Carbon Trading for Renewable Energy in Bangladesh: Unlocking Low-Carbon Potential, Economic Value and Policy Pathways Under Article 6 of the Paris Agreement

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ABSTRACT

Bangladesh wants renewable sources to meet 20% of its electricity demand by 2030 and 30% by 2040, but installed renewable capacity stood at only 1,819 MW in July 2026 and private investment has been slow. Article 6 of the Paris Agreement offers a way to sell verified mitigation abroad, and the government has moved quickly to use it: an Article 6 authority was created in 2024, a carbon market framework was drafted in 2025, and the first Article 6-aligned transaction, based on solar home systems, closed in January 2026. This paper asks how much saleable mitigation Bangladesh's renewable sector could generate, what it would be worth, whether carbon revenue would change investment decisions, and who would buy the credits. Using secondary data from SREDA, IDCOL, UNFCCC and JCM registries, World Bank transaction documents and the official grid emission factor, it reviews the carbon record of each renewable technology and models the 2026–2030 national pipeline of 10,450 MW. At full build-out the pipeline would displace about 9.7 $MtCO_2$ a year, or 7.9 $MtCO_2$ if the grid emission factor falls to 0.50 tCO_2/MWh. Across eligibility, price and grid scenarios, net carbon revenue ranges from US$4 million to US$170 million a year, at most 18% of the annual investment need. Cash-flow models show that credits at US$15–22 per tonne raise the returns of grid-connected projects by only 1–3 percentage points. That is irrelevant for utility-scale and industrial rooftop solar, which already clear their hurdle rates; it brings wind at current tariffs only to the edge of a 12% hurdle; and it is far too small to make solar irrigation pumps viable without grants. Indicative demand from Japan's Joint Crediting Mechanism, the aviation scheme CORSIA and export garment buyers is about 0.5–3.6 $MtCO_2$ a year, so volumes beyond the restrictive scenario are likely to be limited by demand. The paper sets out policy pathways on eligibility, authorisation, benefit-sharing and domestic demand.

Keywords: Article 6; carbon markets; renewable energy; Bangladesh; additionality; benefit-sharing; climate finance

INTRODUCTION

Few countries have as much at stake in the energy transition as Bangladesh, and few have had as little money to pay for it. The country emits a small share of global greenhouse gases, about 0.4% in 2018 (World Bank, 2024a), yet it ranks among the states most exposed to cyclones, floods and storm surges. Its power system has grown fast, reaching close to 29,500 MW of installed capacity by mid-2026, but most of that capacity burns natural gas, imported liquefied natural gas, coal and oil (SREDA, 2026). Gas from domestic fields is running down, imported fuel has drained foreign reserves, and load-shedding returned as a routine experience in 2022–2023.

Renewable energy is the obvious answer, and on paper the targets are ambitious. The Renewable Energy Policy 2025 aims to meet 20% of electricity demand from renewable sources by 2030 and 30% by 2040. The National Renewable Energy Development Strategy (NREDS) 2026–2030 translates the first target into about 27,000 GWh

of renewable electricity in 2030 and a programme of 10,450 MW of new capacity, mostly rooftop and ground-mounted solar (SREDA, 2026). Bangladesh's third Nationally Determined Contribution (NDC 3.0), submitted in September 2025, commits to cutting emissions 6.39% below business-as-usual by 2035 on its own and a further 13.92% with international support (MoEFCC, 2025). The reality on the ground is less encouraging. On 22 July 2026 the country had 1,818.86 MW of renewable capacity, of which 1,525.77 MW was solar, and renewables supplied less than 6% of electricity (SREDA, 2026). Meeting the 2030 goal requires adding about 2,090 MW a year, a pace never achieved before, and analysts estimate an investment need of US$933–980 million a year to 2030 (New Age, 2025, citing IEEFA).

Carbon markets are one of the few sources of money that grow with the mitigation delivered. Bangladesh has used them before. Under the Clean Development Mechanism (CDM), the Infrastructure Development Company Limited (IDCOL) and Grameen Shakti registered the world's first solar home system Programme of Activities to receive certified emission reductions, and improved cookstove programmes followed. The returns were small. Bangladesh's CDM projects produced about 1.26 million CERs, or 0.53% of global issuance by December 2023 (IEEFA, 2025a), and total carbon revenue over almost two decades has been put at around US$16 million (The Climate Watch, 2026b).

The Paris Agreement changed the rules. Article 6.2 lets countries trade internationally transferred mitigation outcomes (ITMOs) under bilateral agreements, and Article 6.4 creates a centrally supervised crediting mechanism, the Paris Agreement Crediting Mechanism (PACM). Both require the host country to authorise transfers and to apply corresponding adjustments, so that a tonne sold abroad no longer counts towards the host's own NDC. Bangladesh has responded faster than most least developed countries. It formed an Article 6 Designated National Authority in June 2024, completed an Article 6 readiness roadmap, drafted a national Carbon Market Framework with a positive list of eligible activities, and in January 2026 completed what the World Bank describes as its first carbon transaction aligned with Article 6 (World Bank, 2025). On 5 July 2026 the Prime Minister directed officials to prepare an action plan to expand carbon credit generation (The Business Standard, 2026c).

This enthusiasm sits uneasily with a growing body of evidence that renewable energy credits are often not additional. In 2024 the Integrity Council for the Voluntary Carbon Market (ICVCM) refused its Core Carbon Principles label to eight renewable energy methodologies covering about a third of the voluntary market (ICVCM, 2024). Calel et al. (2025) found that at least 52% of CDM credits for Indian wind farms went to projects that would have been built anyway, and a meta-analysis by Probst et al. (2024) found no statistically significant emission reductions from wind projects that earned credits. If Bangladesh simply sells credits from solar parks that would be built regardless, it risks giving away cheap mitigation it will later need for its own NDC, while buyers increasingly refuse to pay for such credits at all.

The existing literature on Bangladesh does not resolve this tension. Studies of the country's renewable sector describe resources, targets and barriers (Islam et al., 2014; Mahbub and Islam, 2023; Akash et al., 2024; Raihan et al., 2025), and a separate literature evaluates solar home systems and solar irrigation (Samad et al., 2013; Mitra et al., 2024). None estimates how much creditable mitigation the national renewable pipeline could generate under the new Article 6 rules, or what it would be worth. This paper fills that gap. It asks three questions:

1. What carbon-market experience does each renewable energy technology in Bangladesh have, and what does it teach?

2. How much emission reduction could the 2026–2030 renewable pipeline generate, and how much of it could plausibly be sold?

3. What would that be worth in market and social terms, would it change investment decisions, who would buy it, and which policy choices would decide the outcome?

The paper makes four contributions. It provides the first technology-by-technology inventory of Bangladesh's renewable carbon record, from the CDM to the Ci-Dev pilot. It offers a transparent, reproducible estimate of the

mitigation and revenue potential of the NREDS pipeline under explicit integrity, price and grid emission factor scenarios. It tests the additionality of representative projects with simple cash-flow models and sets the supply of credits against indicative demand. And it draws policy lessons on eligibility, authorisation and benefit-sharing that apply to other least developed countries entering Article 6 markets.

The rest of the paper is organised as follows. Section 2 reviews the literature on carbon markets and renewable energy. Section 3 describes Bangladesh's policy and institutional setting. Section 4 sets out the data and methods, Section 5 presents the results, and Section 6 discusses them. Section 7 proposes policy pathways and Section 8 concludes.

CARBON MARKETS AND RENEWABLE ENERGY: WHAT THE LITERATURE SHOWS

2.1 From the CDM to Article 6

The CDM was the first large experiment in paying developing countries for emission reductions, and renewable energy dominated it. Grid-connected wind, hydro and solar projects in China and India produced a large share of all CERs, while least developed countries hosted few projects and earned little (Michaelowa, 2012). Two features of the CDM shaped that outcome. Projects were approved one at a time, with high transaction costs that favoured large installations in big economies. And demand depended almost entirely on the European Union's emissions trading system; when the EU restricted the use of CERs after 2012, prices collapsed and many projects never sold their credits (Michaelowa et al., 2019b).

Programmes of Activities (PoAs) were introduced partly to fix the first problem. A PoA lets a coordinating entity add many small units, such as household solar systems or cookstoves, under one registration. Bangladesh became an early and successful user of this model, and its solar home system PoA was the first of its kind anywhere to be issued credits (Chang, 2015; UNFCCC, n.d.).

The Paris Agreement replaced the Kyoto split between buyers and sellers with a world in which every country has an NDC. That change brought a new problem. When a host country sells a tonne of mitigation abroad, both countries could claim it unless the seller adds the tonne back to its own emissions balance through a corresponding adjustment. Article 6.2 handles this through bilateral cooperative approaches with authorisation and adjustment, and Article 6.4 through a supervised mechanism that took over eligible CDM activities. Decision 3/CMA.3 also requires that 5% of issued Article 6.4 units go to the Adaptation Fund as a share of proceeds and that 2% be cancelled to deliver an overall mitigation in global emissions (UNFCCC, 2021). Schneider and La Hoz Theuer (2019) set out the conditions for environmental integrity under this framework: robust accounting, high unit quality, ambitious NDCs and safeguards against over-selling. Schneider et al. (2020) add that mitigation outside the scope of an NDC carries higher risks, because the host has weaker incentives to guard quality.

Japan's Joint Crediting Mechanism (JCM) offered an early bilateral alternative. Bangladesh signed a JCM agreement in March 2013 and hosted projects on energy-efficient chillers, high-efficiency looms and a solar-diesel hybrid system at a factory (ADB, 2016; JCM, n.d.). The JCM is now often cited as a template for Article 6.2 deals.

2.2 Additionality and the integrity of renewable energy credits

The central question for any credited project is whether it would have happened without carbon revenue. For renewable energy this question has become harder to answer in the affirmative over time. As solar and wind costs fell, many projects became profitable without credits, and carbon revenue became a small addition to cash flows dominated by power sales. Michaelowa et al. (2019a) argue that additionality testing under Article 6 must move from project-level investment analysis towards standardised baselines, positive lists and dynamic benchmarks tied to host-country policy.

Empirical studies now quantify the problem. Calel et al. (2025) built a dataset of more than 1,000 Indian wind farms and estimated that at least 52% of approved CDM offsets went to projects that would very likely have been built anyway, which means the sale of those offsets raised global emissions. Probst et al. (2024) synthesised 14 rigorous studies covering 2,346 crediting projects and concluded that fewer than 16% of issued credits represent real emission reductions, with no statistically significant reductions for wind power. These findings shaped the ICVCM's 2024 decision to deny its quality label to the main grid-connected renewable methodologies (ICVCM, 2024). In 2026 the Council conditionally approved a new Verra methodology for grid-connected renewables that requires stronger additionality and baseline tools (ClearBlue Markets, 2026), which suggests a narrow path back for renewable credits where carbon revenue is shown to be decisive.

The market has responded. The average voluntary credit price in 2024 was US$6.34 per tonne, pulled down by legacy renewable credits, while transaction volumes fell by 25% (Ecosystem Marketplace, 2025). Credits eligible for the aviation sector's CORSIA scheme traded at US$15–22 per tonne between September 2025 and April 2026 (World Bank, 2026). Price, in other words, now depends heavily on perceived integrity.

2.3 Carbon finance in the Bangladesh energy literature

Research on renewable energy in Bangladesh is extensive but rarely engages with carbon markets. Reviews describe solar, wind, hydro and biomass potential and the barriers of land, finance and grid capacity (Islam et al., 2014; Mahbub and Islam, 2023; Akash et al., 2024; Raihan et al., 2025). Studies of foreign investment identify institutional stability, local finance and land as the decisive factors for wind and solar investors (Mahbub et al., 2022; Mahbub, 2026). The off-grid literature documents the welfare benefits of solar home systems, including longer evening study, lower kerosene use and health gains for women (Samad et al., 2013), and the organisational model of Grameen Shakti (Sovacool and Drupady, 2011). Work on solar irrigation estimates diesel savings and emission reductions per pump and compares business models (Hoque et al., 2016; Mitra et al., 2024).

Where carbon finance appears, it is mostly as a passing reference to CDM revenue. Mitra et al. (2024) come closest to an economic valuation, using a social cost of carbon of US$185 per tonne (Rennert et al., 2022) to value solar irrigation pumps. Policy commentary since 2025 has discussed Article 6 readiness (IEEFA, 2025a) and the risks of a credit rush (The Business Standard, 2026a), but no peer-reviewed study has estimated the creditable volume and value of Bangladesh's renewable pipeline under Article 6 rules. That is the gap this paper addresses.

POLICY AND INSTITUTIONAL CONTEXT IN BANGLADESH

3.1 Renewable energy policy

Bangladesh's first Renewable Energy Policy, issued in 2008, set a target of 10% renewable electricity by 2020. The target was missed by a wide margin; renewables supplied about 3.6% of grid electricity in early 2025 (ITA, 2025). The Sustainable and Renewable Energy Development Authority (SREDA) was created by law in 2012 to coordinate renewables and efficiency, and the Integrated Energy and Power Master Plan of 2023 set longer-term scenarios to 2050.

The current framework rests on four instruments. The Renewable Energy Policy 2025 sets the 20% and 30% demand-share targets for 2030 and 2040 and introduces tax holidays, import-duty relief, a feed-in tariff and renewable purchase obligations. The Net Metering Guideline 2025 raised the permitted rooftop system size to 100% of a consumer's sanctioned load and opened net metering to single-phase users (pv magazine, 2025). A Power Division circular of December 2025 made net-metered rooftop solar mandatory for new connections in buildings with at least 1,000 square feet of usable roof (BSS, 2025). Finally, NREDS 2026–2030 and the draft National Renewable Energy Roadmap 2026 set a year-by-year build-out of 5,500 MW of rooftop solar, 4,500 MW of ground-mounted solar, 150 MW of wind, 200 MW of waste-to-energy and 100 MW of other technologies (SREDA, 2026). Notably, the Roadmap lists "carbon-credit procedures" among its regulatory priorities and includes a dedicated section on carbon credits and Article 6 as a financing source.

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Commentators have questioned whether the targets are coherent. The Centre for Policy Dialogue argues that NDC 3.0's 25% renewable power share for 2035 is inconsistent with the 2025 policy and that the underlying arithmetic confuses capacity with demand (Moazzem and Preoty, 2025). IEEFA notes that only about 400 MW of utility-scale projects were under construction when the policy was approved and that foreign developers had retreated after contract cancellations (IEEFA, 2025b).

3.2 Building an Article 6 system

Bangladesh's carbon-market institutions have been built quickly and largely with World Bank support (Fig. 1). The Ministry of Environment, Forest and Climate Change (MoEFCC) issued a gazette notification forming an Article 6 Designated National Authority on 27 June 2024, with a Governing Board chaired by the ministry, a secretariat in the Department of Environment (DoE) and a technical committee (World Bank, 2024a). DoE published an Article 6 Readiness Roadmap in late 2024 (DoE, 2024) and, as the Article 6 authority, notified an official grid emission factor of 0.61 tCO_2/MWh for 2019–20 and 0.62 tCO_2/MWh for 2020–21 and 2021–22 (DoE, 2025a).

The draft Bangladesh Carbon Market Framework was "pre-launched" at COP30 in November 2025 (Carbon Pulse, 2025). It covers Article 6.2 cooperative approaches, the Article 6.4 mechanism and voluntary-market projects that seek authorisation for NDC use, and it provides for a national carbon registry, approved standards, fees and a share of proceeds (DoE, 2025b). A positive list of priority activities, with renewable energy at the top, went to public consultation until February 2026, and a share of carbon revenue is to flow to a national climate fund (The Climate Watch, 2026a). The government's stated rule is that activities in the conditional part of NDC 3.0 may be developed for Article 6, while unconditional actions are reserved for domestic compliance (A6IP, 2026). An inter-ministerial meeting reviewed the draft framework on 28 July 2026 (The Climate Watch, 2026c).

Bangladesh has also been one of the most active host countries in approving the transition of CDM activities to the Article 6.4 mechanism. By December 2025 it had approved 92% of the credits from its activities that requested transition, mainly improved cookstoves, water purification and gas-leak repair (Fastmarkets, 2025). None of these is a renewable electricity project, which is itself telling.

3.3 The Ci-Dev pilot: a first Article 6-aligned transaction

The most important precedent for renewable energy is the World Bank's Climate and Carbon Finance for Renewable Energy project. Under an Emission Reduction Purchase Agreement signed with IDCOL in January 2025, the Carbon Initiative for Development (Ci-Dev) agreed to pay up to US$16.76 million for verified emission reductions generated between January 2021 and December 2024 by 3.3 million existing solar home systems (World Bank, 2024a; Ci-Dev, 2025). The reductions are quantified under a Bangladesh-specific methodology approved by the Article 6 authority and issued under the Standardized Crediting Framework, a country-owned crediting scheme developed by Ci-Dev. A Host Country Agreement between the government and the World Bank followed in November 2025, and the transaction was completed in January 2026 (World Bank, 2025).

The design of this deal matters more than its size. The reductions bought by Ci-Dev, called Type 1 units, are transferred back to Bangladesh and can only be used towards its own NDC. Converting them into ITMOs (Type 2 units) that leave the country requires separate bilateral agreements, authorisation and corresponding adjustments, and the appraisal document explains that such conversion would need additional payment because it creates an opportunity cost for the government's own target (World Bank, 2024a). IDCOL intends to use the proceeds to keep existing solar home systems working, many of which were at risk as partner organisations struggled with household loan defaults, and to fill part of the funding gap in its solar irrigation programme, where available funds covered only 52% of the required cost (World Bank, 2024a, 2024b).

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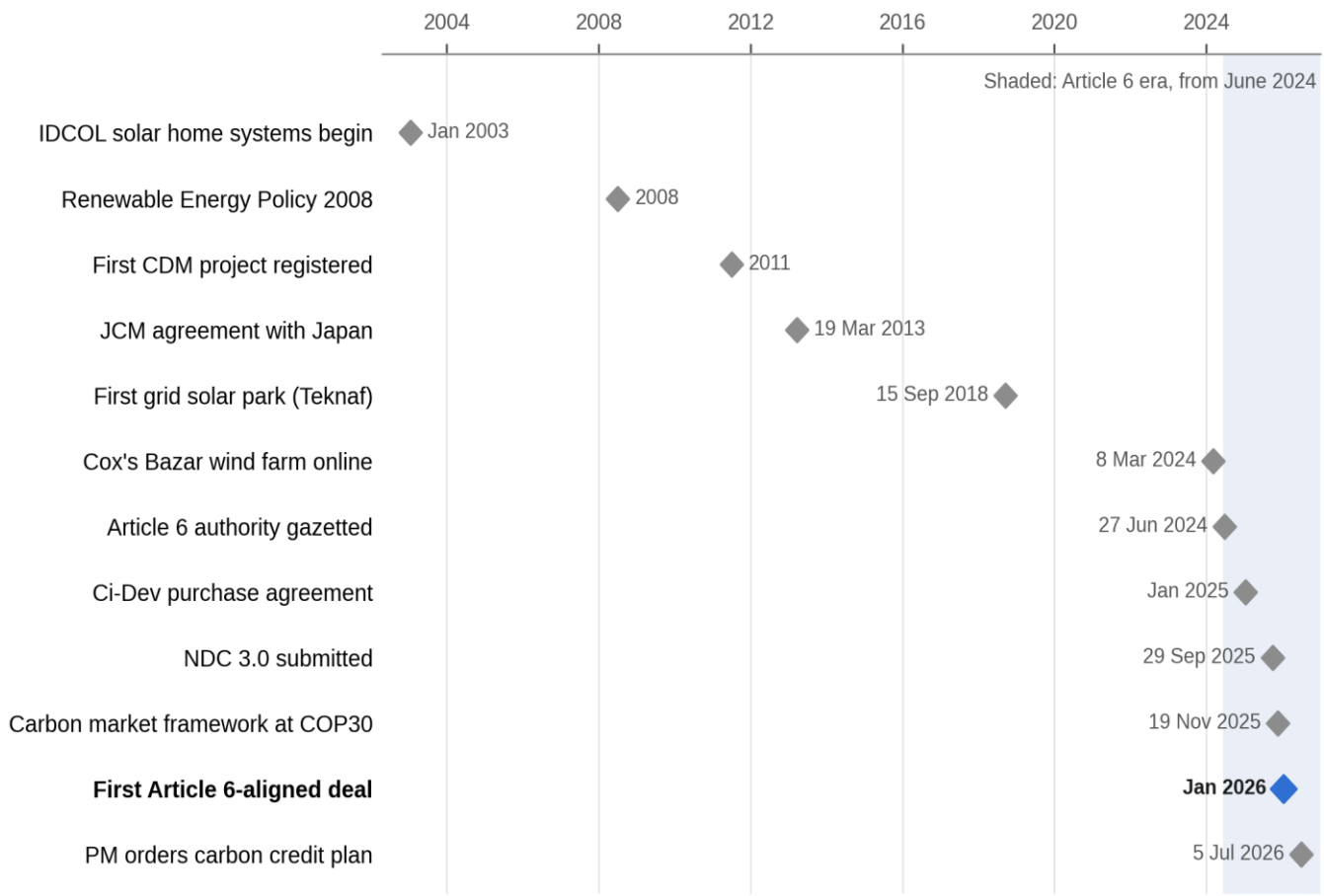


Fig. 1. Milestones in Bangladesh's renewable energy and carbon-market history, 2003–2026. Two decades of project-by-project crediting were followed by a compressed period in which the main Article 6 institutions and the first aligned transaction arrived within about two years. Events known only by year are placed mid-year. Source: SREDA (2026); World Bank (2024a, 2025); Ci-Dev (2025); MoEFCC (2025); Carbon Pulse (2025); ADB (2016); The Business Standard (2024a, 2026c).

MATERIALS AND METHODS

Research design and data

The study uses a mixed design built entirely on secondary data. A structured document review establishes the carbon-market record of each renewable technology, and a transparent accounting model estimates the mitigation and economic value of the planned pipeline. All inputs come from public sources, listed in Table 1, so that every figure can be reproduced.

Table 1. Data sources

Data	Source	Used for
Installed renewable capacity by technology, 22 July 2026	SREDA National Database of Renewable Energy, as reported in SREDA (2026)	Baseline portfolio
NREDS capacity additions by year and technology, 2026–2030	SREDA (2026), Table 7.14	Pipeline scenario
2030 renewable generation target (27,000 GWh)	SREDA (2026)	Target comparison
Grid emission factor (0.62 tCO_2/MWh)	DoE (2025a)	Baseline emissions
CDM registrations and issuances; CDM-to-Article 6.4 transitions	UNFCCC CDM registry; Fastmarkets (2025)	Carbon record

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue IX September 2026

JCM agreement and projects	JCM Bangladesh–Japan portal; ADB (2016)	Carbon record
Ci-Dev transaction terms	World Bank (2024a, 2024b, 2025); Ci-Dev (2025)	Carbon record and price signal
Voluntary and CORSIA credit prices	Ecosystem Marketplace (2025); World Bank (2026)	Price scenarios
Social cost of carbon	Rennert et al. (2022)	Social value
Solar irrigation emission reductions and costs	Mitra et al. (2024)	Project illustration
Annual renewable investment need	New Age (2025), citing IEEFA	Comparison
Project costs, tariffs and output for cash-flow models	The Business Standard (2024b, 2025b, 2026b); IRENA (2025); Mitra et al. (2024); Alam (2022)	Financial test of additionality
JCM, CORSIA and garment-sector demand indicators	Carbon Credits (2026); DoE (2025c); MoEJ (2022); IATA (2025); Relae (2026); Stand.earth (2026)	Demand estimates
Benefit-sharing rules in other countries	Bowmans (2024); Engineering News (2023); CAP-A (2024)	Benefit-sharing proposal

Estimating emission reductions

For grid-connected technologies, annual emission reductions in year *y* equal net generation multiplied by the grid emission factor:

$$ER_y = \Sigma_i \left(\Sigma_{t \le y} C_{i,t} \right) \times CF_i \times 8{,}760 \times EF_{grid} \quad (1)$$

where C is the capacity of technology *i* added in year *t* (MW), CF is the annual capacity factor, 8,760 is hours per year and EF is the official grid emission factor. Capacity factors are set at 0.16 for rooftop and ground-mounted solar and other technologies (mainly floating solar and agrivoltaics), 0.25 for wind and 0.70 for waste-to-energy. These are conservative values for Bangladesh's irradiance and coastal wind regime; the wind value matches the expected output of the Cox's Bazar wind farm, about 145 GWh a year from 66 MW of installed turbines (The Business Standard, 2024b). A sensitivity range of 0.14–0.18 is applied to solar. For waste-to-energy, only displaced grid electricity is counted; avoided landfill methane, which could be larger, is excluded.

Two simplifications in the base case need to be stated plainly. First, annual figures count the full-year output of all capacity installed by the end of each year, so the 2030 value is the annual run-rate of the completed pipeline rather than the output of the 2030 calendar year. Second, the grid factor is held at its latest official value. The first choice always raises the estimate for a given calendar year. The second raises it if the grid becomes cleaner and lowers it if the grid becomes dirtier, so in the decarbonising case the two compound rather than offset. Section 5.6 quantifies them with a mid-year commissioning convention and three grid factor paths: constant at 0.62 tCO_2/MWh; declining linearly to 0.50 tCO_2/MWh in 2030, as the grid decarbonises; and rising linearly to 0.66 tCO_2/MWh in 2030, if new coal and LNG plants raise the carbon intensity of the margin.

For off-grid systems the baseline is not grid electricity but kerosene lighting and diesel pumping. Their record is taken from published transaction and project data rather than modelled.

From gross reductions to creditable volume

Not every tonne displaced can be sold. Three scenarios capture the main uncertainty, which is which technologies can show that carbon revenue is decisive (Table 2). In all three, a 20% deduction is applied for conservative baselines, uncertainty and buffers, and a further 7% is deducted to reflect the Article 6.4 share of proceeds (5%) and the cancellation for overall mitigation (2%), used here as a proxy for fees under any route.

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Table 2. Creditable-volume scenarios

Scenario	Technologies treated as creditable	Rationale
V1 Restrictive	Wind, waste-to-energy, other emerging technologies	High-cost or early-stage technologies with the clearest additionality case; consistent with the ICVCM's openness to renewable methodologies where clean energy is expensive or hard to deploy
V2 Moderate	V1 plus rooftop solar	Upper-middle case: distributed solar delivered through standardised programmes, where non-financial barriers and positive-list approaches may support additionality (tested in Section 5.7)
V3 Expansive	Entire pipeline, including ground-mounted solar	Upper bound if Article 6 buyers accept host-country authorisation of all listed activities

The scenarios are judgements about eligibility. Section 4.6 describes a financial test that checks them against project-level returns, and Section 5.7 reports the result.

Price scenarios and revenue

Net revenue R combines creditable volume with three prices: US$6.34 per tonne, the average voluntary price in 2024 (Ecosystem Marketplace, 2025); US$15, the lower end of CORSIA-eligible trading; and US$22, its upper end (World Bank, 2026):

$$R_y = ER_y \times \alpha_v \times (1 - d) \times (1 - s) \times P_p \quad (2)$$

where α is the creditable share under volume scenario v, d is the 20% deduction, s is the 7% share of proceeds and P is the price under scenario p. The nine combinations bracket plausible outcomes rather than forecast a single one. Revenue is compared with the estimated annual renewable investment need (midpoint US$956.5 million) and expressed per MWh to compare with the levelised cost of solar electricity, reported at US$97–135 per MWh (BIDA, n.d.).

Social value

The social value of avoided emissions is estimated with the social cost of carbon:

$$SV_y = ER_y \times SCC \quad (3)$$

using the central estimate of US$185 per tonne and its 5–95% range of US$44–413 (Rennert et al., 2022). The ratio of market revenue to social value shows how much of the climate benefit carbon markets actually pay for.

A financial test of additionality

To test whether carbon revenue would change investment decisions, the study builds simple discounted cash-flow models for four representative project types, run as seven cases: industrial rooftop solar used for self-consumption, utility-scale solar at two tariff levels, onshore wind at two tariff levels, and an IDCOL solar irrigation pump with and without its usual grant. Inputs come from public sources and are listed with their sources in Appendix Table A1. For each project the model computes the internal rate of return (IRR) in US dollar terms, first without carbon revenue and then with net credit revenue at the three price scenarios. The net present value (NPV) at discount rate r is

$$NPV = -I + \Sigma_{t=1\ldots N} [E_t \times T - O_t + Q_t \times P \times (1 - d) \times (1 - s)] / (1 + r)^t \quad (4)$$

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where I is the initial investment, E is annual output, T the tariff or avoided bill, O the operating cost, Q the tonnes of CO_2 avoided, P the credit price, and *d* and *s* the deduction and share of proceeds used in Section 4.4. With those deductions, a credit price of US$15 per tonne adds US$6.92 per MWh of grid electricity displaced.

The test follows the investment-analysis logic of the CDM additionality tool. A project is treated as financially additional if its IRR without carbon revenue falls below a hurdle rate, set here at 10–12%, which matches the upper end of the cost-of-capital range IRENA (2025) assumes for developing regions. Carbon revenue is treated as decisive only if it lifts the IRR from below the hurdle to above it. The study also reports the break-even carbon price, the credit price at which the project's NPV at the hurdle rate reaches zero. The models are deliberately simple: they ignore taxes, debt structure and currency risk, so they indicate orders of magnitude rather than bankable returns.

Estimating demand

Demand is estimated for the three buyer groups that dominate the policy debate. For Japan's Joint Crediting Mechanism (JCM), the upper bound assumes that Bangladesh obtains an equal share of Japan's goal of about 100 $MtCO_2$ of international reductions by fiscal year 2030, spread across its 32 partner countries and over 2026–2030 (Carbon Credits, 2026); the lower bound is the expected annual output of Bangladesh's current JCM portfolio (DoE, 2025c). For CORSIA, the estimate assumes that Bangladesh supplies 1–2% of first-phase demand for eligible units, which IATA (2025) puts at 146–236 million units over 2024–2026. Demand in the second phase, from 2027, is expected to be larger as participation becomes mandatory for more states, so the first-phase figure is a conservative proxy for annual demand around 2030. For domestic demand, the study scales Stand.earth's (2026) estimate of the reductions that 15 leading fashion brands could finance in Bangladesh by 2040 to the whole export garment sector, and assumes a linear build-up from 2026. These are order-of-magnitude estimates. Their purpose is to show whether revenue is limited by supply or by demand.

RESULTS

5.1 The carbon record of Bangladesh's renewable portfolio

Bangladesh's renewable portfolio is overwhelmingly solar: 1,525.77 MW of 1,818.86 MW in July 2026, of which 377.47 MW is off-grid. Hydropower (230 MW at Kaptai) and wind (62 MW) make up most of the rest, with under 1.1 MW of biogas and biomass power (SREDA, 2026). Table 3 sets this portfolio against its carbon-market record.

Table 3. Renewable technologies in Bangladesh and their carbon-market status

Technology	Scale	Carbon-market record	Assessment
Solar home systems (IDCOL, Grameen Shakti)	About 4.1 million systems financed	CDM PoA with credits issued; Ci-Dev payment of up to US$16.76m for 2021–24 reductions from 3.3 million systems	The only renewable technology with a sustained revenue record
Improved cookstoves and household biogas	Over 4 million cookstoves and 71,000 biogas plants via IDCOL	CDM registrations; a cookstove PoA moved to Article 6.4	Proven credits, but integrity of cookstove accounting is contested
Solar irrigation pumps	2,716 pumps, 50.4 MW by mid-2022	None issued; named as a use of Ci-Dev proceeds	Strong additionality case; small volumes
Solar mini-grids and peer-to-peer grids	Small, off-grid	None issued	Methodologies still under review

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Utility-scale solar parks	Over 1,148 MW grid-connected solar in total, including Teknaf (first, 2018), Mymensingh and Sirajganj	None found	Weak additionality case under current rules
Rooftop and net-metered solar	About 245 MW in 2025; 5,500 MW planned	None issued	Candidate for programmatic Article 6 crediting
Wind	60 MW Cox's Bazar plant (2024); 55 MW Mongla contracted	None found	Higher-cost technology; better additionality case
Waste-to-energy and biogas power	0.69 MW biogas power; 200 MW planned	None issued	Methane avoidance credits widely accepted
Hydropower	230 MW Kaptai	Not eligible as new mitigation	Excluded

Sources: SREDA (2026); IDCOL figures in The Business Standard (2025a); Mitra et al. (2024); World Bank (2024a); Chang (2015); Fastmarkets (2025); The Business Standard (2024a); New Age (2025).

The pattern is clear. Every carbon credit Bangladesh's renewable sector has earned has come from small, distributed, household-level technologies, where baselines are kerosene and diesel and where carbon revenue plausibly changed what was built or maintained. No grid-connected solar or wind plant appears in any registry reviewed. The JCM projects were mostly industrial efficiency, and the activities Bangladesh approved for transition to Article 6.4 do not include renewable electricity.

Mitigation potential of the 2026–2030 pipeline

If NREDS is delivered as planned, the 10,450 MW added between 2026 and 2030 would generate about 15,711 GWh a year once complete (Table 4) and displace about 9.7 $MtCO_2$ a year at the current grid factor. Summing the full-year output of the capacity in place at the end of each year, cumulative displacement over 2026–2030 reaches about 22 $MtCO_2$; Section 5.6 shows how much lower these figures are under mid-year commissioning and a cleaner grid. Rooftop and ground-mounted solar supply 89% of the total, and the build-up is back-loaded: four-fifths of the capacity arrives in 2028–2030, so annual reductions climb steeply at the end of the period (Fig. 2). With solar capacity factors between 0.14 and 0.18, the 2030 run-rate ranges from 8.6 to 10.8 $MtCO_2$.

Table 4. Pipeline capacity and modelled generation in 2030

Technology	**Capacity added 2026–2030 (MW)**	**Capacity factor**	**Generation in 2030 (GWh)**
Rooftop solar	5,500	0.16	7,709
Ground-mounted solar	4,500	0.16	6,307
Waste-to-energy	200	0.70	1,226
Wind	150	0.25	329
Other (floating solar, agrivoltaics, other)	100	0.16	140
Total	**10,450**		**15,711**

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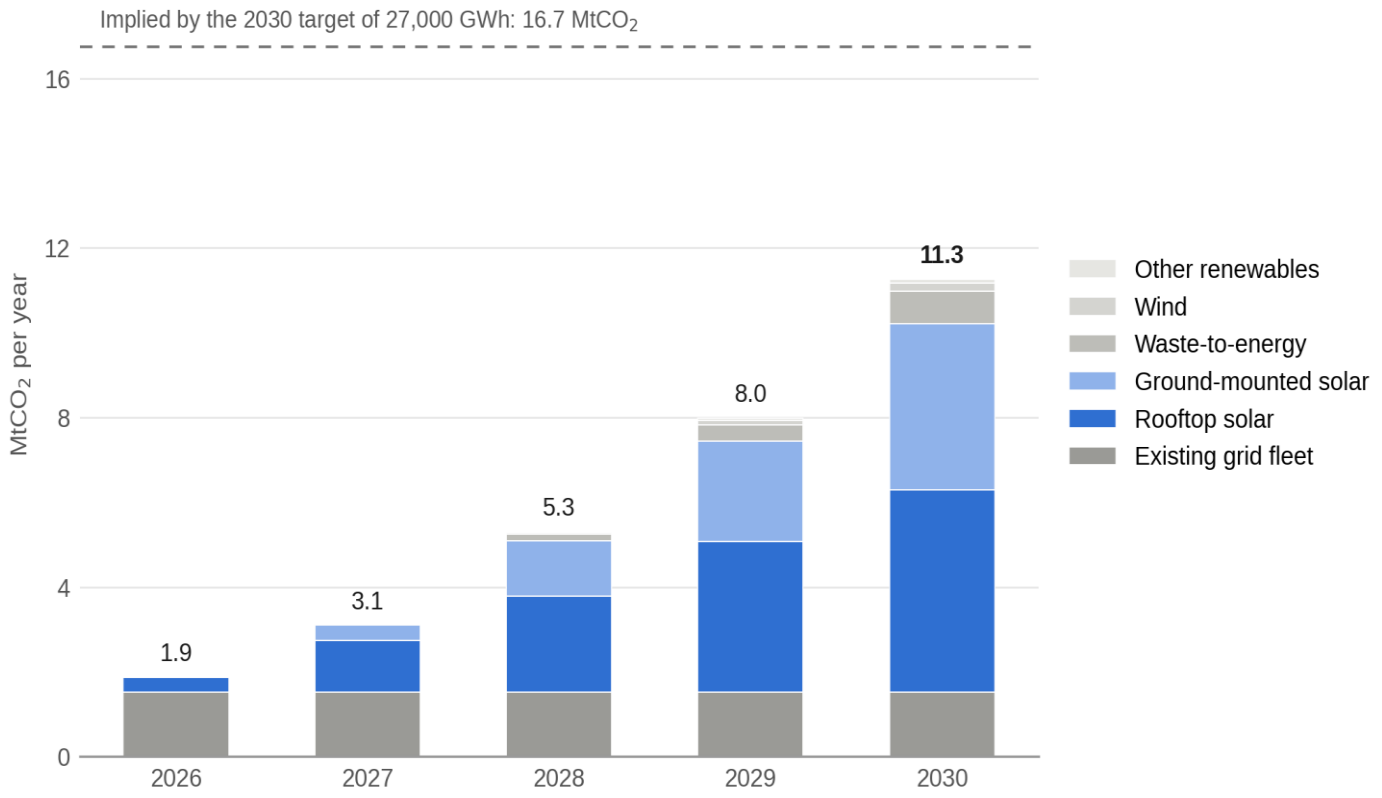


Fig. 2. Annual CO_2 displaced by Bangladesh's renewable fleet under the NREDS 2026–2030 build-out, by technology. Each bar is the full-year displacement of all capacity installed by the end of that year. The grey base is the existing grid-connected fleet (1,148 MW of solar, 62 MW of wind and 230 MW of hydro), and the coloured segments are the capacity added from 2026 under NREDS. Labels give the fleet total in $MtCO_2$; the dashed line marks the displacement implied by the 2030 target of 27,000 GWh (16.7 $MtCO_2$). Assumptions: capacity factors of 0.16 for solar and other technologies, 0.25 for wind, 0.70 for waste-to-energy and 0.35 for hydro; a constant grid emission factor of 0.62 tCO_2/MWh; no degradation or curtailment; off-grid systems excluded. Section 5.6 shows the effect of a declining grid factor and mid-year commissioning. Source: author's calculation from SREDA (2026) capacity data and the DoE (2025a) grid emission factor.

5.3 A capacity–energy gap

The pipeline does not reach the 2030 target on its own terms. Adding the existing grid-connected fleet (1,148 MW of solar, 62 MW of wind and 230 MW of hydro, about 2,450 GWh a year) gives roughly 18,160 GWh in 2030, or 67% of the 27,000 GWh the Roadmap says the 20% target requires. Closing the remaining 8,840 GWh with solar would take about 6.3 GW more capacity than planned. Put differently, delivering 27,000 GWh from about 11,890 MW of grid-connected capacity implies an average capacity factor of about 26%, far above what solar achieves in Bangladesh. The Roadmap acknowledges that its percentage targets are energy shares and that MW figures are only supporting indicators (SREDA, 2026), but the programme as currently sized will fall short unless capacity factors are much higher than assumed here. This matters for carbon finance: every tonne sold abroad from a pipeline that already misses the domestic target makes the NDC harder to meet.

5.4 Economic value

Table 5 shows net carbon revenue at the 2030 run-rate under the nine combinations of creditable volume and price. Panel A gives revenue in US$ million a year; Panel B expresses it as a share of the estimated annual renewable investment need of US$956.5 million.

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Table 5. Net carbon revenue at the 2030 run-rate under nine volume and price combinations

Creditable-volume scenario	Net volume ($MtCO_2$ a year)	US$6.34/t	US$15/t	US$22/t
Panel A. Net revenue (US$ million a year)				
V1 Restrictive	0.84	5.0	11.7	17.2
V2 Moderate	4.66	27.5	65.1	95.4
V3 Expansive	7.79	45.9	108.7	159.4
Panel B. Share of annual investment need (%)				
V1 Restrictive		0.5	1.2	1.8
V2 Moderate		2.9	6.8	10.0
V3 Expansive		4.8	11.4	16.7

Note: Net volume is the creditable volume after the 20% deduction; revenue is also net of the 7% share of proceeds. Grid emission factor 0.62 tCO_2/MWh. Investment need from New Age (2025), citing IEEFA.

Three results stand out. First, even the most generous case covers only about a sixth of the investment need, and the moderate case (V2 at US$15) covers about 7%. Carbon finance can help, but it cannot replace concessional loans, private capital or tariff reform. Second, per unit of electricity, carbon revenue is small relative to cost. At 0.62 tCO_2/MWh, a credit price of US$6.34–22 adds US$3.9–13.6 per MWh before deductions, roughly 3–14% of the reported levelised cost of solar electricity. Third, market prices capture only a small part of the climate value. At US$185 per tonne, the 9.7 $MtCO_2$ displaced each year at full build-out is worth about US$1.80 billion (US$0.43–4.02 billion across the range in Rennert et al., 2022). The highest market scenario captures under 9% of that, and the moderate case under 4%.

5.5 Project-level illustrations

Three cases show how the same arithmetic plays out at different scales.

Solar home systems. The Ci-Dev payment of up to US$16.76 million for four years of reductions from 3.3 million systems works out at about US$1.27 per system per year. That is far too little to buy a system but enough, pooled across a programme, to fund the after-sales service that keeps ageing systems running, which is how IDCOL plans to use it (World Bank, 2024a).

Solar irrigation pumps. Mitra et al. (2024) estimate that an IDCOL pump avoids about 2.8 tCO_2 a year and needs about US$3,900 a year in combined benefits to break even on a US$48,000 investment. At US$15 per tonne, carbon revenue adds about US$42 a year before deductions, roughly 1% of that requirement; valued at the social cost of carbon it would add US$518, about 13%. Replacing all 1.24 million diesel pumps could avoid about 1.2 $MtCO_2$ a year, worth US$18–26 million a year at US$15–22 before deductions.

Cox's Bazar wind farm. Its expected output of about 145 GWh a year displaces about 90,000 tCO_2, worth about US$0.57–1.98 million a year at US$6.34–22 per tonne before deductions, against a social value of about US$16.6 million. Section 5.7 tests whether that revenue would change the investment case.

5.6 Sensitivity to the grid emission factor and commissioning dates

Table 6 shows how the mitigation estimate changes when the two base-case simplifications are relaxed. A grid factor falling to 0.50 tCO_2/MWh by 2030 lowers the 2030 run-rate by 19% and cumulative 2026–2030 displacement by 15%; net revenue in the moderate case (V2 at US$15) falls from US$65.1 million to US$52.5 million a year. Counting capacity from the middle of its commissioning year lowers cumulative displacement

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by 22%, because so much of the pipeline arrives late. Combined, the two adjustments cut cumulative displacement by about a third, from 22.0 to 14.5 $MtCO_2$. Across all eligibility, price and grid scenarios, net revenue at the 2030 run-rate ranges from US$4.0 million to US$169.7 million a year, or 0.4–17.7% of the investment need.

Table 6. Sensitivity of pipeline emission reductions to the grid emission factor and commissioning convention

Assumption	2030 displacement ($MtCO_2$)	Change from base	Cumulative 2026–2030 ($MtCO_2$)	Change from base	Net revenue, V2 at US$15 (US$ million a year)
Base: factor constant at 0.62, full-year operation	9.74	–	21.95	–	65.1
Factor declining linearly to 0.50 by 2030	7.86	−19.4%	18.68	−14.9%	52.5
Factor rising linearly to 0.66 by 2030	10.37	+6.5%	23.03	+5.0%	69.3
Mid-year commissioning, constant factor	8.10	−16.8%	17.07	−22.2%	65.1
Mid-year commissioning and declining factor	6.54	−32.9%	14.45	−34.1%	52.5

Note: Revenue is shown at the run-rate of the completed pipeline, which the commissioning convention does not change. Author's calculation from SREDA (2026) and DoE (2025a).

The direction of change is not settled. The official factor rose from 0.61 to 0.62 tCO_2/MWh between 2019–20 and 2021–22, a period in which large coal-fired capacity, such as the Payra plant, entered service (DoE, 2025a). If coal and imported LNG continue to set the margin, the factor could rise, and each megawatt-hour of renewable electricity would then displace more emissions. That would raise credit volumes and revenue by about 6.5% in 2030, but it would not change any investment decision in Section 5.7: for wind at US$15, a factor of 0.66 adds less than 0.1 percentage points to the IRR. If the renewable programme and efficient gas plants dominate new capacity, the factor will fall. Under the CDM grid tool the factor combines the operating margin with a build margin of recent additions, so a crediting programme should update it at each verification rather than lock in today's value. The reductions most exposed to this uncertainty come from the late-built tranches, which is another reason to update the factor at each verification.

5.7 Does carbon revenue change investment decisions?

Table 7 and Fig. 3 report the financial test. The models fall into three groups.

Table 7. Project internal rate of return with and without carbon revenue, and break-even carbon prices

Project type	IRR without carbon	IRR at US$15/t	IRR at US$22/t	NPV at 10%, without / with US$15 credits (US$ per unit)	Credits as share of income at US$15	Break-even carbon price at 10% / 12% hurdle (US$/t)
Rooftop solar, industrial self-consumption (per kWp)	26.5%	28.5%	29.4%	676 / 761	6.7%	0 / 0
Utility-scale solar, 2025 tender tariff of 8.27 US cents/kWh (per kW)	13.4%	15.0%	15.7%	166 / 246	8.4%	0 / 0

Utility-scale solar, earlier negotiated tariff of 10.42 US cents/kWh (per kW)	18.2%	19.7%	20.4%	415 / 494	6.6%	0 / 0
Wind, Cox's Bazar terms of 12 US cents/kWh (per kW)	10.4%	11.5%	12.0%	45 / 171	5.8%	0 / 22
Wind, tariff of 10 US cents/kWh (per kW)	7.1%	8.3%	8.8%	−317 / −192	6.9%	38 / 66
Solar irrigation pump, 50% grant (per pump)	−0.8%	−0.6%	−0.4%	−14,635 / −14,369	2.0%	825 / 1,014
Solar irrigation pump, no grant (per pump)	−6.5%	−6.3%	−6.2%	−38,635 / −38,369	2.0%	2,178 / 2,557

Note: The IRR at US$22 for wind on Cox's Bazar terms is 11.98%, just below 12%. Credits at US$6.34 add 0.5–0.9 percentage points to the IRR of the grid-connected cases. A break-even price of 0 means the project clears the hurdle without credits. Inputs and sources are listed in Appendix Table A1. At the concessional 6% rate used by Mitra et al. (2024), the break-even carbon price for a grant-supported pump is about US$476 per tonne.

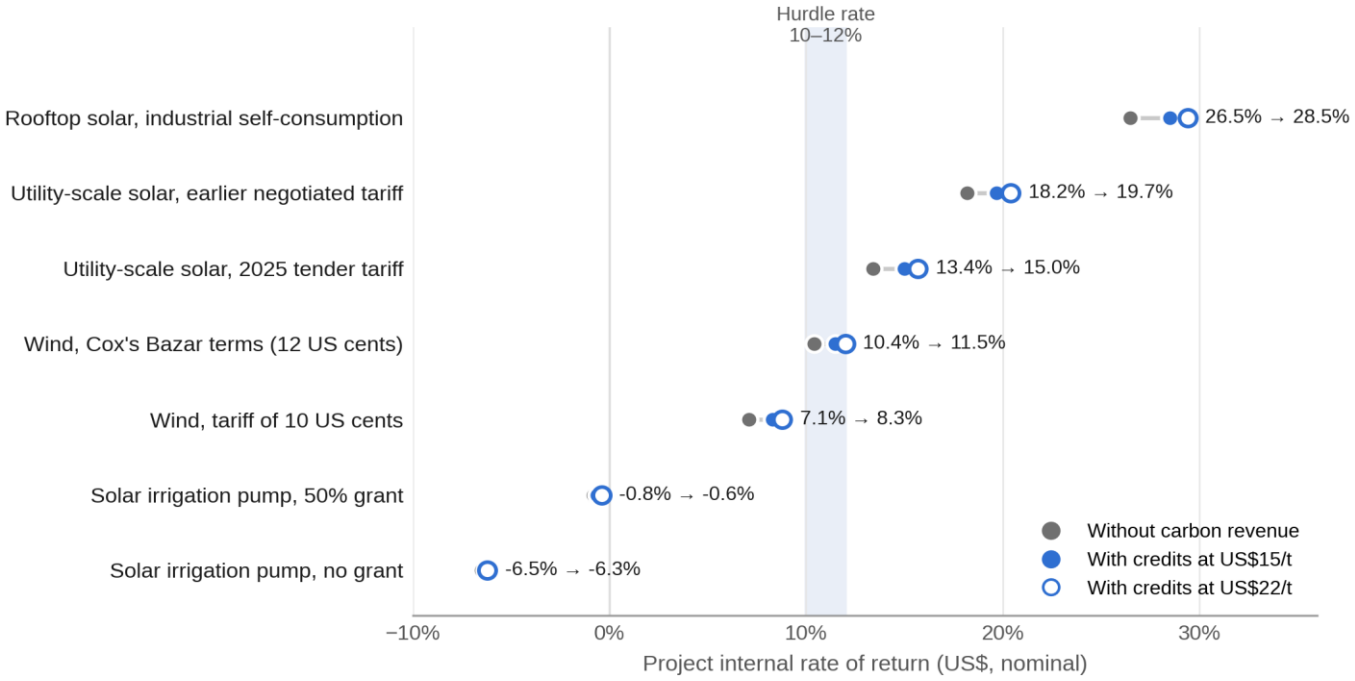


Fig. 3. Project internal rate of return without carbon revenue (grey) and with net credit revenue at US$15 and US$22 per tonne (blue), for seven representative project cases. The shaded band marks the 10–12% hurdle rate. Credit revenue is net of the 20% deduction and 7% share of proceeds. Source: author's cash-flow models; inputs and sources in Appendix Table A1.

The first group, industrial rooftop solar and utility-scale solar, is profitable without credits. Rooftop systems that offset an industrial tariff of Tk 12.52 per kWh (The Business Standard, 2026b) pay back in under four years, and utility-scale plants bid at 8.27 US cents per kWh in the 2025 tenders (The Business Standard, 2025b) still return about 13%. Credits at US$15 raise these returns by 1–2 percentage points, which does not change the investment decision. The result is robust: with rooftop capital costs of US$750 per kWp, or at the pre-2026 industrial tariff, the rooftop IRR stays above 16%. Only a utility-scale plant on a poor site or with high land costs (US$800 per kW, or a capacity factor of 0.14) falls to about 11%, where credits at US$15 would lift it to 12.4%. Such cases would need project-specific evidence. Rooftop solar faces a further problem: since December 2025, net-metered rooftop solar has been mandatory for new connections in buildings with at least 1,000 square feet of usable roof (BSS, 2025), and a legally required activity cannot normally claim to be additional.

The second group is wind. At the Cox's Bazar tariff of 12 US cents per kWh, the project returns about 10.4%, close to the hurdle. Credits at US$15–22 add 1.1–1.6 percentage points, bringing the IRR only to the edge of a 12% hurdle at the top price; the break-even price is about US$22 a tonne. If competitive tendering pushes future wind tariffs down to 10 US cents, the project would need US$38–66 per tonne to clear the hurdle, well above current market prices but well below the social cost of carbon. This is the narrow band in which carbon revenue could be decisive.

The third group is the solar irrigation pump. With revenue from water sales of about US$1,580 a year, estimated from the price and acreage data in Mitra et al. (2024), the pump does not recover its cost even with a 50% grant. Carbon revenue at US$15 equals about 2% of income. Pumps are therefore clearly additional, since they would not exist without public support, but carbon finance cannot close their viability gap at any market price. Its realistic role is the one it plays in the Ci-Dev pilot: a performance-linked stream that pays for maintenance and keeps grant-funded assets working. Solar home systems, where the Ci-Dev payment is about US$1.27 per system per year, are in the same position.

These results narrow the claim made for distributed technologies. Carbon revenue does not close their viability gaps; grants and concessional loans do. It can, however, make results-based support possible and sustain operation, and these are outcomes that would not happen otherwise. For the scenarios in Table 2, the test is consistent with V1 for wind, although waste-to-energy and other emerging technologies were not modelled. It supports V2 only for rooftop segments that face non-financial barriers and are not mandated, and it does not support V3.

DISCUSSION

6.1 Where carbon finance can make a difference

The results point to a division of labour. For utility-scale and industrial rooftop solar, carbon revenue is a small margin on top of returns that already clear the hurdle, and it does not change investment decisions. Selling credits from such plants would expose Bangladesh to the integrity critique documented by Calel et al. (2025) and Probst et al. (2024), and buyers who follow ICVCM guidance would pay little for them. For wind at current tariffs, carbon revenue is close to decisive against a strict hurdle; if tariffs fall, wind would need US$38–66 a tonne, more than current markets pay. For solar irrigation, solar home systems and mini-grids, the projects are additional but carbon revenue is too small to finance them. Its value lies in paying for results, such as kilowatt-hours delivered or systems kept running, alongside grants. The Ci-Dev pilot is a working example: modest payments are used to keep existing assets in service and to fill a funding gap in solar irrigation, outcomes that would plausibly not happen otherwise.

This suggests that Bangladesh's positive list should be narrower than "renewable energy" as a whole. Placing wind, waste-to-energy, mini-grids and results-based programmes for household and irrigation systems on the list, while leaving utility-scale and mandated rooftop solar under ordinary procurement, would focus Article 6 on the cases where additionality is strongest. It would also align with the direction of travel in the ICVCM, which has signalled openness to renewable methodologies for places where clean energy is expensive or hard to deploy (ICVCM, 2024).

A further eligibility risk is graduation from least developed country (LDC) status. Since 2019 the Verified Carbon Standard has registered grid-connected renewable projects only in LDCs (Verra, 2025). Bangladesh is scheduled to graduate on 24 November 2026; the UN Economic and Social Council backed a three-year deferral in July 2026, but the General Assembly had yet to decide (The Daily Star, 2026). Graduation would close this voluntary-market route for grid-connected projects and make Article 6 authorisation, with its stricter accounting, the main route to market.

6.2 Selling tonnes the NDC will need

The second issue is accounting. Under Article 6, every authorised tonne sold abroad must be added back to Bangladesh's emissions balance. The government's rule, that only activities in the conditional part of NDC 3.0

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may be sold, is sensible in principle, because conditional actions are by definition those that need international support (A6IP, 2026). In practice, the line between conditional and unconditional renewable capacity is blurred, and Section 5.3 shows that the planned pipeline already falls short of the 2030 energy target. If the cheapest tonnes are sold first, Bangladesh may later have to buy back mitigation or pay more for harder abatement to meet its own commitments, the over-selling risk that La Hoz Theuer et al. (2019) argue should be limited by caps on international transfers.

The Ci-Dev transaction offers a useful model. By keeping purchased reductions in the country as Type 1 units and requiring separate, compensated agreements before any become ITMOs, it treats authorisation as something with a price. Future deals should follow that principle explicitly: the price of an authorised tonne should reflect both the market and the cost to Bangladesh of replacing it in its NDC. A transparent register showing which tonnes are reserved for domestic use and which are authorised for transfer would make this visible to buyers and to the public.

6.3 Who benefits, and how benefits should be shared

Carbon revenue raises distributional questions. Under the draft framework a share of proceeds is to flow to a national climate fund (The Climate Watch, 2026a), and commentators have urged that benefits reach the households and communities whose behaviour generates the reductions (The Business Standard, 2026c). The renewable case is less contested than forestry or blue carbon, where land rights are at stake, but it is still real. Solar home system users bore the cost of their systems through microfinance loans, and the after-sales network that Ci-Dev payments now support is what protects their investment. The appraisal document commits IDCOL to spend the proceeds on keeping systems working and on the solar irrigation funding gap, but it does not set out how much reaches individual households or how spending will be reported (World Bank, 2024a). Solar irrigation raises further questions of elite capture and groundwater use (Mitra et al., 2024).

Other countries have already legislated benefit-sharing, and their experience is instructive (Table 8). Kenya's 2024 regulations require projects on public or community land to pay 40% (land-based) or 25% (non-land-based) of the previous year's aggregate earnings, net of costs, into community funds managed under community development agreements (Bowmans, 2024). Zimbabwe first proposed a 50% government share, which unsettled investors, and then settled on a 30% levy for the first ten years, with developers required to invest part of their earnings in communities (Engineering News, 2023). Voluntary standards set similar benchmarks: Plan Vivo requires 60% of carbon revenue to reach communities, and an investor benchmark classes 60–75% as high value, while large engineered projects such as renewable plants typically commit a fixed share of net revenue, often about 10%, to projects chosen by community committees (CAP-A, 2024). The same review finds that small cash transfers are often poorly managed and that in-kind services and infrastructure usually work better, unless cooperatives or similar bodies handle the money (CAP-A, 2024).

Table 8. Benefit-sharing rules elsewhere and a proposal for Bangladesh's renewable energy credits

Model	Rule	Lesson for Bangladesh
Kenya, Carbon Markets Regulations 2024	40% (land-based) or 25% (non-land-based) of previous year's aggregate earnings to communities, through community development agreements	Fixed, published shares give certainty; agreements set who decides spending
Zimbabwe, 2023 regulations	30% government levy for ten years after an initial 50% proposal; developers invest part of earnings in communities	Excessive state shares deter investment; set levies early and keep them moderate
Plan Vivo and investor benchmarks	60% to communities (Plan Vivo); 60–75% rated high value	Household and community programmes can pass most revenue through
Large engineered renewable projects	About 10% of net revenue to community-selected projects	A small fixed share suits grid-scale projects without household participants

Proposal: household and irrigation programmes (SHS, SIP, mini-grids)	At least 60% of net proceeds spent on services to participating households and farmers, such as maintenance, battery replacement, lower water tariffs or connection subsidies	Keeps assets working, which is also the basis of their additionality
Proposal: grid-connected wind, waste-to-energy and eligible solar	At least 10% of net proceeds to a community fund in the host upazila, allocated by a committee that includes women and local government	Visible local benefit at little cost to project returns (about 0.1 percentage points of IRR for wind at US$15)
Proposal: national share	A fixed levy of about 5% of net proceeds to the national climate fund, earmarked for adaptation	Mirrors the Article 6.4 share of proceeds; avoids deal-by-deal bargaining

Sources: Bowmans (2024); Engineering News (2023); CAP-A (2024); author's proposals.

Four design principles follow. First, shares should be technology-specific and fixed in advance in the Carbon Market Framework, so that every project knows its obligation before it is authorised. Second, household-level benefits should normally be delivered as services rather than cash: at about US$1.27 per solar home system a year, a cash transfer would be trivial, while pooled maintenance and battery-replacement funds are not. Third, every authorised activity should publish, through the national registry, its annual credit revenue, the amounts paid under each share and the recipients, with an independent audit and a grievance channel run by the Article 6 authority. Fourth, benefits should be tied to continued performance. Paying for maintenance and for kilowatt-hours actually delivered makes the carbon revenue visible to households, and it links the payment to an outcome, keeping systems working, that would not occur without it. That strengthens the additionality case on which the credits depend.

6.4 Who will buy

Demand is the least certain part of the picture, and Table 9 sets out indicative volumes. Voluntary buyers increasingly favour removals and nature-based credits, and in late 2025 project developers reported that only a small share of buyer enquiries turned into deals (Ecosystem Marketplace, 2026).

Table 9. Indicative annual demand for Bangladesh's renewable energy credits around 2030 compared with creditable supply

Buyer group	**Indicative volume ($MtCO_2$ a year)**	**Price signal (US$/t)**	**Basis and constraints**
Japan, JCM and Article 6.2	0.02–0.63	Not published	Current Bangladesh JCM portfolio of five projects expects about 24,000 tCO_2 a year; upper bound is an equal share of Japan's 100 $MtCO_2$ goal across 32 partners
Airlines, CORSIA first phase	0.49–1.57	15–22	1–2% of 146–236 million units of demand over 2024–2026; large grid-connected renewables are excluded and a host letter of authorisation is required
Domestic export garment buyers	0–1.37	Not known; likely 6–15	Scaled from 15 brands that could finance 1.26 $MtCO_2$ a year of reductions by 2040; no domestic scheme yet exists
Total indicative demand	0.51–3.57	–	About US$7–60 million a year of net revenue if supply were unconstrained
Creditable supply at the 2030 run-rate	0.84 (V1), 4.66 (V2), 7.79 (V3)	–	From Table 5

Note: Revenue assumes US$6.34–15 per tonne for JCM, US$15–22 for CORSIA and up to US$15 for domestic buyers, net of the 7% share of proceeds. Sources: DoE (2025c); MoEJ (2022); Carbon Credits (2026); IATA (2025); Relae (2026); Stand.earth (2026); World Bank (2026); author's calculation.

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Three sources of demand matter for Bangladesh. The first is sovereign buyers under Article 6.2, above all Japan through the JCM. Japan aims to secure about 100 $MtCO_2$ of international reductions by fiscal year 2030 across 32 partner countries (Carbon Credits, 2026). Bangladesh's own JCM record is small. Its first issuance, in 2022, covered 499 tCO_2 from a chiller and a solar–diesel hybrid project (MoEJ, 2022), and its five projects together expect about 24,000 tCO_2 a year (DoE, 2025c). Even an equal share of Japan's goal would amount to only about 0.6 $MtCO_2$ a year.

The second source is aviation. Airlines need an estimated 146–236 million eligible units for CORSIA's first phase, while only about 15.8 million had been made available by September 2025, so supply is short (IATA, 2025) and eligible units trade at US$15–22 (World Bank, 2026). CORSIA's technical rules, however, exclude most large grid-connected renewable projects and require a host-country letter of authorisation with a corresponding adjustment (Relae, 2026). Bangladesh's CORSIA-eligible supply would therefore come from distributed systems, mini-grids and waste-to-energy rather than from solar parks. A 1–2% share of first-phase demand would mean about 0.5–1.6 $MtCO_2$ a year.

The third source is domestic. Bangladesh's export garment sector faces growing pressure from European buyers on emissions, and IEEFA has suggested it could become a domestic buyer of credits (IEEFA, 2025a). Stand.earth (2026) estimates that 15 leading brands, which account for 26.3% of the sector's exports by weight, could finance reductions of 1.26 $MtCO_2$ a year by 2040. Scaled to the whole sector and phased in from 2026, that implies up to about 1.4 $MtCO_2$ a year around 2030. Brands, however, prefer to buy renewable electricity directly, and no evidence exists yet on what price manufacturers would pay for domestic credits. A domestic market would keep tonnes inside the NDC while still putting a price on them.

Taken together, indicative demand is about 0.5–3.6 $MtCO_2$ a year. Restrictive supply (0.84 $MtCO_2$) sits within that range, while moderate and expansive supply (4.7–7.8 $MtCO_2$) exceed even the upper estimate. Revenue in the V1 scenario is therefore limited mainly by supply, and revenue in V2 and V3 by demand. If supply were unconstrained, these buyers would pay about US$7–60 million a year; with supply limited to the restrictive scenario that the financial test supports best, revenue would be about US$5–17 million. Both figures sit at the lower end of Table 5. This reinforces the case for a narrow, high-integrity offer: the extra tonnes in the expansive scenario are both the hardest to defend and the least likely to find a buyer.

6.5 Limitations

The analysis has several limitations. It relies on planned rather than realised capacity, and Bangladesh's record of meeting renewable targets is poor. It does not model whether new solar displaces gas, coal or oil at the margin; Section 5.6 brackets this uncertainty with alternative grid factors rather than resolving it. The capacity factors are national values rather than site-specific measurements. The financial models are stylised: they use average capital costs, tariffs and outputs, and ignore taxes, debt structure and currency risk. Residential and commercial net-metered rooftop systems, mini-grids and waste-to-energy were not modelled for lack of published cost and tariff data, so the creditable-volume scenarios remain judgements for those technologies. The demand estimates are orders of magnitude built on announced goals and a single sectoral study. Finally, the price scenarios draw on voluntary and CORSIA markets; Article 6.2 sovereign prices are rarely disclosed, and the Ci-Dev price per tonne was not published. Future research could use project-level generation and cost data, a dynamic grid factor, surveyed willingness to pay among export manufacturers and transaction prices as Bangladesh's registry begins to report them.

POLICY PATHWAYS

The findings support nine recommendations, grouped by the institution best placed to act.

7.1 For the Article 6 Designated National Authority (MoEFCC and DoE)

1. Target the positive list. List wind, waste-to-energy, mini-grids and results-based programmes for solar home systems and solar irrigation as eligible renewable activities. Exclude utility-scale solar, industrial

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self-consumption rooftop solar and any rooftop system required by the December 2025 circular, unless a published financial test shows that carbon revenue is decisive (Section 5.7).

2. Price authorisation. Treat each authorisation for international transfer as a decision with an NDC cost. Set a floor price for authorised ITMOs that reflects the cost of replacing those tonnes domestically, and keep unauthorised reductions for NDC use, following the Type 1 and Type 2 structure of the Ci-Dev deal (Sections 3.3 and 6.2).
3. Cap transfers. Fix an annual ceiling on authorised renewable-energy transfers, linked to progress against the 2030 renewable energy target and reviewed at the 2028 mid-term review of the Roadmap (SREDA, 2026; Sections 5.3 and 6.2).
4. Publish the registry. Make the national carbon registry public, showing for every unit its technology, vintage, authorisation status, whether a corresponding adjustment has been applied, and the benefit-sharing payments made (Section 6.3).
5. Set benefit-sharing rules in advance. Write technology-specific shares into the Carbon Market Framework: at least 60% of net proceeds spent on services to participating households and farmers in household and irrigation programmes, at least 10% to host-community funds for grid-connected projects, and about 5% to the national climate fund. Require annual disclosure, independent audit and a grievance channel (Section 6.3, Table 8).
6. Update the grid factor at each verification. Recalculate the factor with the CDM grid tool for every verification period instead of fixing today's value, so that credited reductions follow the actual evolution of the grid (Section 5.6).

7.2 For SREDA and the Power Division

7. *Close the capacity–energy gap first.* Restate the NREDS programme in GWh with explicit capacity factors and add the capacity needed to reach 27,000 GWh, and extend the national renewable database to record metered generation by plant and by rooftop programme. Carbon revenue cannot help a programme that is too small for its own target, and reductions cannot be verified cheaply without metered data (Section 5.3).

7.3 For IDCOL and financial institutions

8. *Scale the Ci-Dev model.* Use the solar home system methodology and verification experience to bring solar irrigation and mini-grids under the Standardized Crediting Framework and, where buyers require it, the Article 6.4 mechanism. Blend carbon payments with grants rather than expecting them to replace grants, ring-fence proceeds for operation, maintenance and new connections, and publish how they are spent (Sections 5.5 and 5.7).

7.4 For Bangladesh Bank and trade bodies

9. *Create domestic demand.* Explore a domestic crediting scheme in which export-oriented manufacturers, starting with garments and textiles, buy verified renewable reductions that remain inside the NDC. Demand of up to about 1.4 $MtCO_2$ a year around 2030 would put a price on mitigation without exporting the tonnes Bangladesh needs. A survey of manufacturers' willingness to pay should come first (Section 6.4).

CONCLUSIONS

Bangladesh has built the basic machinery of an Article 6 carbon market in under three years: a designated authority, a readiness roadmap, an official grid factor, a draft framework with a positive list, and a first Article 6-aligned transaction based on its solar home systems. Its renewable energy sector is the natural place to put that machinery to work, but this paper finds that the opportunity is both smaller and more selective than current enthusiasm suggests.

At full build-out, the planned 2026–2030 renewable pipeline would displace about 9.7 $MtCO_2$ a year at today's grid factor, or about 7.9 $MtCO_2$ if the factor falls to 0.50 tCO_2/MWh. Depending on which technologies can be credited, at what price and on how the grid evolves, net carbon revenue would be US$4–170 million a year, at most about 18% of the annual investment need and less than a tenth of the social value of the avoided emissions.

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Indicative demand from Japan, airlines and export manufacturers, about 0.5–3.6 $MtCO_2$ a year, suggests that realistic revenue lies at the lower end of that range. A financial test shows where the money matters. Credits do not change the economics of utility-scale or industrial rooftop solar, which already clear their hurdle rates. For wind at current tariffs they bring returns only to the edge of a strict hurdle. For solar irrigation and household systems, which depend on grants, they work best as performance payments that keep assets running. The record supports this pattern: every renewable carbon credit Bangladesh has earned so far has come from household-scale systems.

The most consequential choices are therefore about eligibility, accounting and benefit-sharing rather than price. A narrow positive list, a priced and capped authorisation process, fixed and published benefit-sharing rules, a public registry and a domestic market for export industries would let Bangladesh earn carbon revenue where it changes outcomes, without selling the tonnes it needs to meet its own targets. Those lessons are likely to apply well beyond Bangladesh, to the many least developed countries now preparing to enter Article 6 markets with renewable energy as their main offer.

APPENDIX A. FINANCIAL MODEL INPUTS

Table A1. Inputs to the project cash-flow models

Project type	Capital cost	Output	Tariff or avoided cost	Operating cost and life	Sources and notes
Rooftop solar, industrial self-consumption	US$500 per kWp, about Tk 61,000 (tested at US$750, about Tk 91,500)	1,402 kWh per kWp a year (capacity factor 0.16); 0.5% annual degradation	Medium-voltage industrial tariff of Tk 12.52 per kWh (US$0.103)	1.5% of capital cost a year; inverter replacement in year 13 (10% of capital cost); 25 years	The Business Standard (2026b); Alam (2022); Fakir Technologies (2026) quotes Tk 75,000–110,000 per kWp for hybrid systems with batteries
Utility-scale solar	US$700 per kW (tested at US$600–800)	1,402 kWh per kW a year; 0.5% annual degradation	8.27 US cents per kWh (2025 tender average); 10.42 US cents (earlier negotiated rate)	1.5% of capital cost a year; 20 years	The Business Standard (2025b); IRENA (2025) global average of US$691 per kW
Onshore wind	US$116.51 million for 66 MW (US$1,765 per kW)	145.7 GWh a year (2,208 kWh per kW)	12 US cents per kWh for 18 years; 10 US cents tested	2.5% of capital cost a year (1.5% tested); 18 years (PPA term)	The Business Standard (2024b)
Solar irrigation pump (IDCOL)	US$48,000; 50% grant case	Irrigates 18 acres; avoids 2.8 tCO_2 a year	Water sales of about US$1,580 a year: boro irrigation priced 25% below the diesel cost of US$74–84 per acre, with boro providing 65–70% of annual revenue	1% of capital cost a year; 20 years	Mitra et al. (2024)
All projects	–	Grid factor 0.62 tCO_2/MWh	Credit revenue net of 20% deduction and 7% share of proceeds	–	DoE (2025a); Section 4.4

Note: All values in nominal US dollars at Tk 122 per US$. Hurdle rates of 10% and 12%; the concessional 6% rate of Mitra et al. (2024) is also reported for the irrigation pump.

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