (Danish Energy Agency, 2015).

Transferability to the Bangladeshi context

Different performance levels could be set for GB/nZEB standards in Bangladesh, including future enhancements of building standards in a building code or policy. This will provide planning security for developers and even encourage them to comply with future standards before they become mandatory.

2.1.3 Sweden – Boverket's Building Regulations

Post-occupancy energy verification focusing on the actual energy consumption of buildings was first established by a handful of countries. In Sweden, two methods of assessment can be used for compliance with the Boverket's Building Regulations (BBR18: 1) the control of calculated values during the development of the project, or 2) the control of the measured values during the second year of occupancy. The building sector in Sweden has undergone a major positive trend of reduced energy consumption since the introduction of compliance via measured values (Global Buildings Performance Network [GBPN], 2014).

Transferability to the Bangladeshi context

Calculated values by experts and by using computer simulations with the latest software might be expensive, time consuming and difficult to organise during the development phase of the project in Bangladesh. At the same time, using a post-occupancy control method for compliance would be easier under a GB/nZEB framework, ensuring that buildings meet the requirements not only in theory or on paper, but also in practice. The actual energy consumption of pilot projects could advise developers, and could also inform the thresholds and criteria for the code itself.

2.1.4 EU – Energy Efficiency Directive

Targeted at developers, the EU's Energy Efficiency Directive (EED) encourages member states to establish a long-term strategy for triggering investment in renovation of the existing building stock. As such, more strict efficiency standards should be met by buildings undergoing renovation, especially of the building envelope or electrical equipment such as boilers or lighting (EC, 2019).

Transferability to the Bangladeshi context

Setting long-term targets and higher efficiency standards for renovating the existing building stock could help to build a similar strategy for Bangladesh.

2.1.5 Texas, USA – Residential Building Energy Codes

At the state level, Texas leads the USA in energy consumption and also represents a high proportion of the new building market (Herbert, 2014). With a long tradition in oil trading, engaging Texan building industry stakeholders to comply with building code requirements was a major challenge. Thus, the Texas Energy Code Compliance Collaborative (TECCC) was created to provide support to local governments in training and educating stakeholders, as well as in implementing campaigns. Together with the South-central Partnership for Energy Efficiency as a Resource (SPEER) and local Energy Code Ambassadors, the building industry eventually agreed to the code and even supported its implementation (Cox, 2016).

Transferability to the Bangladeshi context

Involving stakeholders from an early stage to secure adoption and implementation of a GBC or nearly Zero Energy Building Code (nZEBC) is highly recommended for Bangladesh. The approach can easily be adapted by setting up agencies or technical committees similar to the TECCC and SPEER, or having them carried out by the Sustainable and Renewable Energy Development Authority (SREDA) or the MoEFCC.

2.1.6 New York, USA – New York Energy Conservation Construction Code

A large share (~85%) of the expected 2030 building stock in New York City already exists today in the heavily built up city. Their building code, therefore, must deal with renovations and retrofits. In response, the New York Energy Conservation Construction Code (NYECCC) addresses energy efficiency in the renovation of all large existing buildings, outlining that all refurbishments and retrofits must adhere to the code standards that would apply to new buildings.

Transferability to the Bangladeshi context

Dhaka is the tenth-largest and the fourth most densely populous city in the world with 10.3 million residents within the city limits, and a population of over 21 million in the Greater Dhaka Area (World Population Review, 2021). In 2015, the built-up area of Dhaka was 867.49 square kilometres (Statistia, 2020). In the last five decades, Dhaka has been going through an unprecedented pace of urban growth spatially in all directions. It has been witnessing the construction of buildings, roads, drainage systems, flyovers, rapid mass transport, electricity and water supply, and health and educational institutions—most of which are concentrated in the currently built up part of the city. As it will be difficult to demolish them, a better option would be to go for renovation (Ahmed, 2021). There is an essential difference between the physical growth of rural and urban areas. While much of Bangladesh's development foreseen for 2030 is yet to happen, most of it outside Dhaka, one of the main issues with the current Bangladesh National Building Code (BNBC, 2020) is that

many buildings neglect the rules, especially for energy efficiency (EE) and conservation (SREDA, 2016). Including standards for renovated and refurbished buildings in a new GBC/nZEBC would ensure that this gap is narrowed.

2.1.7 Nepal – National Building Code

To increase compliance rates for the new National Building Code in Nepal, programmes were used to raise awareness among stakeholders, including engineers, policy makers, media, international agencies, builders and developers, and the general public. Especially targeting the citizens helped to increase demand for use of the code, leading to its successful implementation (Guragain et al., 2018).

Transferability to the Bangladeshi context

Increasing awareness of the code through a bottom-up approach can be integrated into a similar strategy in Bangladesh. As one of the main obstacles to compliance with the BNBC 2020 was lack of awareness of the code, this method could greatly increase compliance rates for a potential GBC/nZEBC (Ahmed et al., 2019). Awareness-raising programmes would also help to overcome barriers and increase investment potential for GB/nZEB among building owners, investors, managers, developers, lenders and technology experts.

2.1.8 China – 12th Five Year Plan

China has been working towards well-developed building energy standards since the early 1990s. The main feature of its latest code for energy performance is the regional differentiation. It stipulates different requirements for regions that predominantly use heating and those that predominantly use energy for non-heating uses. The code further differentiates residential housing, creating targets per household rather than by square metre. These measures have led to compliance reaching a significant level.

Transferability to the Bangladeshi context

Differentiating between urban, suburban and rural areas for Bangladesh could be effective as these regions too have different energy needs. The GBC/nZEBC could additionally differentiate between commercial and residential buildings, high-rise and low-rise, or further, by building typology.

2.2 Rewards and advisory instruments

2.2.1 Germany – Building Energy Act

Germany's new Building Energy Act, Gebäudeenergiegesetz (GEG), came into force in late 2020, replacing the previous Energy Savings Act (EnEG), Energy Savings Ordinance (EnEv) and Renewable Energies Heating Act (EEWärmeG). It contains requirements for the energy quality of buildings, creates and promotes the use of energy certificates, stipulates heating and cooling requirements, and mandates the use of renewables in new buildings (Federal Ministry of the Interior, Building and Home Affairs [BMI], 2020). To support the GEG, the German bank KfW continues its promotional products for energy efficient construction and renovation. Newly built and renovated residential buildings, for example, can receive up to €150,000 credit for a so-called "Efficiency House" for renovation, construction or purchase, or up to €60,000 credit for individual EE measures. With the repayment subsidy, between 15% and 50% less of the loan is paid back, depending on the level of EE achieved (KfW, 2021).

Transferability to the Bangladeshi context

Bangladesh Bank has many initiatives to support environment-friendly technology and construction under different finance schemes. In the condition of lending, credit, repayment subsidy etc., compliance with GBC/nZEBC could be included to motivate relevant stakeholders. Commercial banks could similarly design incentives for projects that overachieve the minimal relevant legislative standards in Bangladesh. Different thresholds can be defined for energy efficiency in terms of the percentage of energy consumed by the project in comparison to a model building, constructed according to the legal building code. Buildings that consume less energy than the legal standard could apply for financial support, which could vary according to the energy savings.

2.2.2 Germany – Small and Medium Enterprise Initiative for Energy Transition and Climate Protection

Together, the German Association of Chambers of Commerce and Industry (DIHK), the German Confederation of Skilled Crafts (ZDH), the Federal Ministry for Economics and Energy (BMWi) and the Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMU), implement the Small and Medium Enterprise (SME) initiative for Energy Transition and Climate Protection (Mittelstandsinitiative Energiewende und Klimaschutz) to support the SME sector in energy transition. The advisory instrument supports SMEs to gain knowledge about energy saving measures through training and assistance with local contacts (Mittelstandsinitiative Energiewende und Klimaschutz, 2021).

Transferability to the Bangladeshi context

In Bangladesh, real estate finance and investment are often inhibited by the lack of information, awareness and technical knowledge on GB/nZEB. The Federation of Bangladesh Chambers of Commerce and Industries (FBCCI), Bangladesh Small and Cottage Industries Corporation (BSCIC), Department of Inspection for Factories and Establishments (DIFE), Bangladesh Garment Manufacturers and Exporters Association (BGMEA),; Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA); Ministry of Power, Energy and Mineral Resources (MoPEMR); and Ministry of Environment, Forest and Climate Change (MoEFCC) can together take the initiative to support the SME sector in energy transition through training and assistance with local contacts.

2.3 Concessional finance

2.3.1 EU – EuroPACE

Image source: https://europace.gnesolutions.com/

A European pilot project for Property Assessed Clean Energy (EuroPACE) financing funds that allow investors to lend money for extensive retrofits. The financing model for EE projects develops and standardises on-tax financing for energy retrofits in European cities in order to support the EU's clean energy transition, designed to make home renovation affordable and simple, combining affordable, long-term financing with technical assistance. The instrument works by adding a special charge to a property tax bill over a term of up to 20 years. Risk-sharing facilities additionally help provide access to credit to all to ensure an equitable energy transition (EuroPACE Programme, 2020).

Transferability to the Bangladeshi context

A property-assessed clean energy financing programme can be structured to influence private investment with almost zero impact on the city budget. In Bangladesh, the Infrastructure Development Company Limited (IDCOL) and Bangladesh Infrastructure Finance Fund Limited (BIFFL) could lend money for extensive property retrofits. The National Board of Revenue (NBR) could collect the instalment of repayment by adding an extra charge to the property/income tax bill over the long term and directly return it to IDCOL/BIFFL. Support to such high-efficiency voluntary measures would contribute to reducing the total energy consumed by buildings in the country, and foster the development of a culture of energy efficient building by including small private developers in the financial scheme. In addition, favourable tax policies can be developed to incentivise the construction of new GB/nZEB. In the context of Bangladesh, direct cash incentives to customers who invest in renewable energy applications will work better and faster than soft loans (lower interest rates, better terms, lower transaction costs. etc.)

2.3.2 EU – SUSI Energy Efficient Fund

Image source: https://www.southpole.com/uploads/media/susi-pr-aetflaunch-en-rop-nka-20170710-clean.pdf

The SUSI Energy Efficient Fund (SEEF) was the EU's largest fund dedicated to EE, designed for institutional investors and financiers of building retrofits, manufacturing facilities and public infrastructure. It aimed at reaching the EU energy and climate targets. and had a total investment volume of €3000 million, covering technologies such as light emitting diode (LED) lighting, heat recovery, ventilation, and building management systems (BMS) that ensure quantifiable EE savings.

Transferability to the Bangladeshi context

The SEEF programme can provide interesting insights for the design of incentives for projects that are willing to invest more in energy efficiency measures and reach superior performance. Buildings that consume less energy in comparison to the legal standard could apply for financial support, which may vary according to the amount of energy savings.

2.4 Voluntary certification schemes

2.4.1 Global – International Finance Corporation's Excellence in Design for Greater Efficiencies

Image source: https://olc.worldbank.org/content/edge-green-building-certification-system

The Excellence in Design for Greater Efficiencies (EDGE) building certification programme for resource efficient and zero-carbon buildings focuses on the business case for GB. The International Finance Corporation (IFC, a member of the World Bank Group) developed the system in 2014 to bring speed, market intelligence and a focus on investment to GB certification, responding to the need for measurable and credible solutions. Using a sophisticated set of climate and cost data, the cloud-based platform is able to calculate both the costs and savings of greening specific aspects of a building. EDGE originally received funding from Switzerland's State Secretariat for Economic Affairs (SECO) and is currently funded by the UK Government (EDGE, 2021).

Transferability to the Bangladeshi context

Focusing on the business case for GB/nZEB also has the potential to be effective in Bangladesh. Pairing climate and cost data together on one platform can help to avoid going for measures that are not particularly cost effective for a particular project.

2.4.2 Global/USA – Leadership in Energy and Environmental Design

The Leadership in Energy and Environmental Design (LEED) system is well-established worldwide, giving green building projects the opportunity to score points in a number of categories, from energy and atmosphere to materials and resources. Depending on the number of points earned, a completed building is awarded a level of LEED certification. After the application fee is paid, a project team is assembled and all sustainability features are documented via provided forms. Once the documentation is complete, another fee is paid that is representative of the level of sustainability achieved, only then is the certification verified and awarded. LEED can now be used to verify sustainability at multiple scales and for many different project types, including from individual housing units to entire cities and municipalities (USGBC,2021).

Figure 1: Logos of different levels of LEED certification

Transferability to the Bangladeshi context

The United States Green Building Council (USBGC) that implements LEED is a member of the Global Green Building Council, a network of organisations accelerating GBs worldwide. While the widespread applicability of the LEED system in Bangladesh is questionable, it would greatly benefit the country to have a rating system within this global network.

2.4.3 Germany – German Sustainable Building Council

DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

Image source: https://searchlogovector.com/dgnb-german-sustainable-building-council-logo-vector-svg/

The German Sustainable Building Council (DGNB) founded in 2007, committed itself to sustainable development of the building sector and districts in Germany. It is also recognised by the Global Green Building Council. Unlike other rating systems, the DGNB has specifically designed a rating system and set of criteria for buildings already in use. This system helps to identify possibilities for optimisation of existing buildings, regardless of their type or use (DGNB, 2021).

Transferability to the Bangladeshi context

Providing certification options for existing buildings could definitely be applied in Bangladesh, especially considering that the current building stock does not yet meet the code standards. Having an option for existing buildings would be likely to increase acceptance and uptake of a GBC.

2.5 Energy labelling programmes

2.5.1 USA – ENERGY STAR and Energy Guide

Energy Guide labelling programme (1980) and ENERGY STAR endorsement labelling programme (1992) in the United States are considered among the best practice examples for the implementation of energy labelling programmes for household appliances. The mandatory Energy Guide labelling programme provides consumers with information about the energy consumption, efficiency and operating costs of different appliances, including boilers, central air conditioners, clothes washers, dishwashers, freezers, furnaces, heat pumps, pool heaters, refrigerators, televisions, water heaters and window air conditioners. The voluntary ENERGY STAR programme aims at promoting products that are more efficient than the legal minimum standards, and providing customers with credible and unbiased information on the energy performance of different appliances. The label covers, at present, different categories of products, such as appliances,

building products, commercial foodservice equipment, heating and cooling equipment, lighting, office equipment and water heaters. Since its introduction in 1992, the ENERGY STAR labelling has enabled the saving of four trillion kilowatt-hours of electricity in the US and achieved over 40 million metric tons of GHG reductions (Energy Star, 2018).

Figure 2: Energy Guide label and Energy Star logo

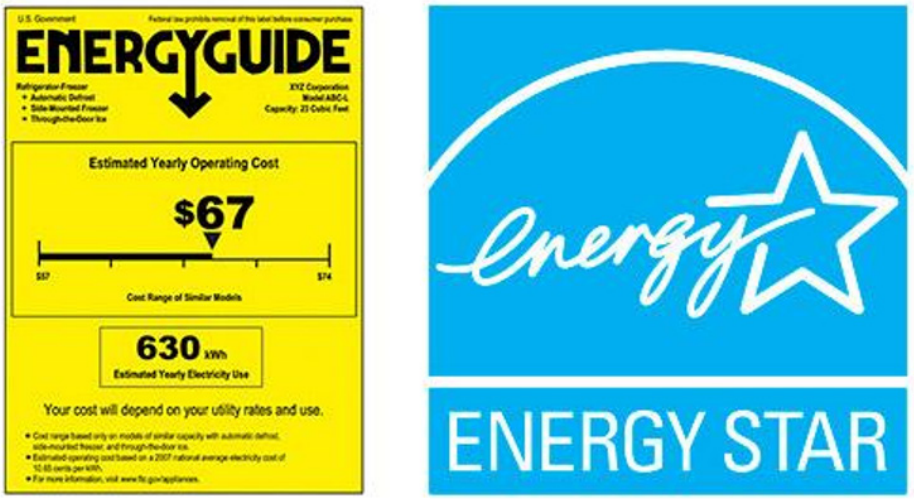


Image source: https://www.energystar.gov/products/ask-the-experts/whats-the-difference-between-the-energy-guide-and-energy-star

Transferability to the Bangladeshi context

Bangladesh does not have any comprehensive labelling programme. As one of the longest existing and most successful international experiences, the US Energy Guide and Energy Star programmes can provide valuable lessons for the development of energy labelling in Bangladesh. To implement energy labelling needs a strong legal basis in the national law and the responsibilities of implementing agencies for enforcement need to be clearly defined. In addition to the mandatory minimum standards established by law that are time bound and difficult to change, a flexible and quick revision process needs to be independently designed for voluntary labelling to adapt to market changes to welcome more efficient products. Rigorous certification, evaluation and monitoring processes need to continue for products for improvement based on stakeholders' feedback.

2.5.2 EU – Energy Label

Figure 3: An EU energy label for a refrigerator without a freezer

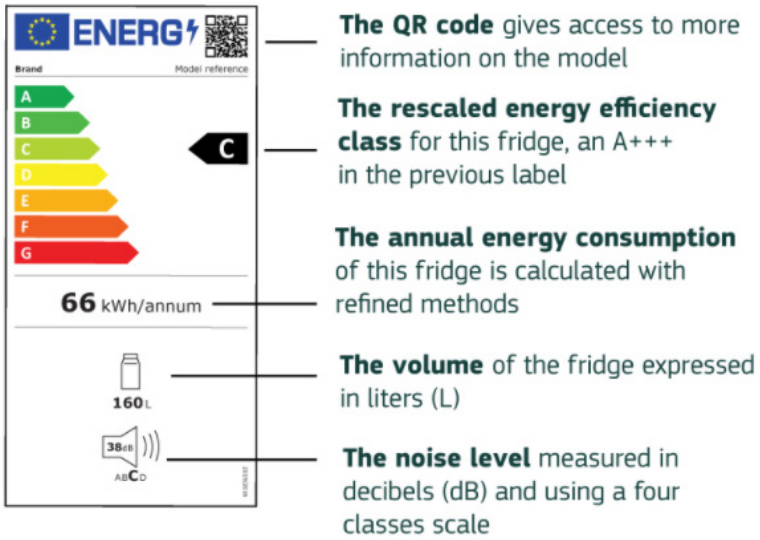


Image Source: https://ec.europa.eu/info/sites/default/files/energy_climate_change_environment/overall_targets/images/how_to_recognise_energy_labels_focus_article.jpg

Since 1994, a comparative scale from A (most efficient) to G (least efficient) has been used to help consumers identify appliances which use energy efficient technology. First introduced for household appliances, the label now covers refrigerators and freezers, dishwashers, washing machines, televisions and lamps, with other product groups to be introduced in the coming years. Guidance is provided for manufacturers to learn how to create their own labels for energy efficient products using an energy label generator, and citizens are informed about the energy labels through a variety of awareness raising programmes and campaigns. In 2019, the Eurobarometer[1] found that as many as 93% of consumers recognised the label, and almost 80% took it into consideration when buying a new appliance (EC, 2021b).

Transferability to the Bangladeshi context

Raising the awareness of citizens towards an energy label can help to increase demand for energy efficient products in Bangladesh. Following the EC model of clear, identifiable and easy-to-read labels, Bangladesh could similarly design labels that help consumers understand which appliances are more energy efficient, and thereby to use efficient technologies.

2.6 Model GB/nZEB projects

2.6.1 Sweden – The Hammarby Sjöstad Project

Hammarby Sjöstad is one of Stockholm's biggest urban development projects, acknowledged worldwide as a model of sustainability in its redevelopment of a declining industrial district into a mixed-use area comprising housing, commercial areas and recreational spaces. From the beginning, ambitious goals for sustainability were integrated into the design of the project. One of the main goals of the development was to keep the environmental impacts of the district 50% lower than they would be with the technology level applied in the 1990s. Besides, the development was designed to employ 100% of energy from renewable sources, whereas 80% of it should be produced from the waste collected in the area (Modarres-Sadegui & Konstari, 2015). The strategic master plan was divided into 12 sub-neighbourhoods to be developed in phases along with the construction works (Foletta, 2011). The strong and interdisciplinary environmental goals that shaped the plan contributed to its conception as a "closed-loop" urban metabolism.

Figure 4: Buildings in the Hammarby Sjöstad urban development project

Image source: https://upload.wikimedia.org/wikipedia/commons/8/87/Hammarby_sj%C3%B6stad_2013_06.JPG

1 Eurobarometer is a series of public opinion surveys conducted regularly on behalf of the European Commission and other EU Institutions since 1973 (Wikipedia).

Known as the Hammarby Model, the methodology applied allowed for creating a unique eco-cycle for the district that describes environmental solutions for energy, waste, water and sewage in an integrated manner (Modarres-Sadegui & Konstari, 2015). Energy is produced from sources such as biogas products and purified waste heat. The district heating system is also based on the reutilisation of waste, which is collected through a large-scale vacuum transport system that comprises 12,000 apartments in the district, as well as other facilities. Stormwater, rainwater and snowmelt are treated locally and reutilised in multiple ways in the district (Foletta, 2011).

Figure 5: The Hammarby model

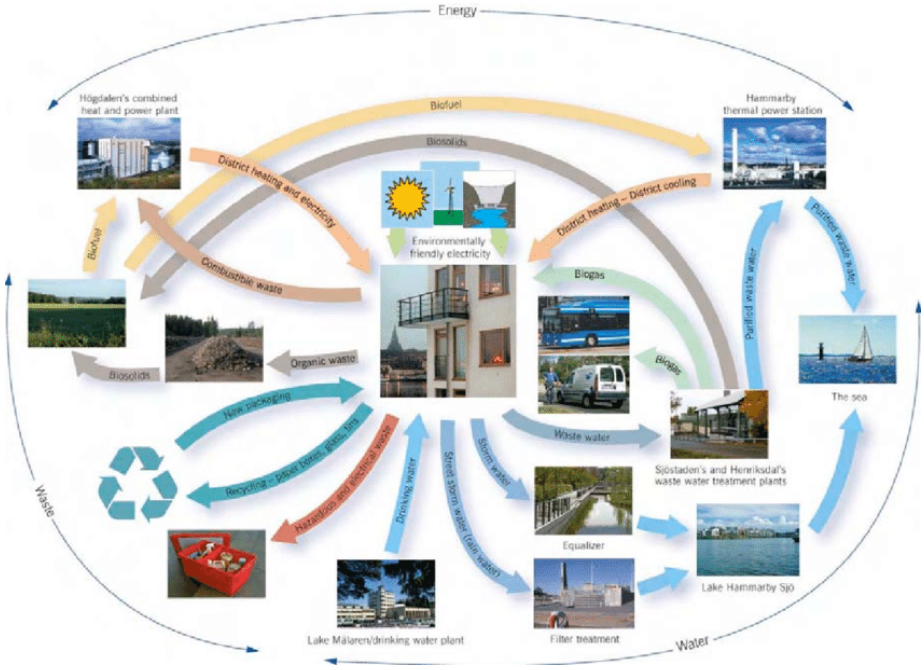


Image source: https://theworldenergyfoundation.org/in-search-of-the-sustainable-city-the-hammarby-model/

Transferability to the Bangladeshi context

In the context of Bangladesh, the Hammarby Model can be applied from a single multi-storeyed apartment building to a community, a district or a region, to integrate sustainable practices in managing water, energy and waste with a life-cycle cost analysis to justify higher initial costs. The involvement of architects, engineers, owners, contractors and other stakeholders in this interdisciplinary work can contribute to the improvement of the model for Bangladesh and adaptation of innovative technologies.

2.6.2 California, USA – Star Apartments Social Housing in Los Angeles

California has, by far, more homeless people than any other state in the United States, many of whom live on the streets of Skid Row (Cristi, 2019). The Skid Row Housing Trust was created in 1989, and during the 1990s the Trust developed a new model of supportive housing, focused not only on housing provision but on creating architectural structures that would offer safety, support, permanence, independence and a sense of community to formerly homeless individuals (Kilston 2014). To do so, it partnered with small, creative architectural firms to develop a building model combining single rooms, communal facilities and services such as mental health treatment and substance abuse recovery (Mclaughlin 2013). The project of the Star Apartments in Downtown Los Angeles was developed by the architecture firm Michael Maltzan to tackle the challenges related to homelessness in the neighbourhood of Skid Row, with an emphasis on sustainable and affordable housing. The project was completed in 2014, transforming an existing one-storey commercial building into a mixed-use complex with 102 residential units organised around a large area dedicated to communal use (Michael Maltzan Architecture, 2019). The Star Apartments was certified under LEED for Homes Platinum and awarded many prizes since its construction for not only providing conditions to mitigate the effects of homeless, but also employing innovative design approaches and construction methods that guarantee the sustainability of the project.

Figure 6: Star Apartments in Los Angeles

Image source: https://www.architecturalrecord.com/articles/7997-star-apartments-los-angeles

Transferability to the Bangladeshi context

In the context of Bangladesh, some model apartment buildings could be constructed across the country in prime locations to advocate and demonstrate the benefits of GB/nZEB. The design could be developed under a participatory process engaging the residents who are targeted to live in the buildings so that users can find their own solutions.

2.7 An innovative European holistic approach

The European Green Deal[2] has set the way for GB objectives, including for renovation and decarbonisation, as well as for energy performance of buildings.

The *New European Bauhaus* platform has been introduced in 2021 to shape a sustainable and inclusive form of community living, collaboration and networking, fostering innovative solutions, and most importantly, connecting the European Green Deal to living spaces. The NEB initiative is presented by the European Commission (EC) and focuses on providing a space to convene and think about the design of buildings in a creative, forward-looking and interdisciplinary way, including topics on art, culture, social inclusion, science and technology. Bringing the Green Deal into living spaces, the principles of the initiative incorporate inclusive, accessible spaces, sustainable solutions, creating dialogue between the ecosystem and the built environment, using regenerative approaches, and improving the quality of life through experience (EC, 2021a).

The platform will facilitate networking among the general public, experts, businesses and academic institutions to facilitate affordability and accessibility of living spaces. It will also help to mobilise leading creative people and organisations in the field of engineering, architecture, design and science to reimagine sustainable living. Calling attention to circularity of materials while maintaining comfort and attractiveness, and providing financial support for innovative ideas and products are central to the programme. From September 2021 onward, the platform has started implementing pilot projects, highlighting lessons learned and knowledge sharing. Beyond the delivery of the initiative, to accompany the *New European Bauhaus* the EC plans to promote further initiatives and policy instruments through the digital platform. Overall, it will support the goal of creating a market for beautiful, sustainable and inclusive living spaces (EC, 2021a).

2 The European Green Deal, approved in 2020, is a set of policy initiatives by the European Commission with the overarching aim of making the EU climate neutral in 2050 (Wikipedia).

3. Conclusions

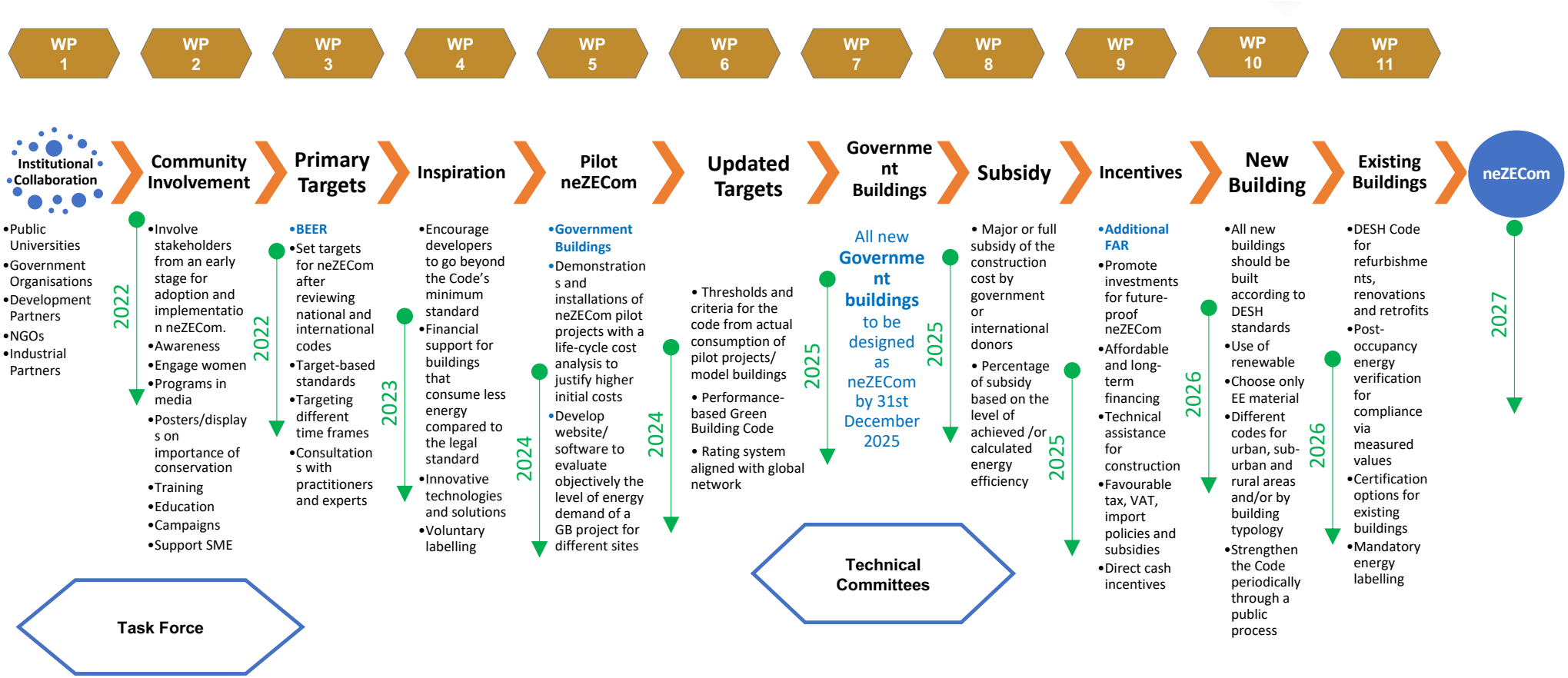
The study of international good practices can contribute greatly to guide the development of a roadmap and action plan for the implementation of GB/nZEB in the context of Bangladesh. SCP can be integrated into the four key themes: energy efficiency; water use efficiency and water recycling; waste recycling and resource recovery; and use of sustainable and environmentally friendly construction and materials. A building's life cycle can be evaluated through these SCP approaches in the context of Bangladesh, as for other countries.

In the developed world, in particular the EU, notable success in the implementation of GB has been achieved in many countries. With several years' practice of the establishment of GB, these countries' knowledge, experience, technology and methodology with practical outcome can be transferred to the local context of Bangladesh. For speeding up the implementation of the GB, both bottom-up (voluntary measures) and top-down (mandatory measures) approaches need to be considered while developing a GB Action Plan for the housing and buildings sector of Bangladesh. In response to the information collected in this report, the proposed Action Plan for the Government of Bangladesh towards a GBC has been updated (see Figure 7).

Lessons learned include, but are not limited to:

- GB should be defined at the national level while at the same time leaving flexibility for regional needs. This is necessary for the implementation of GBCs;
- Post-occupancy controls can make compliance easier under a GBC framework to ensure buildings meet requirements not only in theory but also in practice. This should be tested in pilot projects so that thresholds and criteria can be set effectively;
- Long-term targets and higher efficiency standards should be laid out for the existing building stock;
- Stakeholders should be involved from an early stage;
- Standards for renovated and refurbished buildings should be included;
- A bottom-up approach will be helpful in increasing awareness of a GBC for Bangladesh. Awareness raising programmes can help to overcome barriers in implementation;
- Differentiating between building types and geographies can be useful in setting up codes for different energy needs;
- Different thresholds in energy efficiency can dictate the level of subsidies provided to owners and developers;
- A variety of financing programmes or incentive mechanisms can be used to support both mandatory and voluntary GB measures;
- Focusing on the business case can lead to higher compliance and accelerate implementation of GB policies;
- Certification options for existing buildings can be defined to consider the current building stock. Energy labelling should be both comprehensive and flexible to adapt to changing markets; and
- A holistic and harmonised approach can help to create a market for inclusive, sustainable, living spaces.

Figure 7: Proposed Action Plan for implementation of SCP in GB policy in Bangladesh



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