Bangladesh's NDC-3.0:

Pathways for Ambition, Action, and Finance

September 2025

Change Initiative Research Team

About Change Initiative

About Change Initiative

Change Initiative (CI) is an emerging organisation dedicated to research and evidence generation as well as pushing for innovative governance and integrity to find creative solutions and be a pioneer of change. CI was founded with the primary goal of accelerating the establishment of a society based on equity, justice, and wellbeing. The name 'Change Initiative' (CI) represents the goal of embarking on the journey of devising an alternative research paradigm beyond the orthodox modalities.

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Abbreviations

NDC -	Nationally Determined Contribution
BAU -	Business-As-Usual
$MtCO_2$ -	Million Tons of Carbon Dioxide
RE -	Renewable Energy
EF -	Emission Factor
IPPU -	Industrial Processes and Product Use
AFOLU -	Agriculture, Forestry, and Other Land Use
MWh -	Megawatt Hour
GWh-	Gigawatt Hour
TWh -	Terawatt Hour
CO_2e -	Carbon Dioxide Equivalent
SREDA -	Sustainable and Renewable Energy Development Authority
BPDB -	Bangladesh Power Development Board
DoE -	Department of Environment
MCPP -	Mujib Climate Prosperity Plan
GREF -	Global Renewable Energy Fund
GDP -	Gross Domestic Product
IPCC -	Intergovernmental Panel on Climate Change
SDGs -	Sustainable Development Goals
GHG -	Greenhouse Gas
MRV -	Monitoring, Reporting, and Verification
WACC -	Weighted Average Cost of Capital
UNFCCC -	United Nations Framework Convention on Climate Change
REMC -	Renewable Energy Monitoring Committee
MOU -	Memorandum of Understanding

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Chapter 1: Introduction

Bangladesh is frequently cited as one of the world's most climate-vulnerable countries. (Shaw, 2022) Its geographical position on a low-lying delta, combined with a high population density and reliance on agriculture, makes it extremely susceptible to climate hazards. The country faces regular and severe floods, cyclones, droughts, heatwaves, and storm surges. For example, over the past two decades Bangladesh has consistently ranked among the top ten nations affected by extreme weather; it was the seventh most impacted country in the Global Climate Risk Index for the period 1999–2018 (Mahmood, 2022). These environmental pressures pose grave risks to lives and livelihoods, especially for poor and rural communities.

The impacts of climate change in Bangladesh are already significant and are projected to worsen. Sea levels are rising along Bangladesh's coast, with studies estimating that by 2050 up to 0.9–2.1 million Bangladeshis in low-lying areas could be displaced by direct inundation (Shaw, 2022). Tropical cyclones, which strike the country regularly, impose an average annual economic cost of about $1 billion in losses. By 2050, climate variability and extreme events could cause a one-third reduction in the country's agricultural GDP – a devastating prospect given that agriculture employs roughly half the population. Increased flooding and erosion threaten food security and infrastructure; in a severe flooding scenario, Bangladesh's GDP could shrink by as much as 9% each year. Climate change may also drive large-scale human impacts: an estimated 13.3 million people in Bangladesh could become internal climate migrants within the next 30 years due to worsening floods, river erosion, drought, and sea-level rise (The World Bank, 2022). These figures underscore Bangladesh's extreme vulnerability and the urgency of building resilience.

Despite its vulnerabilities, Bangladesh has made notable strides in climate adaptation and disaster preparedness. Over the last few decades, the country has vastly improved early warning systems and community preparedness, managing to reduce cyclone-related fatalities by a factor of 100 since the 1970s (The World Bank, 2022). Bangladesh was among the first developing nations to formulate a comprehensive Climate Change Strategy and Action Plan (in 2009), and it has become a global leader in locally led adaptation initiatives. However, as climate risks intensify, even these commendable efforts are being outpaced. Without strong and sustained action, climate change could undermine Bangladesh's hard-won development gains, with the poorest and most vulnerable populations hit the hardest. This precarious outlook makes it clear why robust mitigation and adaptation measures are imperative for Bangladesh's future.

1.1 The Paris Agreement and the Role of NDCs

Globally, the Paris Agreement (2015) established a framework to limit global warming to below 1.5°C, requiring all countries to submit Nationally Determined Contributions (NDCs) (UNFCCC, 2015). These pledges include unconditional targets (achievable with domestic resources) and conditional targets (subject to external support), reflecting common but differentiated responsibilities. Central to this framework are NDCs, which reflect each country's plan to reduce GHG emissions and adapt to climate impacts. NDCs combine targets, policies, and sectoral measures, and often identify financing, technology, and capacity-building needs. They are updated every five years to ensure clarity, transparency, and progressively higher ambition. This cycle of increasing ambition is critical to meeting the Paris Agreement's collective goals. Bangladesh submitted its first NDC in 2015, targeting 5% emission cuts below business-as-usual (BAU) by 2030 unconditionally, and 15% with international support, focused mainly on energy-related emissions in power, industry, and transport. Although accounting for just 0.4% of global emissions, this was a significant step for a climate-vulnerable developing nation.
In 2021, Bangladesh submitted an updated and more ambitious NDC, broadening its scope to following sectors: Energy, IPPU, AFOLU, and Waste. Using 2012 as the base year, the new targets pledged a 6.73% unconditional cut by 2030 and up to 21.8% with international support, potentially avoiding 89 metric tons of carbon dioxide equivalent ($MtCO_2e$). Most reductions are expected from the energy sector, but actions also include afforestation, industrial efficiency, improved transport, and waste man-

agement. To operationalize these commitments, the government has prepared an NDC Implementation Roadmap, supported renewable energy expansion, energy efficiency initiatives, and afforestation programs. Yet, major barriers remain-particularly financing, technology transfer, and cross-sectoral coordination. Meeting the unconditional targets requires at least $12.5 billion, well beyond domestic capacity, underscoring the importance of international climate finance. If adequately supported, Bangladesh can not only meet but surpass its pledges, aligning mitigation with its development needs while advancing resilience and low-carbon growth.

1.2 GHG Emission Trends of Bangladesh

Bangladesh, though responsible for only a fraction of global emissions, faces severe climate risks. Its emissions trajectory (2009–2030) shows a steady increase, with BAU projections reaching about 409.4 $MtCO_2e$ by 2030 (Figure-1). Under the country's updated NDC, unconditional measures could lower this to 381.9 $MtCO_2e$, and with adequate international support, conditional measures could reduce it further to 319.9 $MtCO_2e$. The trend demonstrates that while Bangladesh is on track to achieve its earlier NDC targets, future mitigation ambition must be sharpened to align with the Paris temperature goal and safeguard national development.

Figure 1: Past, Present, and Predicted GHG Emission for Bangladesh (Source: EDGAR)

Despite rising aggregate emissions, Bangladesh's per capita GHG emissions remain among the lowest globally. In 2023, its per capita emissions were far below the world average, OECD members, and high- and upper-middle-income countries (Figure-2).

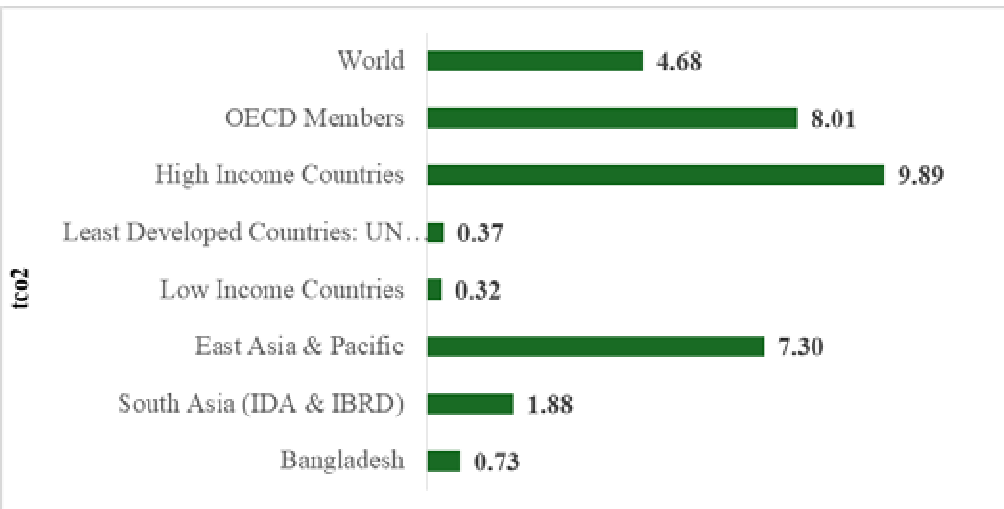


Figure 2: Per capita GHG emission (tco2): where we stand on 2023, Source: World Bank

Yet, when compared within its peer group, Bangladesh emerges as one of the highest emitters among Least Developed Countries (LDCs) and South Asian nations. This dual reality highlights the paradox: Bangladesh contributes little to the global problem, but relative to LDCs, its emissions are not insignificant. As climate vulnerability intensifies, Bangladesh cannot afford to remain complacent in its mitigation agenda.

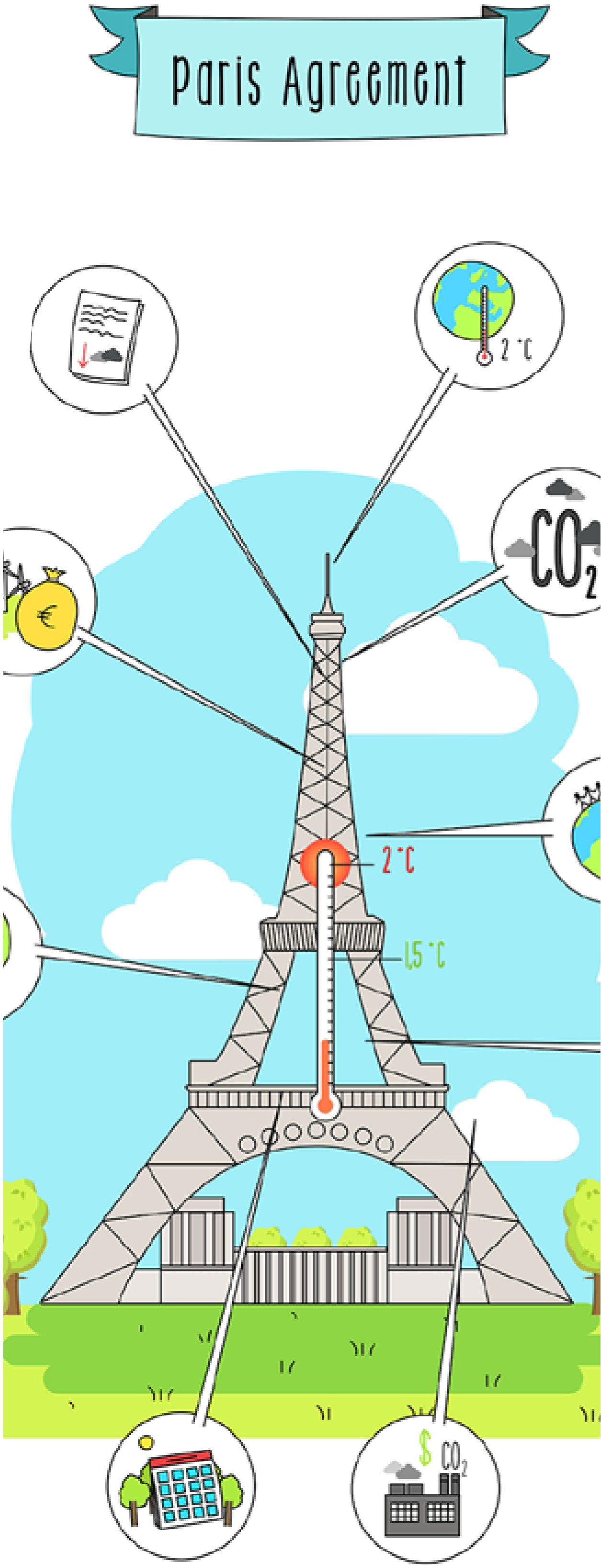
1.3 Development pathways and policy alignment

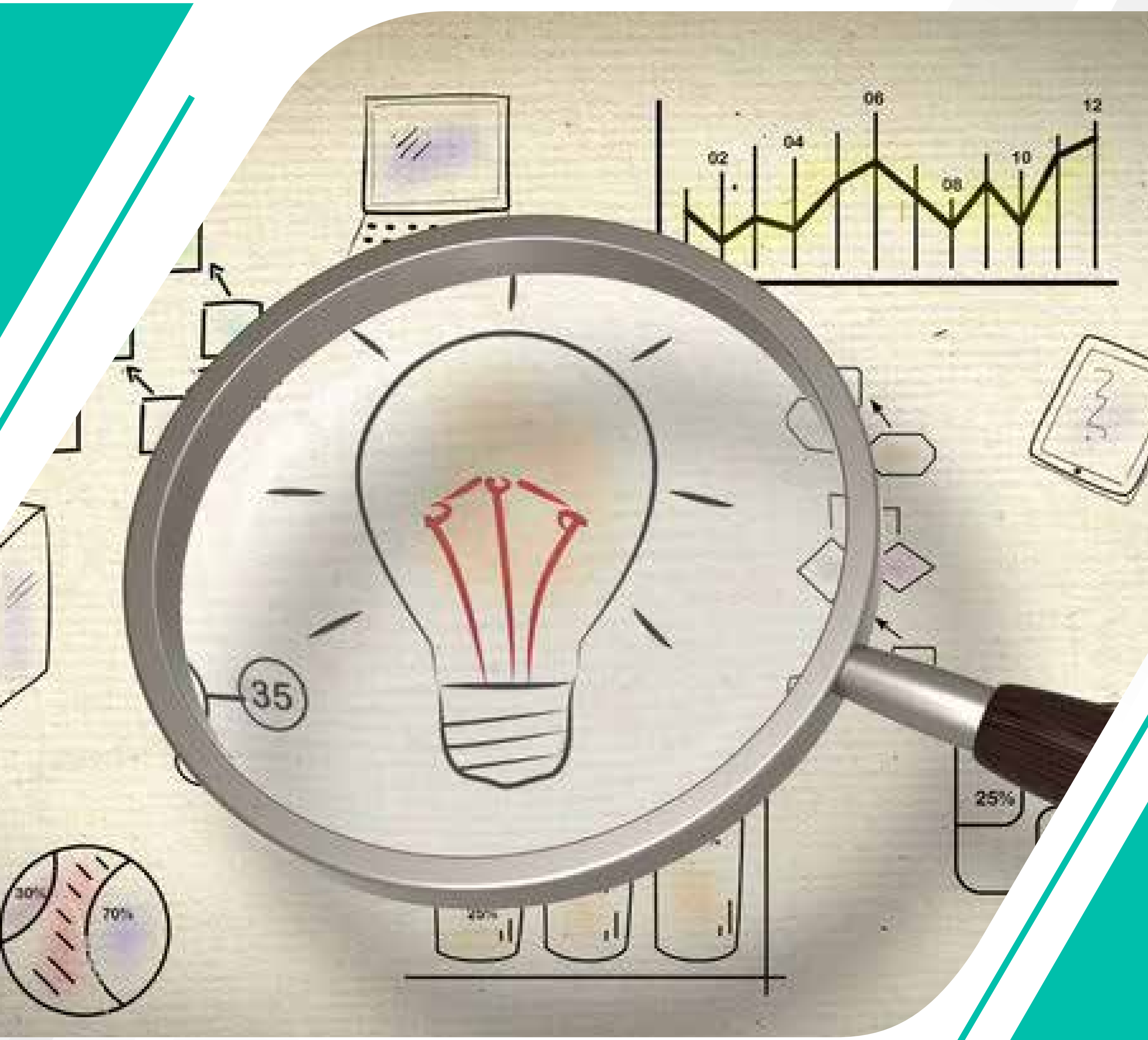
Government strategies and plans were examined to align sectoral actions with the Nationally Determined Contribution (NDC, 2021).

The NDC 2.0 (2021) commits to reducing GHG emissions by 6.73% unconditionally and up to 21.85% conditionally by 2030, with energy and transport identified as priority sectors. The NDC Implementation Roadmap specifies milestones, including integrating renewable energy into the national grid and achieving 24.5% renewable generation capacity by 2035. The Power System Master Plan (2021) targets diversification of energy generation with 40% capacity from renewables and imported clean power by 2041, supporting NDC mitigation goals by phasing down coal-based capacity. The MCPP links economic growth with decarbonization, aiming for net economic gains of US$903 billion by 2070 through clean energy investment and improved climate resilience. The Renewable Energy Policy (2025) sets a target of expanding Renewable Energy Capacity to 20% within 2030 (MoPEMR, 2025).

Sectoral guidelines reinforce these ambitions. BPDB's renewable energy policy focuses on 4,540 MW of renewable generation by 2030, while SREDA's energy efficiency roadmap calls for 20% energy intensity reduction in industries by 2030. BBS data frameworks are strengthening national GHG inventories for transparent MRV systems, and DoE directives include stricter emission standards for brick kilns and power plants to curb air pollution and CO_2 emissions.

Collectively, these documents establish a coherent framework connecting policy intent with measurable mitigation actions. The review highlights progress in renewable capacity expansion, efficiency gains, and emission controls but underscores the need for sustained financing and institutional coordination to meet conditional targets.





Chapter 2: Methodology

This study employs a mixed-method approach combining policy analysis, expert interviews, and quan titative modeling to estimate Bangladesh's emission reduction potential and associated investment costs.

2.1 Policy and Document Review

Government strategies and plans, including the updated Nationally Determined Contribution (2021), the NDC Implementation Roadmap, the Power System Master Plan (2021), the Mujib Climate Prosperity Plan, and sectoral guidelines from BPDB, SREDA, BBS, and DoE were systematically reviewed to identify existing and planned mitigation measures. Policies were assessed for legal basis, sectoral coverage, implementation progress, and resource allocation.

2.2 Key Informant Interviews

Semi-structured interviews were conducted with officials from relevant ministries, industry associations, and civil society organizations. The interviews validated the feasibility of mitigation options, clarified barriers to adoption, and provided sector-specific data on costs, implementation capacity, and expected uptake trajectories.

2.3 Emission Estimation

Emission reduction potentials were estimated following the IPCC 2006 Guidelines and 2019 Refinement, complemented by activity data from national agencies and emission factors from the IPCC Emission Factor Database. For each measure 'm' in year 't', avoided emissions were calculated as:

$$ER_{m,t} = \left(AD_{m,t}^{base} \times EF_{m,t}^{base}\right) - \left(AD_{m,t}^{mit} \times AD_{m,t}^{mit}\right) \text{---------------------------------} (1)$$

where, AD represents activity data and EF the relevant emission factor. Sectoral models included transport (vehicle stock, fuel economy, and electrification), Afforestation and Livestock Management (AFOLU), Industry and Urban Settlements (IPPU). Almost similar, but slightly different approach was used for the Energy Sector which is given below:

Accounting framework for Energy sector Activity-emission identity

For year

$$E_y = \sum_{f \in \{coal, oil, gas\}} G_{y,f} \times EE_f \text{---------------------------------} (2)$$

Were,
$G_{y,f}$ = Generation by Fuel F (MW-h)
EE_f = Operational Emission Factor (kgCO_2/MWh)

Grid car

$$GridEF_y = \frac{E_y}{\sum_f G_{y,f}} \times 1000 \left(\frac{kg}{MWh}\right) \text{--------------------} (3)$$

Linear interpolation between anchors yields year-by-year = $G_{y,f}$
E_y = Energy Yield at year y

Scenarios

• BAU: as constructed above.
• Unconditional (2025–2030): annual RE additions ramp from 300/150/100 MW (utility-solar/rooftop/wind) in 2025 up to 800/250/250 MW in 2030; cumulative loss-cut 0.4 pp/yr; gas-efficiency +0.3 pp/yr.

• Conditional: annual RE additions to reach global standards provided that required external finance is received, conditional 60% scenario is a scenario where we assume that 60% of the required external finance is received

• Ideal: The most feasible Net-Zero Scenario

Translating measures to TWh

For each year:

- New RE capacity → energy:

$$TWh = \frac{MW \times 8760 \times CF}{10^6} \text{----------------------(4)}$$

- Loss reduction of Δpp saved $TWh = BAU\ total\ TWh \times \frac{\Delta\%}{100}$
- Gas efficiency Δ%→saved TWh=G_gas^BAU×(Δ%)/100
- Coal derate/retire and imports/nuclear are entered in TWh.

All low-carbon energy and savings are pooled, then dispatched to displace fossil generation in this order: oil → coal → gas (reflects both cost and air-quality value). Coal derate/retire reduces the coal "room" before displacement.

Capital Expenditure (CAPEX)

The annualized CAPEX considers the upfront cost of renewable technologies (solar, wind) and is based on the annuity factor formula. This is done for each year of new installations (2025–2030) across the different technologies:

$$Annualized\ CAPEX = \frac{Capex \times WACC}{\{1-(1+WACC)\}^{-N}} \text{--------(5)}$$

Where:

WACC (Weighted Average Cost of Capital (WACC):
Unconditional: 8%
Conditional: 6% (assuming reduced finance costs under conditional climate finance scenarios).

Operation & Maintenance Costs

Fixed O&M costs are incurred annually for each renewable technology, based on their cumulative installed capacity. These are calculated for each scenario for 2025–2030:

$$O\&M\ Costs = Capacity\ (MW) \times Fixed\ O\&M\ cost\ \left(\frac{USD}{MW}\right) \ldots\ldots\ldots\ldots (6)$$

Where the O&M costs are estimated at:

Fuel Savings

As renewable energy replaces fossil fuels, the fuel savings (e.g., coal, oil, and gas) and Variable O&M (VOM) savings are calculated by comparing the displaced MWh with fuel cost savings. Fuel Savings=Displaced MWh×Fuel Cost per MWh

Investment Cost Analysis

Capital and operating costs of technologies were drawn from government reports, IPCC AR6 mitigation cost data, IEA databases, and peer-reviewed literature. The cost-effectiveness of each measure was expressed as the unit abatement cost (USD per tCO_2e):

$$UAC_m = \frac{C_m^{total}}{ER_m^{total}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where C_m^{total} denotes net present investment and operational costs and ER_m^{total} the cumulative emission reductions.

2.4 Carbon Credit Potential

$$R_{total} = \sum_{i=1}^{n}(P_i \times Q_i) \ldots\ldots\ldots\ldots\ldots (9)$$

Where:

- R_{total} = Total annual revenue potential (USD)
- P_i = Average carbon credit price in sector i (USD/tCO_2e)
- Q_i = Annual credit volume in sector i ($MtCO_2e$)
- n = Number of sectors considered

2.5 Data Sources

Data Type	Unit	Value	Reference
Operational Emission Factor	$kgCO_2$/MWh	Coal = 850 Oil = 590 Gas =185 Renewables = 0	Conversion Guidelines
Capacity Factor	Ratio	Utility-solar 19%, Rooftop-solar 16%, Onshore-wind 32%.	Kaushik et al.
CAPEX cost	USD/ MW	Solar =650,000 Wind= 1.2 M	NREL
O & M cost	USD/MW/year	Solar utility: 12,000 Solar rooftop: 15,000 Wind: 25,000	NREL
Fuel Savings	USD/MWh	Oil: $90/MWh Coal: $35/MWh Gas: $30/MWh	Fuel Economy
Proposed Mitigation Activity			IPCC AR6
Emission Conversion Factors	tCO2/activity		GOV UK
Average Unit price of Carbon Credit Potential	USD/tCO2e		Verra Standard Value form KII

Chapter 3: Study Findings

3.1 Overall Scenario of NDC 2.0

Bangladesh's NDC 2.0 aims for significant emission reductions by 2030, compared to a Business-As-Usual (BAU) scenario:

• Unconditional Contributions: Reduction of 27.56 $MtCO2e$ (6.73%) below BAU.
• Conditional Contributions: Reduction of 61.9 $MtCO2e$ (15.12%) below BAU, dependent on international financial and technological support.

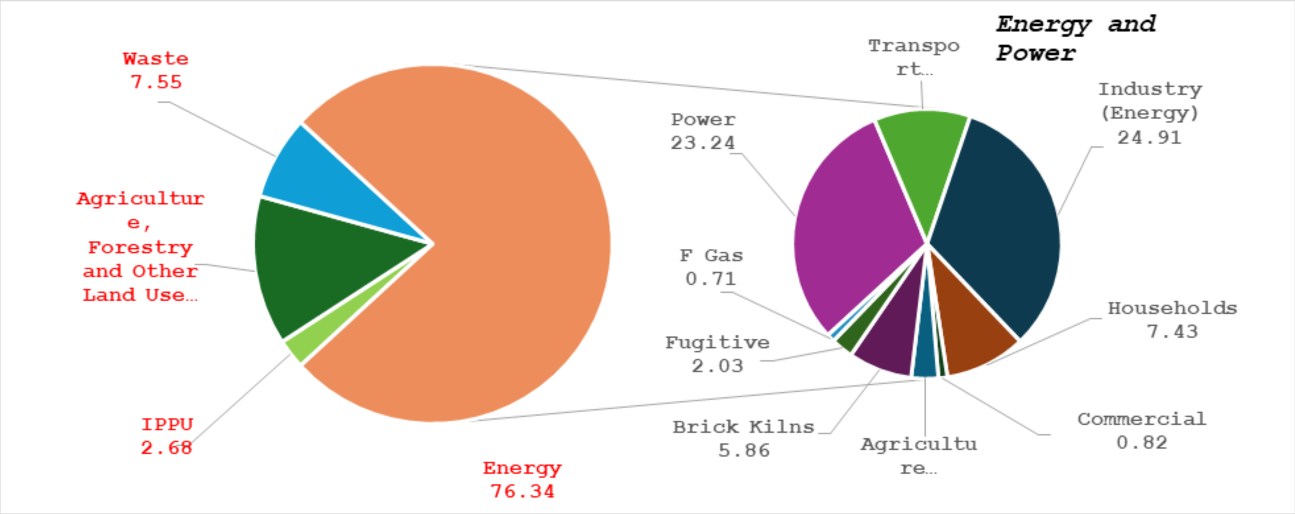


Figure 3: Snapshots of NDC 2.0 of Bangladesh: Sector Wise Emission Scenario (BAU 2030)

The NDC update extends the coverage of emissions sectors, including:

• Energy: Power, transport, and industry, alongside renewable energy integration, energy efficiency, and electrification projects.
• Agriculture, Forestry, and Other Land Use (AFOLU): Actions to reduce emissions from rice fields, livestock, and improved forest management.
• Waste: Measures to reduce methane emissions from solid waste and wastewater.
Bangladesh has emphasized the importance of incorporating various sectors, such as energy, IPPU (Industrial Processes & Product Use), AFOLU, and waste, within the NDC to meet its climate goals. The targets reflect both the country's immediate and future aspirations for low-carbon growth, with a mix of unconditional actions (to be funded locally) and conditional actions (requiring external financial and technological support).
Here, in this study we have worked on Energy Sector, AFOLU, IPPU and Urban Settlements sector.

3.2 Energy Sector

Bangladesh's power sector is projected to generate 95.14 $MtCO_2e$ by 2030 under the BAU scenario. Without intervention, reliance on fossil fuels and inefficient systems will lock the country into high-carbon growth. However, a mix of renewable energy deployment, efficiency measures, and technology upgrades can dramatically reduce emissions.

3.2.1 Capacity Versus Consumption

• Installed capacity (MW) measures potential but does not reflect actual use.
• Electricity generation and consumption (GWh/TWh) provides the real basis for emissions forecasting.
• Accurate projections must be considered:
o Utilization factors of solar, wind, hydro, and fossil plants.
o Demand-side consumption patterns and grid efficiency.

• Without aligning capacity with consumption, emission forecasts risk over- or underestimating reductions.

3.2.2. Renewable Requirements

Bangladesh's renewable energy targets (20% by 2030, 24.5% by 2035, and 30% by 2040) (Centre for Policy Dialogue, 2025) require far greater installed capacity than the actual renewable share in generation, largely because of the low plant factor of renewable technologies (average 0.25 across solar, wind, hydro, and biomass).

• 2030: Demand is projected at 22,702 MW. Meeting the 20% renewable target requires 4,540 MW of renewable generation, translating into 18,162 MW of installed renewable capacity.
• 2035: With demand rising to 26,277 MW, a 24.5% renewable share requires 6,438 MW of renewable supply, equating to 25,751 MW installed.
• 2040: At a projected demand of 29,761 MW, the 30% target requires 8,928 MW of renewable supply, necessitating 35,713 MW installed capacity.

This demonstrates that renewables require three to four times the installed capacity of fossil fuels to deliver the same electricity share.

3.2.3 Renewable Energy Potential by Source

According to SREDA analysis, the renewable mix is expected to expand significantly across technologies:

Renewable Source	2030 (MW)	2035 (MW)	2040 (MW)
Solar (utility, rooftop, irrigation, mini-grids, etc.)	6,332	12,024	17,229
Wind (coastal & offshore)	4,520	9,509	13,625
Hydro	1,505	2,490	3,567
Biogas	4	7	10
Biomass	43	45	46
Off-grid RE	554	554	554
Imports (India, Bhutan, Nepal)	5,243	1,163	721
Total	**18,202**	**25,791**	**35,753**

TABLE 2: RENEWABLE ENERGY POTENTIAL BY SOURCES

Solar and wind dominate the expansion, with solar accounting for over 46% of renewable supply by 2035, while wind contributes nearly 38% by 2040. Imports are projected to decline as domestic capacity scales up.

3.2.4 Cost Trends

• Solar PV costs are projected to fall from USD 1.32 million/MW (2021) to USD 1.05 million in 2030, USD 1.00 million in 2035, and USD 0.95 million in 2040.
• Wind energy is expected to decline from USD 1.03 million/MW (2021) to USD 0.98 million in 2030, USD 0.93 million in 2035, and USD 0.88 million in 2040.
•Biomass, bioenergy, and geothermal remain stable at USD 0.89 million/MW, while waste-to-energy stays the most capital-intensive at USD 4.92 million/MW.
•Hydropower remains relatively costly at USD 1.80 million/MW.

3.2.5 Investment Needs

Meeting these targets will require USD 35.2–42.6 billion in total renewable investment by 2040, with

most frontloaded between 2025–2035.
• Solar and wind absorb the largest shares, with USD 5.9 billion for solar and USD 4.4 billion for wind by 2030.
• Hydropower contributes to baseload diversification with USD 2.3 billion investment by 2030.
• Imports account for USD 5.5 billion in 2025–2030, declining in later years as domestic RE expands.

3.2.6 Strategic Implications

• The gap between renewable generation potential and required installed capacity underscores the need for massive infrastructure expansion, storage, and grid modernization.
• Achieving the targets will depend on regional cooperation for imports in the early years and scaling up domestic private sector participation by 2035–2040.
• The declining costs of solar and wind technologies create a window of opportunity for Bangladesh to align investment mobilization with NDC 3.0 commitments and avoid stranded fossil assets.

3.2.7 Renewable and Low-Carbon Options

Mitigation measures and their estimated abatement potential include:
• Solar power (utility + rooftop): 42.5 $MtCO_2$
• Wind power: 18.5 $MtCO_2$
• Energy loss reduction: 26.5 $MtCO_2$
• Gas efficiency improvements: 12.3 $MtCO_2$
• Coal derating/retirement: 0.4–9.1 $MtCO_2$
• Imports/nuclear power: 7.5 $MtCO_2$

These options illustrate that system-wide transformation requires both renewable expansion and fossil displacement.

3.2.8 Emission Scenarios (2030)

Scenario	Generation (TWh)	Emissions (Mt CO_2)	Grid EF (kg/MWh)	Reduction from BAU (Mt)	Low-Carbon Share (%)	RE Generation (TWh)	Imports/ Nuclear (TWh)
BAU	191.00	108.87	570.0	0.0	20.0	19.10	19.10
Unconditional	185.21	97.55	526.7	11.32	26.1	29.22	19.10
Conditional 60%	170.74	75.44	441.8	33.43	34.3	39.45	19.10
Conditional	157.23	50.60	321.8	58.27	45.9	51.01	19.10
Ideal	123.46	8.55	69.2	100.32	85.9	86.92	19.10

TABLE 3: EMISSION SCENARIOS (2030)

3.2.9 Key Insights:

• BAU maintains emissions near 109 $MtCO_2$, with a grid EF of 570 kg/MWh.
• The Conditional full scenario nearly halves emissions to 51 $MtCO_2$.
• The Ideal Scenario reduces emissions by over 90%, cutting intensity to 69 kg/MWh.

We have potential of installing **24,106 MW** Renewable Energy plants, if under conditional scenario funds are received.

3.2.10 Policy and Strategic Implications

1. Grid Integration: Investments must prioritize system reliability, loss reduction, intermittency management.
2. Fossil Retirement: Coal derating/retirement and efficient gas plants are critical for immediate abatement.
3. Renewable Scaling: Achieving conditional and ideal pathways depends on accelerated deployment of solar, wind, hydro, and imports/nuclear.
4. Cost Efficiency: The Ideal scenario demonstrates the long-term financial benefit of frontloaded investment.
5. International Support: Conditional and ideal scenarios require concessional finance and technology transfer to ease upfront CAPEX burdens.
6. Vertical & Horizontal Cross Check: Studies have shown that adopting vertical and horizontal cross checking can reduce collusive practices in power sector and thereby reduce LCoE. (Mushtaq Khan, 2024)

Bangladesh has the potential to cut power sector emissions nearly in half by 2030 under a conditional scenario, and by over 90% under an ideal scenario. Achieving this requires aligning installed renewable capacity with actual consumption, scaling investment to over $20 billion, and leveraging international climate finance.

Transitioning toward a low-carbon power sector is not only possible but also cost-effective in the long run, ensuring energy security, emission reduction, and climate resilience for Bangladesh.

3.3 Industrial Process Emissions (IPPU)
3.3.1 Current Situation

The Industrial Process sector in Bangladesh, encompassing Iron and Steel, Fertilizer, and Cement industries, currently has no defined mitigation reduction targets under the existing NDC. Industrial Process emissions are a key contributor to Bangladesh's overall GHG profile, and identifying actionable mitigation pathways is essential to meet the country's climate goals while supporting sustainable industrial growth.

The industrial sector is a major contributor to GHG emissions, responsible for approximately 34% of global emissions when both direct and indirect sources are considered, and 24% from direct fuel combustion, process emissions, product use, and waste alone (IPCC AR6, 2022). Emissions-intensive industries such as iron and steel, cement, and fertilizer are central to economic development, particularly in rapidly urbanizing countries like Bangladesh, where infrastructure and industrial growth drive demand for these materials. Under a business-as-usual scenario, industrial emissions are projected to rise due to continued expansion of basic material production, mirroring historical trends observed globally since 2000 (IPCC AR6, 2022).

Decarbonizing the industrial sector is both technically feasible and essential for achieving national climate commitments. Technologies such as electrification of steel production (EAF), clinker substitution in cement, and energy efficiency in fertilizer production have demonstrated potential to significantly reduce emissions while maintaining production capacity (IEA, 2021; IPCC AR6, 2022; Cheng et al., 2023). Moreover, material efficiency, circular economy approaches, and low-carbon feedstocks can complement these strategies, further lowering the GHG intensity of industrial output without compromising economic growth (AR6, 2022).

Including the IPPU sector in Bangladesh's NDC is critical for several reasons:
1. High mitigation potential: Transformational measures in steel, cement, and fertilizer production c

1. can collectively reduce approximately 3.1 $MtCO_2$ annually, representing a significant contribution to the country's overall mitigation targets.

2. Economic and developmental alignment: These industries are foundational to Bangladesh's urbanization, infrastructure development, and manufacturing growth. Targeted mitigation interventions can drive efficiency, innovation, and competitiveness while supporting climate-resilient industrialization.

3. Feasibility of conditional actions: The selected mitigation activities-partial electrification of steel, energy efficiency in fertilizer production, and clinker substitution in cement are commercially available or near-horizon technologies, allowing for realistic implementation within the next 5–10 years (IEA, 2021; Cheng et al., 2023).

4. Alignment with global best practices: These interventions reflect international recommendations for deep decarbonization of energy- and emissions-intensive industries, combining technology adoption, material efficiency, circular economy strategies, and low-carbon feedstocks (IPCC AR6, 2022; IEA, 2021).

5. Strategic policy readiness: Including the industrial process sector in the NDC provides a clear signal for private sector investment, supports development of low-carbon industrial clusters, and enables alignment with international climate finance mechanisms.

Given the growing demand for basic materials in Bangladesh and the global trajectory toward net-zero industrial emissions, integrating the IPPU sector into the NDC through these targeted mitigation activities is both necessary and actionable, ensuring that Bangladesh's industrial growth is compatible with its climate and sustainable development goals (SDGs).

3.3.2 Proposed Conditional Activities for NDC 3.0

Iron and Steel Industry

• Current Emissions: 9.9 $MtCO_2$ (IDLC, 2022)
• Mitigation Strategy: Electrification -Transitioning from blast furnaces to Electric Arc Furnaces (EAFs) powered by renewable electricity.
• Emission Reduction Potential: 60% reduction per unit of steel produced using EAFs (IEA, 2021)
• Adoption Scenario: 30% of national steel production shifted to EAF
• Expected Emission Reduction: 1.782 $MtCO_2$

Rationale: Electrification of steel production provides one of the largest opportunities for reducing CO_2 emissions in energy-intensive industrial sectors. Even partial adoption can yield significant reductions while preparing the sector for long-term low-carbon transformation.

Fertilizer Industry

• Current Emissions: 3.97 $MtCO_2$ (NDC baseline)
• Mitigation Strategy: Energy Efficiency Improvements – Implementing advanced energy-saving technologies and operational optimizations in fertilizer production.
• Emission Reduction Potential: 12% reduction in CO_2 emissions (IPCC AR6, 2022)
• Expected Emission Reduction: 0.4764 $MtCO_2$
Rationale: Energy efficiency is a cost-effective option that reduces fuel consumption, operational costs, and emissions simultaneously. Implementation in fertilizer plants aligns with global best practices for low-carbon process improvements.

Cement Industry

• Current Emissions: 7.0 $MtCO_2$ (NDC baseline)
• Mitigation Strategy: Clinker Substitution – Replacing clinker with supplementary cementitious

materials (SCMs) such as fly ash, slag, or natural pozzolans.
• Emission Reduction Potential: 12% reduction in CO_2 emissions (Cheng et al., 2023)
• Expected Emission Reduction: 0.84 $MtCO_2$

Rationale: Clinker substitution reduces process emissions directly, decreases energy demand, and supports a circular economy by utilizing industrial by-products.

3.3.3 Investment Requirements for Mitigation

The financial requirements for implementing these conditional activities are summarized below:

Sector	**Emission Reduction ($MtCO_2$)**	**Cost Range (USD million)**	**Cost per tCO_2e (USD/tCO_2e)**
Iron & Steel (30% EAF)	1.782	450–720	252–404
Fertilizer	0.4764	35.7	75
Cement (Clinker Subst.)	0.84	14.7	17.5
Total	3.098	500–770	161–249 (weighted average)

TABLE 5: INVESTMENT REQUIREMENTS FOR MITIGATION

Notes:

1. Weighted average cost per tCO_2e reflects the combined mitigation measures across the three industrial subsectors.
2. Co-benefits such as energy savings, operational efficiency, and material cost reductions are expected but not monetized in this analysis.
3. Investment estimates are conditional on partial adoption rates (e.g., 30% steel to EAF). Scaling up adoption would proportionally increase emission reductions and required investments.

3.3.4 Key Insights and Recommendations

1. Industrial Decarbonization Potential: Implementing these measures can help achieve a 3.1 $MtCO_2$ reduction, representing a significant contribution to Bangladesh's industrial mitigation targets and NDC ambitions.
2. Cost-Effectiveness: Clinker substitution in cement is the most cost-effective option (USD 17.5/t-CO_2e), followed by fertilizer efficiency improvements. Steel electrification requires higher capital investment but yields the largest absolute emission reduction.
3. Policy Implications:

o Government incentives (tax credits, low-interest loans, and public-private partnerships) are recommended to accelerate adoption.
o Integration into NDC planning provides clarity on sector-specific mitigation targets.
o Co-benefits such as energy savings and circular economy opportunities should be emphasized to strengthen investment cases.

4. Next Steps:

o Expand feasibility studies to identify industrial clusters suitable for EAF and SCM adoption.
o Explore financing mechanisms for high-CAPEX interventions, particularly for steel electrification.

o Include these targets in Bangladesh's next NDC update under a conditional scenario framework, aligning with international climate finance opportunities.

The IPPU sector in Bangladesh offers substantial opportunities for conditional mitigation. With a total estimated emission reduction of 3.1 $MtCO_2$ and a well-defined investment framework, integrating these activities into the NDC can accelerate industrial decarbonization while supporting sustainable development objectives.

3.4 Agriculture, Forestry and Other Land Uses (AFOLU)

The Agriculture, Forestry, and Other Land Use (AFOLU) sector remains a critical contributor to greenhouse gas (GHG) emissions in Bangladesh, while simultaneously offering significant mitigation and carbon sequestration potential. Globally, AFOLU contributes 13–21% of total anthropogenic GHG emissions, with major gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (IPCC 2019; IPCC AR6, Sections 7.1.1, 7.3.2). In Bangladesh, emissions from this sector are primarily driven by rice cultivation, livestock production, fertilizer use, and deforestation, alongside significant opportunities for carbon sequestration through reforestation, mangrove conservation, and soil carbon management.

The sector is unique because, unlike most other sectors, it can both reduce emissions and actively remove CO_2 from the atmosphere. Land-based mitigation measures, such as afforestation/reforestation, soil organic carbon management, improved livestock management, and coastal wetland restoration, have the potential to deliver significant co-benefits including enhanced food security, biodiversity conservation, adaptation capacity, and ecosystem services (IPCC SRCCL 2019; AR6 WGIII, Ch.7).

3.4.1 Drivers of AFOLU Emissions

Agriculture

• Rice cultivation: Flooded rice fields are a major source of CH_4 emissions. Emissions intensity is influenced by water management, fertilizer application, and rice varietal characteristics. Practices such as Alternate Wetting and Drying (AWD) can substantially reduce methane emissions while maintaining productivity (IPCC AR6, Section 7.4.3.5).
• Fertilizer use: Excessive nitrogen-based fertilizer leads to increased N_2O emissions from croplands. Improved nutrient management including precision application, deep placement of urea, and intercropping with pulses can reduce emissions while enhancing soil fertility (IPCC AR6, Section 7.4.3.6).
• Livestock: Enteric fermentation dominates CH_4 emissions from ruminants, while manure management produces both CH_4 and N_2O. Emissions are proportional to herd size, productivity, and feed efficiency (IPCC AR6, Section 7.3.2.1). Interventions such as feed additives, high-productivity crossbred livestock, and improved manure management can significantly reduce emissions per animal while supporting productivity.
Forestry and Coastal Ecosystems
• Deforestation and forest degradation: Loss of forest carbon stocks through illegal logging, land conversion, and unsustainable land use contributes significantly to CO_2 emissions. Maintaining forest cover, promoting afforestation, and restoring degraded lands are critical mitigation pathways (IPCC AR6, Sections 7.4.2.1–7.4.3.3).
• Mangroves and coastal wetlands: Mangrove forests and other coastal wetlands contain some of the highest carbon stocks globally. Their conservation and restoration prevent emissions from biomass loss and soil carbon, while also delivering adaptation co-benefits against storm surges, flooding, and erosion (IPCC AR6, Section 7.4.2.8–7.4.2.9).

3.4.2 Current AFOLU Targets and Activities

As per NDC 2.0, Bangladesh currently has the following mitigation targets in AFOLU sector:

Sub-Sector	BAU 2030 Emissions ($MtCO_2e$)	Unconditional Reduction	Conditional Reduction	Combined Reduction
Agriculture & Livestock	54.64	0.64 $MtCO_2e$ (≈2.32%)	0.40 $MtCO_2e$ (≈0.65%)	1.04 $MtCO_2e$ (≈1.9%)
Forestry	0.37	–	–	–
Total AFOLU	**55.01**	**0.64 $MtCO_2e$ (≈2.32%)**	**0.40 $MtCO_2e$ (≈0.65%)**	**1.04 $MtCO_2e$ (≈1.9%)**

TABLE 6: CURRENT AFOLU TARGETS AND ACTIVITIES

The AFOLU activities currently targeted under Bangladesh's NDC 2.0 include:

Agriculture

• Sustainable Rice Cultivation: Alternate Wetting and Drying (AWD) in 100,000 ha of dry-season rice, improved rice varieties on 2.13 million ha, and enhanced fertilizer management across 627,000 ha with deep urea placement in 150,000 ha.

• Livestock Productivity and Feed Improvement: Replacement of low-productive cattle with 1.88 million large ruminants and 1.78 million small ruminants; improved feed for 1.01 million large and 1.36 million small ruminants.

• Manure Management: Deployment of 107,000 mini biogas plants and expansion of training and awareness programs.

Forestry and Ecosystem Management

• Afforestation/Reforestation: 150,000 ha

• Restoration of Degraded Forests: 337,800 ha

• Protected Area Co-Management: 72,000 ha

• Tree Cover Enhancement: Increase from 22.37% to 24%

• Community Engagement and Livelihoods: Support 55,000 forest-dependent families through alternative income sources, plus roadside, embankment, and private land plantations.[1]

3.4.3 Proposed Additional Activities for NDC 3.0

Based on emission drivers, mitigation potential, cost-effectiveness, and feasibility in the context of Bangladesh, the following activities can be selected for inclusion in NDC 3.0:

These activities were selected because they target high-emission sources while providing co-benefits for livelihoods, biodiversity, and climate adaptation. The combination of crop, livestock, forestry, and wetland interventions ensures a balanced approach across multiple ecosystems, reflecting Bangladesh's high vulnerability to climate impacts and the need for nature-based solutions (NBS)

[1] Bangladesh Ministry of Environment, Forest and Climate Change (MoEFCC) NDC Report, 2021.

Sector	Activity	Rationale
Agriculture	Cover Cropping & Conservation Tillage	Enhances soil organic carbon, improves soil health, and reduces CO_2 emissions from croplands; cost-effective and widely deployable (IPCC AR6, 7.4.3.1–7.4.3.6).
Agriculture	Livestock Feed Additives	Reduces enteric CH_4 emissions from ruminants; can improve feed efficiency and productivity; medium-cost intervention with scalable potential (IPCC AR6, 7.4.3.1).
Agriculture	Improved Fertilizer Management	Reduces N_2O emissions from croplands; promotes sustainable nutrient use and crop yields; aligns with cost-effective mitigation (<USD100 tCO_2-eq) (IPCC AR6, 7.4.3.6).
Forestry	Agroforestry Systems Expansion	Integrates trees with crops/livestock, sequestering carbon in soil and biomass; diversifies farmer income and enhances climate resilience (IPCC AR6, 7.4.3.3).
Forestry	Mangrove Restoration	Protects and restores coastal blue carbon; prevents emissions from land conversion and soil carbon loss; delivers ecosystem-based adaptation co-benefits (IPCC AR6, 7.4.2.8–7.4.2.9).

TABLE 7: PROPOSED ADDITIONAL ACTIVITIES FOR NDC 3.0

3.4.4 Emission Reduction Potential

The estimated emission reduction potential from these activities is summarized below, divided into Unconditional (mandatory, ~25% of potential) and Conditional (optional, additional, ~75% of potential) measures.

Activity Name	Description	Area/ Units	Emission Reduction Factor	Unconditional (tCO_2-eq)	Conditional (tCO_2-eq)	Total Emission Reduction (tCO_2-eq)
Cover Cropping	Soil carbon sequestration	100,000 ha	1.0 tCO_2/ha/year	25,000	75,000	100,000
Livestock Feed Additives	Methane reduction	0.50 million animals	0.2 tCH_4/animal/year	25,000	75,000	100,000
Agroforestry	Agroforestry expansion	50,000 ha	5 tCO_2/ha/year	62,500	187,500	250,000
Mangrove Restoration	Coastal restoration	20,000 ha	1 tCO_2/ha/year	5,000	15,000	20,000
Total Additional				117,500	352,500	470,000

TABLE 8: EMISSION REDUCTION POTENTIAL

Source of emission factors: IPCC AR6 WGIII (Ch.7), FAO (2018), World Bank (2021), FAO Mangroves (2020).

3.4.5 Mitigation Investment Requirements for NDC 2.0

The cost estimate for the implementation of key mitigations measures in the AFOLU sector under the unconditional and conditional scenario as per NDC 2.0 is outlined below:

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Mitigation Measure	Estimated investment required (million USD, 2021–2030)	
	Unconditional	**Conditional**
Implement AWD in dry season rice field	17.65	35.29
Varietal improvement	79.65	153.82
Land management	1.23	3.69
Fertilizer Management (deep placement in rice field)	2.40	7.20
Bring more area under pulse cultivation	5.29	0.00
Replacement of low-productive animals with high-producing crossbred cattle	8.15	16.29
Feed improvement (use of balanced diet and beneficial microorganism)	138.70	275.68
Improve manure management (promotion of mini biogas plants, maintenance, training and awareness)	16.47	14.71
Forestry-related activities	500.00	2000.00
Total	**769.54**	**2506.68**

TABLE 9: MITIGATION INVESTMENT REQUIREMENTS FOR NDC 2.0

Additional activities and investment below are required to achieve the targets of NDC 3.0:

Activity Name	**Unconditional (tCO_2-eq)**	**Conditional (tCO_2-eq)**	**Cost Unconditional (USD)**	**Cost Conditional (USD)**	**Source**
Cover Cropping	25,000	75,000	625,000	1,875,000	IPCC AR6 WGIII, Ch.7
Livestock Feed Additives	25,000	75,000	1,625,000	4,875,000	FAO, 2018
Agroforestry	62,500	187,500	1,093,750	3,281,250	World Bank, 2021
Mangrove Restoration	5,000	15,000	225,000	675,000	FAO Mangroves, 2020
Total	117,500	352,500	3,568,750	10,706,250	

TABLE 10: ADDITIONAL ACTIVITIES AND INVESTMENT BELOW ARE REQUIRED TO ACHIEVE THE TARGETS OF NDC 3.0

The investment required to implement these mitigation activities has been calculated based on typical costs per tCO_2-eq reduction.

Investment assumptions:

- Cover Cropping: 20-30 USD/tCO_2
- Livestock Feed Additives: 50-80 USD/tCO_2
- Agroforestry: 10-25 USD/tCO_2
- Mangrove Restoration: 30-60 USD/tCO_2

3.4.6 Total Sectoral Highlight for NDC 3.0

The Total Sectoral Highlight for NDC 3.0 outlines Bangladesh's emission reduction targets by 2030, detailing both unconditional and conditional reductions along with the necessary investments.

BAU Emission (2030)	55.51 MtCO2
Unconditional	54.2525 MtCO2
Unconditional Reduction	0.757 MtCO2
Unconditional Reduction %	1.38%
Unconditional Investment Required	USD 773.108 million
Conditional	50.45 MtCO2
Conditional Reduction	0.752 MtCO2
Conditional Reduction %	1.368%
Conditional Investment Required	USD 2517.386 million

TABLE 11: TOTAL SECTORAL HIGHLIGHT FOR NDC 3.0

It projects a total emission reduction of approximately 1.38% and 1.37% under each scenario, with corresponding financial requirements of USD 773 million and USD 2.52 billion.

3.4.7 Key Highlights

1. New Activities Introduced
   - o Cover cropping and conservation tillage for soil carbon.
   - o Livestock feed additives for improved enteric fermentation mitigation.
   - o Agroforestry expansion combining food production with carbon sequestration.
   - o Mangrove restoration with species and hydrology optimization.

2. Emission Reduction Potential
   - o The total additional mitigation from proposed activities is 0.47 $MtCO_2$-eq per year.
   - o 25% of the reduction (~0.1175 $MtCO_2$-eq) is unconditional (mandatory), with the remaining 75% (~0.3525 $MtCO_2$-eq) conditional upon additional support and funding.

3. Investment Needs
   - o Total required investment: ~USD 14.27 million (sum of unconditional and conditional).
   - o Cost-effective mitigation is achievable, particularly in agroforestry and cover cropping.

4. Co-Benefits
   - o Enhanced soil fertility and productivity, reduced methane and N_2O emissions, increased forest and tree cover, protection of coastal ecosystems, and livelihoods support for forest-dependent communities.

3.5 Urban Systems and Other Settlements

Urban areas are at the forefront of both economic growth and climate vulnerability. Globally, urban systems are responsible for a substantial portion of GHG emissions due to concentrated energy use, transportation, and waste generation. Urban pollution is directly co-related with Natural Rights Index where the more the pollution, the more deviation from Natural Rights. (Annex-1) In Bangladesh, rapid urbanization, population growth, and increasing industrial and household energy demand are intensifying the carbon footprint of cities, particularly Dhaka.

While IPCC AR6 highlights the significant mitigation potential in urban systems, this sector remains underrepresented in Bangladesh's current NDC. Addressing emissions in urban areas through socio-behavioral interventions and Nature Based Solutions offer a dual benefit: reducing GHG emissions while enhancing urban resilience, health, and livability (IPCC AR6, 2022).

Cities are critical to climate mitigation, contributing roughly 70% of global CO_2-equivalent emissions while facing growing exposure to climate risks. Urban growth, if unmanaged, locks in long-term emissions through infrastructure, energy systems, and behavioral patterns. Globally, effective urban mitigation requires integrated strategies across three dimensions: (i) reducing energy and material demand through compact, mixed-use, and walkable urban forms; (ii) electrifying end-use sectors and decarbonizing energy supply; and (iii) enhancing carbon storage via green and blue infrastructure. Socio-behavioral interventions amplify these benefits by shaping individual and collective choices across mobility, consumption, and resource use.

A natural-rights-based ecological audit of Dhaka (1980–2024) illustrates the stakes of urban inaction. Rapid urbanization expanded built-up areas from 6.8% to 48.9% of the city, while tree cover halved, waterbodies shrank by 61%, and grasslands fell by 56%. Land surface temperatures rose sharply, by 2024-78% area of the city's temperature was above 30°C , disproportionately affecting low-income communities lacking green access. Within DNCC and DSCC, tree cover and per capita green space remain well below WHO recommendations, while waterbody access is critically limited. These changes exemplify how poor spatial planning, weak governance, and the absence of nature in urban planning drive both carbon lock-in and environmental injustice (M. Zakir Hossain Khan et al., 2025).

For NDCs, this evidence underscores the importance of embedding urban mitigation policies that align global strategies with local context. Recommended actions include integrating ecological buffers in urban planning, legally protecting waterbodies and forests, expanding urban tree cover, restoring wetlands, adopting low-carbon building materials, and prioritizing vulnerable neighborhoods for greening interventions. Coupled with electrification of mobility and building systems, smart grids, and circular economy approaches to materials and waste, such measures can reduce urban emissions, lower heat stress, and enhance resilience while generating co-benefits in public health, equity, and livelihoods.

Urban mitigation is thus both a global and local imperative: it delivers deep decarbonization, addresses systemic inequalities, and ensures that cities, particularly in rapidly growing Global South contexts like Dhaka, remain livable, resilient, and aligned with SDGs.
Incorporating these strategies into Bangladesh's NDC 3.0 will provides a pathway to align urban development with climate targets, optimize energy use, and foster sustainable living practices among urban populations.

3.5.1 Socio-Behavioral Change for Sustainable Urban Living

Activity Details

Behavioral changes in urban populations can significantly reduce emissions by influencing household

energy consumption, transportation patterns, and waste generation. Key activities include:
• Promoting energy-efficient appliances: Replacing older, inefficient household appliances with energy-efficient models to reduce electricity demand.
• Reducing car dependency: Encouraging cycling, walking, and the use of public transport to lower transport-related emissions.
• Waste reduction: Reducing food and material waste through recycling, composting, and awareness campaigns.

Emission Reduction Potential through Sustainable Urban Living

Evidence from global urban studies suggests that socio-behavioral shifts can reduce urban emissions by 5–20%:

Activity	**Estimated Reduction**	**References**
Energy-efficient appliances	10–30% reduction in household energy use	IPCC AR6, 2022
Reduced car use	15–25% reduction in transport emissions	IPCC AR6, 2022
Waste reduction	10–15% reduction in waste-sector emissions	IPCC AR6, 2022

TABLE 12: EMISSION REDUCTION POTENTIAL THROUGH SUSTAINABLE URBAN LIVING

By fostering sustainable urban lifestyles, these interventions can cumulatively achieve meaningful mitigation while generating co-benefits such as reduced household energy bills, improved air quality, and increased public health.

3.5.2 Green and Blue Infrastructure (Nature-Based Solutions)

Activity Details

NBS leverage urban green and blue infrastructure to mitigate emissions and enhance urban resilience. In Bangladesh, key NBS interventions include:

• Urban forests and street trees: Planting and maintaining trees along streets, in parks, and in communal spaces.
• Green roofs and walls: Installing vegetation on rooftops to provide insulation and reduce cooling demand.
• Urban wetlands and water bodies: Restoring or creating ponds, wetlands, and water retention areas to manage stormwater, improve biodiversity, and provide cooling.

Emission Reduction Potential

1. Carbon Sequestration:
o Urban trees, forests, and green spaces act as carbon sinks, absorbing CO_2 from the atmosphere.
o Studies indicate that urban forests and street trees can sequester 2–5 tCO_2 per hectare annually, depending on species, density, and local conditions (IPCC AR6, 2022; Nowak et al., 2013).

2. Cooling Energy Savings:
o Urban green spaces mitigate the urban heat island effect, lowering ambient temperatures and reducing electricity demand for air conditioning.
o For Dhaka, operating 1.82 million air conditioners at 26°C instead of 22°C could reduce peak electricity demand from 12,847 MW to 8,545 MW, saving approximately 4,302 MW, which translates into significant emissions reductions from fossil-fuel-based power generation (Local energy modeling, Dhaka City Corporation, 2024).
o The cooling effect of greenery can reduce AC energy demand by 5–15%, complementing carbon sequestration benefits (IPCC AR6, 2022).

Nature-Based Solution	Emission Reduction Mechanism	Potential Reduction	References
Urban forests / street trees	Carbon sequestration	2–5 tCO_2/ha/year	IPCC AR6, 2022; Nowak et al., 2013
Green roofs / walls	Reduced energy for cooling	5–15% energy savings	IPCC AR6, 2022
Urban wetlands / water bodies	Cooling + flood mitigation	Indirect energy reduction + co-benefits	IPCC AR6, 2022

TABLE 13: EMISSION REDUCTION POTENTIAL THROUGH NATURE BASED SOLUTIONS

Co-Benefits

• Improved urban air quality and biodiversity
• Flood mitigation and stormwater management
• Heat stress reduction and improved human health
• Enhanced aesthetic and recreational value, promoting social well-being

3.5.3 Rationale for Inclusion in Bangladesh's NDC

The urban systems sector presents an untapped mitigation opportunity for Bangladesh. Key reasons to include socio-behavioral change and NBS in the NDC are:

1. Significant Mitigation Potential: Combined interventions in energy efficiency, sustainable transportation, and urban greening can reduce urban emissions by 5–20%, translating into millions of tons of CO_2 avoided annually.

2. Alignment with Climate Resilience Goals: Urban nature-based solutions not only reduce emissions but also build climate resilience against flooding, heatwaves, and other climate risks, which are critical for highly vulnerable cities like Dhaka.

3. Feasibility and Cost-Effectiveness: Many interventions, such as green roofs, street trees, and awareness campaigns for behavioral change, are low-cost, high-impact, and implementable within short to medium time horizons.

4. Behavioral and Cultural Shift: Encouraging sustainable lifestyles fosters long-term systemic change, complementing technological and infrastructural mitigation strategies in other sectors.

5. Global Best Practices: International experience highlights that urban systems, when integrated into NDCs, significantly enhance national mitigation ambitions while delivering local co-benefits (IPCC AR6, 2022; UN-Habitat, 2020).

Urban systems in Bangladesh represent a critical yet overlooked sector in the current NDC framework. Mitigation through socio-behavioral change and nature-based solutions offers a cost-effective, socially inclusive, and environmentally sustainable pathway to reduce emissions in cities.
Integrating these interventions into the NDC would not only enhance Bangladesh's climate ambition but also improve urban resilience, health, and livability. A combination of policy incentives, public awareness campaigns, and infrastructural support will be essential to realize the full mitigation potential of urban systems.

3.6 Transport

In Bangladesh's NDC 2.0, the transport sector is a key focus area for achieving the country's climate mitigation goals. The sector is projected to significantly contribute to reducing emissions, with a target of reducing 36.28 $MtCO_2$ from the Business-As-Usual (BAU) scenario by 2030. To achieve this, the NDC outlines a range of measures aimed at enhancing fuel efficiency, promoting the use of cleaner technologies, and reducing emissions from the transport sector. Specific actions include the expansion of public transportation systems, such as Bus Rapid Transit (BRT) and Metro Rail (MRT) in major cities, promoting electric and hybrid vehicles, and improving road infrastructure. The introduction of Intelligent Transport Systems (ITS) and the development of a charging infrastructure for electric vehicles are also integral to these plans. By adopting these measures, the NDC 2.0 aims to transform the transport sector into a more sustainable, low-emission contributor to Bangladesh's overall climate objectives.

In alignment with Bangladesh's commitment to reducing greenhouse gas emissions and fostering a sustainable transport system, we propose the introduction of 10,000 Electric Vehicles (EVs) under NDC 3.0. This initiative aims to significantly cut carbon emissions by replacing traditional internal combustion engine vehicles with cleaner, energy-efficient EVs. The estimated emission reduction from this activity is approximately 25,000 tonnes of CO_2 per year, derived from the transition of 10,000 vehicles.

3.6.1 Estimated Investment and Costs

Each mid-range EV is estimated to cost USD 25,000. With 10,000 vehicles in the program, the total investment required for this initiative amounts to USD 250 million. This investment will cover the purchase of EVs, establishment of necessary infrastructure, such as charging stations, and the provision of incentives to encourage adoption.

3.6.2 Key Challenges

Despite the significant environmental benefits of EVs, several challenges must be addressed to ensure the successful implementation of this initiative:

1. Resistance from Fossil Fuel Promoters: Stakeholders in the fossil fuel sector may resist the transition to EVs due to the potential reduction in demand for fossil fuels, which would negatively impact their business models. Overcoming this resistance will require strong government policies, including subsidies and incentives, to facilitate the shift.

2. High Import Duties and Costs: The existing high import duties and taxes on electric vehicles increase their upfront costs, making them less accessible for the broader population. Reducing import duties and providing tax breaks will be crucial for making EVs more affordable and attractive to consumers.

3. Profit-driven Focus Over Public Health: Some industries may prioritize short-term profits over the long-term public health benefits associated with reduced air pollution and climate change mitigation. A shift in focus towards the public good, through awareness campaigns and policy reform, will be essential to align business practices with national climate goals.

4. Infrastructure Constraints: The lack of an extensive and reliable charging infrastructure poses a significant barrier to EV adoption. To address this, an investment in widespread, accessible charging facilities is essential, particularly in urban centers and along key transport corridors. Public-private partnerships can play a vital role in establishing this infrastructure.

5. Operation and Maintenance (O&M) Support: Ongoing operation and maintenance (O&M) of EVs and charging infrastructure will require a dedicated support system. This includes trained technicians,

service centers, and continuous monitoring of performance. Establishing a robust O&M framework will ensure that EVs remain reliable and functional.

6. Resale Value Apprehensions: Potential buyers often have concerns about the resale value of EVs due to the relatively new market for these vehicles. Providing clear guarantees on resale value, backed by government policies or manufacturer support, could alleviate this concern and boost consumer confidence in EV ownership.

The inclusion of EV adoption in NDC 3.0 is an essential step toward achieving a low-carbon, climate-resilient future for Bangladesh. By addressing the challenges related to cost, infrastructure, and market acceptance, this initiative can provide significant emission reductions while also promoting cleaner air and enhanced public health. With the necessary investment, policy support, and infrastructure development, the shift to EVs can become a cornerstone of Bangladesh's efforts to reduce its carbon footprint and foster sustainable development.

Chapter 4: Overall Proposal for NDC 3.0 of Bangladesh

To reduce GHG emission by 2030, Change Initiative recommends the following:

• Unconditional - 2.42% increase compared to NDC 2.0.
• Conditional - 11.77% increase compared to NDC 2.0.

The following table shows the sectoral potential for Bangladesh:

Sectoral Contribution	BAU				Unconditional Reduction				Conditional Reduction			
	NDC 2.0		NDC 3.0 (Estimated)		NDC 2.0		NDC 3.0 (Estimated)		NDC 2.0		NDC 3.0 (Estimated)	
	Mt CO2	%	Mt CO2	%	Mt CO2	%	Mt CO2	%	Mt CO2	%	Mt CO2	%
Energy (Power)	95.14	23.24	108.87	25.17	8.01	29.06	11.32	10.40	35.73	48.9	58.27	53.52
Transport	36.28	8.86	36.28	8.39	3.39	12.3	3.39	9.34	6.33	10.23	6.58	18.13
IPPU	10.97	2.68	20.37	4.71	-	-	-	-	-	-	3.908	19.18
AFOLU	55.01	13.44	55.01	12.72	0.64	2.32	0.757	1.38	0.4	0.65	0.752	1.368
Total	**409.41**	**100**	**432.58**	**100**	**27.56**	**6.73**	**39.58**	**9.15**	**61.9**	**15.12**	**116.35**	**26.89**

TABLE 14: OVERALL PROPOSAL FOR NDC 3.0 OF BANGLADESH

Energy/Power:

o Utility + rooftop solar (up to 42.5 $MtCO_2$ avoided in ideal scenario).
o Wind power (up to 18.5 $MtCO_2$ avoided).
o Grid loss reduction (26.5 $MtCO_2$ avoided).
o Gas efficiency (12.3 $MtCO_2$ avoided).
o Coal retirement/derating (0.4–9.1 $MtCO_2$ avoided).
o Nuclear/low-carbon imports (7.5 $MtCO_2$ avoided).

Industry (IPPU):

o Iron & steel: Shift to electric arc furnaces → ~1.78 $MtCO_2$ reduction.
o Fertilizer: Energy efficiency improvements → ~0.48 $MtCO_2$ reduction.

AFOLU:

o Sustainable rice cultivation, livestock feed improvements, manure management, and large-scale afforestation/reforestation.
o Tree cover target: raise from 22.37% to 24%.

Urban Systems:

o Energy efficiency in households (AC efficiency shift in Dhaka can save 4,302 MW).
o Socio-behavioral change (sustainable transport, reduced waste, efficient appliances).
o Green & blue infrastructure → carbon sequestration and urban cooling.

Transport:

o EV replacement program (10,000 vehicles).
o Estimated reduction: 25,000 tCO_2/year, but cost is high (≈USD 10,000 per tCO_2/year).

Overall mitigation finance required by 2030

a. Unconditional: USD40.29 billion (est.) for proposed NDC 3.0 (USD32.257 billion was estimated-for NDC 2.0)

b. Conditional: USD270.126 billion (est.) proposed for NDC 3.0 (USD143.710 billion was estimated for NDC 2.0)

Chapter 5: Cross-Cutting Priorities

Bangladesh's updated NDC must embed cross-cutting priorities to ensure that mitigation and adaptation efforts are equitable, inclusive, technologically progressive, and corruption-resilient. These priorities bridge sectors and anchor climate ambition in justice and accountability.

5.1 Just Transition and Equity

Bangladesh's energy shift affects an estimated 2.5 million workers in fossil-fuel–linked sectors and informal energy supply chains. A just transition strategy must create social protection mechanisms (cash transfers, pension coverage) and reskilling programs, targeting at least 30% workforce reskilling by 2030 to avoid job losses. Labor participation in energy planning and transparent benefit-sharing mechanisms is critical to prevent social exclusion and resistance to decarbonization.

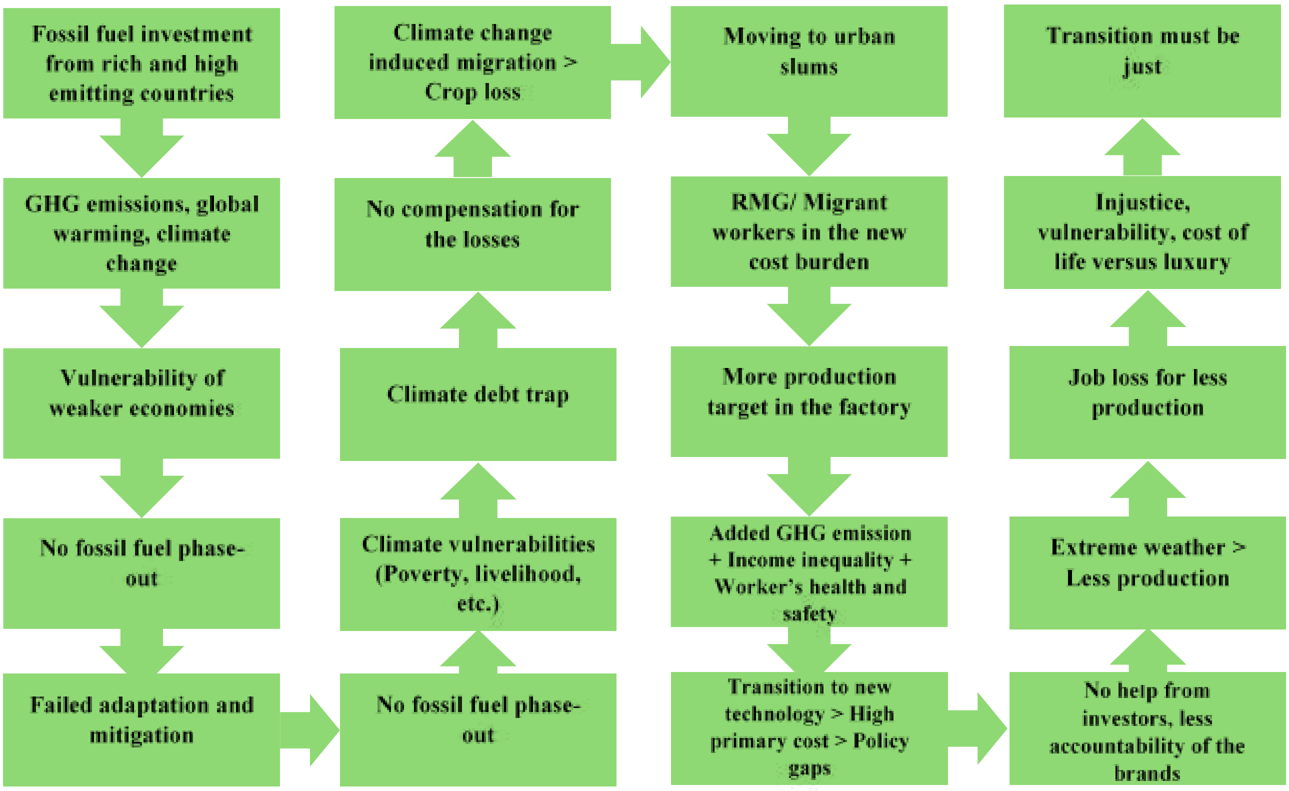

FIGURE 4: JUST TRANSITION AND EQUITY FLOW

GREF will act as a key arm of CFAF, dedicated to promoting mitigation strategies, specifically through the expansion of renewable energy. By redirecting a portion of the G20's fossil fuel subsidies, GREF will facilitate the flow of climate finance towards low-carbon projects in LDCs, accelerating their transition to renewable energy while also addressing loss and damage. Both mechanisms will work in tandem to strengthen climate finance flows, ensuring that countries and companies participating in these initiatives can meet their NDC targets while fostering equitable and sustainable energy transitions.

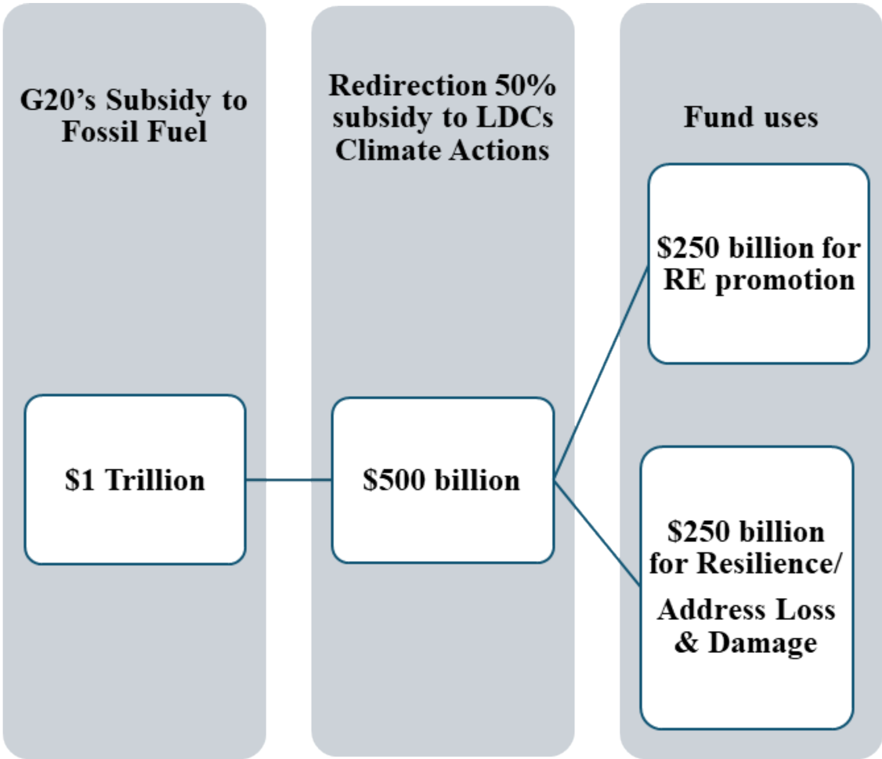

FIGURE 5: GLOBAL RENEWABLE ENERGY FUNDING(GREF) MECHANISM

5.2 Gender and Social Inclusion

Women represent nearly 50% of Bangladesh's rural agricultural labor force yet face higher exposure to climate shocks. During the 2022 flash floods, 1.9 million women and girls were affected in just 11 districts (Relief Web, 2022). Gender-responsive NDC implementation should target 50% female participation in community climate committees, and earmark at least 20% of climate finance flows for women-focused livelihood and resilience programs. Collecting sex-disaggregated MRV data will help track progress and close gender gaps.

5.3 Technology, Research, and Innovation

Meeting NDC 3.0 targets requires deploying 18,162 MW of renewable capacity by 2030 and cutting grid emission intensity by nearly 44 kg/MWh under the conditional scenario. This calls for advanced technologies such as AI-based grid monitoring, blockchain-enabled carbon accounting, and climate-smart agriculture research. A national research consortium could co-develop solutions like saline-tolerant rice varieties and affordable battery storage, aligning with a projected USD 35–42 billion investment requirement for renewables by 2040.

5.4 Governance Integrity and Anti-Corruption Safeguards

Governance failures currently result in only 1.25% of required conditional climate finance being mobilized (USD 3.39B out of USD 270B needed). Strengthening governance integrity means digitizing climate finance tracking, mandating independent audits, and establishing a National Climate Finance Force with civil society representation. Deploying satellite monitoring for AFOLU and smart meters for energy/transport can minimize leakage and double-counting, improving credibility in international carbon markets.

5.5 The outcome of mitigation activities in Natural Rights

Mitigation is portrayed not merely as a technical pathway to decarbonization but as an ethical cornerstone of planetary survival. By reducing GHGs, restoring ecosystems, and building resilience, mitigation enforces the natural rights of all beings to life, liberty, and security. It is intrinsically linked to preventing climate-induced poverty, forced migration, and violent conflict - outcomes that erode both human dignity and ecological integrity (Khan, 2025).

Mitigation Measures and Natural Rights Outcomes (NRLG Framework)

Mitigation Measure / Action	Natural Rights & NRLG Pillar Protected
Emission Reduction (Energy Transition, Renewable Energy)	Protects the *Right to Life* by reducing air pollution–related mortality and heat stress; advances **Nature Justice** by lowering planetary temperature rise, safeguarding ecosystems.
Nature-Based Solutions (Mangrove Restoration, Wetland Protection, Afforestation)	Upholds *Protection of Life and Property* by reducing disaster risk (storm surges, floods); preserves **Ecological Integrity** and the right of species to exist and regenerate.
Climate-Resilient Infrastructure (Cyclone Shelters, Flood Barriers)	Realizes the *Right to Security* and **Human-Ecological Security** by preventing loss of lives and livelihoods during disasters.
Sustainable Urban & Rural Planning	Protects *Liberty* (freedom from forced displacement) and secures **Shared Rights** to land, housing, and safe living spaces.
Pollution Control & Industrial Regulation	Safeguards *Right to a Safe Environment*; enforces **Natural Accountability** by obliging polluters to restore ecosystems and prevent harm.
Community-Led Early Warning & Preparedness Systems	Strengthens *Community Stewardship* and **Peaceful Governance**, giving local actors agency to protect lives and mediate resource conflicts.
Carbon Pricing & Just Transition Policies	Embeds **Equity and Intergenerational Justice** by ensuring that climate action costs are distributed fairly and that future generations inherit a habitable planet.
Legal Recognition of Nature's Rights (Constitutional / Statutory)	Codifies **Rule by Natural Law**; prevents exploitative projects that would infringe upon ecosystems' right to exist and regenerate.
Corporate & State Accountability for Restoration	Aligns with **Natural Accountability** and the duty to repair harm done to natural systems, restoring trust between society and governance structures.

TABLE 15: MITIGATION MEASURES AND NATURAL RIGHTS OUTCOMES (NRLG FRAMEWORK)

Chapter 6: Bangladesh’s NDCs: Stuck Between Ambition and Reality

Bangladesh stands at a critical juncture. Having submitted its revised NDC in 2021, the country has missed the 2024 deadline for its third update. This lapse is not a trivial matter, it reflects deeper structural, political, and financial obstacles that threaten to turn the NDC into a symbolic gesture rather than a functional roadmap for climate action.

6.1 Political Uncertainty and Institutional Drift

Political transitions create hesitation around long-term commitments. The NDC is legally a state obligation, not a government's preference. Yet interim arrangements and election cycles have stalled decisive action. Still, history shows continuity: the Bangladesh Climate Change Strategy and Action Plan (2008) survived political shifts. The real barrier is not the instability of governments but the absence of political leadership strong enough to push beyond paperwork into execution.
Institutional weaknesses deepen this paralysis. Agencies like SREDA were described as "toothless," unable to drive change in sectors like industrial processes (IPPU), which emit nearly 11 million tons CO_2e annually but remain excluded from reduction targets. Coordination failures among DOE, BERC, and energy authorities further fragment responsibility.

6.2 Narrow Targets and Ignored Sectors

The NDC's structure itself is flawed. Conditional and unconditional targets are poorly defined, with government officials claiming unconditional goals are already achieved, without transparent evidence. Many experts questioned these claims, citing missed commitments like the 2013 deadline for brick kiln reform.

More alarming is the omission of major polluting sectors.

• **Transport:** Identified as Bangladesh's second-largest emitter, reliant on diesel-heavy, poorly maintained fleets that spew black carbon. Yet transport decarbonization is absent from the current NDC framework.
• **Waste:** Despite being one of the most polluted cities globally, waste management remains an afterthought in climate planning. Methane emissions from landfills across Dhaka remain unchecked.
Without bringing these sectors into the mitigation portfolio, the upcoming NDC risks missing the very sources it claims to tackle.

6.3 Data Deficits and MRV Failures

Bangladesh suffers from a crippling lack of reliable data. There is no central database to track transport emissions, vehicle fuel mix, or actual renewable energy generation. Even the national carbon inventory reports "carbon stock" rather than tradable CO_2, making them unusable for international markets.
Globally, the shift is toward digital MRV (D-MRV) AI, satellite imagery, geofencing, blockchain verification. Local developers have already deployed these tools in pilot projects, but government systems lag far behind. Without verifiable data, Bangladesh cannot credibly prove emission reductions, access low-interest finance, or avoid double counting under Article 6 of the Paris Agreement.

6.4 Finance, Mindset, and Missed Opportunities

Climate finance is another battleground. The country needs USD3.225 billion/year for unconditional implementation as per the NDC 2.0; but from 2020-2024, the Bangladesh government allocated only USD 0.36 billion/year on average. Besides, the country needs almost USD27.12 billion/year for conditional implementation. But there is a huge mitigation gap here, as the country received only USD 3.39 billions of the required USD 270.126 billion (only 1.254%).

Officials lament the lack of funds for conditional targets, but experts Argue the real issue is a "begging bowl" mindset-building unrealistic $230 billion plans without aligning with actual financial flows. Adaptation continues to dominate domestic spending priorities, leaving mitigation underfunded.

Yet, carbon finance offers an underutilized pathway. While cookstove credits are losing value, blue carbon (mangroves, seaweed) and AFOLU (agroforestry, AWD agriculture) projects could fetch $40–90 per ton, compared to the paltry $3–4 per ton from renewables. If Properly scaled, Bangladesh could earn up to $5 billion annually by 2030 through carbon credits. However, policy gaps, lack of government capacity, and preference for foreign developers prevent local actors from seizing this opportunity.

Sector	**Credit Price Range (USD/tCO_2e)**	**Illustrative Annual Potential (MtCO_2e credits)**	**Revenue Potential (USD, bn)**	**Notes/Justification**
Blue Carbon (Mangroves, Seaweed)	$75 (mangroves); $80–90 (seaweed)	~15–20	1.2–1.6	High-value credits; Sundarbans mangroves + coastal seaweed farms. Strong co-benefits for adaptation and biodiversity.
Forestry/Agroforestry	$36–42	~25–30	0.9–1.2	Agroforestry and homestead forestry can be scaled nationwide. Reforestation gaps (21% vs. 50% ideal cover) show large room for credit generation.
Agriculture (AWD, regenerative)	$36–55	~20–25	0.9–1.3	AWD in rice, regenerative soil practices; aligns with food security while cutting methane and nitrous oxide.
Waste Management	(Comparable to AFOLU range $30–40)	~10–15	0.3–0.5	Methane capture from landfills, waste-to-energy, composting. Dhaka's unmanaged waste streams = high mitigation potential.
Electric Vehicles	3-wheelers $25–26; 4-wheelers $40	~10–12	0.3–0.5	EV shift depends on charging corridors; high-value credits if linked to zero-emission grids.
Renewables (Solar, Wind)	$3–4 (lowest globally)	~50–60	0.15–0.2	Already crowded market; credits fetch lowest value, but high volume possible (rooftop solar, mini-grids).
Total Expected Potential			~4.7-5.3	

TABLE 16: SECTORAL CARBON CREDIT POTENTIAL FOR BANGLADESH BY 2030

6.5 Governance and Trust Building

Underlying all technical and financial issues is a governance deficit. Corruption and weak enforcement mean that even well-designed plans falter. Old, polluting buses remain on the road because bribes replace inspections. Households resist waste separation because collectors are untrained and unaccountable. Without institutional trust and enforcement, even the most visionary NDC cannot work.

6.6 Call to Action

- Introduce carbon tax, pollution tax and carbon trading.
- Establish a National Data Hub and a Digital Decentralised Autonomous MRV system.
- Establish an integrated Climate Finance Task Force.
- Monitor through satellite & geofencing for AFOLU/forestry.
- Install smart meters & fuel registries for energy/transport.
- Waste methane monitoring (landfill gas, compost).
- Conditional ambition must be realistic and linked to finance.
- Documentation of NDC 3.0 implementation plan within a year after consulting relevant stakeholders.
- Install smart meters & fuel registries for energy/transport.
- Waste methane monitoring (landfill gas, compost).
- Conditional ambition must be realistic and linked to finance.
- Study potential for CSRs, Philanthropy e.g. Zakat, donations etc.
- Allocate a portion of funds to local authorities, academia, and community-based groups to strengthen ownership and increase diverse ideas (as suggested in KII) rather than keeping budgets centrally controlled.

Bangladesh's NDC challenges are not technical mysteries; they are political, institutional, and financial choices. The results show a country with ample potential 50 GW of solar, lucrative blue carbon reserves, and untapped waste-to-energy but hamstrung by weak governance, poor data, and narrow thinking.

If NDC-3.0 is to be more than a "tick-mark exercise," it must recognize these realities. Only then can Bangladesh shift from pledges on paper to emissions reduced in practice, from missed deadlines to measurable progress, and from being a climate victim to becoming a credible leader.

Chapter 7: Conclusion

In conclusion, Bangladesh's updated NDC 3.0 presents a critical opportunity to significantly reduce emissions and enhance climate resilience. Through a combination of unconditional and conditional measures, including renewable energy expansion, energy efficiency improvements, and nature-based solutions, the country can achieve substantial emission reductions. However, the success of these efforts will depend on securing adequate financial support, strengthening institutional coordination, and overcoming barriers in policy implementation. By aligning ambition with actionable steps and external support, Bangladesh can make meaningful progress toward its climate goals while fostering sustainable development.

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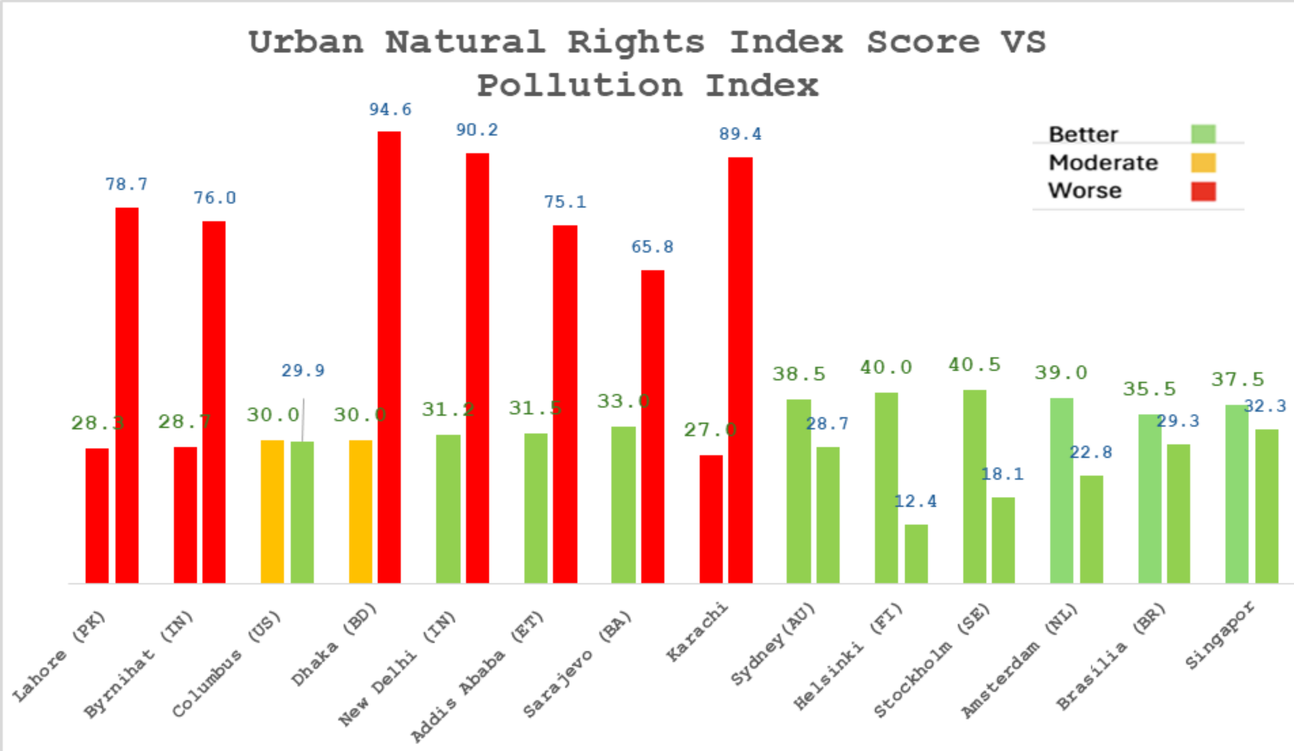
Annex

The Need for Urban System-Based GHG Emission Reduction



Dhaka (30, 94.6) stands out as an outlier, with pollution levels far higher than its UNRI score would suggest. In contrast, Columbus (30, 29.9) sits well below the regression line, showing much lower pollution than predicted. The red-coded cluster in the upper-left-Karachi, Lahore, and Byrnihat-combines poor UNRI performance with severe pollution, placing them in the most concerning category. New Delhi and Addis Ababa (which has worked to expand green space), along with Sarajevo (supported by relatively stronger governance), have somewhat higher UNRI scores but still face significant pollution burdens. On the other end, the green-coded cities in the bottom-right-Columbus, Brasília, Singapore, Sydney, Amsterdam, Stockholm, and Helsinki-pair strong rights protection with cleaner air. This quadrant signals cities where UNRI scores are strong but there's still room to reduce pollution further, which would secure their place among the best-performing group.

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