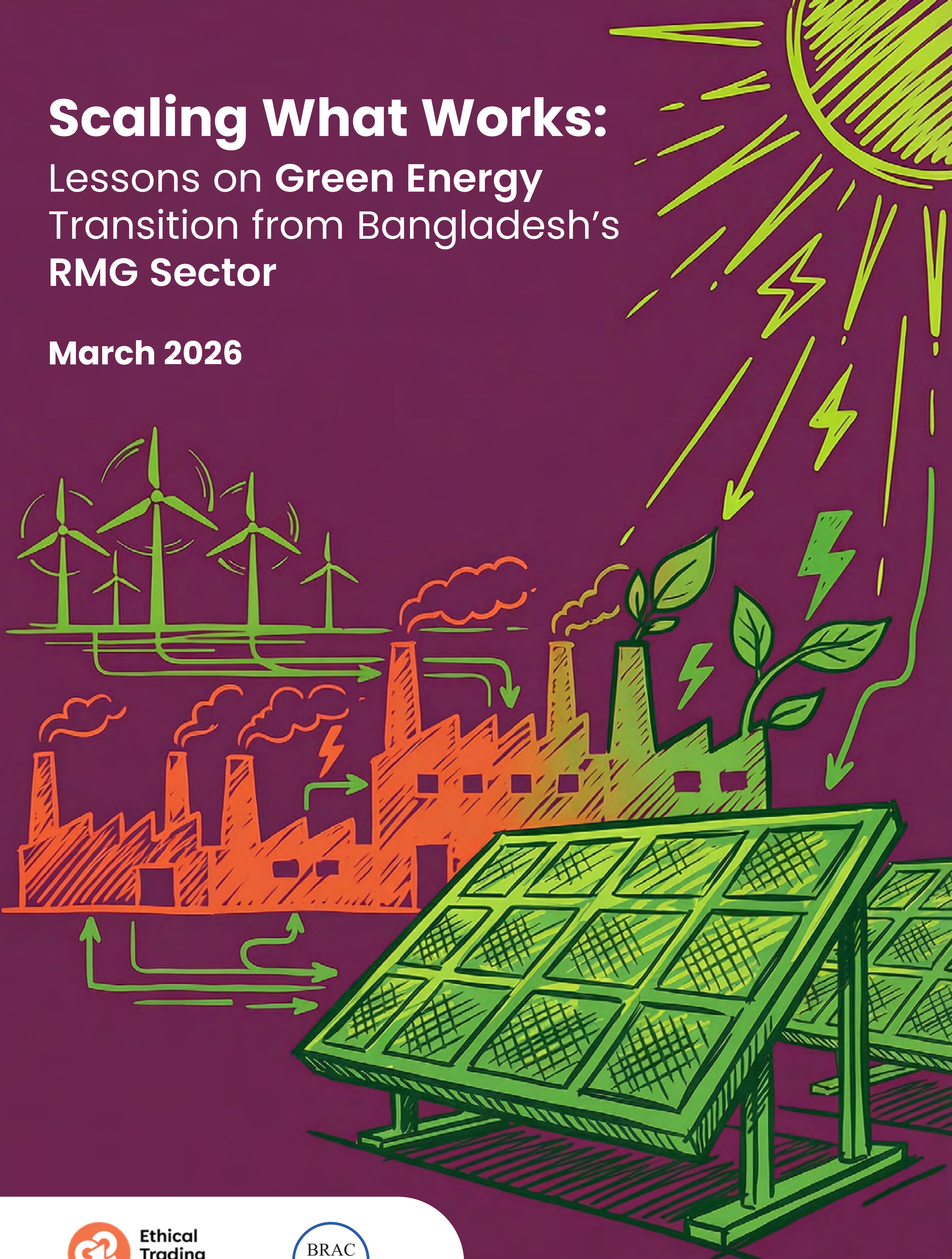
Scaling What Works:

Lessons on **Green Energy** Transition from Bangladesh's **RMG Sector**

March 2026



Ethical Trading Initiative Bangladesh

BRAC UNIVERSITY

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Lessons on Green Energy Transition from Bangladesh's RMG Sector

This research is a joint initiative of Ethical Trading Initiative Bangladesh and BRAC University.

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Foreword

Since its inception, Ethical Trading Initiative (ETI) has been dedicated to addressing the complex challenges within the global supply chains and improving the lives of workers worldwide. ETI began its journey in Bangladesh from 2014. Guided by ETI's global vision and strategy, ETI Bangladesh's mission is to enable the most vulnerable workers in Bangladesh achieve decent work and, create an environment where workers can advocate for improved pay, better working conditions and economic equality. Driven by its mission statements, ETI Bangladesh intends to continually adapt and work on a diverse thematic range and produce more tangible and sustainable outcomes.

Against this backdrop, as climate change increasingly reshapes the future of industries, employment, and supply chains, ETI Bangladesh has adopted climate action, including addressing the adverse impacts of climate change on workers, as one of its key strategic priorities. For us, worker rights and environmental sustainability are not separate agendas, but deeply interconnected. This is particularly evident in Bangladesh's ready-made garment (RMG) sector, which remains central to both our national economic growth and the livelihoods of millions of workers. At the same time, the sector is operating within a rapidly shifting landscape, as global buyers increasingly expect stronger environmental sustainability performance and reductions in carbon emissions across supply chains, while production demands remain unchanged.

Through ETI Bangladesh's ongoing consultations with industry stakeholders, including business associations, factory owners, brands, and other sector representatives, it has become increasingly clear that these expectations are often emerging in ways that feel fast-moving, uneven, and fragmented. With different brands requiring different forms of sustainability reporting and compliance, suppliers are often left to navigate a complex and uncoordinated transition process. These consultations have also underscored an important reality: even where finance or technical solutions may be available, factory owners are far more likely to invest if the business case for a green transition is clear to them.

Compliance pressure alone will not drive transition at scale. What is needed is stronger evidence, clearer examples, and more practical demonstration that renewable energy and decarbonisation can enhance business resilience, strengthen competitiveness, and create longer-term value for Bangladesh's RMG sector. At the same time, to remain competitive, it is vital that the sector not only adapts, but does so in accordance with the just transition principles.

It is in this context that this study is especially timely and important. We have developed this study in response to repeated stakeholder recommendations for more practical evidence from within the sector. This publication is our first attempt to document best practices across Bangladesh's RMG industry and reflects an ongoing learning process. It seeks to highlight emerging models and demonstrate that a green energy transition can also present a clear business case. While it offers an important starting point, there is scope to deepen this work through more in-depth case studies and continued documentation of evolving practices across the industry. I would like to extend my sincere gratitude to the research team for conducting this study and to all the respondents who generously contributed their time, perspectives, and experience.

Lastly, we, the team at ETI Bangladesh hope the selected best practices contribute to a more grounded and constructive conversation within the industry, while encouraging wider confidence, collaboration, and innovation around the transition ahead.

Abil Bin Amin
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Acknowledgements

The research team would like to express its sincere gratitude to ETI Bangladesh for recognising the importance of this issue and for initiating this study to explore renewable energy transition and decarbonisation practices within Bangladesh's ready-made garment sector. We deeply appreciate of ETI Bangladesh's support throughout the research process, from conceptualisation to finalisation of the report.

We would especially like to acknowledge the guidance and support of colleagues at ETI Bangladesh, particularly Abil Bin Amin and Munir Uddin Shamim whose inputs were invaluable in shaping and finalising this publication. We are also grateful to Kazi Akib Hassan, Mahbuba Akbar, Nafiz Mahmud Ayon and Priyong Sabastini of ETI Bangladesh for their consistent coordination and support in the finalisation of this report.

We extend our thanks to the factories whose early key informant interviews helped sharpen the research objectives and ground the study in the practical realities of the sector. We are equally grateful to the BGMEA, BKMEA, and the Department of Environment for their support during the data collection process. Our sincere appreciation also goes to the development organisations, brands, and other industry stakeholders who generously shared their time, experience, and insights, enriching the study with diverse perspectives on the sector's current challenges and emerging pathways. Finally, the research team acknowledges the contributions of Masuma Warda Khan from BRAC University for her relentless efforts in assisting the research team in various capacities.

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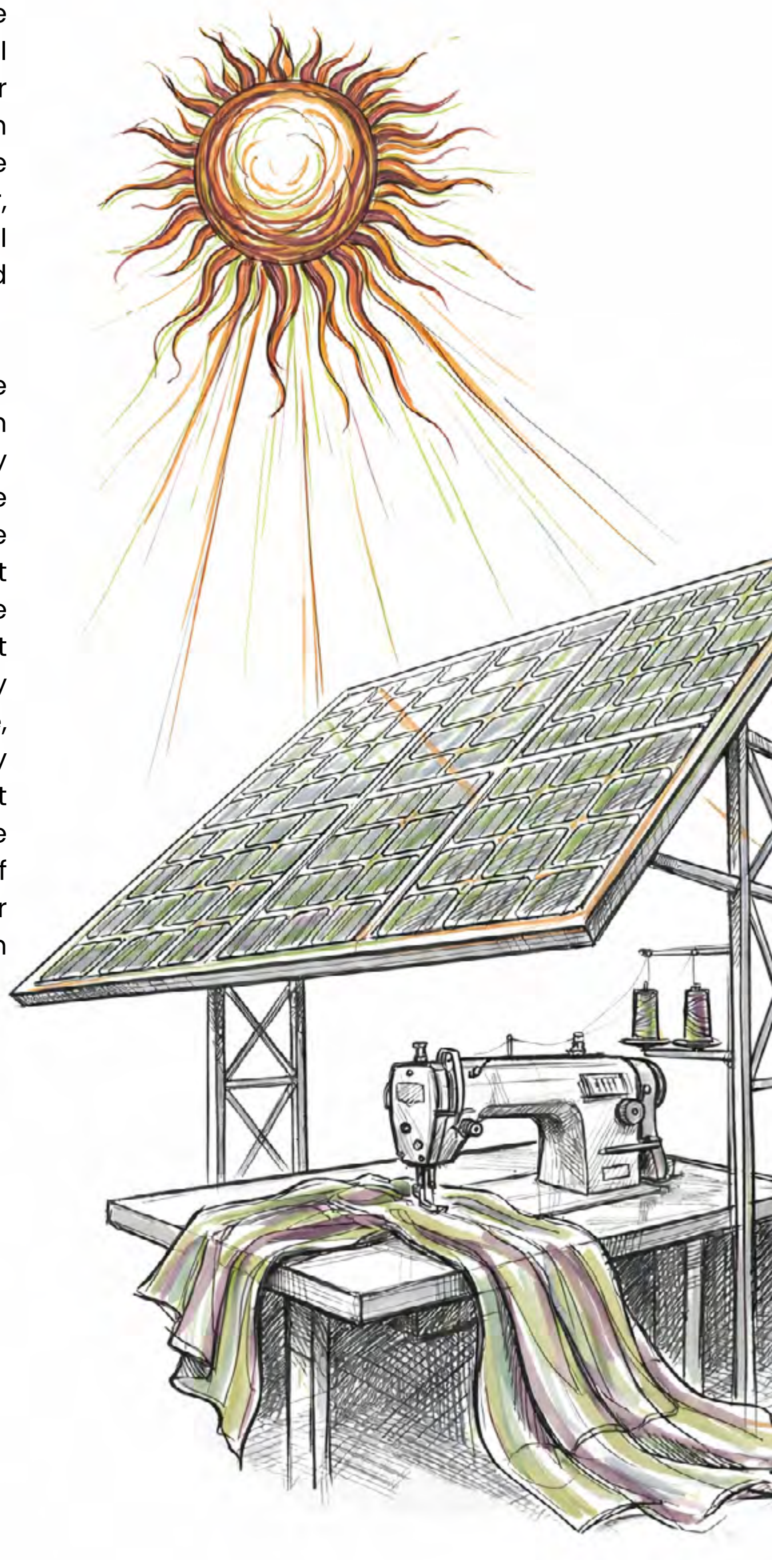

List of Acronyms

AI	Artificial Intelligence
BDT	Bangladeshi Taka
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BKMEA	Bangladesh Knitwear Manufacturers and Exporters Association
BOLT	Build-Own-Lease-Transfer
BRM	Brand & Retail Module
CAPEX	Capital Expenditure
CEO	Chief Executive Officer
CLF	Capital Lease Financing
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CPPA	Corporate Power Purchase Agreement
CSDDD	Corporate Sustainability Due Diligence Directive
DC	Direct Current
DoE	Department of Environment
EGB	Exhaust Gas Boiler
EIS	Environment Impact Statement
ESG	Environmentally Sustainable Governance
ETI	Ethical Trading Initiative
EMI	Equated Monthly Installment
EPC	Engineering, Procurement and Construction
ESCO	Energy Service Company
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
ETP	Effluent Treatment Plant
EU	European Union
FRP	fibreglass reinforced plastic
GCF	Green Climate Fund
GEF	Grid Emission Factor
GGI	Greener Garments Initiative
GHG	Greenhouse Gas
GSD	Green Social Dialogue
GTF	Green Transformation Fund
HREDD	Human Rights and Environmental Due Diligence
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electrotechnical Commission
I-REC	International Renewable Energy Certificate
IRR	Internal Rate of Return
ISO	International Organisation for Standardisation
JICA	Japan International Cooperation Agency
KPI	Key Performance Indicator
KII	Key Informant Interview
kW	Kilowatt
kWh	Kilowatt-hour
kWp	Kilowatt-peak
LCOE	Levelised Cost of Electricity
LEED	Leadership in Energy and Environmental Design
MWh	Megawatt-hour
NDC	Nationally Determined Contribution
O&M	Operation and Maintenance
OPEX	Operational Expenditure
OREL	Omera Renewable Energy Limited
PC	Participation Committee
PDB	Power Development Board
PPA	Power Purchase Agreement
PV	Photovoltaic
RAL	Radiant Alliance Limited
RCC	Reinforced Cement Concrete
RE	Renewable Energy
RMG	Ready-Made Garment(s)
ROI	Return on Investment
SME	Small and Medium-sized Enterprise
SPV	Solar Photovoltaic
SREDA	Sustainable and Renewable Energy Development Authority
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WHR	Waste Heat Recovery

Table of Contents

Introduction

The Ready-made Garment (RMG) industry of Bangladesh is the world's second-largest apparels and textiles exporter. The industry employs approximately 4 million workers directly (BGMEA Export Database, 2025; BGMEA, 2024; ILO, 2020). Concurrently, the combined apparels and textiles value-chain in Bangladesh contributes approximately 27.8% of the nation's overall industrial greenhouse gas (GHG) emissions, making Bangladesh's RMG and its extended value chain, the country's largest industrial emitters (Moazzem et al., 2024). A recent study using factory-level data from a major industrial cluster found that textile and RMG facilities together emitted around 6 million tonnes of CO_2e in 2022, with RMG contributing roughly one-third of that total (Biswas et al., 2024). While this reflects a specific cluster rather than a nationwide estimate, it reinforces that the RMG–textile value chain is among Bangladesh's most energy- and resource-intensive industrial sectors.

Bangladesh is also the seventh most climate-vulnerable country globally (UNDP, 2023). Climate-related disruptions are already affecting industrial operations, including the RMG sector. For instance, the August 2024 flash floods disrupted transport routes and supply chains, reportedly reducing production by up to 50% in affected areas (The Daily Star, 2024). Climate impacts also have direct implications for working conditions. Various industry reports indicate rising levels of heat stress impacting worker productivity in factories, including a 2022 survey where nearly 78% of sampled apparels workers accustomed to high heat reported wishing for cooler working conditions during the city's hottest and most humid months (Bach et al., 2022; Chowdhury et al., 2017).

Projections suggest that without adequate adaptation, climate risks could threaten up to USD 65 billion in export earnings and displace nearly one million workers by 2030, while broader economic losses under business-as-usual scenarios could reach USD 711 billion by 2050 (Judd et al., 2023). At the same time, with effective adaptation and transition measures, Bangladesh's RMG sector is projected to grow significantly, potentially reaching USD 1 trillion in value by 2050 (ibid.). These figures underscore how climate risks and market pressures are increasingly converging on the sector.

Globally, regulatory expectations are also shifting. The European Union and United Kingdom have committed to net-zero emissions by 2050, with interim reduction targets of 55%[1] and 68%[2] by 2030, respectively (European Commission, 2024; Government of the UK, 2024). Regulatory frameworks such as the European Union Green Deal[3], Corporate Sustainability Due Diligence Directive (CSDDD), and Scope 3 emission reporting requirements (on carbon emission reductions), introduces more stringent requirements on environmental and social performance across supply chains. These developments, alongside broader frameworks such as the Human Rights and Environmental Due Diligence (HREDD) and Environmental Social Governance (ESG) compliance, are increasing pressure on suppliers to be more environmentally sustainable and decarbonise, particularly in export-oriented sectors like Bangladesh's RMG industry.

In response to these combined pressures, both global and domestic, the RMG sector must adapt, decarbonise, and transition toward renewable energy to maintain its competitiveness. Given its economic contribution and reliance on fossil-fuel-based energy, the sector's transition pathway will be central to Bangladesh's broader climate commitments, including its Nationally Determined Contributions (NDCs)[4] and national renewable energy targets[5]. Industry-level commitments further reinforce this shift, including the BGMEA's pledge[6] to reduce sectoral emissions by 30% by 2030 (as a UNFCCC signatory).

This transition is particularly challenging given the sector's current energy profile. The RMG and textile sectors combined, consume over 3,740 KTOE of energy annually (GIZ, 2023). Estimations by the Centre for Policy Dialogue (CPD) suggest that the industry's annual electricity demand is around 6,251 GWh, which is equivalent to about 8.2% of Bangladesh's total electricity consumption and 7.3% of total national electricity generation (Khatun and Bari, 2024). However, renewable energy adoption remains limited. Estimates further suggest that solar energy contributes only around 6% of the sector's electricity demand, indicating a significant gap between potential and current uptake (SREDA, 2025; BPDB, 2025)[7]. Meeting 10–40% of electricity demand through solar would require approximately 450–1,800 MW of rooftop solar capacity (Khatun and Bari, 2024).

Several structural and financial barriers constrain this transition. In many cases, rooftop solar deployment is limited by the physical characteristics of factory buildings, as older facilities may lack the structural capacity for large solar arrays and current policy caps can further restrict how much rooftop capacity is installed in practice (BUILD-IFC, 2024; Cascale[8], 2025). In addition, solar deployment involves high upfront capital expenditure. Bangladesh's tariff structure also creates a disadvantage for rooftop solar compared with utility-scale projects. Although imported solar panels carry only 1% customs duty, the total tax incidence reportedly rises to 11.2% once additional taxes are applied, while key rooftop solar accessories such as fibreglass reinforced plastic (FRP) walkways, imported inverters, mounting structures, and DC (direct current) cables face import duties ranging from 15.25% to 58.6% (Alam, 2023). Access to affordable finance also remains limited. Commercial borrowing for renewable energy projects often still falling in the 12–15% range and typically requiring collateral, strong repayment capacity, and other strict eligibility conditions, which further discourages investment (GIZ, 2025).

Despite these constraints, important practices are already emerging across the sector. Factories, brands, worker representatives, technology providers, development organisations, financial institutions, and other actors are experimenting with different approaches to renewable energy adoption, energy efficiency, and emissions reduction. These range from technical innovations and financing models to operational adjustments and partnership-driven initiatives. However, these efforts remain fragmented and unevenly documented, limiting their usefulness for broader sectoral learning. Consultations with key industry actors including, representatives from brands, business associations and factory management, have underscored an important reality: even where finance or technical solutions may be available, factory owners are far more likely to invest if the business case for a green energy transition is clearly articulated and supported by credible & well-documented evidence.

It is against this backdrop that the present study was undertaken. The broader research aimed to systematically identify, map, and analyse green energy transition practices in Bangladesh's RMG, including renewable energy and energy efficiency practices. The primary aim was to understand existing approaches, identify promising models, and generate practical insights to promote wider adoption across the industry.

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1 For more information, please see: Net-Zero Industry Act. European Commission.

2 For more information, please see: The UK's plans and progress to reach net zero by 2050 - House of Commons Library

3 For more information, please see: The European Green Deal - European Commission

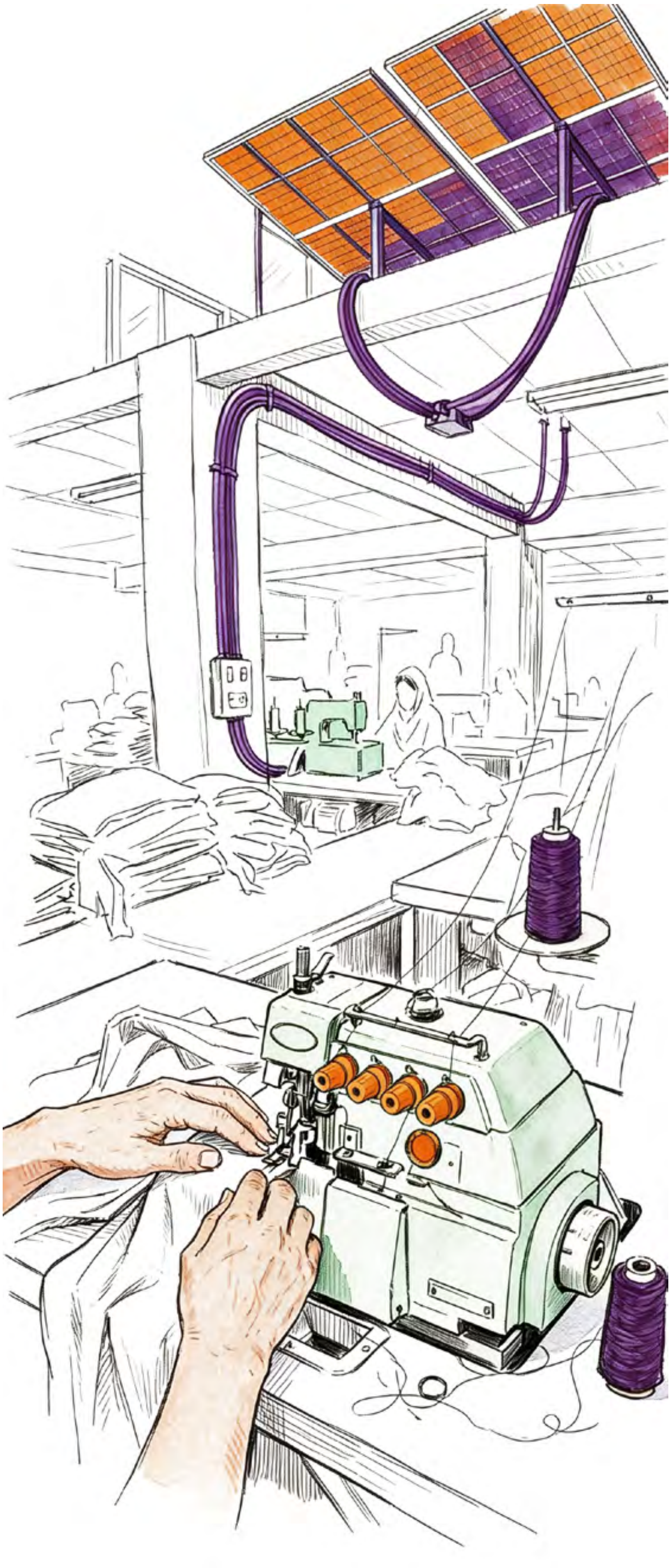
4 For more information, please see: Bangladesh Third Nationally Determined Contributions Report (2025)

5 For more information, please see: Renewable Energy Policy 2025

6 For more information, please see: BGMEA | BGMEA joins UN Climate Charter

7 According to the national energy database by SREDA, total installed **renewable energy (RE) capacity is 1689.43 MW (as of 2025);** Bangladesh's total on-grid installed generation capacity is roughly **28,949MW (as of 2025)** according to BPDB, **therefore, the percentage of RE in national energy mix amounts to 5.8% based on the above datasets.**

8 Formerly known as the Sustainable Apparel Coalition.



Research Objectives

The overall aim of this study was to showcase the potential "business case" of a green energy transition, including transitioning to renewables & decarbonising in Bangladesh's RMG, thereby, promoting a wider green energy transition. Accordingly, intermediate objectives of the research were as follows:

I. Explore and document existing green practices in RMG (renewable energy, energy efficiency, worker-led behavioural practices, partnerships, etc.).

II. Categorise the mapped cases by theme, uniqueness, stakeholder involvement, and implementation model to identify distinct patterns and approaches.

III. Prioritise and analyse the most replicable best-practice cases that demonstrate green energy transition as a credible business case for wider sectoral adoption.

Methodological Overview

By nature, this research followed was qualitative in design, and was developed broadly through a case study approach. The analyses are primarily qualitative, with limited quantitative analysis incorporated where relevant to strengthen the assessment of selected initiatives. Primary data collection was conducted between **December 2024 and July 2025.**

The research was carried out in four steps:

Step 1: The Exploration

The study began with an exploration to identify existing industry practices. Using a snowball sampling approach, the research identified, explored, and mapped a total of 131 initiatives across Bangladesh's RMG industry.

Step 2: Thematic Organisation of Identified Initiatives

The mapped initiatives were then organised across key thematic areas, such as: technical support, collaboration and partnership, solar efficiency, green financing, rooftop solar financing models, alternative solutions, policy mechanisms, innovation, and energy efficiency measures, including worker-led initiatives. This helped structure the wider landscape of practices and identify patterns across different types of interventions and stakeholders.

Step 3: Prioritisation and In-Depth Case Analysis

From the wider pool of 131 initiatives, 26 cases were prioritised for further analysis based on their thematic relevance and potential significance as emerging best practices for the RMG industry. These cases were examined in greater depth using 35 key informant interviews (KIIs), participation observation, and desk review of relevant literature and project documentations. Interview participants included representatives from factories, brands, development partners, government agencies, financial institutions, business associations, worker representatives, and relevant research institutes.

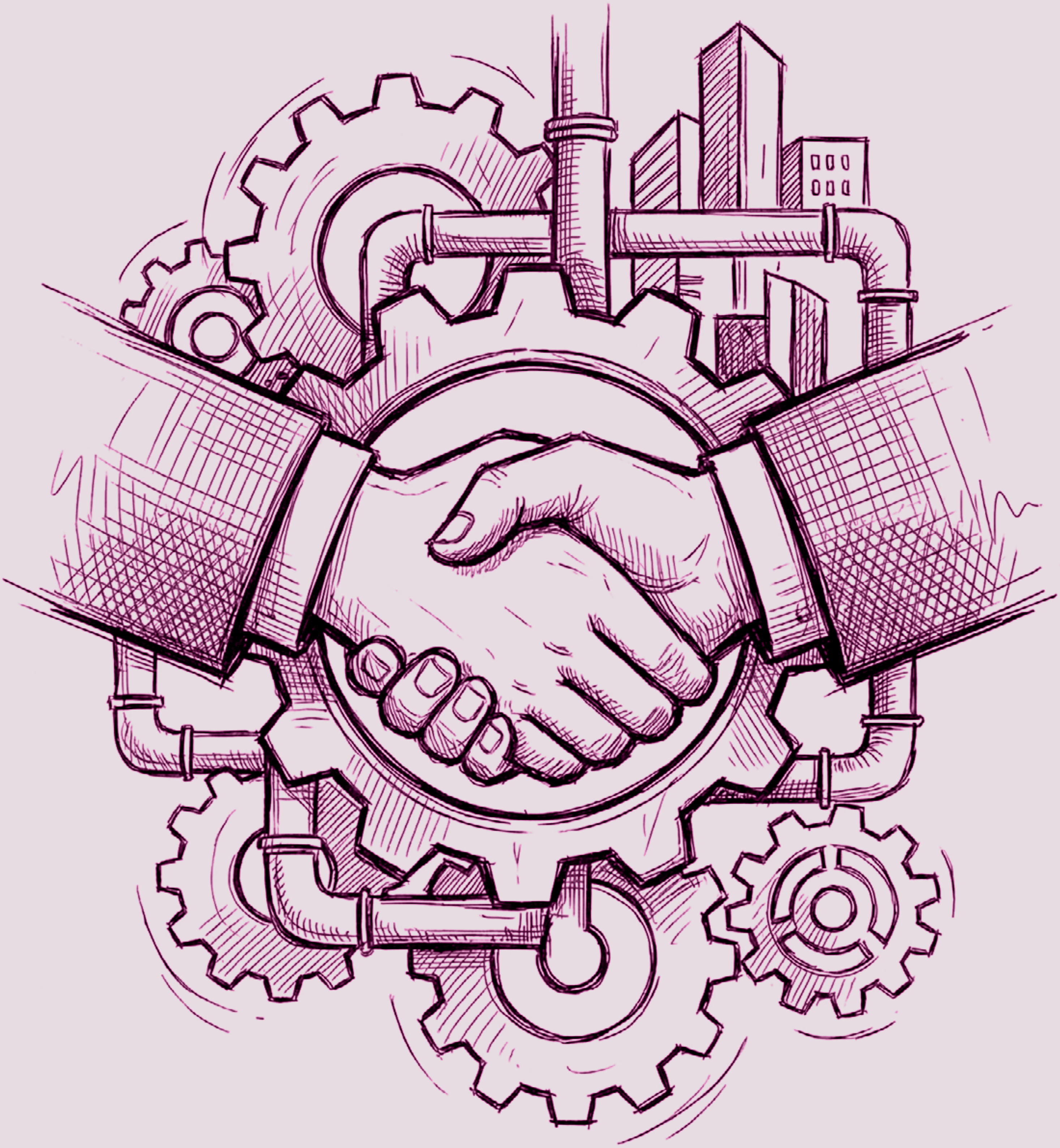
Step 4: Final Selection for Publication

From this larger body of analysis, the 15 case studies presented in this publication were selected through internal discussion between the research team and the research advisory team. The selected case studies were found to be the most relevant and useful for publication and because together, they reflect a diverse but credible cross-section of how a green transition is currently being pursued in Bangladesh's RMG sector.

Collectively, these cases demonstrate that while transition pathways vary, the convergence of technical feasibility, financial viability, participation, shared responsibility, and institutional support is critical for scaling progress towards a green energy transition in Bangladesh's RMG industry.

Confidentiality Note:

Some case studies in this publication are presented using pseudonyms. Of the total number of cases included, a portion of participating organisations provided consent for their names to be used, while others are anonymised. Due to time limitations, the research team was unable to secure final endorsement of the content from all featured organisations. Nevertheless, the majority of the information presented is based on primary-source interviews and documentation, with only a limited number of cases drawing on secondary sources.



Simplifying Solar for Manufacturers:
The Greener Garments Initiative by Bestseller

CASE STUDY 1

Simplifying Solar for Manufacturers: The Greener Garments Initiative by Bestseller

The Challenge Factories Could Not Solve Alone

To ensure a solar-driven energy transition in Bangladesh, two of the most critical challenges faced by the Ready-made Garments (RMG) sector involve: (a) access to finance/funding and (b) access to reliable renewable energy/ solar suppliers. Factories often depend on sources such as Bangladesh Bank or other financial institutions for funding and seek help from local consultants or EPC (Engineering, Procurement and Construction) developers to gain access to solar installations. Usually, the burden of installing solar panels or any renewable energy installation in fact, falls upon manufacturers alone. This has been reportedly extremely challenging for manufacturers, even when they have the intent to transition towards renewables. Factory personnel often lack the necessary knowledge in identifying feasible funding/green financing sources or reliable renewable energy vendors. Ideally, such complications would be easier to tackle if brands provided the necessary technical and advisory support to source green financing and in recruiting EPCs., Considering this challenge, the global fashion company, Bestseller sought to enter into a joint venture with a climate-tech company called SOLShare through the Greener Garments Initiative (GGI) in 2022. Through this partnership, Bestseller has been able to manage the necessary investment and procurement of solar panels for their suppliers in Bangladesh.

How the Initiative was Designed

The Greener Garments Initiative (GGI), launched in December 2022, marks a significant collaboration between SOLShare and Bestseller, a global fashion conglomerate. This is a unique project because, for the first time in Bangladesh, a climate tech company and a global fashion brand has joined forces to create an Energy Service Company (ESCO) to develop and set up solar rooftop installations across the country for a greener supply chain. This collaboration signifies the collaboration of relevant bodies towards a single goal: a green and sustainable industrial future. This innovative partnership is aimed at reducing the carbon footprint of Bangladesh's garment sector through the adoption of solar energy. It is also innovative because the initiative aims to contribute towards the general restructuring of the energy grid in Bangladesh. Together, they formed a joint venture, an Energy Service Company (ESCO), with the goal of providing solar rooftop installations at several of Bestseller's suppliers' factories in Bangladesh. The Greener Garments Initiative aims to roll out solar photovoltaic rooftop installations on a multi-megawatt scale across Bestseller's suppliers.

Bestseller's **"Greener Garments Initiative"** focuses on supporting its supply chain through financial and practical assistance to transition to more sustainable practices. This includes helping suppliers invest in renewable energy, specifically solar power, by providing access to financing their parent company, Heartland.

With a target to scale up to **10 MW of solar capacity** across the garment sector, the initiative addresses two major challenges for RMG factories, by linking them with a reliable ESCO. This initiative's flagship project was the installation of a **558 kWp solar rooftop system** at C group Ltd.'s factory in Gazipur. This was followed by additional projects with other factories, including H Knit Ltd. in Mouchak, Gazipur.

The role of each stakeholder under this collaboration is as follows:

Stakeholders	Role
Bestseller	Fund the project through its parent company, 'Heartland' and appoint a solar supplier company for its suppliers in Bangladesh
Factory	Provide space for installing the power plants
SOLshare	Install, operate and maintain the solar power plants in Bestseller's supplier factories

Table 1: Role delegation between Bestseller, SOLShare & associated RMG factories.

Why Bestseller Stepped in

Discussions with Bestseller revealed that majority of Bestseller's total climate footprint is from their indirect value chain. Indirect greenhouse gas (GHG) emissions from areas such as material production and suppliers reportedly make up **95%** of Bestseller's total emissions. The simultaneous growth of the brand and their expansive supply chain, alongside increasing production rates resulted in a huge increase in Bestseller's share of Scope 3 GHG emissions from their extended value chain. This negatively influences Bestseller's overall carbon footprint, limiting the brand's ability to reach their desired carbon reduction targets. Bestseller believes that it is crucial for the factories they collaborate with to also have better opportunities to use renewable energy, leading them to establish a financing pathway for their suppliers through their parent company, Heartland. With this initiative, Bestseller aims to strengthen their suppliers' opportunity to invest in more sustainable solutions, not only to negate carbon emissions within Bestseller's or their suppliers' supply chains, but to help local communities as well, whilst scaling RMG's overall green transition. Representatives from Bestseller themselves have noted,

"Renewable energy is one of our priorities. Our ultimate target is to reduce carbon emission by 30% within 2030. Our way of working is by collaborating with our suppliers."

How the Model Works in Practice

Conversations with Bestseller revealed how the overall collaboration proceeds:

"Manufacturers have the freedom to make decisions and through this freedom we proceed with our custom action plan, which Bestseller and SOLShare helps tweak. Factories set their own deadline, which they share with us. Afterwards, we follow up with factories on their action plan, as per their own set deadlines or interim milestones. Some suppliers shared that they have the space and interest but they do not have the capacity for investment. We communicate these concerns with our headquarters and recommend a partnership investment.

Currently, we are simultaneously investing in our supplier factories and have also involved SOLShare. Initially, a USD 10 million investment came in from our parent company. We plan on using this investment under the OPEX financing model so that our participating factories can install rooftop solar panels at no cost. We will implement it according to European standards. No initial upfront investment is therefore, required from our factories. Latter payments will be based on the energy each factory generate monthly – similar to monthly utility bills, but with a 10-15% discount. Bangladesh's Power Development Board (PDB) has two rates- peak rates and off-peak rates, where off-peak rates are lower. Our solar project rate is 10-15% less than the off-peak rate. We have done 5 projects already and 2 are currently in the pipeline."

In other words, the factory has provided the space (factory rooftop) for the installation of solar panels, SOLShare has installed, operated and maintained solar power and Bestseller has arranged the funding of this solar project. Although there has been no investment from the factory, the management needs to pay Bestseller the energy, the factory is generating monthly.

What the Initiative has Started to Achieve

The Greener Garments Initiative has already demonstrated considerable success in reducing greenhouse gas (GHG) emissions through its solar installations. The first project, completed at C group Ltd, has resulted in a significant decrease in the factory's GHG emissions. By replacing traditional grid electricity with renewable solar power, the factory is now reducing its carbon footprint by approximately **481 tonnes** of CO2e annually. The factory projects that in 5 years, this number will increase to **2405 tonnes** of CO2e if other conditions remain the same. As the initiative continues to expand to other factories, the cumulative GHG emissions reductions are expected to grow substantially. The goal of scaling to **10 MW** of solar capacity could potentially reduce CO2 emissions by an estimated **8,640 tonnes** annually across all participating factories.

Bestseller and SOLShare aim to not only to reduce carbon emissions in participating factories, but strengthen the market competitiveness of Bangladesh garment factories, making them more attractive to international buyers looking for sustainable production hubs.

Hence, the Greener Garments Initiative not only addresses environmental sustainability but also plays a pivotal role in enhancing energy security and factory competitiveness. By transitioning garment factories to renewable energy, particularly solar power, the initiative reduces factory dependence on grid electricity, which is often subject to fluctuations in availability and rising costs.

Challenges to Address in the Road Ahead

Despite the prospective benefits of the GGI, several challenges hinder broader implementation of solar rooftop systems in the garment sector. Bestseller notes that that one of the key challenges to scaling renewable energy is limited knowledge among factory management noting,

"The biggest gap in the factories is awareness because people are not aware the many ways energy is getting wasted. Our colleagues who work in the factories have a competency gap."

Although the GGI has resolved this problem by offering technical knowledge on solar power and basic information on their operation and maintenance, the upfront cost of installing solar panels remains a significant barrier, particularly for small and medium-sized enterprises (SMEs). While the long-term savings in energy bills are substantial, many factories struggle to access financing for the initial capital outlay.

Not all factories have the necessary roof space or structural integrity to accommodate solar panels. Some factories need to invest in roof repairs or reinforcements before installation can take place, further adding to the costs and complexity of solar installation projects. GGI has extended support to mitigate this challenge by identifying suitable technologies that can operate efficiently even with limited or compromised roof space. For factories needing structural upgrades, GGI may offer support with additional renovation costs to make solar adoption feasible.

Solely relying on solar power, which is a variable form of energy may not always be feasible. Bangladesh experiences significant seasonal fluctuations in sunlight, especially during the monsoon season. Solar energy systems are less efficient during periods of heavy rain or cloud cover, which can lead to inconsistent power generation. Factories are encouraged to complement solar energy with other backup power solutions to ensure consistent operations. GGI has encouraged factories to adopt hybrid systems, combining solar with backup power solutions, to ensure uninterrupted operations. They also promote technologies that can generate electricity even in low-light conditions, helping mitigate seasonal fluctuations.

While solar energy can significantly reduce reliance on grid electricity, integrating the generated power into the national grid poses logistical challenges. Many RMG factories are yet to install net-metering as well. The renewable energy regulatory framework in Bangladesh is still developing, and factories face challenges navigating net metering policies and grid connection procedures. Delays in regulatory approval processes could slow the adoption of solar energy across the garment sector. GGI has actively engaged in policy dialogues with relevant authorities. Their goal is to identify bottlenecks in net metering and grid connection processes and advocate for streamlined, factory-friendly regulatory solutions. Meanwhile, energy storage systems, such as batteries, are necessary to store surplus energy for use during periods of low solar output. However, the cost of energy storage remains a barrier, especially for smaller factories.

While challenges exist, the initiative's potential for scaling up and creating a lasting environmental impact remains high.

In the words of Shamsuddoha, CEO of SOLshare,

"This is just the beginning. We are excited about the future and look forward to expanding our solar solutions to more factories, helping them make a tangible difference in the fight against climate change."

Ways to Scale Up the GGI

The Greener Garments Initiative is a pioneering effort to promote sustainability in Bangladesh's garment industry. By leveraging solar energy, SOLshare and Bestseller have already made significant strides in reducing the sector's carbon footprint while simultaneously helping factories reduce their operational costs.

To make solar energy more accessible, SOLshare and Bestseller can continue working with local financial institutions, banks, and government bodies to offer tailored financing options such as green bonds, subsidies, and low-interest loans for small and medium-sized factories. Moreover, SOLshare and Bestseller could collaborate with relevant government agencies to upgrade the national grid infrastructure, allowing for more efficient integration of solar power and smoother energy distribution.

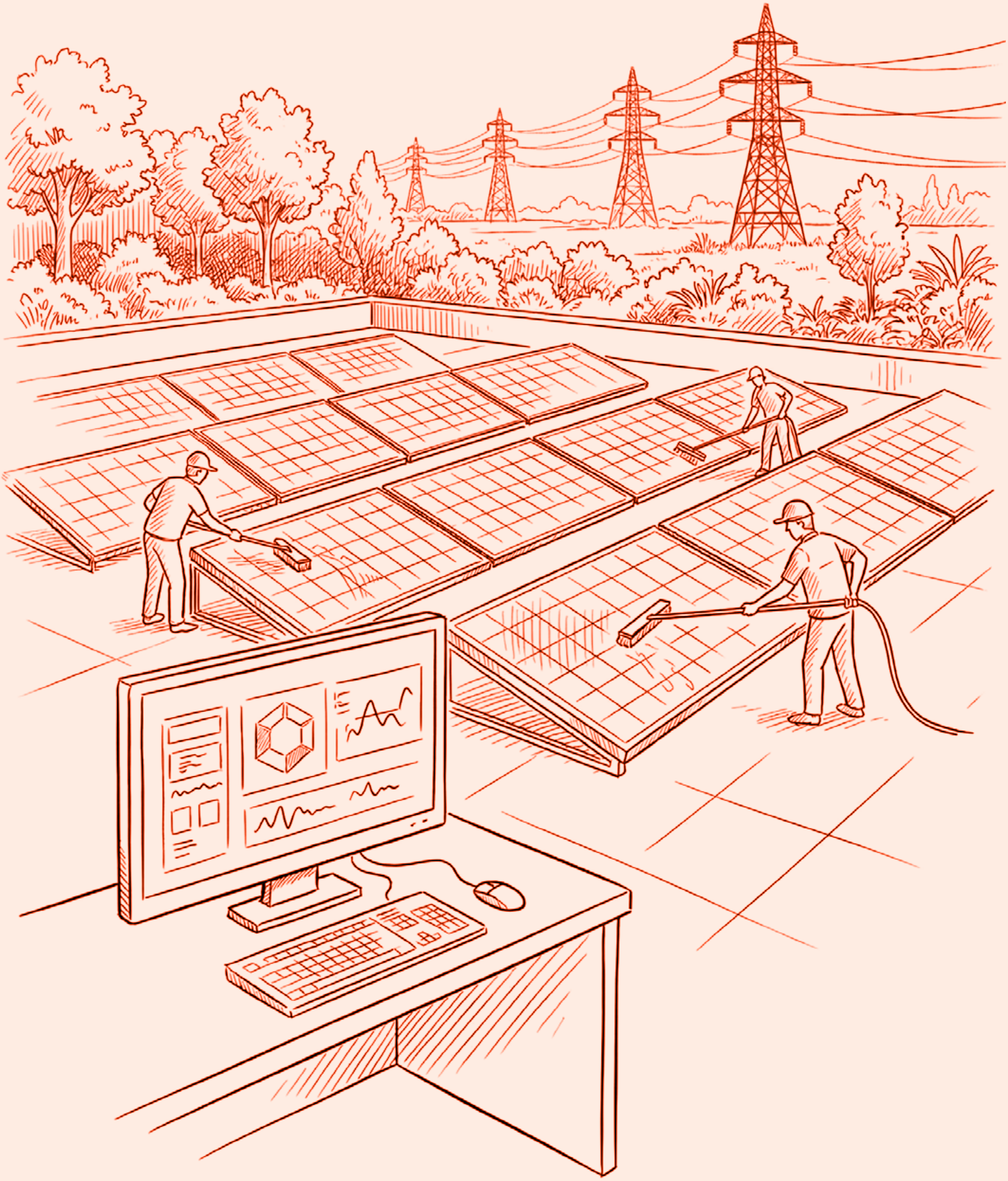
Introducing flexible financing models such as Power Purchase Agreements (PPAs) or Energy-as-a-Service (EaaS) could help factories pay for solar installations based on the energy savings they achieve. This would lower the initial investment barrier, particularly for factories reluctant to pay upfront.

At the same time, increasing awareness about the benefits of solar energy, both financial and environmental, is essential for widespread adoption. SOLshare and Bestseller can provide training programmes to factory managers and staff to ensure proper operation and maintenance of solar systems.

Finally, the Greener Garments Initiative should continue to scale its ongoing solar rooftop projects, with the aim of reaching the expected **10 MW capacity** in the near future. An option can be to accelerate this initiative by partnering with other fashion brands and boosting investment in renewable energy, for Bangladesh's RMG.

Key Lesson

This case shows that manufacturer-level solar uptake becomes far more feasible when brands move beyond setting sustainability expectations towards supporting factories in addressing the practical barriers faced. Through the Greener Garments Initiative, Bestseller has combined financing, technical support, and implementation partnership in a way that reduces the burden on manufacturer and makes solar adoption more achievable. The case demonstrates that where factories have the interest and space to install solar but lack upfront capital, technical confidence, or access to reliable vendors, brand-backed models such as this can help turn renewable energy from a difficult aspiration into a feasible intervention. At the same time, the experience also shows that scaling such models will require stronger factory awareness, more enabling infrastructure, and a more supportive regulatory environment.



Beyond Installation: Improving Solar Efficiency through Better Planning, Monitoring & Maintenance

CASE STUDY **2**

Beyond Installation: Improving Solar Efficiency through Better Planning, Monitoring & Maintenance

The Challenge

As sustainability expectations from global brands increase, many RMG factories in Bangladesh have started installing solar panels to demonstrate progress. Yet, installation alone does not guarantee results. In many cases, factories are not able to achieve the level of efficiency initially promised by service providers, and expected returns from solar installations can fall sharply over time.

A key reason is limited internal technical capacity. While EPC firms, solar suppliers, and consultants are available, many factories do not have enough in-house expertise to assess design options, question technical aspects pertaining to said installations, or monitor system performance after installation. Ideally, this role would be led by a dedicated research and development (R&D) unit. In its absence, sustainability teams or senior management need to make these decisions themselves. Where that knowledge is limited, factories risk overinvesting, accepting unsuitable designs, or failing to maintain systems properly.

As noted during an interview with the BGMEA:

"There is a crucial need for technical experts in solar technology management. Many factories that invest in solar panels lack sufficient manpower. ROI decreases due to improper maintenance, which increases over time."

Against this backdrop, this case study draws on the experiences of primarily **3 factories** that approached the issue differently, but arrived at the same conclusion: solar performance depends not just on installing panels, but on understanding how to design, monitor, and maintain the system well.

How Factories Approached the Problem

One factory first identified different locations where solar systems had already been installed and visited them to understand variations in efficiency and the reasons behind those differences. This field-based learning helped factory management make more informed decisions before investing. According to the factory's environmental engineer,

"I have visited 7 establishments with solar panel installations. Among them two were universities in Chattogram where efficiency was 1% and 10%. Then I visited garment factories. I saw a solar power generation of 40% which surprised me and, in Manikganj, efficiency of a factory was 60%. I tried to understand the reason behind the differences."

These visits allowed the factory to compare actual performance across different sites rather than relying only on theoretical advice.

From these visits, the factory found that one major reason for variation in solar efficiency was the direction of the rooftop panels. Contractors had not always properly considered the orientation of the system. The factory learned that for maximum production, the panels needed to be positioned in an east-west direction. Although this guidance may exist in theory, its practical significance became much clearer through direct observation of existing installations.

The factory also observed that the efficiency of solar systems varied depending on the curve of the structure on which the panels were installed. In some locations, the panels were not steep enough to capture maximum sunlight, which contributed to lower solar energy production.

Another important factor was the sun pathway. In some sites, one side of the rooftop received adequate sunlight while the other side received much less. Despite both sides having solar panels installed, one side generated less electricity. Drawing on this lesson, the environmental engineer in one factory chose to install panels only on the side of the shed where maximum production could be achieved and left out the side with lower sunlight exposure. This allowed the factory to save money by avoiding investment in the low-performing space.

The engineer also considered other factors such as shadow and production time. Based on this analysis, he concluded that the factory should install **1.4 MW DC or 1250 AC**. The contractor had predicted **1.8 MW**, but after reviewing the field-level evidence, the engineer decided not to invest above **1.4 MW**, judging that the additional investment would not be justified by actual efficiency and would simply lead to unnecessary additional investment.

Panel angle was also found to be important. According to the factory's engineer, even a small difference in angle can affect output and long-term costs. Reportedly, a one-degree change in angle for solar panels can potentially reduce efficiency by **4%**. One engineer explained:

"Rooftops are the best place to set up a solar panel, and most efficient when it is set at 60 degrees. It is not always possible to set it at 60 degrees because of the adjustment on the shades. Because of this curve adjustment, there's a 2-3% difference. If there's a daily loss of 21 kilowatts, then yearly it has a loss of 6552 kilowatts, which amounts to a loss of electricity worth 78,000 taka."

This illustrates how design decisions made at the outset can have significant financial implications over time.

Alongside field visits, the factory also used software to make better decisions. One tool mentioned was PBCist, which provides suggestions based on a site's latitude and longitude, including the appropriate degree of tilt and the likely sun path. This type of sun path analysis helped the factory better understand how much sunlight could realistically be received and how panel placement could be adjusted to improve efficiency. According to the factory's engineer, using such software can support more accurate planning and contribute to greater solar efficiency.

While the previous factory concentrated on learning from existing sites and improving design choices, another focused more heavily on monitoring performance after installation. Its engineer described the use of a scatter system, which allowed the company to monitor panels across multiple factories from one central screen. Though the system required additional investment, it gave management a much clearer picture of what was happening across the network.

As the factory's engineer explained:

"The system through which we measure efficiency is called the scatter system. A lot of other people don't use it. We can monitor all the system panels of all factories of our group in this location from just one monitor. Installing this system cost us around 25 lacs taka. This gives us a comprehensive overview of everything."

The engineer described the system as giving the company an "eagle's eye view" of its operations. It made it easier to monitor overload at any point in the system, compare how much energy was being consumed from the solar panels installed, national grid, and generators separately, and manage billing more accurately. According to him, this also helped the company address billing disputes and identify where electricity losses were taking place.

He further explained:

"To set up the scatter system, we had to attach meters at each point, which cost BDT 35,000 each. We also purchased all the accessories and software related to it. All these cost us BDT 25 lacs."

For the engineer, the value of the system lay not only in data collection, but in the ability to act on that data immediately. Sitting at his desk, he could see whether a particular meter was operating normally and could send technicians to investigate if anything looked unusual.

As he described it:

"If it wasn't operating properly, I would notice the anomaly from my desk and send the technicians to fix the issue or figure out what was causing it. Having the system enables me to see what is happening considering all the factors, or if we are losing at any point of the system."

He also linked this continuous monitoring directly to cost savings:

"We can control voltage and save costs by using the same motor with the same watt. This can only be achieved if we have a constant monitoring system. So, if you didn't have this system, you would be losing money on the electricity bill every month and you would not be able to know why. These small actions are saving us 10% of the energy every month."

Another part of the story came from a sustainability head of D garment company, with **18 factories** spread across Sirajganj, Narayanganj, Demra, Gazipur, Jessore, and Cox's Bazar. Rather than assuming that one solar model would work equally well everywhere, he conducted feasibility studies across sites, worked with multiple consultants, and compared efficiency across zones. By comparing efficiency data from one zone to another, he tried to understand why solar performance differed and then adjusted decisions accordingly. This helped the company understand that solar performance was highly location-specific.

This process also revealed how factory type and operating environment affect solar efficiency. According to the factory's findings, spinning factories often perform less efficiently than RMG factories because of micro dust particles, which settle on the solar panels and block sunlight. If this is not properly understood and factored into planning and maintenance, efficiency can drop by as much as **10%**.

Why Maintenance Mattered

Both case archetypes thus point to the same broader lesson: even a well-designed system can underperform if it is not properly maintained.

Factory respondents noted that poor cleaning practices were one of the most common reasons for reduced efficiency. Many factories cleaned their panels only every **15–20 days**, even though dust accumulation could quickly cut performance. One environmental engineer described how his factory improved results simply by increasing the frequency of cleaning:

"Before, we used to clean at 7-day intervals in 15 buildings using 2 cleaners. Later we increased the number of cleaning workers to 4, which helped us clean the panels every 2 days. This increased our efficiency by 5–7%."

This example suggests that maintenance does not always require complex interventions. In some cases, relatively simple operational adjustments can make a significant difference.

These experiences also helped explain why expected returns on solar investment do not always match actual returns. According to one factory respondent, owners often do not get more than **50–60% efficiency** because of issues such as dust, perforation, and generation losses. Where expected efficiency was **80%**, the shortfall translated directly into financial loss. Under those conditions, an investment that was expected to pay back in **7–8 years** could instead take **12–14 years**, and if efficiency fell further, even up to **20 years**.

As D group's head of sustainability put it:

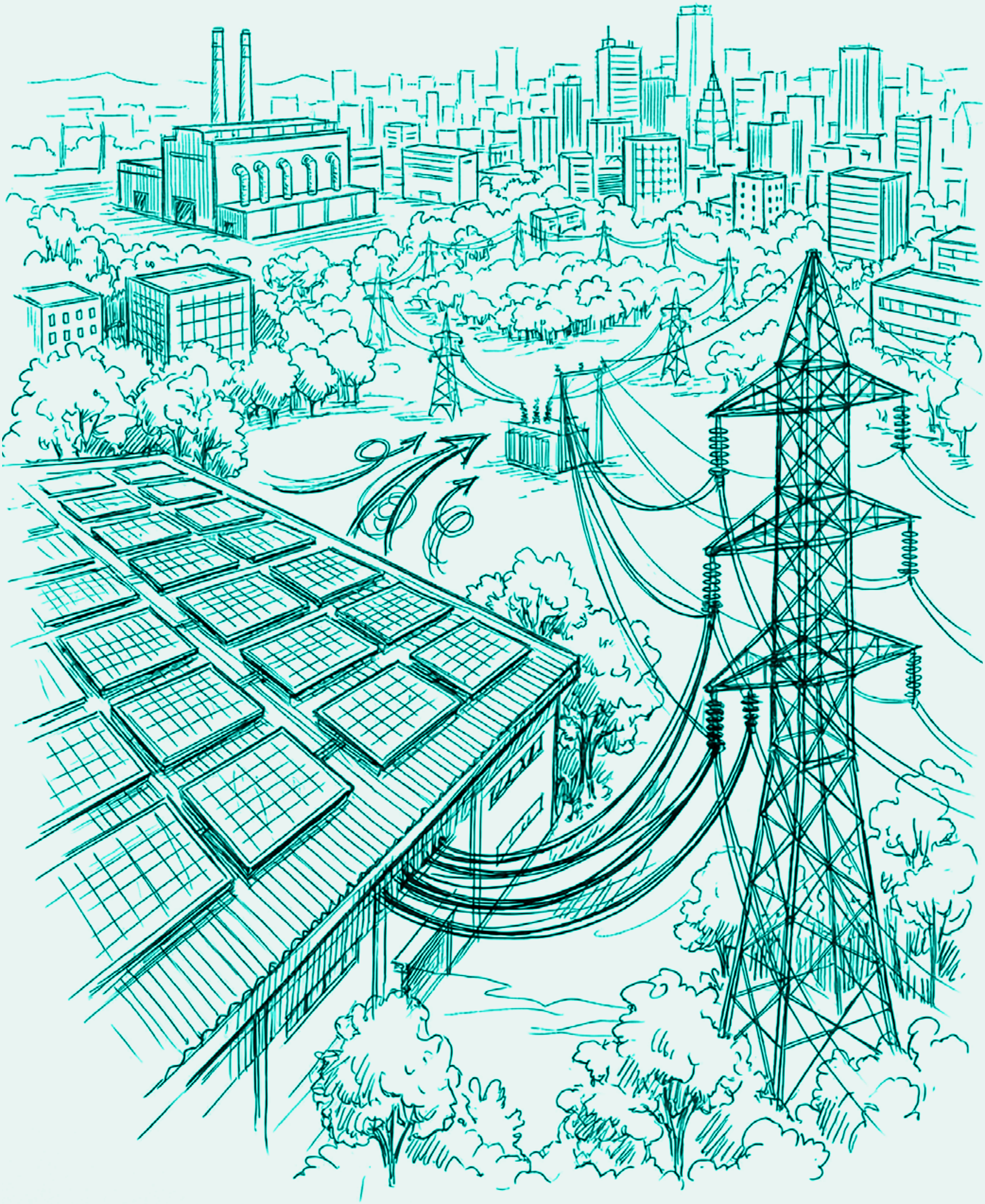
"This means that what one would invest in 20 years with non-renewables, you are doing the same with renewables and therefore, the owner will not be interested in any way."

For this reason, the factories interviewed within this broader case, repeatedly stressed that top-level management also needs a working understanding of how solar systems function in practice. The business case here is not only about whether factories installed solar panels, but whether they have the knowledge and systems needed to make these systems work well.

Key Lesson

This case study shows that solar efficiency is shaped by what factories do both before and after installation. Site visits, system design, sun path analysis, zonal comparison, centralised monitoring, and regular cleaning all played a role in improving performance. Together, these experiences suggest that the value of solar investment depends not only on access to finance or equipment, but on the internal capacity to plan carefully, monitor continuously, and maintain consistently.

For factories considering solar, the lesson is clear: installation is only the beginning. The real business case depends on how well the system is understood and managed over time.



Making Solar Work with Captive Power: Connecting Solar to the Grid While Keeping Critical Operations on Generators

CASE STUDY **3**

Making Solar Work with Captive Power: Connecting Solar to the Grid While Keeping Critical Operations on Generators

The Challenge

A senior manager from a garment factory shared that using solar power alone in factories that are not connected to the national grid, known as captive power plants, does not always deliver the expected benefits. The main issue is that solar power depends on the weather. On sunny days, it might produce a lot of electricity, but when clouds come, the power drops suddenly. This creates a risk for factory operations, so generators have to be kept running as backup all the time.

In practice, this limits the fuel-saving value of solar. Even after installing solar panels, the factory may continue using nearly the same amount of gas because generators still need to run as backup. Under this setup, solar does not significantly reduce fuel use.

The Factory's "Way Out"

To address this problem, the factory decided to connect an external electricity line from the Power Development Board (PDB). Before this, the factory had no PDB connection and operated entirely through its own power generation. Once the grid connection was in place, the factory could link its solar system to the PDB line, allowing excess solar energy to flow into the grid instead of going unused. For this reason, the factory sought a PDB connection. While not explicitly detailed, it was implied that establishing a connection with the PDB involved some formal process, likely including technical arrangements and regulatory approvals. There may have been initial costs for infrastructure and metering, but these were considered worthwhile given the long-term savings in fuel and operational efficiency.

At the same time, the factory kept its dyeing section on captive power. Rather than replacing one system with another, it adopted a hybrid model: solar connected to the grid for part of the operation, and captive power retained for the most critical and energy-intensive section.

How the Model Worked

The key change was in how the power sources were distributed. By connecting solar to the PDB line, the factory could push excess solar energy into the grid when available, and draw from the grid when solar output dropped—without relying on generators to fill the gap. This flexibility meant that generators no longer had to run continuously as backup.

The dyeing section, however, continued to run on captive power because of its heavy and constant energy demand. The solar panels were installed across four units of the company — garments, washing, finishing, and knitting — while dyeing remained fully covered by captive power. Dyeing required 2200 kilowatts per hour, while garments and the other sections required 1100 kilowatts. On average, the factory received 600 kW from solar panels and 500 kW from PDB. As a result, the number of active generators was cut from four to two, leading to significant fuel savings and more stable operations.

Measured Impacts

The factory explained that the main issue with solar in a captive-only setup is variability. Suppose the solar plant produces **800 kilowatts** in sunny weather, but sometimes falls to **200 kilowatts** due to cloudy weather. Efficiency might instantly drop to **20%** from **70%**. To meet the power requirement, the factory has to run a generator as a backup. This backup generator takes charge and supplies the rest of the electricity to prevent a factory shutdown. In this method, there is no saving in gas/fuel.

By connecting solar to the PDB line and keeping only dyeing on captive power, the factory cut generator use from four units to two. Since each gas generator consumes around **200 cubic metres of gas**, the factory is now saving around **400 cubic metres of fuel per day**. This has reduced fuel consumption, lowered costs, reduced carbon emissions, and extended generator life. The arrangement also meant that solar power was no longer being wasted. When connected to the grid, all solar energy produced could be properly utilised, while dependence on PDB power also dropped significantly because much of the daytime load was met through solar.

The cost comparison also showed clear savings. The factory received **500 kW from PDB**, which cost **6,000 takas**, whereas generating the same amount through gas would have cost **9,000 taka**. This meant a saving of **3,000 taka per hour** by using solar power together with PDB.

Area	Solar with Grid (PDB) Connection	Solar with Captive Power
Operating arrangement	Solar energy is used together with the PDB line during the regular shift (9:00 am–5:00 pm). After 5:00 pm, operations shift back to the gas generator as PDB tariff increases.	Solar is used alongside captive power, but due to fluctuations in solar output, additional gas generator backup is required.
Power tariff / unit cost	During regular hours, the average cost is around **Tk. 7 per unit**.	The average cost of power from gas generator is **Tk. 8.30 per unit**.
PDB tariff	Regular PDB rate: **Tk. 12 per unit**; after 5:00 pm: **Tk. 17 per unit**.	Not applicable.
Gas cost reference	Gas-based generation cost: **Tk. 8.30 per unit.**	Gas-based generation cost: **Tk. 8.30 per unit.**
Savings per unit	**Tk. 1.30 per unit saved** during regular operating hours compared to gas generation.	No comparable saving.
Additional gas requirement	No additional gas required under the current arrangement.	Requires **400 cubic metres of gas more** compared to the solar-plus-grid arrangement.
Additional hourly cost	Lower than captive-only arrangement.	**Tk. 12,000 more per hour** (400 × 31.5).
Additional daily cost	Lower than captive-only arrangement.	**Tk. 75,000 more per day**.
Additional monthly cost	Lower than captive-only arrangement.	Approximately **Tk. 19,65,000 more per month**.
Environmental implication	Lower fuel consumption and associated carbon emissions.	Higher fuel use and carbon emissions due to the additional 400 cubic metres of gas required.

Table 2: Cost Comparison: Solar with Grid (PDB) Connection vs. Solar with Captive Power

Why the Factory did not Choose Battery Backup

The case also compared this hybrid model with battery storage. According to the factory's environmental engineer:

"Having a battery backup of similar value to solar and captive power is a costly practice."

He explained that if a factory had **1 megawatt/1250 kilowatt solar** with a **1-megawatt battery backup**, fluctuations in solar output would not affect generator use because the backup would come from the battery instead. However, the cost of a **1-megawatt battery** would be around **10 crores**, and the battery would need replacement after **3–5 years**. In contrast, a grid connection was described as a one-time investment.

According to the same engineer,

"The government is using this battery backup with solar panels. It's a wrong decision. 40% of this solar production is used to charge the battery, and 60% of the rest goes to the grid. But if you give 100% to the grid and use the fuel/power grid at night, then it will save more."

Key Lesson

This case shows that for factories operating on captive power, solar becomes much more useful when paired with grid connection rather than treated as a stand-alone substitute for generators. This idea emerged from a practical need to reduce fuel consumption and improve energy efficiency. By connecting solar to the grid while keeping critical operations such as dyeing on captive power, the factory was able to reduce fuel use, improve energy efficiency, and make better use of the solar power it generated.

The case also highlights an important wider lesson: for some factories, the question is not whether to choose solar or captive power, but how to combine available energy sources in a way that protects operations while improving cost efficiency.

Turning Sheds into Solar Space:
How Tarasima Used Shed-Based Buildings to Expand Solar Generation

CASE STUDY **4**

Turning Sheds into Solar Space: How Tarasima Used Shed-Based Buildings to Expand Solar Generation

The Space Challenge

A major constraint to scaling solar power in Bangladesh's RMG sector is space. As industries increasingly rely on high-rise factory buildings to make the most of limited commercial land, the available rooftop area for solar installation often remains too small in relation to overall production demand. While rooftop solar has enabled some renewable energy generation, it is often insufficient to meet the energy needs of large manufacturing operations.

To put this into perspective, the generation of 1 kilowatt power requires space worth **6 square metres**. If a factory were to construct a five-storied building in a space of **20,000 square metres**, it would produce a rooftop with the size of **5000 square metres**. When it comes to solar power installation, the power generated for the entire building would be solely based on the rooftop space of **5000 square metres**. This means that the factory's solar generation capacity is limited by rooftop size, even though the building's actual energy demand is much higher. As a result, factories often remain dependent on backup generators and grid-based electricity.

Pointing to this structural constraint, a BGMEA representative noted,

"The challenge regarding technical feasibility lies in the structure. Many factories are high-rise buildings with limited space for renewable projects. Larger factories have more available space. However, most factories are 6-7 story buildings, and the only space they have for renewable energy is the rooftop, which is very limited."

The Factory's Response

This case shows how one factory approached the problem differently. Instead of relying mainly on a conventional high-rise building, Tarasima Apparels in Manikganj used a factory design that included large single-storey shed-based structures across a wider land area. While this model requires more land because of horizontal expansion, it creates much more usable surface area for solar installation. In effect, the shed itself becomes dedicated solar space, connected to the main factory operations and capable of generating far more renewable energy than a limited rooftop alone. Figure 01 provides a graphical comparison of solar energy production spaces between high rise buildings and single-storey sheds.

Tarasima Apparels had purchased **20,000 square metres** of land in a remote location and used **14,806 square metres** for shed-based, single-storey factory buildings. When concerns around carbon emissions and renewable energy became more prominent in the sector, the company saw this design as a major opportunity to generate electricity at greater scale through solar power.

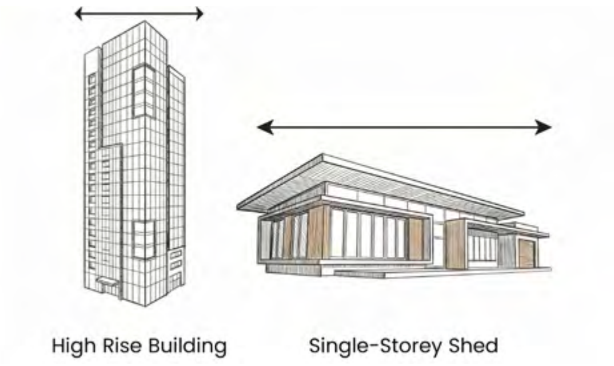


Figure 1: Graphical Representation of Solar Energy Production | High Rise vs. Shed

When concerns over carbon emissions and the use of renewable energy came upon the RMG sector, Tarasima Apparels immediately grasped the opportunity to generate additional electrical power through the installation of solar panels in their building. It became a unique opportunity to rely on renewable energy with greater capacity for efficient electrical power generation.

In this context, the Executive Director of Tarasima Apparels commented,

"Space for solar power in Bangladesh is a challenge. We construct spaces based on our production demand. To do so, we initially analysed the factory's open rooftop, its total capacity and consulted with different suppliers to see who can provide the best quality panels followed by maximum utilisation of the space provided. Given the outcome of our practices over time, I believe that sheds are a better option for more solar power generation."

Apart from lower construction cost, another advantage of shed-based factory design is that it can create more usable surface area. In Bangladesh's RMG sector, factories have in practice been instructed to keep part of the rooftop open and free for fire-safety purposes; for example, a BGMEA notice on occupational health and safety standardisation for member factories directed that **25%** of the rooftop be kept open and free. More broadly, factory design and use are governed by the Bangladesh National Building Code (BNBC) 2020 and the Bangladesh Labour Act, which together frame building safety, access, and unobstructed movement as core compliance concerns. In this context, shed-based factory layouts can offer an important advantage: they expand the total built surface available for solar beyond the main RCC rooftop, making it easier to install larger solar systems while still preserving the clear space needed for safety compliance (BGMEA, 2013; Government of Bangladesh, 2020; Government of Bangladesh, 2006/2018).

A solar supplier company was commissioned to install solar panels at Tarasima. To achieve the desired maximum power from the solar PV system, the supplier designed and used the latest artificial intelligence integrated inverter in order to enhance the power output. The calculation of solar power was based on the satellite data collected from Google Maps. The system was designed by considering the PV modules and array configuration on prefabricated rooftops set at a **7° angle.** Following a one-day site assessment, the survey team identified one RCC building and six prefabricated shed rooftops. Based on the findings of the site visit, a rooftop layout plan was then developed covering one RCC building and five shed structures.

Figure 2: Tarasima's Solar Site Design Layout

Since much of the factory consisted of prefabricated shed rooftops, the supplier adopted a steel tile roof system that was suitable for large factory roof areas. It adopts special rail fixing method using a trackless installation approach, making the installation very flexible. This made the installation simpler and faster by reducing the number of components needed. It could also be adapted to steel tiles of different sizes.

Figure 3: Solar Panels at Tarasima

What the System Made Possible

In Tarasima, a solar supplier company was commissioned to install solar panels for their factory. To achieve maximum power from a photovoltaic (PV) system as an energy source, the supplier had used the latest artificially intelligent, integrated inverter system to enhance power output. A survey team studied the project site for a day and found that constructing one Reinforced Cement Concrete (RCC) building with five prefabricated shed-based rooftops would support efficient, solar energy output for the company. For reference, the rooftop solar layout plan is summarised in the following table.

Building Name	Rooftop Potential, in KWp (Approx.)	Type of Roof	Roof Orientation
Building A	870.96	Shed	North South faced
Building B	259.92	Shed	East West faced
Building C	150.48	RCC	South Faced
Building D	112.48	Shed	North South Faced
Building F	526.68	Shed	East West Faced
Building G	396.72	Shed	North South Faced

Table 3: Rooftop Solar Layout Plan Summary

As provided above, it is evident that the sheds (Buildings A, B, D, F and G) provide a greater amount of energy that totals to **2,166.76 kWp** compared to the main RCC building (Building C) that has the capacity of **150.48 kWp**. The lower construction cost of shed-based buildings, combined with the larger surface area available for solar installation, allows for substantially higher power generation. This is evident in Tarasima's case, where the factory is able to generate a total of **2,317.24 kWp of solar energy** with a collective performance ratio of **79.4%**.

Pointing out the advantages of shed-based solar, Tarasima's Executive Director notes,

"We bought land and made shed buildings. My space increases. Then we saw that due to this huge amount of space, we get more than 2000 kilowatts which could have been limited to 200 kilowatts if it was a multi-storeyed building."

Investment and Power Generation

Tarasima adopted the BOLT financing model, which came to a total cost of **USD 2,115,923** (approximately **BDT 257,000,000**). It was a six-year contract and the company was expected to repay the amount in **60 instalments**. For individual payments, the monthly instalment was about **USD 34,579** (estimated as **BDT 42,00,000**). Particulars for this investment plan are provided below.

Particulars	Amount (USD)
Solar System	1,745,430.59
Annual Maintenance Cost (6 Years)	98,797.95
Interest	271,694.38
Total Cost	**2,115,923.00**

Table 4: Tarasima Apparels' Investment for Solar Power Generation

Why the Shed-Based Solar Worked

Adjustable Clamping Angles

This feature allows the mounting system to conform to various shed-based roof profiles, including curved or uneven surfaces, which are common in factory architecture here in Bangladesh. The adaptability reduces the need for structural modifications or customisations, thereby lowering installation costs and time. It also ensures that solar panels can be optimally oriented to capture maximum sunlight, improving overall energy yield. The implications of this feature for the factory are the following.

- Faster and more cost-effective installation
- Compatibility with diverse shed designs
- Improved energy generation efficiency

Flexible Height and Width Adjustment

During rooftop solar installation, minor discrepancies in shed dimensions or alignment often occur. The ability to adjust height and width helps absorb these errors without compromising on the integrity or performance of the system. This flexibility ensures a secure fit and reduces the likelihood of post-installation issues. The implications of this feature for the factory are the following.

- Reduced risk of installation delays or rework
- Enhanced structural stability of the solar array
- Lower maintenance and repair costs over time

Adjustable Tilt Angle *(between 8° to 30°, based on the requirement)*

This is a critical feature for optimising solar panel performance. In Bangladesh, the ideal tilt angle varies depending on geographic location and seasonal sun path. Adjustable tilt allows the system to be fine-tuned for maximum solar exposure throughout the year, which directly impacts energy production. The implications of this feature for the factory are the following.

- Maximised solar energy output
- Improved return on investment (ROI)
- Flexibility to adapt to future energy needs or panel upgrades

Improved Waterproofing

Water-proofing is essential for protecting both the solar system and the shed structure, especially during the monsoon season. The use of double silicon waterproofing materials ensures that water does not seep through mounting points, preserving the integrity of the roof and electrical components. The implications of this feature for the factory are the following.

- Enhanced durability and lifespan of the solar system
- Protection against water damage and corrosion
- Reduced maintenance costs and downtime during rainy seasons

Adaptable Lock Clamps and Rail Frame

This feature allows the mounting system to accommodate different types and sizes of photovoltaic (PV) modules. It provides flexibility in sourcing panels from various manufacturers and supports future upgrades without needing to overhaul the mounting infrastructure. The implications of this feature for the factory are the following.

- Flexibility in procurement and panel selection
- Scalability for future expansion
- Cost savings in system upgrades or replacements

These features collectively make shed-based structures in factories an ideal platform for rooftop solar installations. They not only simplify the technical aspects of installation but also contribute to long-term operational efficiency, sustainability, and financial viability.

Environmental Impacts

Tarasima Apparels avoids **1,805,626.80 kg of CO2 emissions per year**, equivalent to **1,805.63 metric tonnes** annually. This scale of emissions reduction in a single location was made possible because the factory was able to generate solar power across **14,806 square metres** of shed-based built space. This is one of the clearest advantages of using sheds for solar installation: they create far more usable surface area for renewable energy generation than a conventional multi-storey rooftop alone.

Addressing Concerns Around Leakage and Durability

Despite these advantages, shed-based solar has long faced hesitation within the industry. A major concern has been water leakage during rainfall, as panel installation requires perforation of the shed structure. Factory owners have often worried that this could damage the roof and disrupt production during the rainy season.

There are also concerns around timing and lifespan. In practice, factories often install solar only after sheds are already **5–6 years** old, even though the practical life of a shed may be closer to **12 years**, while solar panels typically carry a **20-year guarantee**. This creates a mismatch, as replacing the shed later also means bearing the cost of unmounting and reinstalling the solar system.

However, interviewees noted that technical solutions are now available to address some of these concerns. As the sustainability head of a factory notes,

"To address the problem of perforation, an amazing solution came which is sealant that has a 3-4 years guarantee. There is a washer that is water-proof. With this combination, if it is changed after 3-4 years there won't be any leakage."

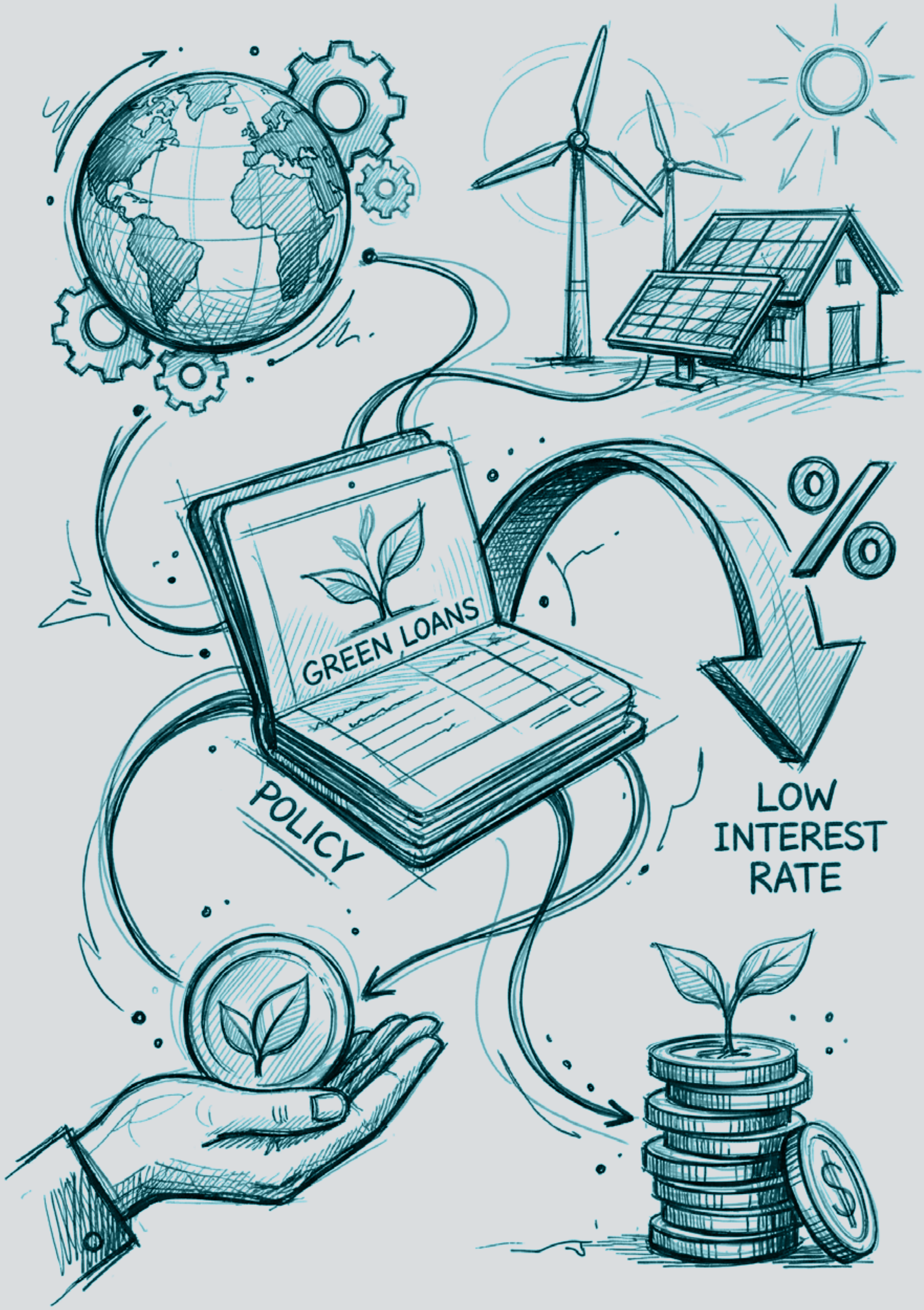
This suggests that while concerns around leakage and durability remain, improved materials and installation methods are making shed-based solar a more practical option.

Key Lesson

This case shows that one of the biggest barriers to solar uptake in Bangladesh's RMG sector is not always lack of interest, but lack of usable space. For multi-storeyed factory buildings, rooftop area often remains too limited to generate solar power at a scale that matches production demand. The experience of Tarasima Apparels demonstrates that shed-based factory design can offer a practical alternative by creating much more surface area for solar installation, allowing factories to generate significantly more renewable energy.

At the same time, the case also highlights that technical feasibility depends not only on space, but on whether long-standing concerns around leakage, durability, and replacement costs can be addressed. Tarasima's experience suggests that with the right design, mounting systems, and waterproofing solutions, these concerns can be managed more effectively.

Taken together, the broader lesson is that factory design matters. Where land is available, shed-based structures can expand the space available for solar, lower construction costs, and unlock much larger environmental gains. In that sense, this case shows that scaling solar in the RMG sector may depend not only on financing and technology, but also on rethinking how factories are physically built for energy transition.



Lower Investment Rates Driving Green Financing:
Through KTex's Lens

CASE STUDY **5**

Lower Investment Rates Driving Green Financing: Through KTex's Lens

The Financing Challenge

For factories seeking to invest in greener production, the challenge is often not whether sustainability measures are desirable, but whether they are financially viable. This is particularly relevant in Bangladesh, where industries face the dual pressures of rapid industrialisation and environmental vulnerability. As climate change intensifies and global sustainability expectations become more pressing, access to affordable finance has become increasingly important for factories seeking to invest in cleaner technologies and more sustainable operations.

Bangladesh Bank, the country's central monetary authority, distinguished itself as a global innovator in this domain, establishing one of the world's first comprehensive green banking frameworks as early as 2011. This pioneering initiative positioned Bangladesh at the forefront of sustainable finance in developing nations, demonstrating how central banks can actively shape economic growth while addressing environmental concerns. In spite of Bangladesh Bank's efforts, access to green finance remains a concern for the stakeholders.

Pointing to the challenge of limited awareness around green finance, the sustainability head of a commercial bank stated:

"I believe the primary problem here is a lack of curiosity. The majority of people are unaware of sustainability because they are uninterested. Even in numerous foreign banks, the situation is the same. Due to their lack of interest in the topic, many well-known banks in our nation are ignorant of sustainable banking practices. So, the primary causes are ignorance and indifference. If you can meet your customers' needs, they will come to you. Their needs must be understood by you, and you must earn their trust. Learning more about this is crucial in this regard. The interest of customers in low-cost funding is one of their issues. Their approach just has to be more astute."

A particularly impactful strategy in Bangladesh Bank's approach has been its deliberate manipulation of interest rates for environmentally sustainable projects. By creating financial incentives through preferential loan terms, Bangladesh Bank has sought to redirect capital flows toward green initiatives ranging from renewable energy to other environmentally sustainable initiatives. This case study examines how that shift became meaningful in practice through the experience of **Ktex Ltd.**, a textile spinning mill in Dhamrai, Dhaka. **Bangladesh Bank's Green Financing Framework**.

Bangladesh Bank launched its first green refinancing scheme in 2009 with a fund of **Tk 200 crore**, targeting solar energy, biogas, and Effluent Treatment Plants (ETPs). The initial interest rate was set at **10%**, but uptake was sluggish. By 2015, Bangladesh Bank introduced the Technology Development and Upgradation Fund (**Tk 1,000 crore**) to support industrial upgrades, followed by the Green Transformation Fund (GTF) in 2022, offering Tk **5,000 crore**.

Offering a somewhat different perspective on the issue, one garment owner stated:

"For financing, the government has many projects and has many donor agencies. So, I don't think financing is a huge issue."

Even so, disbursement rates remained low. By 2020, only **21%** of the GTF had been utilised. The primary deterrent was the high interest rate, which made traditional loans more appealing to businesses and provided little incentive for banks to promote green financing.

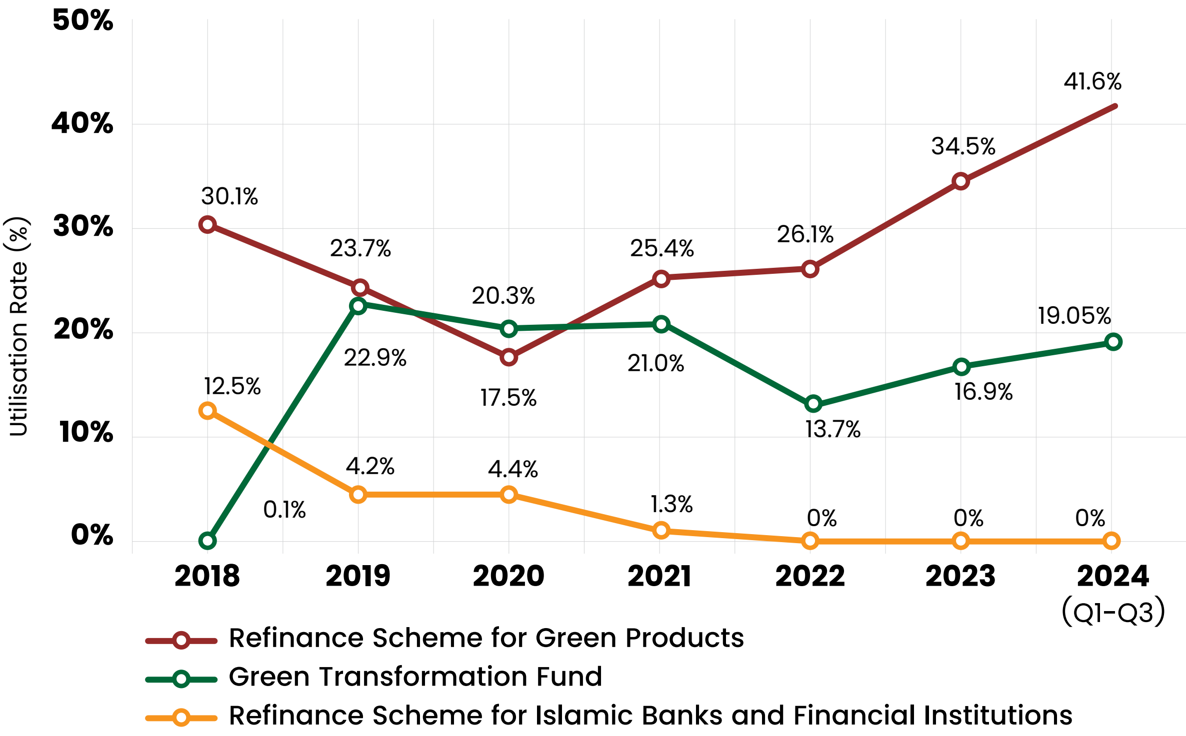


Figure 4: Changes of Interest Rate Over Time

The Turning Point: Interest Rate Reduction in 2023

In August 2023, Bangladesh Bank implemented a transformative policy:

- Interest rates for green loans were slashed from **10% to 5%**.
- Banks' margins increased from **2% to 4%, making green loans** more profitable for lenders.
- Bangladesh Bank retained only **1% of the interest**, passing the bulk of the benefit to borrowers.

This shift had an immediate impact. Private banks, previously indifferent, began actively marketing green loans. Factories and manufacturers, facing high conventional loan rates (**12-15%**), found the **5%** rate irresistible.

As one sustainability head at a leading private bank noted:

"The revised interest structure has triggered a surge in green projects since 2023."

What Changed for Borrowers: The Case of Ktex Ltd.

Ktex Ltd., a large-scale spinning mill located in Kalampur, Dhamrai, provides an example of how the revised framework changed the economics of green investment. The project involved the construction of a modern facility equipped with energy-efficient machinery, a solar power system, and a comprehensive environmental management plan. The total project cost was approximately **Tk 865.86 million**, with a fixed cost of **Tk 837.37 million**.

This case shows how Ktex Ltd. was able to access green financing under Bangladesh Bank's Green Transformation Fund (GTF), and how the reduced interest rate significantly improved the financial viability of Ktex's green financing project.

The company initially secured a commercial loan at **12–14%** interest. Then the lending bank applied to Bangladesh Bank for refinancing under the GTF at **5%.** After a four-month audit and approval process, the interest rate was retroactively adjusted to **5%.**

To avail the concessional loan, Ktex Ltd. had to fulfill four criteria. The company conducted a comprehensive Environmental and Social Impact Assessment (ESIA) aligned with DoE, IFC, JICA, and GCF standards. The installation of solar panels and energy-efficient machinery were completed. Management also implemented an Effluent Treatment Plant (ETP) and solid waste management systems, and submitted a commitment to sustainable sourcing and labour welfare to the bank.

Loan rate	Costing for a loan of USD 80,00,000 over five years	Savings
Conventional Loan Rate: 12–14%	USD 48,00,000	USD 28,00,000
Green Loan Rate (Post-2023): 5%	USD 20,00,000	

Table 5: Economic impact of the revised green financing scheme

The company saved BDT **280 million** after reduction of interest rate to **5%**. This substantial reduction in financing cost significantly improved the project's financial viability and return on investment.

What Still Needs to be Addressed

Despite this progress, the path to truly transformational impact remains obstructed by several persistent challenges. Bureaucratic complexities in the approval process continue to deter potential borrowers, particularly for small and medium enterprises that lack the resources to navigate extensive documentation requirements. The knowledge gap among banking professionals also remains significant, with fewer than ten dedicated sustainability finance experts nationwide, limiting effective implementation at the institutional level. In addition, the current loan structure still requires borrowers to initially secure conventional high-interest loans before qualifying for a green rate adjustment. This creates unnecessary financial strain and uncertainty, even where the final outcome is favourable.

Key Lesson

The case of Ktex Ltd. shows that interest rate reform can directly change the business case for green investment. What made the difference was not only the availability of a green fund, but the drop from **12–14%** commercial borrowing to 5% refinancing under the GTF. For Ktex, this translated into **Tk 280 million** in savings, making a greener factory investment significantly more financially attractive. The case therefore suggests that concessional green finance is most likely to drive uptake when it produces clear and substantial savings at project level. However, it also shows that unless approval processes are simplified and access becomes more direct, the benefits of lower-cost finance may remain easier for larger firms like Ktex to capture than for smaller factories.

Rooftop Solar Without the Wait: Multifabs' Rooftop Solar Investment Story

CASE STUDY **6**

Rooftop Solar Without the Wait: Multifabs' Rooftop Solar Investment Story

Why Multifabs Chose the CAPEX Model

Faced with bureaucratic hurdles and delays in accessing green financing schemes, Factory Multifabs Limited made a bold move. It chose to self-finance its rooftop solar installation using internal capital. This decision stood out in an industry where most factories rely on external financing or donor-backed support to initiate renewable energy projects. The factory faced rising energy costs and increasing pressure from global buyers to adopt green practices and initially explored government refinance options like the Bangladesh Bank's green transition fund to fund their solar rooftop installation. However, they encountered prolonged application processes, delayed fund disbursement, and a lack of capacity at local banks. Constrained by these limitations, the factory faced a trade-off between time and capital.

Multifabs limited currently operates across knitting, printing, dyeing, dyeing finishing, and garments production.. Their garments production capacity per day is roughly **1,38,000 pieces**. The total factory electrical load is **1800kW**. To reduce energy costs and support its sustainability goals, Multifabs decided to implement a **360 kWp grid-connected**, rooftop solar photovoltaic (SPV) power plant under the CAPEX model.

By choosing the CAPEX model, Multifabs was able to move ahead without administrative delay, retain full control over implementation, and secure the long-term financial benefits of owning the system outright. For Multifabs Limited, rooftop solar was also a strategic decision. Factory management linked the investment to growing buyer expectations around carbon reduction and environmental sustainability. In their view, adopting renewable energy could help the factory respond more credibly to these expectations and strengthen its positioning in export markets over time.

This case study examines that decision and its outcomes, focusing on the project's business rationale, financial returns, environmental benefits, implementation challenges, and the strategies used to manage them.

Parameter	Details
Factory Name	MULTIFABS Ltd.
System Name	360 kWp Grid-Connected Rooftop Solar Photovoltaic (SPV) Plant
Operation Start Date	3rd September 2023
Ownership Model	CAPEX (Self-Financed)
Developer	G-Tech Infrastructure Ltd.
O&M Responsibility	G-Tech Infrastructure Ltd. (under contractual agreement)
Total Factory Electrical Load	1800 kW
Solar Contribution to Load	~15% of total energy requirement
Grid Connection	Net-metered, synchronised with the national grid

Table 6: Multifabs' Rooftop Solar Photovoltaic (SPV) Plant | Project Overview

Under the CAPEX model, the factory bears the full upfront cost of the solar system and owns it from day one. This gives the factory full control over the asset and its long-term savings, although it also means taking on the initial investment burden and responsibility for operation and maintenance. In Multifabs' case, the upfront cost was significant, but the company considered the longer-term financial and environmental benefits sufficient to justify the investment.

Energy Savings and Financial Returns

The rooftop solar installation at Multifabs Limited was designed to generate substantial energy savings, with an estimated annual energy production of approximately **511,000 kWh** (**511 MWh**). This energy generation, derived from the **360 kWp grid-connected solar system**, translates to roughly **1,400 kWh per day**, significantly reducing the factory's reliance on grid electricity.

At an average cost of BDT 10 per kWh for grid-supplied electricity, the factory stands to save around **BDT 5.11 million** (approx. **USD 46,500**) annually. This reduction in energy costs plays a crucial role in strengthening the factory's financial position, contributing to long-term sustainability and cost efficiency. The initial CAPEX investment for the solar system was estimated at **BDT 28-30 million**. With a projected payback period of **5.5–6 years**, the factory was set to recover its initial investment relatively quickly. After the payback period, the system is expected to continue providing virtually free solar electricity for the next **19–20 years**, excluding operational and maintenance costs. This extended post-payback profit window ensures significant cost savings over the system's lifespan, further enhancing the factory's cost competitiveness in a market where energy costs are continually rising.

Moreover, the solar system helps offset peak-hour energy demands, a crucial advantage to reduce demand charges, which are typically higher during periods of high electricity usage. This ability to manage peak demand not only supports cost savings but also stabilises the factory's energy consumption patterns.

Figure 5: Solar Panels in Multifabs Limited

"At Multifabs, we view sustainability not just as a responsibility, but as a strategic asset. The rooftop solar installation is a pivotal step in our journey toward becoming a more energy-efficient and environmentally conscious manufacturer. Despite the challenges we faced, from structural limitations to financing barriers, the decision to invest in renewable energy has already proven beneficial for both our bottom line and our long-term environmental goals. We are committed to continuous improvement and innovation in sustainability, and this solar project is a clear example of how we are leading the way in Bangladesh's textile industry."

– Senior Manager, Sustainability, Multifabs Limited

Wider Environmental Benefits

For Multifabs Limited, the rooftop solar project was not only a response to energy costs, but also part of a broader effort to reduce the factory's environmental footprint. The **360 kWp** system is expected to generate around **553 MWh** of clean energy annually, reducing dependence on non-renewable power sources. According to available estimates, over a **20-year period** the system could offset **9,580 metric tonnes of carbon emissions**, along with the equivalent of almost **40 lac gallons of gasoline, 21,000 barrels of oil, and 5,618,949 pounds of coal** (Textile Focus, 2023).

Using Bangladesh's grid emission factor of **0.69 tCO_2/MWh** (SREDA, 2022), the project is also estimated to avoid around **352.6 tCO_2 per year**, or roughly **3,520 tons of CO_2 over 10 years**. In this way, the investment contributes not only to the factory's own sustainability efforts, but also to Bangladesh's broader climate commitments under its Nationally Determined Contributions (NDCs).

The environmental gains go beyond carbon reduction. By lowering reliance on fossil fuel-based electricity and diesel generators, the project also helps reduce pollutants such as **PM2.5, SOx, and NOx**, which are harmful to both human health and the environment. Taken together, these outcomes show that the rooftop solar system offers wider environmental value alongside its financial and operational benefits.

Implementation Challenges

Although the rooftop solar project offered clear economic and environmental benefits, Multifabs Limited had to navigate several practical challenges during implementation. These included limited usable rooftop space, high upfront capital costs under the CAPEX model, grid integration requirements, and ongoing operation and maintenance concerns. The factory addressed these issues through a series of technical and management decisions that allowed the system to be integrated successfully into its operations.

Limited Rooftop Space and Structural Constraints

Due to the factory being housed in a multi-storey building, the available rooftop space for solar panel installation was limited. The rooftop could only accommodate about 70% of the available area due to concerns overload distribution and safety. Extensive structural engineering assessments were carried out to ensure that the roof could support the weight and structure of the solar panels. This limitation led to trade-offs in system size, balancing the need for optimal energy generation with the safety and integrity of the building's structure.

High Upfront Capital Cost

The CAPEX model requires a significant one-time investment of **BDT 28-30 million**, a financial burden for the factory without subsidies or concessional loans. This high, upfront cost was a considerable challenge, but through careful financial planning, Multifabs justified the investment based on the long-term returns and cost savings associated with the solar system. With the levelised cost of electricity (LCOE) estimated at around **BDT 5/kWh** (**USD 0.046/kWh**), compared to an industrial grid tariff of **BDT 10.55/kWh** (**USD 0.096/kWh**), the factory assessed that the long-term savings over the project's expected **25-year life outweighed** the upfront cost.

Grid Integration Challenges

Integrating the solar system into the national grid also posed technical and regulatory challenges. The factory needed to gain approval from the local electricity distribution utility, requiring careful synchronisation of the inverter with the national grid frequency (**50 Hz**), as well as compliance with anti-islanding protections and net-metering regulations. The process was time-consuming, involving extensive paperwork and multiple inspections by the authorities.

Operation & Maintenance Concerns

The industrial setting of the factory created another challenge: high levels of dust and pollution, which could reduce the efficiency of the solar panels over time. To address this, Multifabs introduced a quarterly cleaning schedule and real-time performance monitoring to help maintain system efficiency. Since the factory also lacked internal operation and maintenance expertise, it entered into an annual maintenance contract with G-Tech Infrastructure Ltd. to support the long-term performance of the system. Lastly, the use of digital performance monitoring tools helped maximise the energy yield and track panel degradation over time.

The table below provides a breakdown of the mitigation strategies adopted by Multifabs Limited to ensure a smooth, green transition towards their rooftop solar system plan under the CAPEX Model.

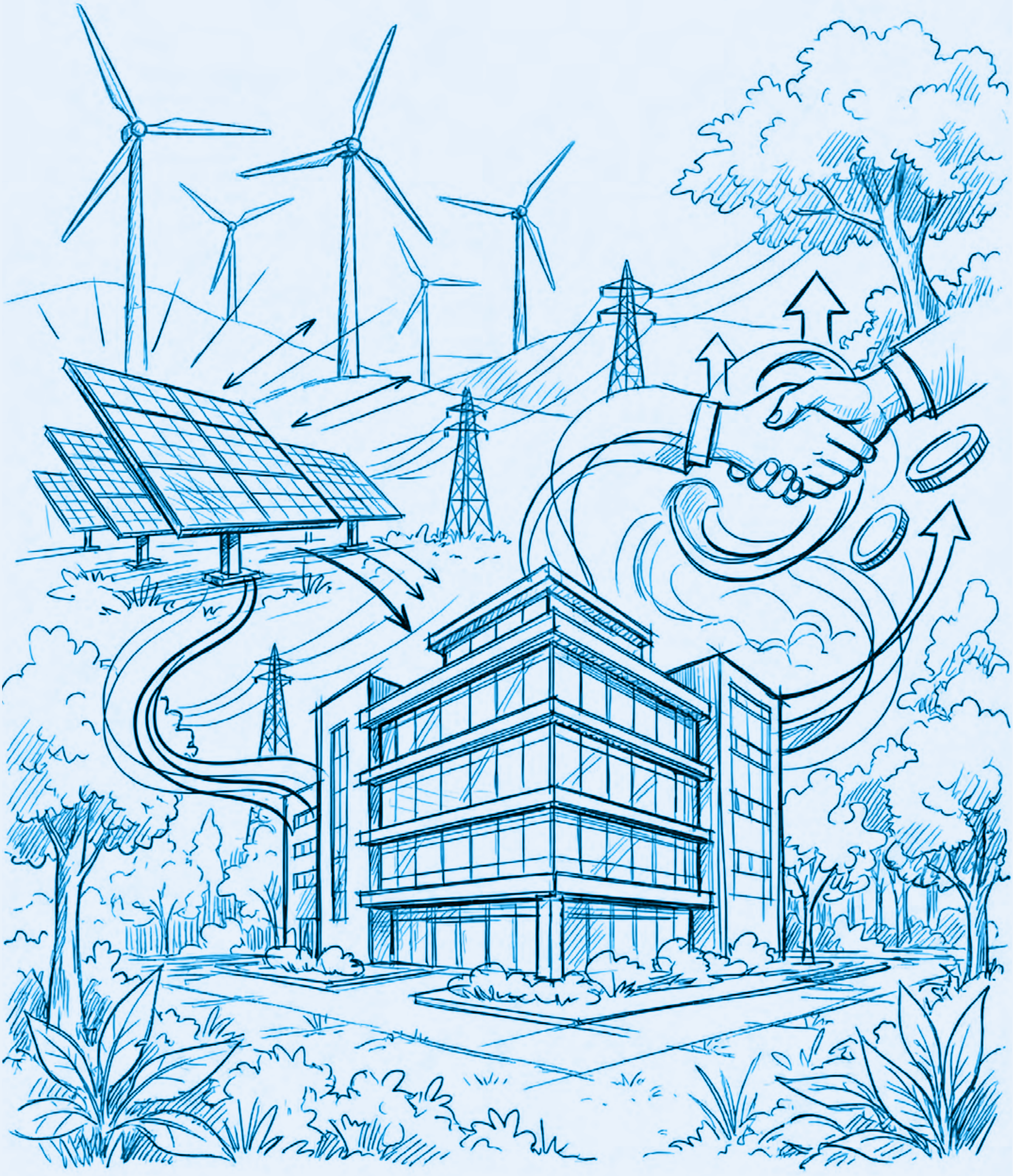
Challenge	Mitigation Action
Limited Roof Space Usage	Installed high-efficiency modules (~18-21% efficiency) and optimised panel orientation.
Structural Safety Concerns	Conducted a structural audit to avoid areas with high vibration/load risk.
Green Financing Barriers	Shifted to self-financing using internal funds to avoid delays and missed opportunities.
High CAPEX Burden	Evaluated LCOE (Levelised Cost of Electricity) over 25 years to justify ROI.
Grid Connectivity and Net Metering	Early engagement with the utility ensured smoother approval; compliant inverters were used.
O&M Concerns	Entered an annual maintenance contract with G-Tech Infrastructure Ltd. for ongoing support.
Dust and Efficiency Losses	Implemented a quarterly cleaning schedule and integrated remote monitoring.

Table 7: Mitigation Strategies Adopted by Multifabs Limited

Key Lesson

This case illustrates that in contexts where green finance is difficult to access quickly, self-financing can become a strategic decision rather than simply a financial one. For Multifabs Limited, the CAPEX model made it possible to implement rooftop solar without waiting for external approval processes, while also securing long-term savings, energy stability, and reputational value with buyers. The experience suggests that although CAPEX places a heavy burden on upfront capital, it may still be the preferred option for factories that want to move quickly and are confident in the long-term business case for solar.

Self-financing can expedite project implementation, but it requires careful management of cash flow and financial resources. Particularly, mechanisms for green financing in Bangladesh require simplification and improved outreach to facilitate easier access for industries. Rooftop solar adoption in multi-storeyed RMG factories can start with comprehensive structural safety audits. Collaborating with experienced EPC developers and O&M providers can mitigate long-term risks and enhance system efficiency.



Going Solar Without Upfront Investment: How Stylesmyth San Apparels Used the OPEX Model

CASE STUDY 7

Going Solar Without Upfront Investment: How Stylesmyth San Apparels Used the OPEX Model

The Challenge

With monthly electricity bills eating into profit margins and little room in the budget for large-scale upgrades, Stylesmyth San Apparels was stuck between rising costs and rising expectations from international buyers demanding greener supply chains. Instead of taking on debt or delaying action, the factory turned to an unconventional solution: a OPEX rooftop solar partnership with Fourth Partner Energy Bangladesh. The OPEX finance model ensured a win-win situation for Stylesmyth San Apparels by allowing the factory to decrease energy cost from day one without any upfront payment while meeting sustainability targets by brands.

This case study examines why Stylesmyth San Apparels chose the OPEX model, how the arrangement worked in practice, and what business, environmental, and operational benefits it generated. It also highlights the implementation challenges that arose and the strategies used to address them.

Why Stylesmyth San Apparels Chose the OPEX Model

Under the OPEX model, the solar developer bears the upfront cost of installation and maintenance. The factory does not need to invest anything at the start. Instead, it pays a monthly bill based on the energy it consumes from that solar installation, which is usually cheaper than the grid. In Bangladesh, this setup often involves a three-way agreement between the developer, the factory, and the local electricity distribution company.

In this case, Fourth Partner Energy Bangladesh installed and operated the solar power system at Stylesmyth San Apparels under a power purchase agreement (PPA). This allowed the factory to avoid significant capital expenditure while benefiting from lower energy costs, reduced exposure to future tariff increases, and direct use of renewable energy.

Parameter	Details
Factory Name	Stylesmyth San Apparels Ltd.
System Name	1030.05 kWp grid-connected rooftop solar photovoltaic (SPV) power
Time of Implementation	October 2022
Ownership Model	OPEX
Developer	Fourth Partner Energy
O&M Responsibility	Fourth Partner Energy
Total Factory Electrical Load	1450.05 kW
Solar Contribution to Load	~61% of total energy requirement
Grid Connection	Net-metred, synchronised with the national grid

Table 8: Overview of Stylesmyth San Apparels' Solar System

The Competitive Advantage

Lowered Energy Costs from Day One

For Stylesmyth San Apparels, one of the strongest reasons for choosing the OPEX model was the immediate relief it offered on electricity costs. The factory had a total electricity load of **1450.05 kW**, and meeting that demand through conventional sources was becoming increasingly expensive. Although rooftop solar could reduce those costs, the upfront cost of installing solar PV was itself substantial. The OPEX model helped resolve that dilemma by allowing the factory to adopt solar without making a large capital investment. Instead, the factory paid only for the electricity generated by the solar system, at a rate lower than its usual grid-based cost.

The buy-back tariff in this case is **BDT 7.21/unit,** which is a competitive rate compared to the factory's previous energy expenditure from conventional sources which is on average **BDT 10/kwh (US$ 0.09/kwh)** for industrial buildings. With the implemented solar PV generating 61% of the factory's energy needs, this system is expected to generate around **1,050,000 kWh** annually, providing substantial energy savings over its 25-year expected lifetime. The expected projection of this initiative (assuming there is no system depreciation) is given in the table below:

Metric	Value
Annual Solar Generation	1,050,000 kWh
Grid Tariff	USD 0.099/kWh
OPEX Buy-Back Tariff	USD 0.0721/kWh
Per Unit Savings	USD 0.0269
Annual Financial Savings	USD 28,245
25-Year Projected Savings	USD 706,125

Table 9: Financial Savings through the OPEX model

By purchasing its own electricity produced through the solar panels at a fixed rate, the factory reduces reliance on the national grid, ensuring more stable and predictable energy costs and protecting the business from future price hikes in grid electricity.

Reduced Emissions

In this sense, the shift to solar power also had a direct environmental outcome. By replacing part of its grid-based electricity consumption with a clean and renewable energy source, Stylesmyth San Apparels was able to reduce its greenhouse gas (GHG) emissions. Estimations suggest that within its 25-year lifetime, this system alone can help reduce **13,571 metric tonnes** of CO_2 emissions, as illustrated below:

Annual Solar Energy Generation	1,050,000 kWh
Average CO_2 Emission Factor for Grid Electricity in Bangladesh	0.517 kg CO_2/ kWh (based on the national grid's emission intensity)
Annual GHG Emission Reduction	= 1,050,000 kWh × 0.517 kg CO_2/kWh = 542,850 kg CO_2 (or 542.85 metric tonnes of CO_2 per year)
25 year projection	13,571 metric tonnes of CO_2

Table 10: Approximate Carbon Emission Reductions via Stylesmyth's Solar System

Strengthened Business Positioning

For Stylesmyth San Apparels, the solar project was not only about lowering energy costs. It also responded to growing buyer expectations around carbon reduction and environmental responsibility. By using direct renewable energy rather than relying only on instruments such as I-RECs, the factory was able to demonstrate a more visible commitment to sustainability. From the factory's perspective, this helped align operations more closely with brand expectations and supported its longer-term positioning in an increasingly sustainability-conscious export market.

Figure 6: Stylesmyth San Apparels' Solar System

Implementation Challenges and How the Factory Managed Them

Although the OPEX model brought clear benefits, Stylesmyth San Apparels still had to navigate several challenges. Implementation still required a number of practical decisions and adjustments.

One of the first challenges was making the most of available roof space. Since the capacity of the solar plant depended heavily on how efficiently the rooftop could be used, space utilisation became critical from the outset. To address this, Fourth Partner Energy carried out detailed site surveys and engineering assessments to optimise the system design and ensure that the available roof area was used as effectively as possible.

A second challenge was choosing the right implementation partner. With many EPCs in the market, selecting a developer was a major decision, particularly because the factory would be giving full rooftop access and depending on the partner for everything from technical assessment to design, engineering, procurement, installation, and commissioning.

To manage this, the factory approached several service providers and conducted detailed discussions before making its choice. Fourth Partner Energy was selected based on the strength of its installation strategy and the competitiveness of its tariff offer, helping ensure that the arrangement worked commercially for both sides.

Once the system was in place, maintenance and operational reliability became equally important. Any downtime in the solar plant could affect the factory's energy supply and disrupt operations. To reduce that risk, Stylesmyth San Apparels and Fourth Partner Energy established a strong maintenance and monitoring arrangement, including regular performance assessments and prompt issue resolution. The plant's performance is also monitored remotely so that anomalies can be detected in real time.

The factory also had to consider seasonal variation in solar generation. Since solar output depends on sunlight, weather fluctuations — especially during the monsoon season — could affect electricity generation. This was addressed during the design phase itself. The 1030.05 kWp system was carefully optimised so that the factory would continue receiving an adequate level of energy even during lower-generation periods. In addition, a hybrid grid-connected arrangement was kept in place to provide backup support whenever solar generation was insufficient.

Reflecting on the overall experience, the General Manager of Stylesmyth San Apparels Pvt Ltd. noted:

"The implementation of the rooftop solar project has been a game-changer for us. Not only have we reduced our dependency on the national grid, but we've also made significant strides toward our sustainability goals. The savings we have realized from the lower energy costs are now being reinvested into other sustainable initiatives within the factory. As a company, we are proud to be part of the green transition in Bangladesh's RMG industry. Our partnership with Fourth Partner Energy has been instrumental in achieving this."

Project Summary

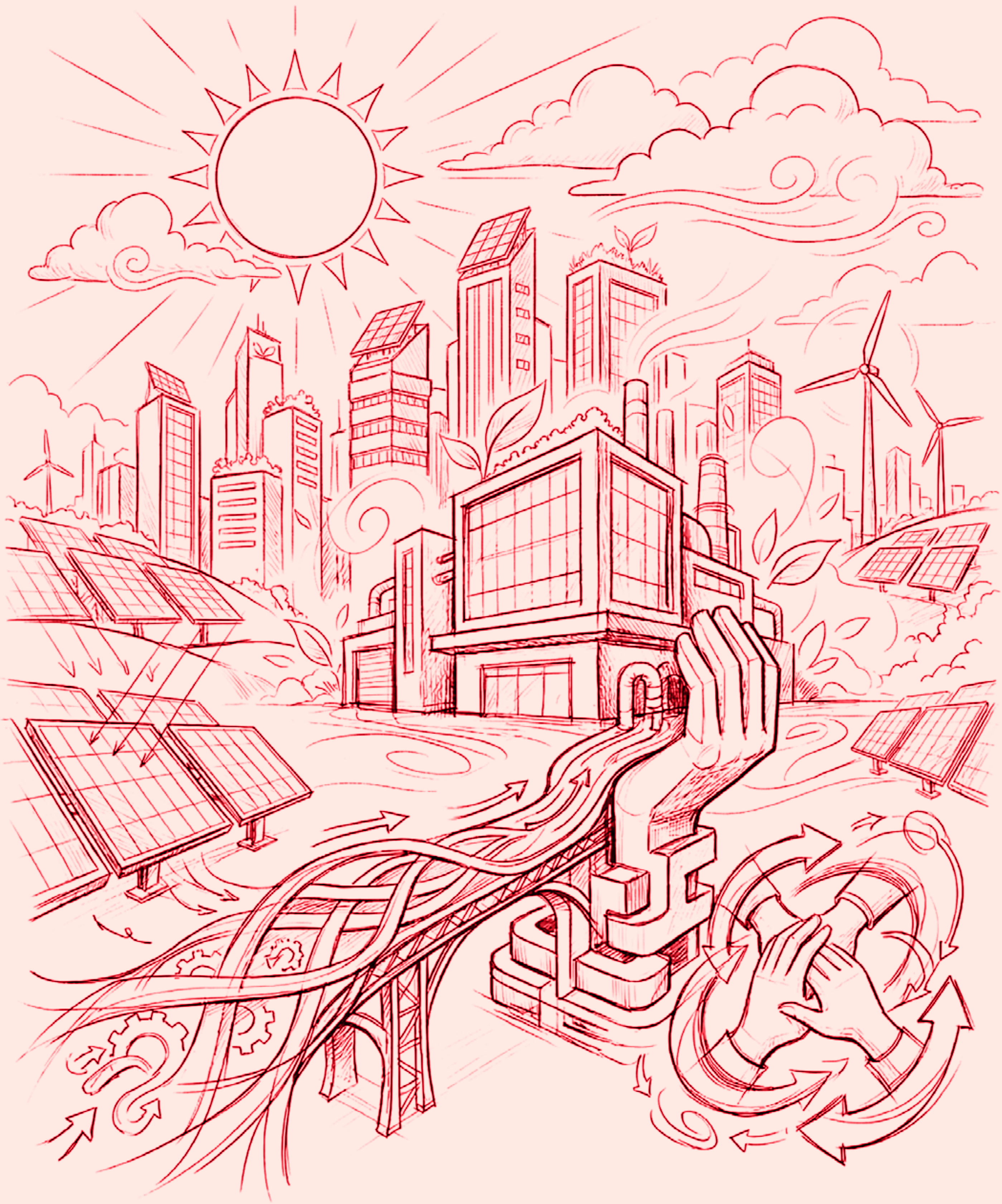
The table below summarises the key features of the rooftop solar project developed by Stylesmyth San Apparels Pvt Ltd. in partnership with Fourth Partner Energy Bangladesh Ltd.

Parameter	Details
Factory Name	Stylesmyth San Apparels Pvt Ltd.
Location	Village- Amtoil, P.O- Hat Amtoil, P.S- Sreepur, Dist. Magura, Bangladesh
Rooftop Solar Capacity	1030.05 kWp
Annual Energy Generation	1,050,000 kWh
Roof Space Utilised	6000 sq.metre
Buy-back Tariff	7.21 BDT/unit
Electricity Load	1450.05 kW
Developer	Fourth Partner Energy Bangladesh
SPV Operation Date	27th October 2022
Expected Lifetime	25 years
GHG Emission Reduction (Annual)	542.85 metric tonnes of CO_2
10 Years projection	5420 metric tonnes of CO_2 reduction

Table 11: Rooftop Solar Power Project in OPEX Model | Summary Table

Key Lesson

The rooftop solar power project at Stylesmyth San Apparels Pvt Ltd. exemplifies the potential of the OPEX model in facilitating sustainable energy transitions within the RMG sector. By leveraging the OPEX model, the factory has been able to enjoy immediate cost savings, enhance energy security, reduce GHG emissions, and contribute to its long-term environmental goals. At the same time, the experience shows that successful implementation still depends on careful planning. Efficient use of rooftop space, selection of the right implementation partner, strong maintenance arrangements, and preparation for seasonal fluctuations all played an important role in making the project work. The broader lesson is that OPEX can lower the financial barrier to solar adoption, but operational success still depends on choosing the right technical and commercial setup from the beginning.



A Strategic Partnership for Large-Scale Solar Transition: Tarasima Apparels, Omera Solar, and the BOLT Financing Model

CASE STUDY 8

A Strategic Partnership for Large-Scale Solar Transition: Tarasima Apparels, Omera Solar, and the BOLT Financing Model

The Investment Challenge

When Tarasima Apparels, a garment company under Bitopi Group, first considered transitioning to solar energy, the numbers looked promising but the upfront investment did not. With over **19,000 square metres** of usable rooftop space, the factory had the potential to house something unprecedented i.e. the largest grid-tiled rooftop solar plant for a single RMG unit in Bangladesh. But unlocking that potential came with a significant price tag. Traditional CAPEX financing was off the table, given the competing priorities for operational cash. OPEX models, while appealing, often lacked long-term ownership and control. That is when Tarasima turned to an innovative solution, the Build-Own-Lease-Transfer (BOLT) model. It offered the best of both worlds zero upfront investment with a clear path to future ownership, enabling Tarasima Apparels to take a bold step toward energy independence without compromising financial stability.

Meanwhile, the broader renewable energy landscape in Bangladesh also suffers from gaps in reliable EPC service providers, as only a fraction of the **51** listed EPCs under SREDA were active and fully capable (at the time Tarasima conducted their initial feasibility assessment). Omera Solar is one of the few EPC providers with the financial innovation and technical know-how to enable factory-scale transitions at this magnitude. Omera offers in total three flexible financial models to RMG factories encompassing, namely, CAPEX, OPEX, and lease financing. They also have a local solar panel manufacturing in Ashulia with export capacity.

This case explores Tarasima's strategic journey towards installing a **3.57 MWp** rooftop solar system - the largest grid-tiled rooftop solar plant for a single RMG unit in Bangladesh implemented through the BOLT (Build-Own-Lease-Transfer) model, in partnership with Omera Solar. It unravels the financial, technical, and strategic decisions made by Tarasima, the unique service model of Omera, and the broader implications of this collaboration for scalable decarbonisation pathways in the RMG sector.

Why Tarasima Chose a Partnership-Based Financing Strategy

Tarasima Apparels Ltd. first conceived the idea of solar power integration back in 2015, reflecting early awareness of the environmental and economic imperatives for decarbonisation. However, the actual execution was delayed until October 2022, mainly due to the COVID-19 pandemic and the complexities behind aligning financing, technology, and operational readiness. Holding a LEED Platinum certification and being recognised as one of the highest-rated green factories among existing industrial structures in Bangladesh, Tarasima was under pressure to set an example for local exporters and manufacturers. In 2019, after assessing the feasibility of three business models, CAPEX (Capital Expenditure), OPEX (Operational Expenditure), and Capital Lease Financing (BOLT), Tarasima reached an agreement to proceed with the BOLT model.

The BOLT model, essentially a form of capital lease financing (CLF), which allows an EPC (partner, in this case, Omera, to build, own, and operate the solar infrastructure, while the factory pays back in instalments over a 5-year period. Ownership is transferred to the factory after full repayment. This approach offers:

- No upfront investment burden for the factory.
- Fixed lease instalments that include all necessary services.
- Ownership transfer after 60 months, making it financially efficient in the long run.

Omera provided an end-to-end service designing, planning, engineering, installation, commissioning, and even maintenance for the 5-year period reducing technical and operational burden on Tarasima.

Lease Financing Model is where the finance will be arranged by the supplier. Consumers (factories) will pay to the supplier by **3 to 5 years** of EMI under a Lease & Buyback Agreement. This model is also known as Build, Own, Lease and Transfer (BOLT). Unlike CAPEX models, which required significant upfront investment, and OPEX models, which did not provide the company with eventual ownership of the system, the BOLT model struck balance for Tarasima - enabling gradual ownership transition with minimal risk.

Why Omera Became the Implementation Partner

Omera Solar is a brand of East Coast Group which is one of the fastest growing business conglomerates in Bangladesh, having more than four decades of experience in diversified business areas which includes power generation and renewable energy. Omera Solar's operations are carried out through two divisions: Omera Renewable Energy Limited (OREL), which has been active in rooftop solar EPC services since 2020, and Radiant Alliance Limited (RAL), which has been assembling solar PV modules since 2011.

Omera Solar provides a plethora of renewable energy solutions including PV module assembly, project development, EPC solution provider, project finance arranger, project operation & maintenance. Not only that they also provide initial load assessments and site survey, and post installation monitoring and generation analysis. This helps the clients understand their factories strengths and weaknesses regarding the solar implementations. What makes Omera truly a different player in the solar industry is their CLF/ lease financing model. They are the only supplier in the industry that offers the CFL model, which is a mixture of BOLT with the option of instalment repayment.

What sets Omera apart is their commitment to long-term performance. Their involvement does not end with installation. They provide ongoing operations and maintenance (O&M) services, monitor system performance remotely, and respond quickly to any issues that arise. This end-to-end support ensures that the solar system continues to deliver optimal results throughout its lifespan.

Unlike many EPC providers who focus solely on low-cost installation, Omera prioritises technical excellence and client trust. Their ability to navigate complex grid-captive hybrid environments, combined with their engineering expertise and quality assurance, enables them to deliver solar solutions that are not only functional but also fully optimised for long-term efficiency.

When Omera started working with Tarasima, the process began with a detailed site and load assessment. This involved evaluating the rooftop's structural integrity, sunlight shading patterns, and available space, as well as analysing the factory's energy consumption trends. However, there were different challenges behind the project's execution, particularly on how best to maximise the solar installation's efficiency. Many older RMG factories in Bangladesh are not originally designed to accommodate variable solar input. Their electrical distribution boards (DBs) are often configured for single-source power, either from the national grid or captive gas generators. Introducing solar into this setup could potentially lead to compatibility issues, such as back-feeding, voltage instability, or even, system failure. Moreover, captive generators, which are commonly used due to unreliable grid supply, typically require a minimum threshold to remain operational. For example, if a generator needs to maintain at least **25%** load, and solar panels are producing more than **75%** of the demand, the excess solar energy cannot be utilised by the factory.

To address these challenges, Omera conducted in-depth electrical audits during the feasibility stage. Their team, consisting of experienced electrical engineers, carefully examined the factory's existing infrastructure to identify potential risks and limitations. Based on these findings, they designed a customised solar integration solution that was technically compatible, future-proof and ensured maximum efficiency.

A key part of Omera's strategy was the use of high-quality, AI-powered inverters. These smart inverters were capable of real-time synchronisation with both the grid and captive generators. They help manage fluctuations in solar output, maintain voltage stability, and enable remote diagnostics and performance monitoring. This ensured that the system remains stable and efficient even under variable conditions. In factories where gas generators are used, Omera calibrated the system using fuel-saving devices to ensure that solar and generator inputs can coexist without conflict. This allows the factory to maximise solar usage without compromising generator performance. If the existing DB is not capable of handling dual-source input, Omera upgrades or retrofits it to ensure safe and efficient operation.

Technical Specifications of Tarasima's Rooftop Solar

The Solar energy system spans **20,000 square metres** across eight factory sheds in Tarasima Apparels Ltd., using high-efficiency monocrystalline PV modules (brands: Longi, Trina, Jinko) with a module efficiency of around **19.6%**. Despite initial preferences for German brands like SMA, Omera advised the factory to use Huawei inverters due to their robust performance and local service availability in Bangladesh.

Key System Attributes

- System Capacity: 3.57 MW
- Module Type: Monocrystalline
- Inverter Brand: Huawei
- Structure: MS for RCC rooftops, aluminum for prefab sheds
- Monitoring: Inbuilt remote monitoring system
- System Lifespan: 20 years

Financial Arrangement

Omera access refinancing from Bangladesh Bank at approximately **5% interest** and offers CLF to clients at around 6% maintaining only a modest margin. This package also includes one year of free maintenance, with an additional **2 years** of O&M services included into the instalment structure. Clients repay the investment in manageable instalments over a **3-5year** period, after which full ownership of the system is transferred to them.

The total cost of the solar project under BOLT was **BDT 258,278,672**.

The cost structure included:

- Solar system cost: **BDT 212,315,040**
- 5-year maintenance cost: **BDT 12,000,000**
- Interest: **BDT 33,963,632**

Tarasima pays a monthly lease instalment of **BDT 4,278,311 over 60 months**, after which the ownership is transferred. Importantly, the ROI (Return on Investment) is estimated at just 6 years, compared to **6–10 years** in the CAPEX model.

Parameter	Value
Total System Cost	BDT 258,278,672
Monthly Lease Payment	BDT 4,278,311
Lease Duration	60 months (5 years)
ROI	6 years
Annual Maintenance (5 yrs)	BDT 12,000,000
Capacity	3.57 MW
Energy Output (Est. annually)	4 million kWh
Carbon Emission Reduction	40% of electricity-related CO_2
I-REC Saving (Annually)	$1.24 million->$60,000

Table 12: Summary of Tarasima's Financial Metrics Under the BOLT Model

Financial Savings	LCOE from rooftop solar: Tk 5/kWh Industrial grid tariff: Tk 9.9/kWh Savings per unit: Tk 4.9/kWh
Annual savings	= 4,170,960 kWh × Tk 4.9 = Tk 20,437,704/year (≈ USD 186,400/year) Projected Savings over 20 years if we assume no degradation of the solar PV happens= Tk. 408,747,080
I-REC Savings	Pre-solar: 260,000 I-RECs × $5 = $1,300,000 Post-solar: 12,000 I-RECs × $5 = $60,000 Annual savings: $1.2 million
Note: The actual generation could be higher depending on sun exposure and system efficiency.	

Table 13: Breakdown of Tarasima's Energy, Environmental & Cost Savings Under BOLT

What The Project Changed for Tarasima

For Tarasima Apparels, the rooftop solar project changed more than just its energy source. It reduced the factory's electricity-related emissions, lowered its dependence on I-RECs, created long-term savings on power costs, and reduced procurement and performance risks by placing system responsibility with an experienced EPC partner under the BOLT model. In this sense, the project was not only a renewable energy investment, but also a strategic step toward greater cost control, emissions management, and operational assurance.

Electricity Generation	If, 1.00 MWp Solar Rooftop System Can generate up to 11,68,000 kWh/ units of electricity yearly 1.00 MW solar = planting 670 grown trees/year Then, 3.57 MW solar = planting 2391.9 grown trees/year Offsetting 2200 tonnes of CO2 emissions/year

Factory-level emissions data revealed that approximately **40%** of Tarasima Apparels Ltd. total greenhouse gas (GHG) emissions originated from electricity consumption. Prior to the installation of the solar system, the company had to rely extensively on purchasing International Renewable Energy Certificates (I-RECs) to offset its carbon footprint.

Without on-site renewable energy, the factory required **260,000 I-RECs** annually to cover its electricity-related emissions, costing around **$1,260,000** per year (at $5 per I-REC). However, after commissioning the **3.57 MW** rooftop solar system, the demand for I-RECs dramatically reduced to just **12,000 units** annually equivalent to **$60,000**. This not only represented an annual cost savings of **$1.2 million** but also substantially lowered the company's dependence on external market mechanisms for emission mitigation.

Beyond financial and environmental savings, the BOLT model created strategic insulation against a major operational risk prevalent in traditional CAPEX models: substandard component procurement. Many garment factories in Bangladesh lack in-house technical teams with expertise in solar system engineering and energy management. In CAPEX arrangements, this knowledge gap may lead to the procurement of inferior products at inflated prices. Tarasima was able to bypass this risk by transferring the full responsibility of procurement, installation, and performance assurance to Omera, its EPC partner. Omera, in turn, had reputational and contractual incentives to use globally reputed brands like Longi, Jinko, and Huawei, thereby ensuring that the system met international standards.

In addition, the performance-based payment structure under BOLT added a layer of accountability. If the solar system failed to meet its promised generation capacity, payments could be adjusted downward. This compelled the EPC to deliver a system optimised for performance, not just installation—minimising operational downtime and maximising energy yield.

Trade-Offs Within the Model

Despite its many advantages, the BOLT model is not without its limitations. One of the key constraints experienced by Tarasima was the lack of flexibility in customising certain system components, particularly the inverters. While the factory initially preferred SMA, a German-manufactured inverter brand known for its performance and longevity, Omera proposed Huawei inverters instead. The rationale provided by Omera was both technical and logistical: Huawei had a dedicated servicing team stationed in Bangladesh, ensuring faster maintenance and troubleshooting support. SMA, by contrast, had no local service office, which could lead to prolonged downtime if any equipment failure occurred.

This illustrates a common trade-off in BOLT and other turnkey solutions. EPC providers often enter into exclusive or preferential agreements with specific manufacturers to streamline logistics, ensure bulk discounts, and maintain consistency across projects. As a result, buyers like Tarasima are limited to the components and brands within the EPC's sourcing framework. While this might be acceptable for many, it may feel restrictive for factories with specific preferences or brand reputations tied to certain technologies.

In effect, while BOLT reduces financial and technical burdens, it demands a degree of flexibility from the client in terms of customisation. The key is to partner with an EPC that prioritises reliability, transparency, and responsiveness, a condition Tarasima successfully met through Omera's track record and local footprint.

Key Lesson

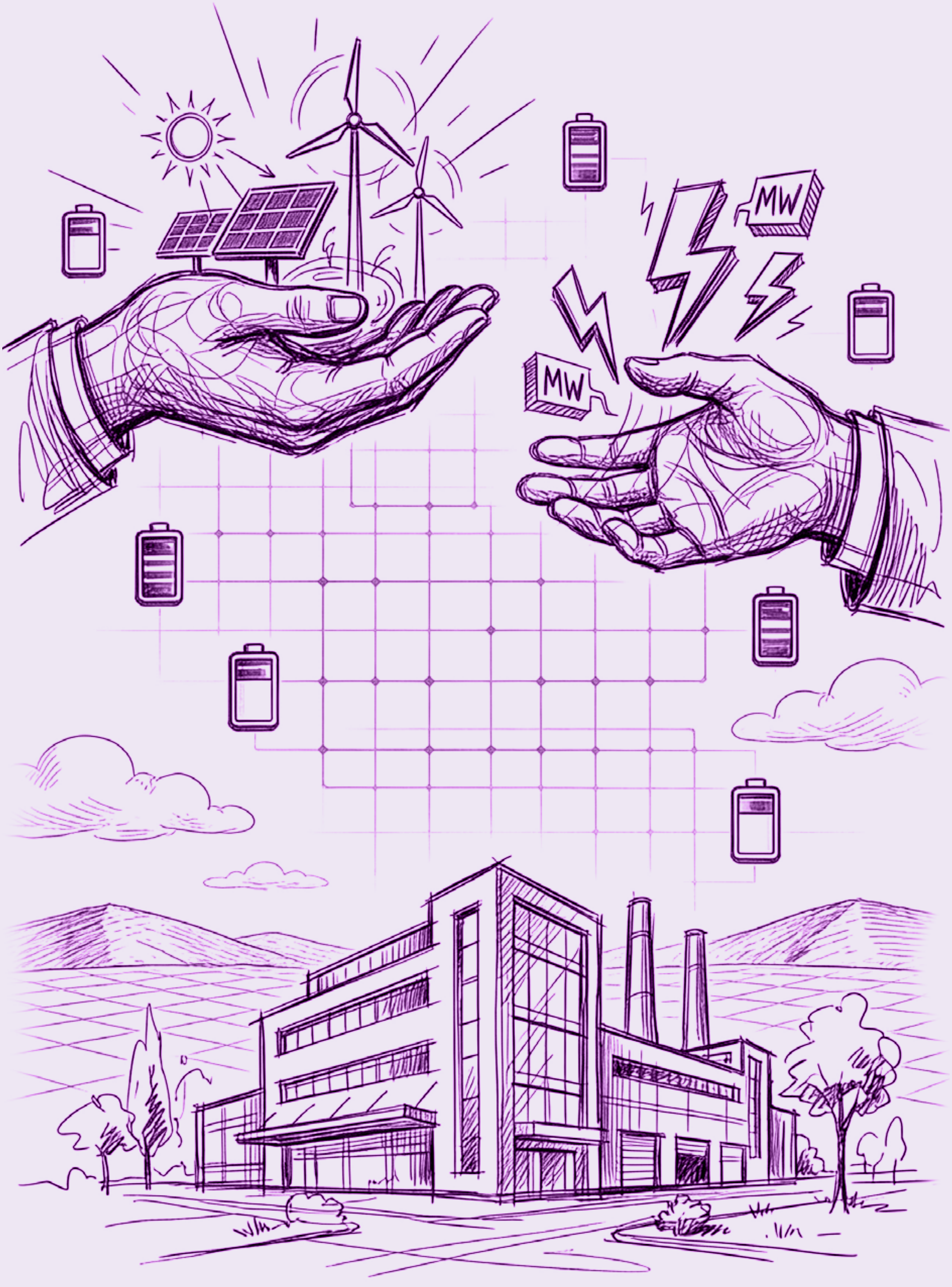
This case shows that the BOLT model can provide a practical pathway for RMG factories to adopt solar without tying up working capital or depending on conventional bank loans. In a context where many factories, particularly SMEs, struggle to meet standard lending requirements because of weak balance sheets, limited collateral, or other financing constraints, this kind of lease-based structure can reduce entry barriers and make the transition to solar more accessible.

At Tarasima Apparels Ltd., however, the value of the model was not only financial. What made the project work was the combination of a suitable financing structure and a capable implementation partner. Omera Solar's technical expertise, together with its flexible and performance-linked financing approach, created a framework of shared accountability that is less common in conventional installations. Tarasima was able to move ahead with a large and technically complex solar project without taking on the full financial and operational risk from the outset, while Omera had a clear incentive to ensure long-term system performance under the lease arrangement.

In that sense, the success of the project came not simply from choosing BOLT as a financing model, but from building the right partnership around that model. With Omera as its partner, Tarasima was able to install the largest grid-tiled rooftop solar system for a single RMG unit in Bangladesh without upfront expenditure, without major technical uncertainty, and without giving up future ownership.

The long-term significance of this arrangement is also clear. After five years of instalment payments, Tarasima will own the system outright and continue to benefit from the electricity generated over the remainder of its estimated 20-year lifespan. At a time when energy prices are expected to remain volatile and pressure to reduce carbon emissions is likely to intensify, this creates both financial and strategic value for the factory.

The broader lesson is that large-scale solar adoption in the RMG sector becomes much more feasible when financing, technical capability, and long-term incentives are aligned. This case suggests that where a willing factory, a capable EPC partner, and a well-structured financing model come together, even ambitious solar projects can be delivered in a way that is both investable and operationally viable.



A Bridge to Renewable Energy Transition: The IRIS Fabrics–BECOUR I-REC Partnership

CASE STUDY **9**

A Bridge to Renewable Energy Transition: The IRIS Fabrics–BECOUR I-REC Partnership

The Problem IRIS Needed to Solve

Before the use of International Renewable Energy Certificates (I-RECs), many factories in Bangladesh wanted to reduce their carbon emissions but faced two major constraints: limited space for rooftop solar installation and high upfront costs for renewable energy infrastructure. IRIS Fabrics was one such factory. Like many manufacturers in the sector, it needed to show progress on emissions reduction in order to meet sustainability targets and respond to brand expectations for lower-carbon production, but it could not immediately rely on on-site renewable energy as the main solution.

In this context, I-RECs offered IRIS a flexible and relatively affordable way to claim renewable energy use without first installing solar panels. By purchasing certificates linked to clean energy generated elsewhere, the factory was able to offset part of its electricity-related emissions and demonstrate progress toward its climate goals. In that sense, I-RECs became a short-term solution that helped the factory respond to immediate sustainability pressures while continuing to explore longer-term options.

Why I-Recs Became a Practical Option

I-RECs are globally recognised certificates that are used to track the generation of electricity through the means of renewable energy sources such as solar or wind power. They allow companies to claim renewable electricity use and reduce their Scope 2 emissions, even when the renewable energy is generated off-site. In countries that do not have fully developed systems for tracking renewable energy attributes, I-RECs provide a transparent and standardised mechanism for doing so(I-REC Standard 2021).

This is particularly relevant in contexts like Bangladesh, where many factories face constraints in installing their own renewable energy systems. For such factories, I-RECs can serve as a practical bridge: they offer a way to meet immediate renewable energy and emissions targets while longer-term investments in on-site solar or other infrastructure are still being developed. The growing global demand for renewable energy has created the need for verifiable systems that track and trade renewable energy production.

Their importance lies in several areas. First, they create positive environmental implications by allowing businesses to offset part of their carbon emissions through verified renewable energy purchases. Second, they provide an alternative tracking mechanism for countries that are not part of systems such as the European Guarantees of Origin (IEA, 2021). Third, they help companies meet renewable energy targets and demonstrate commitment to sustainability (World Bank, 2020), which is becoming increasingly important to buyers and other stakeholders across the global market.

How The I-REC System Works

Renewable energy sources such as solar, wind, or hydropower generate electricity and are registered with the I-REC issuing body under the I-REC Standard. Each unit of generated renewable energy is verified to ensure that the electricity is renewable and is not counted more than once. Once verified, a certificate representing **1 MWh** of renewable energy is issued (I-REC Standard, 2022).

These certificates are tracked on a transparent blockchain-based platform, which helps prevent fraud and secures their legitimacy. I-RECs can then be traded on voluntary carbon markets. Once purchased, the certificate is "retired" to show that the renewable energy attribute has been claimed and accounted for. Companies can then use these retired certificates as proof of renewable energy consumption.

What IRIS Fabrics Did

IRIS Fabrics Limited, a composite knit factory in Savar, adopted I-RECs as part of its broader sustainability strategy. The factory purchased **5,500 MWh worth of renewable energy** in the form of I-RECs from BECOUR AS. The energy for these I-RECs was sourced from a **30 MW grid-tied solar power plant** located in Bangladesh. This initiative was part of the factory's broader strategy to reduce its greenhouse gas (GHG) emissions and meet sustainability targets set by its international fashion brands, who are increasingly demanding low carbon-imprinted supply chains.

Despite intent, IRIS Fabrics faced significant challenges in reducing its emissions, including spatial limitations for rooftop solar installation and limited access to affordable renewable energy sources. As part of its sustainability plan, the factory set an ambitious target of reducing its total GHG emissions by **50%** by the year 2030, using 2019 emission levels as the baseline year.

By purchasing **5,500 MWh** worth of I-RECs from a local **30 MW solar power plant**, IRIS was able to offset **3,256 metric tonnes of CO_2** emissions. This was 10% of their total annual emissions (at the time). Based on dollar conversion rates from 2024, the total cost of the project amounted to **USD 16,500**.

What changed for IRIS

To assess the effect of this approach, the emissions reduction can be estimated using Bangladesh's Grid Emission Factor (GEF) of approximately **0.592 kg CO_2/kWh** (World Bank, 2020).

Carbon Emission Reduction Calculation

Energy purchased: 5,500 MWh (or 5,500,000 kWh)

Carbon reduction = 5,500,000 kWh × 0.592 kg CO_2/kWh

Total emissions reduced = 3,256,000 kg CO_2 or about 3,256 metric tonnes of CO_2

10-year projection: 32,560 metric tonnes of CO_2 emissions reduced

By purchasing I-RECs, the factory reduced its emissions by **3,256 metric tonnes of CO_2**, which was equivalent to around **10% of its total annual emissions**. This gave the factory a measurable way to show progress toward its climate goals and to respond to brand expectations regarding lower-carbon production.

Why this Worked as a Short-term Solution

For IRIS, I-RECs worked because they offered a flexible way to reduce emissions without requiring large upfront investment in renewable energy infrastructure. This was especially important given the factory's space limitations for rooftop solar. Instead of waiting for a full long-term renewable energy solution, the factory was able to take immediate action.

As IRIS Fabrics' General Manager explained,

"The I-RECs purchase has allowed us to reduce our emissions significantly in the short term, but it is just one part of our broader strategy. Our target is to reduce total emissions by 50% by 2030. I-RECs provide us with a flexible, cost-effective way to reduce our carbon footprint while we explore long-term solutions like expanding renewable energy infrastructure."

THE INTERNATIONAL REC STANDARD

This Redemption Statement has been produced for

IRIS FABRICS LTD.

by

BECOUR AS

confirming the Redemption of

5 500.000000

I-REC Certificates, representing 5 500.000000 MWh of electricity generated from renewable sources

This Statement relates to electricity consumption located at or in

Bangladesh

in respect of the reporting period

2024-01-01 to 2024-12-31

The stated Redemption Purpose is

Cancelled for the purpose of electricity consumption for IRIS Fabrics Ltd., Legal org. number 14239/Gazipur in Bangladesh.

Ev.

QR Code Verification

Verify the status of this Redemption Statement by scanning the QR code on the left and entering in the Verification Key below

Verification Key

2 1 4 3 9 4 6 2

https://api-internal.evident.app/public/certificates/en/nQZNLwr72artloglys7KKR9xxacrsTbY4Xx22uxzdmFIfgGweIJDoLAEuIMzyCw1

Figure 7: IRIS Fabrics' I-REC Certificate

At the same time, the case makes clear that I-RECs are not a substitute for direct renewable energy investment. For IRIS, they remained an expense rather than an investment. The certificates helped the factory meet immediate climate goals, but they did not create any on-site renewable energy infrastructure or long-term energy asset within the factory itself.

For this reason, IRIS continues to explore longer-term options, including rooftop solar expansion and Power Purchase Agreements (PPAs), so that progress toward its **50% emissions reduction target by 2030** can continue beyond certificate-based offsetting.

Key Lesson

The experience of IRIS Fabrics shows that I-RECs can provide a practical short-term pathway for factories that need to reduce electricity-related emissions but cannot yet invest in on-site renewable energy. In this case, the purchase of **5,500 MWh** worth of I-RECs allowed the factory to offset **3,256 metric tonnes of CO_2**, equivalent to around **10%** of its total annual emissions, at an estimated cost of **USD 16,500** (at the time of purchase).

At the same time, the case makes clear that I-RECs work best as a transitional tool rather than a complete long-term solution. For IRIS, they helped address immediate sustainability and brand-related pressures while the factory continued to explore longer-term options such as rooftop solar expansion and Power Purchase Agreements (PPAs). The broader lesson is that I-RECs can help factories buy time and show credible short-term progress, but their greatest value lies in supporting the transition toward more permanent renewable energy solutions.

Lighter Solar for Weaker Rooftops: Flexible Solar Technology at Pioneer Knitwears

CASE STUDY **10**

Lighter Solar for Weaker Rooftops: Flexible Solar Technology at Pioneer Knitwears

The Rooftop Challenge Before Flexible Solar

Before the advent of lightweight, flexible solar technology, factories in Bangladesh faced several barriers to adopting rooftop solar. Most factory buildings were not designed to support the weight of traditional silicon-based solar panels, which are heavy due to their glass and aluminium components. Retrofitting these roofs would require expensive structural reinforcements. Even when technically feasible, the initial investment for solar installations was a major deterrent, especially for small and medium-sized enterprises (SMEs) that dominate the garment sector.

It is within this context that lightweight, flexible solar technology began to matter. By offering a lower-weight, factory-friendly alternative, Midsummer's thin-film solar panels presented a possible way around one of the sector's most persistent barriers to solar adoption. The installation at Pioneer Knitwears in Mymensingh therefore serves as an important early example of how this technology could work in practice within Bangladesh's RMG and textiles value-chain.

Why Lightweight Flexible Solar Mattered

Many garment factories in Bangladesh were constructed years ago with little consideration for renewable energy integration, and their roofs are often too weak to bear the weight of conventional solar panels. Space constraints are another factor behind low solar uptake in Bangladesh. Midsummer's flexible thin-film panels were designed to address these limitations. Weighing just **3 kilograms per square metre** and only **2 millimetres** thick, they are well suited to weaker industrial rooftops and come with a carbon footprint that is reportedly nearly **90% lower** than conventional silicon-based panels.

The Pioneer Knitwears Installation

In this context, the collaboration between Swedish solar energy innovator Midsummer and Bangladeshi textile manufacturer Pioneer Knitwears marked an important test case. The installation of a Midsummer BOLD thin-film solar rooftop system at the Mymensingh factory brought together lightweight solar technology, factory-level decarbonisation needs, and brand-backed support. With financing support from one of the world's largest clothing retailers (sourcing from Pioneer), Pioneer Knitwears moved ahead with a rooftop system covering **500 square metres**, with a capacity of **54.7 kWp** and expected annual generation of around **60,000 kWh**.

What The Project Delivered

Using Bangladesh's 2023 grid emissions factor of 0.636 kg CO_2e/kWh, the greenhouse gas (GHG) emissions reduction is calculated as:

60,000 kWh/year×0.636 kg CO_2e/kWh=38,160 kg CO_2e/year=38.16 tons CO_2e/year60

Over the expected 25-year lifespan of the solar panels, this translates to a cumulative reduction of approximately **954 tonnes of CO_2e**. For a relatively small-footprint rooftop installation, this represents a meaningful environmental gain in a context where the national grid remains heavily dependent on fossil fuels.

Project Sumary

The table below summarises the main features of the Pioneer Knitwears flexible solar installation.

Item	Details
Project Title	Rooftop Solar Installation at Pioneer Knitwears by Midsummer
Location	Mymensingh, Bangladesh
Technology Provider	Midsummer AB (Sweden)
Factory Owner	Pioneer Knitwears (part of Badsha Group of Industries)
Brand Involvement	Unnamed brand financed the project
System Type	Midsummer BOLD thin-film solar rooftop system
Installed Capacity	54.7 kWp
Roof Area Covered	~500 m²
Annual Energy Output	Approx. 60,000 kWh
Estimated GHG Reduction	38.16 tonnes CO_2e/year
Projection of 25 years	approx. 954 tonnes CO_2e over 25 years
Technology Features	Lightweight (3 kg/m²), 2 mm thin, suitable for weak industrial roofs

Table 14: Summary of Pioneer Knitwears's Thin Film Solar Project

Why The Financing Details Remain Limited

The case study intentionally focuses on the technological innovation and environmental impact of the project rather than its financial structure. According to Midsummer, the company is not willing to disclose the specific financing figures or investment breakdown due to business confidentiality. As a result, details such as the total capital cost, the equity contribution from Pioneer Knitwears, or the terms of the brand's financial support are not included.

This omission reflects the primary objective of the case study, which is to showcase the technical feasibility and scalability of lightweight, thin-film solar technology in Bangladesh's textile sector. The emphasis is on how Midsummer's ultra-light panels overcome structural limitations of factory rooftops—an issue that has long hindered solar adoption in the region.

While financial transparency would enhance replicability from an investment standpoint, the scalability of this model is expected to be driven more by technical compatibility with existing factory infrastructure than by a one-size-fits-all financing approach. Future projects may adopt different financial models depending on the brand-supplier relationship, factory size, and access to concessional finance.

Why This Case Matters Beyond Just Pioneer Knitwears

Although the installation at Pioneer Knitwears is a single project, its significance extends beyond one factory. The case points to a possible pathway for wider solar adoption in Bangladesh's textile sector, particularly in settings where rooftop strength and space limitations have made conventional solar difficult. In that sense, the project is not only a technology demonstration, but also an indication of how brand support, factory demand, and technical innovation can come together in a more workable model. .

The strategic significance of this solution is owing to its:

1. **High replicability:** Majority of RMG factories in Bangladesh have under-utilised rooftops. As this solution evades the weak rooftop challenge, this can be used to scale renewable energy use across RMG, provided other factors are assured i.e. access to finance, procurement of reliable vendors, willingness of factory management etc.

2. **Evasion of space constraints:** Due to high population density, ground-mounted solar is not viable at scale, making rooftop solar the most practical solution.

3. **Evasion of structural limitations:** Traditional silicon panels are too heavy for most factory roofs. Midsummer's ultra-light, thin-film panels solve this problem, enabling solar adoption without costly structural reinforcements.

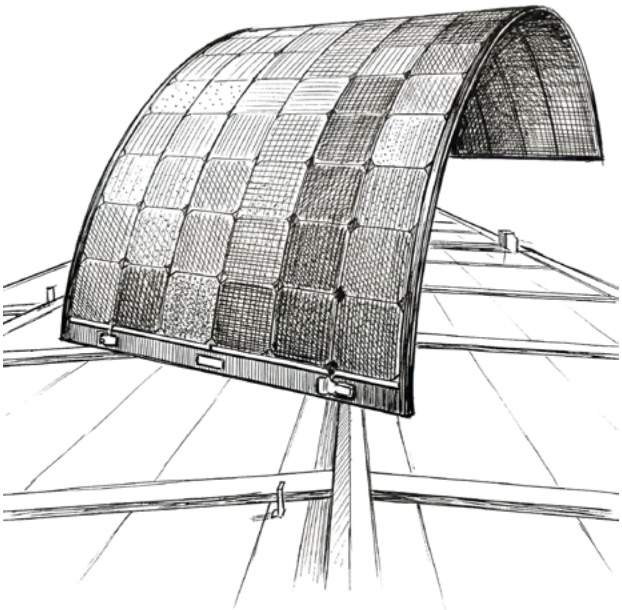


Figure 8: Sketch of the BOLD Solar Panel

What Still Limits Wider Adoption

Despite the compelling benefits of lightweight rooftop solar solutions like Midsummer's thin-film panels, the path to widespread adoption in Bangladesh's textile sector is not without significant challenges.. While thin-film technology addresses part of this challenge with its ultra-light design, structural reinforcement or careful assessment is still required, which can add to the overall project complexity and cost.

Another critical consideration is the access to affordable financing. Even though lightweight solar solutions are more viable for the physical infrastructure of these factories, the upfront investment remains a barrier, particularly for small and medium-sized enterprises (SMEs). Without concessional loans, brand-backed co-investment, or innovative financing models, many factories may find it difficult to justify or afford the transition, especially amid economic uncertainties.

Key Lesson

The Midsummer–Pioneer Knitwears project shows that one of the biggest barriers to rooftop solar adoption in Bangladesh's textile sector is not always lack of interest, but lack of technical fit with existing factory infrastructure. In this case, lightweight thin-film solar offered a way around a problem that conventional panels often cannot easily solve: weak industrial rooftops.

At the same time, the case suggests that technology alone is not enough. The installation moved forward through a combination of factory willingness, external technical expertise, and brand-supported financing. This makes the project important not only as a test of flexible solar technology, but also as an example of how new forms of collaboration may be needed to expand renewable energy uptake in the sector.

The broader lesson is that if lightweight solar is paired with stronger brand-supplier collaboration, and supported where possible through public-private partnerships, it could open up a new pathway for rooftop decarbonisation in parts of Bangladesh's textile industry that have so far remained difficult to reach. Brands, in particular, can play a catalytic role not only by sharing knowledge on new technologies across their supplier networks, but also by helping reduce financial barriers through co-investment or longer-term purchasing arrangements that provide greater certainty for factories.

Building A Business Case for Solar: Using ROI to Drive Investment

CASE STUDY **11**

Building A Business Case for Solar: Using ROI to Drive Investment

The Challenge: When Solar Is Hard to Sell Internally

One of the major barriers to solar adoption in Bangladesh's RMG sector is not only finance or technology, but the difficulty of clearly demonstrating its tangible business value. In many factories, even when mid-level management sees the potential of solar, they often struggle to convince senior management because the economic benefits are not measured in a visible and decision-ready way. As a result, solar is frequently treated as a brand requirement rather than as a business case grounded in data.

This challenge is closely linked to weak data systems in factories. Without proper documentation, transparency, and internal analysis, it becomes difficult to calculate return on investment (RoI) in a way that can support real decision-making.

According to an energy expert,

"The data management system in factories has not yet been established. Factories rarely know about data management and are not able to implement data transparency since they do not have the system. There is no documentation or data practice which limits how much consultants can help factories. They (consultants) give a lot of training but the factories rarely have the resources and capabilities to implement them."

It is within this context that TM Group's experience becomes important. This case study shows how the group moved beyond treating solar as a compliance issue and instead developed it as a measurable business proposition. By calculating savings from grid electricity replacement, total investment, operation and maintenance costs, payback period, and long-term returns, TM Group was able to make solar financially visible, measurable, and attainable.

Why SP Group Approached Solar Installation Differently

SP Group owns five RMG factories, including a LEED Platinum certified factory and a LEED GOLD Certified factory. The motivation for renewable energy derives from internal and external factors that have contributed to their shift towards greener practices. In **2021**, they developed a sustainability framework that seeks to be completed by **2030**. The framework involves developing a futuristic plan for how they want to do business and assess their requirements regarding climate action, circular economy, and environmental stewardship. This framework was developed by considering what brands increasingly look for across the supply chain, while also taking feasibility and profitability into account. As gas prices increased and solar panel prices became more affordable, the feasibility of solar improved significantly. In this way, the shift toward solar was shaped not only by sustainability ambition, but by changing business conditions.

How SP Group Built Their Investment Case

This case presents the business case of a **1 MWp solar power project** introduced by SP Group. The project was framed around a set of concrete financial and operational indicators: savings from grid electricity replacement, total project cost, operation and maintenance cost, net monthly savings, payback time, and longer-term return. The prospect of maintaining long-term business relationships with leading brands was also treated as part of the wider business case. Rather than depending on a general assumption that solar is "good for sustainability," the group approached the project as an investment decision that needed to be proven through numbers.

How The Project Was Designed and Managed

Around **2010-2011**, SP group started building green factories, wherein solar power was identified early on as one of the key features of SP's future green factories. The initiative to install solar panels was taken in **2013**. The group's broader targets are to achieve net zero **by 2050** and **50% emissions reduction by 2030**, using **2019** as the baseline year. Until **2023,** the group had installed 1**.5 MWp of solar capacity**. Its future plan is to reach **4.5 MWp by 2026** and **7 MWp by 2030**.

Before installation, SP Group conducted a feasibility study to assess the available space in its factories. The group collected **four quotations** from different suppliers, reviewed technical feasibility, examined proposals, sought reviews from other customers, and then selected its EPC partner. Around **35% of the space** was reserved for safety issues. The angle of the mounting system was considered carefully, and the company chose **monocrystalline cells**, which are more effective.

The group also paid close attention to quality and operational issues. A quality check of the monocrystalline panels and test certification were carried out. Management regularly checked the type of wiring, safety features, and inverters. When electricity generated by the system was not needed for factory operations, it could either be sold to the grid or used for maintenance.

To maintain the system, the group used a monitoring device called **Sunny Portal,** which showed how much energy had been produced each day. According to the case, installation and maintenance involved a mix of **80% software and 20% engineering skill**. On the maintenance side, work had to be done frequently, almost every day. This included: cleaning, fixing torn wires, and replacing broken inverters in the event of hailstorms.

What The Numbers Showed

The table below summarises the main cost assumptions, monthly benefits, return indicators, and longer-term projections used by SP Group to assess the project as an investment case.

Project Cost Breakdown		Assumptions		Monthly Benefit Calculation		Project Return & Payback		Projections		
Component	Amount	Description	Value	Description	Amount in BDT (Lac)	Metric	Value	Year	Saving per Year	Total Savings
Project Cost	BDT 48 Million	Monthly Generation from Solar Power	87.600 units	Savings from grid electricity replacement	8.97	Project IRR	26%	0-10 Years	BDT 4.9 Million	BDT 49 Million
Loan (80%)	BDT 38.4 Million	Grid Electricity Rate (Off peak)	10.24 BDT/ unit	Monthly repayment of loan	4.5	Payback	5 Years	11-20 Years	BDT 10.3 Million	BDT 103 Million
Equity (20%)	BDT 9.6 Million	Solar Tariff	4.90/ unit	Monthly O&M Expense	0.36					
				Total Monthly Expense	4.86					
				Net Monthly Savings	4.11					

Table 15: SP Group's Solar Project Financial Summary and ROI Assumptions

How SP Group Calculated ROI in Practice

The specific process SP Group uses to calculate Return on Investment (ROI) for their solar power project began by determining the total project cost, which in their case was **BDT 48 million** for a **1MWp** rooftop solar installation. This cost was financed through a combination of **80% bank loan** and **20% equity**. Once the system was operational, they tracked the actual monthly energy generation, which averaged **87,600 units**. They then calculated the cost savings by comparing the grid electricity rate (**BDT 10.24 per unit**) with the internal solar tariff (**BDT 4.90 per unit**), resulting in a monthly gross saving of **BDT 8.97 lacs**.

From this gross saving, they subtract the monthly loan repayment (**BDT 4.5 lacs**) and operation and maintenance costs (**BDT 0.36 lacs**), arriving at a net monthly saving of **BDT 4.11 lacs**. This net saving is used to determine the payback period, which is calculated to be five years. Beyond this period, the system continues to generate savings, with projected total savings of **BDT 152 million** over a **20-year lifespan**. The calculation also includes the internal rate of return (IRR), which is **26%**, indicating a strong financial performance.

Project Cost & Financing

Arranging finance for solar remains predominant challnege for garment factories (Rahman et al., 2024). SP Group was able to overcome this hurdle because of its ability to organise documents, maintain transparency, and secure access to finance. The total project cost of the **1 MWp** rooftop solar project was **BDT 48 million**. Of this, **BDT 38.4 million** came through a bank loan, while the remaining **20%**, or **BDT 9.6 million**, was provided as equity. The group was able to manage the mortgage needed for the loan.

Power Generation & Tariff Comparison

Once the system became operational, SP Group tracked actual monthly energy generation rather than relying only on projected estimates. The project generated a monthly average of **87,600 units** of electricity. The group then compared this with the off-peak grid electricity rate of **BDT 10.24 per unit** and the internal solar tariff of **BDT 4.90 per unit**. This comparison formed the basis of the savings calculation and helped make the financial value of solar visible in operational terms.

Monthly Savings & Operating Costs

Based on this comparison, the monthly saving from grid electricity replacement was calculated at **BDT 8.97 lac** for the **1 MWp** solar project. From this gross saving, SP Group deducted its monthly loan repayment of **BDT 4.5 lac** and operation and maintenance cost of **BDT 0.36 lac**. This brought the total monthly expense to **BDT 4.86 lac**, leaving a net monthly saving of **BDT 4.11 lac**.

According to a manager at SP Group,

"You can find out that how many times the price of gas has changed since 2010. So, when the gas price increases, the cost of producing electricity also increases. On top of that, if you add the depreciation value, if it is gas based, the price would be 8-10 taka and it increases to 11-12 taka during peak hours. On the other hand, if I look at solar, I can avail electricity at the price of 6-7 taka."

The financial gains were also assessed across the full **20-year life** of the system. In the first **10 years**, SP Group expects to save **BDT 49 million**, or about **BDT 4.9 million per year**. In the following **10 years**, after the loan repayment period ends, yearly savings are expected to rise to **BDT 10.3 million**, producing total savings of **BDT 103 million** over that period.

The Payback Period

A major issue with solar installations has historically been its long payback period. Ten to fifteen years ago, payback often took more than **10 years**, when the total system life was only **15–20 years**, making the investment difficult to justify. However, recently the payback period has been reduced significantly due to advancement in technology. According to SP Group, this has now changed significantly because of improvements in technology and falling panel prices.

The group calculated that it would recover its investment within **5 years**. As SP's head of sustainability explains:

"What happened is that the price of solar panels has decreased. Therefore, the feasibility of solar has increased."

He further added,

"There was a time when a solar panel's ROI was around 11-12 years, now it has become 5-6 years. Since the RoI has decreased from 11-12 to 5-6 years, it is more cost-effective, not to mention, it helps reduce carbon footprint and increase our brand rating."

Business Value Beyond Electricity & Cost Savings

Apart from direct financial returns, SP Group also treated brand relationships as part of the wider business case. Maintaining a higher brand rating and aligning with buyer sustainability expectations were seen as strategically important. In line with brand net zero targets, the group's factories embraced renewable energy to strengthen their long-term business relationships, with their Head of Sustainability noting,

"When we use diesel or any kind of fossil fuel, the associated carbon footprint is quite high and we lose our position in our sourcing brands' rating system."

SP's Long-term Scaling Plans

SP Group has laid out a clear roadmap for scaling its solar capacity. As of **2023**, they have installed **1.5 MWp**. Their goal is to reach **4.5 MWp** by **2026** and **7 MWp** by **2030**. This expansion aligns with their broader sustainability targets: a **50% reduction** in emissions by **2030** and achieving net zero by **2050**. If the financial performance of the 1MWp project is replicated at scale, the group could potentially save over **BDT 70–80 million** annually by **2030**.

Why SP Group's ROI Method was Persuasive

What makes SP Group's approach notable is not simply that it calculated ROI, but how it did so. The group used a structured, data-based method grounded in actual project cost, financing terms, monthly generation, tariff comparison, and operating expenses. It then linked these calculations to long-term payback and total savings over the life of the system.

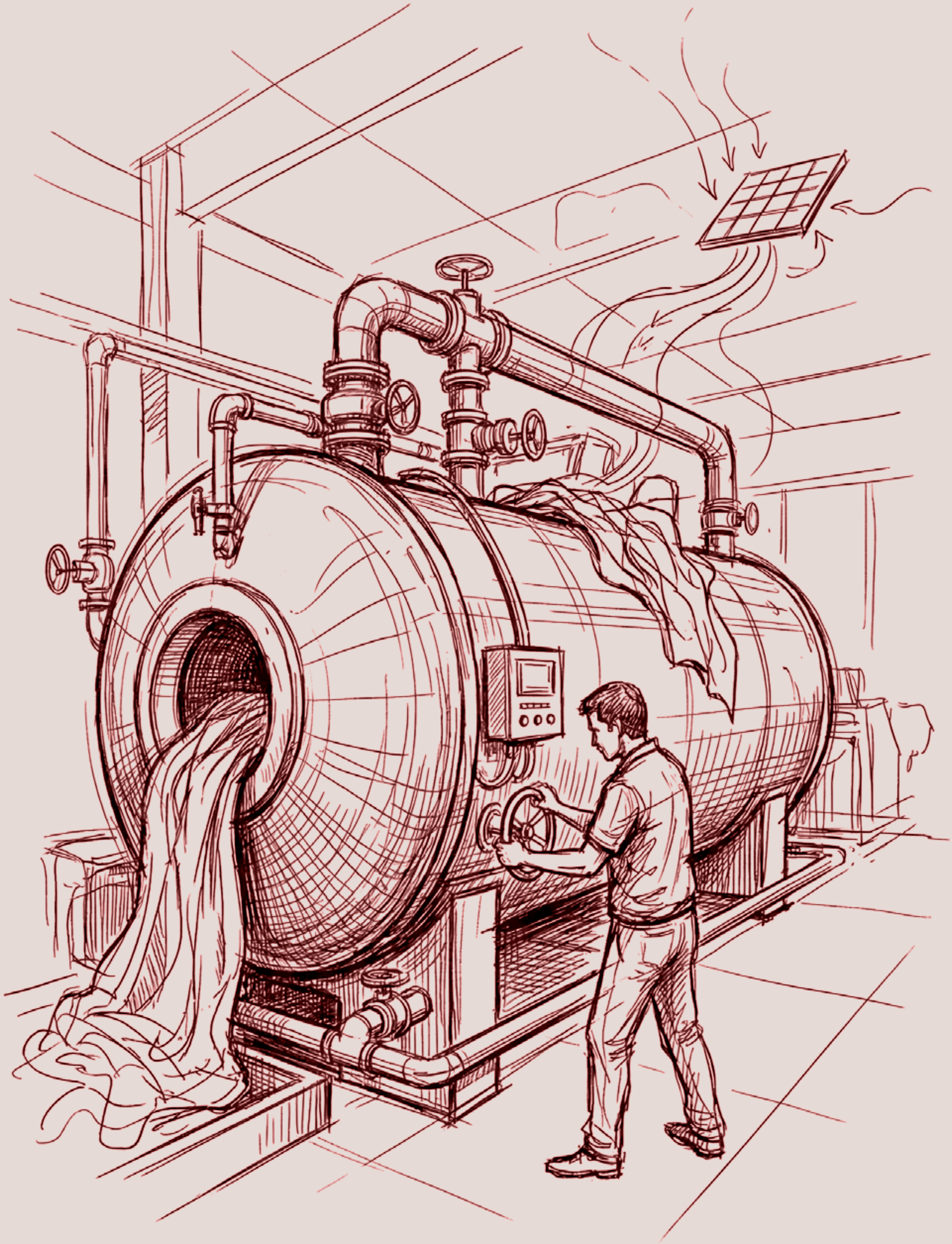
This differs from more traditional approaches to ROI calculation, which often depend on static assumptions and broad estimates. Traditional models may not capture real-time energy production data, changes in electricity prices, or the practical operating conditions of solar systems. They also tend to leave out intangible but important factors such as the company's reputation, compliance with brand sustainability requirements, and the potential to build long-term business relationships with brands. Hence, SP Group's approach, by contrast, is dynamic and grounded in actual performance data, making it more transparent, realistic, and persuasive—especially when presenting the business case to senior management or external stakeholders.

Key lesson

SP Group's experience shows that one of the most important shifts in solar adoption is a shift in mindset. Solar becomes much easier to support internally when it is framed not only as a sustainability measure or brand requirement, but as a business proposition that can be measured, defended, and tracked through data. In this case, the ability to calculate project cost, financing structure, power generation, monthly savings, payback time, and long-term return turned solar from an abstract green ambition into an investable decision.

The case also highlights the strategic role of mid-level and sustainability management. Their ability to not only promote environmental goals, but also translate broader decarbonisation goals into a language that senior management could respond to (cost return, feasibility, business continuity etc.), ensured SP's transition towards solar use.

SP Group's example suggests that factories are more likely to invest in solar when internal teams can build a clear case around actual numbers rather than assumptions alone. The broader lesson is that solar adoption in Bangladesh's RMG sector may depend as much on internal coordination and communication as on external brand pressure. Where factories develop better data systems, stronger financial analysis, and a more strategic approach to sustainability planning, renewable energy becomes easier to justify, not only as compliance, but as a long-term business decision.



Turning Waste to Profit: Echotex's Waste Heat Recovery Strategy

CASE STUDY **12**

Turning Waste to Profit: Echotex's Waste Heat Recovery Strategy

The Hidden Loss in Conventional Dyeing

At Echotex, the problem was not a lack of heat, but the amount of heat being wasted. Dyeing is one of the most resource-intensive stages in textile manufacturing, requiring large volumes of water and energy, particularly for heating water to extremely high temperatures. In conventional dyeing operations, water needs to be heated from **25–27°C** (groundwater temperature) to as high as **90°C** for dyeing and **110°C** for cotton processing. After dyeing, the discharged hot water is typically wasted, even though it still carries significant thermal energy.

This approach requires excessive amounts of fuel for steam generation and water for each cycle. For **one kilogram of fabric**, around **80 litres of water** and **3.5–4 kg of steam** is used, driving up both costs and environmental impacts. Although the country's textile and apparel sectors have begun using modern and efficient power technologies, energy efficiency in many operations is still behind its optimum potential. Residual heat, whether from generators, boilers, or finishing operations — is captured and reused as an additional energy source, at a limited scale, overall.

Echotex's Early Response Through Waste Heat Recovery

Echotex Limited, a leading sustainable garment manufacturer in Bangladesh, recognised this challenge early on and set out to optimise its dyeing operations through waste heat recovery (WHR) technologies. As part of its broader sustainability strategy, Echotex began investing in WHR systems as early as **2010**, long before such practices became common in the industry. The goal was simple but bold: reduce water and energy use without compromising quality or productivity.

As their Sustainability Manager explains,

"We are more concerned about the environment as we understand the importance of sustainability for our own growth and profit. The top management collects resources from different countries and take the necessary steps to make a pathway for a sustainable future."

This early move is what makes the case distinctive. Echotex was not only an early adopter of WHR in Bangladesh's textile sector, but also **integrated waste heat recovery into multiple stages of the dyeing process** rather than treating it as a one-off technical fix. The project was **self-financed**, with return on investment achieved through operational savings.

How the System Worked in Practice

Through waste heat utilisation, Echotex was able to capture heat that would otherwise have been lost and transfer it back into the production process as an additional energy source. The system worked by extracting and reusing waste energy from different stages of dyeing.

After implementation, Echotex used advanced dyeing machines — specifically **Sclavos dyeing machines (Athena series from Greece)** — each equipped with built-in heat exchangers (**Heatex**). These machines captured and transferred residual heat from drained hot water to incoming cold water.

Instead of discarding water at around **55°C** after dyeing, Echotex diverted it into **Hot Water Reserve Boilers**.

The innovation lies in systematically reusing thermal energy embedded in discharged dye water. Water drained at **55°C** is not wasted. It is stored and pumped into the system for steps that require heated water. This significantly reduces the amount of energy required to reach the target dyeing temperatures of **90–110°C**. This stored preheated water was then reused in later process stages, reducing the need to heat water from ambient temperature all over again.

The innovation, therefore, lay not simply in installing a new machine, but in systematically reusing thermal energy already embedded in discharged dye water.

What Changed After Implementation

The table below summarises the key features and operational effects of the waste heat recovery system in Echotex's dyeing process.

Component	Details
Technology Used	Sclavos dyeing machines with Heatex + Hot Water Reserve Boilers
Temperature of Reused Water	~55°C (captured from dye discharge)
Process Scope	Water heating for multiple stages of the dyeing process
Water Use (Before)	80 litres/kg of fabric
Water Use (After)	65 litres/kg of fabric
Steam Use (Before)	3.5–4 kg/kg of fabric
Steam Use (After)	2.75 kg/kg of fabric
Savings (Per kg of Fabric)	USD 0.02
Daily Production	45,000 kg of fabric
Water Saved Daily	675,000 litres
Projection of Savings	Daily USD 900; 1 year USD 300000;
10 years USD 3000000	
Implementation Year	2010
Financial Model	Self-financed

Table 16: Waste Heat Recovery in Echotex's Dyeing Process: Technology and Results

Before WHR, **80 litres of water** were used per kilogram of fabric. After implementation, this fell to **65 litres**, meaning a saving of 1**5 litres per kg of dyed fabric**. At a daily production volume of **45,000 kg**, this translated into **675,000 litres of water saved every day**, or approximately **247 million litres annually**. In percentage terms, this represented an **18.75% reduction in water use per kg**.

Steam demand also dropped significantly from **3.75–4 kg/kg** to **2.75 kg/kg**, resulting in less fuel being burned. With steam costing around **5.5–6 BDT/kg**, this reduction contributed directly to lower operating costs and more energy-efficient production. In total, steam use fell by roughly **26.7%**.

Following reduced water and steam demand, Echotex estimated a saving of **2 BDT per kg of fabric**. At full production capacity, that equalled **90,000 BDT in daily savings** or roughly **3 crore BDT annually**. Assuming a production cost of **100 BDT/kg**, this represented a **2% direct cost saving per kg**, excluding indirect savings from reduced energy and water treatment requirements.

These figures clearly show that WHR was not only environmentally beneficial, but also financially sound.

The following metrics prove the effectiveness of this WHR system:

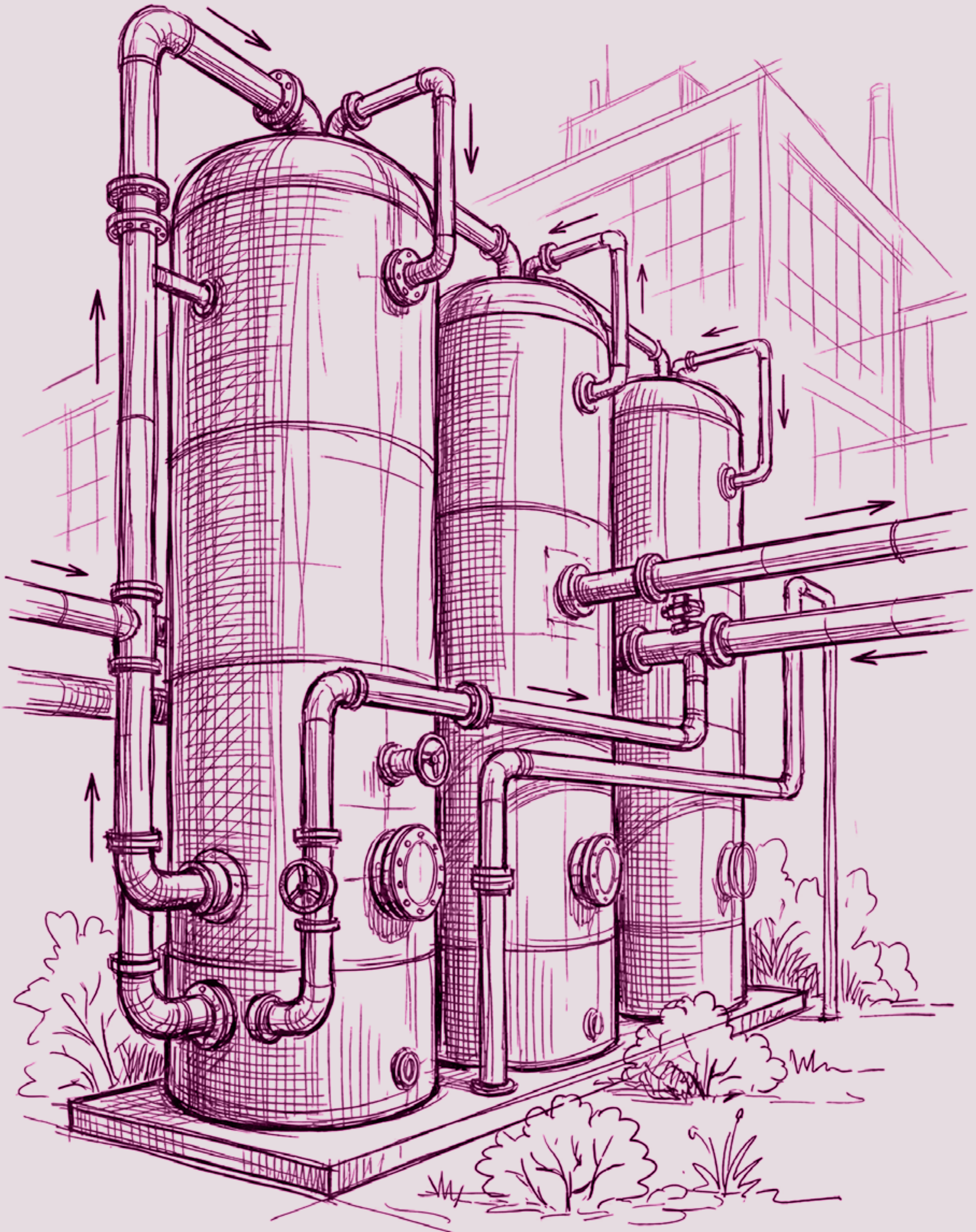
- **Thermal alignment:** The reused water at **55°C** aligned well with the initial heating requirements, reducing energy input without disrupting process flow
- **No quality compromise:** Despite reduced energy and water use, production quality and volume (**45,000 kg/day**) were maintained
- **Operational integration:** WHR was embedded into the dyeing infrastructure, not added as an external system
- **Financial ROI:** The self-financed system paid back through operational savings
- **Sustainability metrics:** As per Echotex's annual internal assessment from 2024, they achieved up to **20% energy reduction** through WHR and related initiatives, in that year alone.

Key Lesson

What makes this case important is that it shows how a factory can improve performance not by adding an entirely new energy source, but by making better use of the energy already moving through its production system. In Echotex's case, the intervention was process-specific, technically aligned with dyeing requirements, and fully integrated into operations. It did not rely on an external sustainability add-on. Instead, it improved efficiency from within the process itself.

Using Echotex's example, it is important to note that heat is a resource, not a waste. When factories begin to see process heat as a recoverable resource, even routine operations can become opportunities for major efficiency gains. Systems that reuse existing energy streams can significantly cut costs and improve efficiency. In this case, Echotex's early investment in WHR reduced water and steam use significantly, generated direct cost savings, and did so without compromising output or quality.

The broader lesson is not only technical, but strategic. Echotex treated efficiency improvement as part of how the business should run, not just as an environmental gesture. Its example suggests that where process alignment is strong and management is willing to invest early, even seemingly modest interventions, such as reusing hot water can produce substantial operational, financial, and environmental benefits at scale.



Maximising a Familiar Technology: Why Echotex's Exhaust Gas Boiler Strategy Stands Out

CASE STUDY 13

Maximising a Familiar Technology: Why Echotex's Exhaust Gas Boiler Strategy Stands Out

The Overlooked Energy Loss

By **2015**, Echotex faced a different but equally important challenge. Textile production in Bangladesh is highly energy intensive, and dyeing and finishing processes require a constant supply of steam. To meet this demand, most factories operate large gas generators around the clock. These generators release exhaust gases at temperatures of **400°C to 500°C**. Traditionally, that heat escaped into the air and was wasted.

Exhaust Gas Boilers (EGBs) are a known solution for capturing this heat and converting it into steam. Several factories in the sector have adopted them. However, only a few examples can genuinely be considered as a "best practice". What makes Echotex notable is not only that it installed EGBs, but that it turned a known technology into a highly effective business case.

Why Echotex Chose EGBs

Although Echotex had already adopted energy-saving practices through waste heat recovery (see Case Study 12), by 2015 it was facing growing pressure from several emerging challenges. Rising gas prices, increased scrutiny from global apparel brands, and the constant challenge of meeting round-the-clock steam demand for their vertically integrated operations, were but a few of the compounding pressures on Echotex. Every kilogram of dyed fabric required around three kilograms of steam, making steam generation a major cost driver.

Instead of investing in additional gas boilers, Echotex identified the wasted energy in its generator exhaust as an untapped resource. Its **four generators**, each rated at **1,500 kW**, meaning, a total of **6 MW** — provided more than enough heat to justify the investment. Turning this "invisible" waste into a productive asset promised significant cost savings while also strengthening the company's environmental credentials with brands.

Project Summary

The table below summarises the core technical and financial features of Echotex's EGB system.

Category	Details
Technology	Exhaust Gas Boilers (EGB)
Year Installed	2015
Number of EGBs	2
Generators Served	4 units × 1500 kW (total 6 MW)
Exhaust Temperature	400°C to 500°C
Supplier	Forbes Marshall Pvt. Ltd.
Installation Cost	~250000 USD
Annual Savings	~700000 USD
10 year projection of Savings	70000000 USD
Payback Period	5–6 months
Primary Use of Steam	Ironing and thermal processes
Feasibility Range	Suitable for factories with ≥3000 kW generator capacity

Category	Details
Not Suitable For	Small factories with low exhaust heat from generators
Maintenance & Monitoring	Managed in-house with supplier support and certified staff

Table 17: Overview of Echotex's EGB System

What The System Delivered

The financial results were striking. The entire installation cost roughly **2.5 crore BDT**. After installation, the factory saved around **7 crore BDT** every year because it no longer needed to burn as much gas to generate steam. This meant that in less than half a year, the savings had already exceeded the installation cost. After the first **5–6 months**, the monthly savings effectively became profit. For an industrial sustainability measure, this was an exceptionally fast return on investment.

These savings came primarily from reducing the cost of steam generation. Before installing the EGBs, Echotex needed around **3 kilograms of steam** for every kilogram of dyed fabric. This cost roughly **18 BDT per kilogram**. After installation, steam use dropped to **2.75 kilograms** per kilogram of fabric. Though that reduction may appear small, it translated into about **2 BDT** saved per kilogram, which became highly significant when multiplied across high daily production volumes.

The environmental gains were equally important. The EGB system captured heat from generator exhaust and converted it into around **1,500 kilograms** of steam or hot water every hour, preventing a large amount of energy from being wasted.

Each year, the system saved around **1,652,892 kWh of energy**. Without the EGBs, this energy would have had to be generated by burning more natural gas. The system also prevented around **3,116 tonnes of CO_2**-equivalent emissions annually.

These reductions supported Bangladesh's decarbonisation goals while also helping Echotex respond to strict sustainability expectations from global apparel brands. In this way, the system created value not only through lower fuel costs, but through lower carbon intensity at factory level.

How The System Was Operated and Maintained

The implementation and maintenance model was a blend of internal expertise and external support. Echotex's in-house engineering team began by conducting a detailed feasibility assessment, mapping exhaust flow and temperature data to estimate potential steam recovery. This internal study allowed the company to tailor the system to its own production needs rather than relying on a generic solution.

Once the feasibility was confirmed, Echotex moved to installation. The process was a collaborative effort: Forbes Marshall supplied the boilers and provided technical guidance, while third-party contractors assisted with structural modifications and ducting work. This combined approach ensured both precision and efficiency, minimising disruption to ongoing factory operations.

After commissioning, the responsibility for day-to-day management shifted to Echotex's own technical staff. Operationally, the EGB system has proven relatively reliable and low maintenance. The system is overseen by certified boiler operators who handle routine monitoring, safety checks, and operational adjustments. To ensure long-term reliability, Forbes Marshall continues to provide annual inspections and technical support. This mix of internal capacity and external expertise ensures both smooth day-to-day running and long-term sustainability of the system.

Where This Model Works & Where It Does Not

While the success of Echotex's EGB system is clear, the case also shows that this solution is not universally applicable.

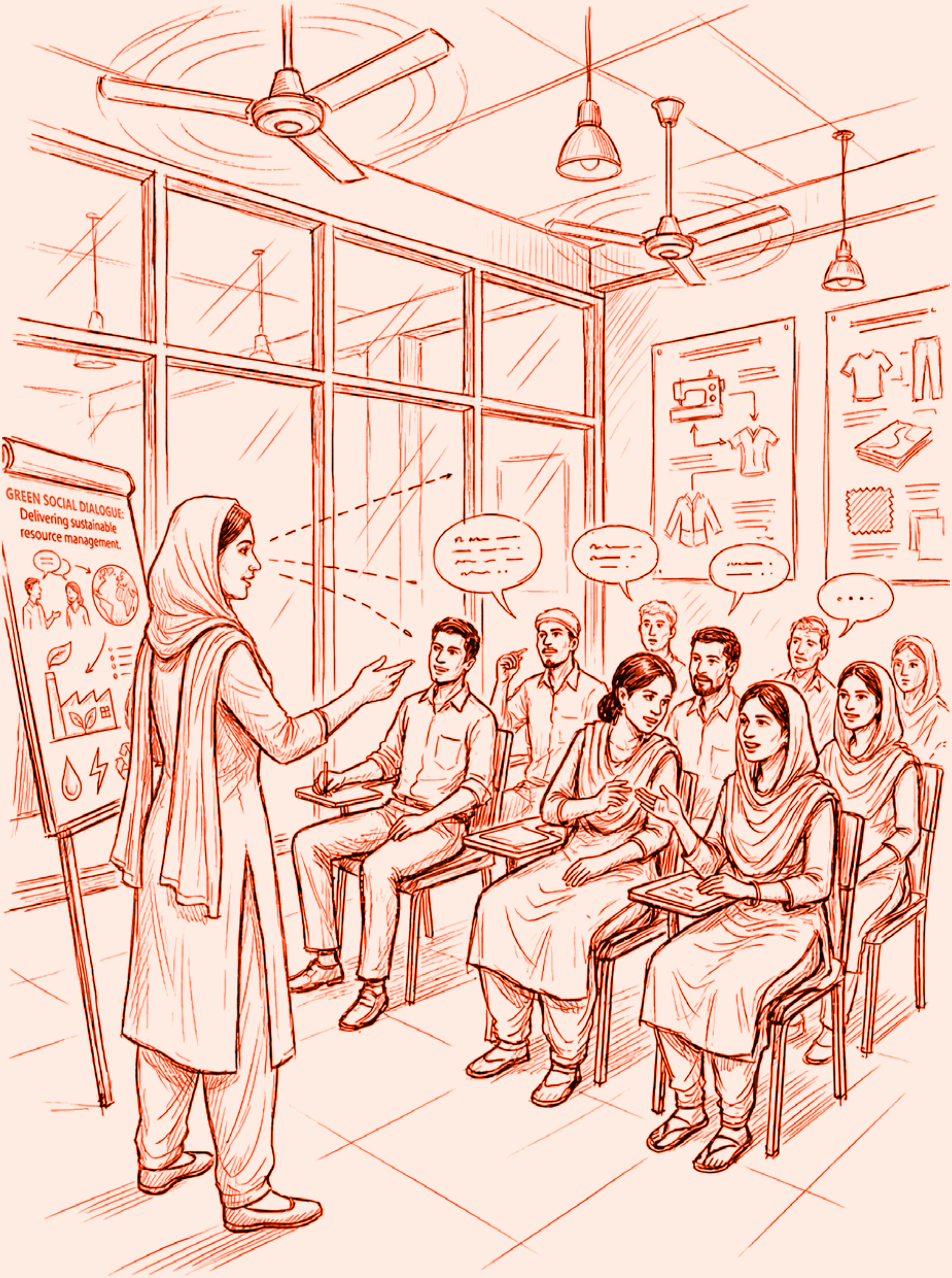
- **Minimum Generator Capacity:** EGB systems become economically viable mainly for factories operating with at least **3000 kW** of generator capacity
- **Small Factories:** Units with smaller generators, for example **500 kW**, do not produce enough exhaust heat to justify installation
- **Infrastructure Requirements:** Adequate space is also necessary, which can be difficult in space-constrained factory environments

This means EGB is best suited to **large-scale manufacturing operations** that can sustain both the technical and financial requirements of implementation. Echotex's vertically integrated structure also made the system more valuable, because recovered steam could be used across multiple departments, including ironing, dyeing, and finishing.

Key Lesson

Echotex's EGB initiative shows that a known technology can still become a best practice case when it is implemented with the right scale, internal capacity, and strategic intent. The project did not depend on reinventing technology. What made it notable was the way Echotex aligned waste heat recovery with real production needs, internal engineering capability, and buyer-facing sustainability priorities.

The broader lesson is that waste heat can become a competitive advantage when factories stop treating it as an unavoidable by-product and begin treating it as an asset. In Echotex's case, generator exhaust was turned into steam, steam was turned into savings, and those savings were achieved with an exceptionally fast payback. For large, integrated factories, this case suggests that the real opportunity may lie not only in adopting cleaner technologies, but in extracting more value from systems they already operate every day.



Green Social Dialogue:
Delivering Sustainable Resource Management

CASE STUDY **14**

Green Social Dialogue: Delivering Sustainable Resource Management

In **2022**, ETI launched a two-year pilot initiative aimed at supporting five factories in Bangladesh in advancing worker-led climate action across four key areas: climate change, sustainable waste management, water resource management, and energy conservation. The initiative aligns with ETI's just transition approach by incorporating these topics into existing social dialogue with workers and their representatives. This case study captures the impact this initiative had at Essential Clothing Ltd.

Introduction

Essential Clothing Ltd. (ECL) is a knit factory in Bangladesh's Gazipur district, which employs over **1,200 people**. A baseline assessment of **10 factories**, including ECL, indicated only **25.9%** were aware of the basic concepts of climate change and worker committees did not include environmental issues in their discussions. The factory had long term plans for energy efficiency and waste reduction but had not engage workers in these efforts or put any immediate action plans in place. Management did not promote energy efficiency or involve workers in renewable energy initiatives. Committee discussions centred on worker rights and safety, with no focus on environmental issues. As a result, workers did not engage in environment friendly practices, wasting water and energy and failing to sort waste properly.

Pilot

In July **2022**, Joint ETI invited its member brands to nominate their suppliers to participate in the Green Social Dialogue pilot. The Very Group nominated ECL to participate in the pilot. This initiative aimed to support factories in achieving a just transition to climate action through social dialogue with workers and their representatives. ETI Bangladesh identified four key areas for climate action at ECL in its baseline assessment. While the factory had a worker participation committee (PC), which facilitated social dialogue in the absence of a trade union, it lacked an agenda on climate action, leaving workers unaware of climate change and environmentally friendly practices. The pilot was implemented across five factories and focused on developing awareness and understanding of climate change among workers to facilitate worker-led climate action through establish social dialogue mechanisms.

Training

ETI Bangladesh developed and implemented a **60-hour** training programme based on needs identified during the baseline assessment and validated by key stakeholders. The programme included social dialogue (how it can be used to identify and address climate issues, and the roles and responsibilities of different committees), climate change and global warming in a global and national context, energy efficiency, natural resources, waste and water resource management, and, action plan development. Training was divided into three phases for management, worker committee members, and general workers, playing close attention to gender representation (**42%** women participants).

Knowledge Sharing

After training, **20** individuals were selected from the participants as 'resource persons', based on their engagement and skills. A targeted **16-hour training session** equipped them to effectively disseminate knowledge within the entire workforce, using pictorial flipcharts containing core messages from the training. Follow-up with ECL revealed that these **20 individuals** shared their new knowledge with **1,156 factory workers**, including **466 women** (as of March 2024). This approach fostered a sense of ownership among workers, leading to improved practices not only in the workplace but also in their communities.

Alongside this work, the factory used various materials created by ETI, including audio-visuals, posters, and flyers, to share information on climate change and environmental sustainability with workers. These resources aimed to raise awareness on the concept of climate change and global warming, and improve practices including social dialogue, sustainable waste management, water conservation, and energy efficiency.

"I have learned about Bangladesh's water scarcity crisis from the GSD training and effective ways to conserve water. Since then, I have made a conscious effort to minimise water wastage both at work and at home. Being inspired by what I learned from the GSD training; I conducted a session with my family. I am delighted to see my 14-year-old daughter adopting sustainable practices. She diligently turns off faucets and prioritises mindful water usage in her daily tasks."

- General worker, sewing section, EC

Climate Action Plan

Equipped with new knowledge and insights from the training, the factory was able to create a time-bound action plan with input from worker representatives and management, measures included:

- Reduce fabric waste by **1%**
- Turn off office AC twice daily for **30 minutes** to cut power usage
- Install solar panels to decrease electricity consumption by up to **40%**
- Add at least one agenda item on climate and environmental issues to Health and Safety Committee meetings
- Save approximately **4,200,000 litres** of water annually by fully utilising ETP water
- Reduce water wastage by treating and reusing AC discharge water, achieving a **0.5%** decrease in consumption
- Raise forestry awareness among all workers
- Increase awareness of water wastage among all workers
- Provide separate training for all operators involved in critical processes (**30%** of production) to reduce production wastage and rejection

Outcomes

Enhanced knowledge and understanding: Worker awareness regarding climate change surged to **100%**, with **93%** understanding its effects—up from **63.9%** and **25.9%**, respectively, at baseline. Training led to **1,231 workers** and management staff gaining knowledge on waste water reduction, promoting ownership of eco-friendly practices. Many workers adopted climate-friendly habits at home, including tree planting (**38.3%**) and mindful resource usage (**23.3%**). Awareness of energy-saving practices among workers rose dramatically from **40.5%** to **98.3%**.

Climate Action: The pilot significantly catalysed climate action at ECL, much of which required financial investment from management. Based on the action plan indicators, the factory adopted several initiatives to enhance sustainability and reduce its environmental impact.

Energy Efficiency: The factory achieved a significant reduction in electricity consumption through various measures. One of these was by installing solar panels with a total capacity of **448 kWh**. Over three months, the factory averaged **31,363.33 kWh** of solar energy monthly, making up **24.12%** of total consumption and saving **BDT 335,897 (2100 GBP)** in non-renewable energy costs. Through other conservative measures, monthly energy consumption was reduced by **15,443 kWh (11.92%)**, leading to additional savings of around **1,000 GBP**.

Water Conservation: Previously, the factory discharged all recycled water. Now, **50%** (2.5m³) of treated water is reused for printing and gardening, thanks to initiatives like the **ECO-RINSE** machine, which allows for multiple uses of water in printing. Plans to expand these practices are underway.

"Through the GSD training, I have come to understand the severity of the global warming crisis in Bangladesh. However, we can reduce its impact by planting trees which absorb carbon dioxide from the atmosphere. Following discussions with my business partner, we planted over 1,000 trees, including fruits and timber varieties, in our leased land aisle. Additionally, we encouraged our neighbours to plant trees in their available land."

- Vice-President, Worker Participation Committee.

Community Impact: The positive impact of these practices extends beyond the factory walls, creating a ripple effect that encourages workers and the broader community to engage in initiatives that promote environmental well-being. Many workers reported personal initiatives, such as planting trees in their hometowns.

Green Social Dialogue: Ahead of the pilot, ECL management had doubts about the role workers could play in understanding and driving climate action. However, as the project progressed, management observed how workers grasped and disseminated climate knowledge across the factory and contributed to action plan development. By the end of the project, management demonstrated recognition of their significant role and the value of green social dialogue. They also recognised the potential benefits of engaging workers in climate action that aligns with their long-term plans. Additionally, worker representatives now consistently include at least one workplace-related environmental issue in their routine meeting agenda.

Green Social Dialogue:
Promoting Climate Action Through Workforce Empowerment

CASE STUDY 15

Green Social Dialogue: Promoting Climate Action Through Workforce Empowerment

Aman Sweaters Ltd., based in Savar in the Dhaka district of Bangladesh, stands out as a compelling success story from the workplace-based Green Social Dialogue (GSD) pilot initiative. The initiative was designed to include workers and empower them as change agents in climate actions—positioning them not just as participants, but as drivers of environmental change. Through structured dialogue and inclusive engagement, the project empowered factory workers to actively address climate and environment-related challenges within their workplaces. It also sought to raise awareness of climate change impacts and embed these discussions into everyday workplace practices.

At the beginning, workers at Aman Sweaters had limited involvement in environment-related initiatives. Over time, however, the factory underwent a transformation, with its workforce becoming actively engaged in driving the green transition.

Introduction

At the baseline stage, Aman Sweaters Ltd.—among the ten factories— demonstrated a significant gap in environmental awareness, practices, and strategic planning. Climate change and sustainability topics were notably absent from worker committee agendas, which focused primarily on labor rights, safety, and wages. Although Aman Group had outlined broad goals for energy efficiency and waste reduction, these remained aspirational, with no concrete actions or worker engagement.

Workers showed limited understanding of environmental issues: only **25.9%** respondents had basic knowledge of climate change and its effects, and just **8.2%** of worker respondents felt any personal responsibility for environmental concerns. Waste management practices were weak, with only **38.1%** of workers familiar with proper procedures to handle waste, and while **56.9%** were aware of energy-saving methods, their practical application was minimal. Everyday operations reflected this disconnect—water and energy were used inefficiently, and waste was poorly managed.

The factory lacked initiative to build worker capacity on climate resilience, renewable energy, or sustainable resource use. Public Awareness systems were narrowly focused on cleanliness and safety, with no communication on green issues. Management had not developed strategic plans for 3R (reduce, reuse, recycle), nor had they introduced energy-efficient technologies or renewable energy systems. Both management and committee members acknowledged the absence of environmental sustainability in formal discussions and factory operations.

Programme Interventions

Programme Outline & Expected Results

ASSESSMENT	• Needs assessment • Endline evaluation
CAPACITY BUILDING	• Training for different groups (general worker, management, worker representatives) • Develop factory resource person • Flip-chart based orientation to workforce
ADVISORY SUPPORT	• Develop worker involved factory-based climate action plan • Post support for rolling-out peer education • Facilitate engagement of committees on addressing climate related issues
AWARENESS RAISING	• Dissemination of IEC materials (message board, songs, audio-visual) in factories • Celebration of special days (World Environment Day)
LEARNING CONSOLIDATION	• Broader stakeholder engagement (national and international) • Learning webinar • Case study and learning document development • Working group with industry representatives

Expected Results

- **Improved knowledge & capacity**
- **Worker inclusion & empowerment**
- **Sensitization & collective engagement**
- **Replication & evidence to influence**

Capacity Building Sessions: The programme delivered tailored **three-day training sessions** for different groups within the factory: management and Trade Union members, as well as other committee representatives such as safety, maintenance, and security, received intensive **8-hour-per-day sessions**. General workers participated in shorter sessions, with **4 hours** of training each day over the same three-day period, ensuring inclusive capacity development across all levels.

Awareness Raising Activities: To foster environmental awareness, the factory celebrated World Environment Day in both **2023** and **2024** through rallies, meetings, and tree plantation events. Ten thematic message boards were installed on factory walls, while two folk audio songs addressing environmental issues were broadcast via the Public Announcement system. Additionally, a climate change awareness video was shown using multimedia tools to reinforce key messages.

Resource Person Development & Flipchart Orientation: Selected participants underwent a two-day resource person training to lead peer education efforts. They were equipped with ten sets of pictorial flipcharts, each covering four thematic topics, and subsequently conducted orientation sessions for the broader workforce using these visual tools to ensure consistent messaging and engagement.

Action Plan Development & Advisory Support: During the training sessions, participants collaboratively identified environmental challenges within the factory and drafted a climate action plan featuring KPIs. With guidance from the programme team, senior management finalized the plan and proceeded to implement targeted activities aligned with each KPI, initiating several sustainability-focused improvements.

Sustainability Plan Development: Factories created sustainability plans to keep worker-led environmental efforts going even beyond the project period. These plans included regular awareness activities, adding green topics to committee discussions, and refresher training for staff. Trained resource persons continued their roles, and management agreed to monitor progress using KPIs to make sure the initiatives stayed active over time.

Interventions in Aman

Aman Sweaters Ltd. employs around **660** people, **62%** of whom are women. The factory has an active trade union. Through the pilot intervention, a total of **65** (**54% women**) management, trade union members, worker representatives and general workers received capacity building session.

A pool of **16** team members (**43% women**) was created as resource person, and they oriented **497 workers** (**63% women**) using flipcharts. Factory regularly conducts awareness raising campaigns including celebrating world environment day, playing audio songs and messages in Public Announcement system with awareness messages, installed information message boards etc.

Climate Action Plan: Building on the increased awareness and capacity gained through the training sessions, the factory—supported by advisory input from the project team and collaborative dialogue— factory worker representatives and management co-developed a time-bound climate action plan, which includes the following issues:

- **2%** reduction of production waste
- Establishment of a waste management committee with clearly defined roles for all members
- **10%** decrease in black smoke emissions from generators
- **7%** reduction in electricity consumption (from **650,000 KWh** to **645,000 KWh**)
- **15%** decrease in water usage through optimised practices (from **600,000L** to **510,000L**)
- Completion of orientation and counselling for all workers by resource person, ensuring **100%** participation
- Full workforce engagement through PA system announcements, audio songs, and visual materials
- Installation of climate-conscious information boards throughout the factory premises
- Plantation of at least **100** plants

Impact

Inclusion – Workers in the Decision-Making Process

Workers played a central role in shaping and implementing the factory's climate and environment initiatives, marking a shift toward inclusive decision- making. The worker representatives collaborated closely with management to develop the time bound action plan during the training. This ensured that the worker perspectives were heard and embedded into the strategic planning. This spirit of collaboration extended into regular committee meetings, where environmental topics such as energy efficiency, water conservation, and waste management became standing agenda items. Workers didn't just attend—they co-led discussions and proposed actionable solutions.

To deepen engagement, trained resource persons from within the workforce facilitated flip chart-based learning sessions for all workers, fostering a shared understanding and sense of ownership around climate issues. These conversations did not stop at formal settings; workers reported discussing climate change and training insights informally during breaks, helping to normalise sustainability dialogue across the factory floor. By the end of the programme, **65%** of workers stated that they now actively raise environmental concerns at work, reflecting a growing confidence in their ability to influence decisions and shape the factory's sustainability journey.

Agency – Workers Taking Action and Influencing Change

Beyond participation, workers have demonstrated the ability to apply their knowledge, influence outcomes, and adopt sustainable behaviour both in the workplace and at home. Worker representatives played a pivotal role, as change agents, in advocating for energy and water conservation, raising awareness among their peers, and bringing environmental concerns into management discussions. They proposed alternative solutions such as energy- saving practices and tree plantation, helping to embed environmental priorities into the factory's agenda.

This learning extended beyond the factory walls. A notable percentage of workers applied their knowledge of tackling impacts of climate change at home: **38.3%** planted trees, **23.3%** practiced mindful resource use, and **26.7%** adopted energy- efficient appliances. Water- saving knowledge at home rose to **95%** workers, while **95%** worker respondents' awareness on wastewater reuse increased. Most significantly, the proportion of workers who felt personally responsible for environmental issues increased from **8.2%** to **40%**, marking a shift from passive awareness to active stewardship.

Workers applied their knowledge at home by planting trees (**38.3%**), using resources mindfully (**23.3%**), and adopted energy efficient appliances (**26.7%**). **95%** of the workers implemented their water saving knowledge at their homes while **95%** of the worker respondents increased. There was a significant rise in the proportion of workers who felt personally responsible for environmental issues from **8.2%** to **40%**.

Workers and management developed a series of long-term sustainability plans to continue this momentum. These include regular refresher trainings, monthly measurement and reporting of energy savings from solar panels, installation of rainwater harvesting systems, adoption of energy-efficient lighting, and the integration of environmental content into worker induction programs. These efforts aim to institutionalize environmental responsibility and ensure that the progress made continues to evolve and deepen over time.

Previously, environmental initiatives within the factory were designed and implemented exclusively by management, with little to no input from workers. This top-down approach limited engagement and long-term impact.

However, a significant shift has occurred. Workers are now actively involved in both the planning and execution of sustainability efforts, fostering a sense of ownership and shared responsibility. With strong support from factory leadership, including financial investment and a commitment to building environmental awareness, this collaborative approach has led to measurable improvements in operational practices.

Energy Efficiency Improvements

The factory showed heightened commitment in saving energy. A **40kW** solar panel was installed, now supplying **7.1%** of monthly energy needs and saving **BDT 38,669** per month. **50%** of conventional bulbs were replaced with LED bulbs, saving **274 kWh monthly**.

This awareness was reflected in worker behaviour. **71.2%** began to turn off the machines/ lights during their breaks; **69.5%** workers showed interest in using solar energy and **27.1%** workers began to use LED lights.

Waste Reduction and Recycling: The factory now reuses over **400 kg** of fabric scrap monthly, thanks to a new recycling machine. Workers helped implement a tri-colored bin system and reported strong awareness of 3R practices: **91.7%** on reduction, **78.3%** on reuse, and **50%** on recycling.

"It is truly satisfying to witness workers stepping up and taking responsibility for water usage, energy conservation, and waste management after the training. They now conscientiously turn off faucets during handwashing and short breaks, switch off machines, lights, and fans when on breaks, and, diligently segregate waste."

-A Women Welfare Officer at Aman

Knowledge and Practice Growth: Worker knowledge on Climate change awareness rose from **63.9%** to **100%** and their understanding of its effects jumped from **25.9%** workers to **85%**. Knowledge of energy-saving practices increased to **98.3%** of workers, with **96.6%** of workers offering suggestions to improve efficiency.

Key Lessons

- Involving workers in planning and KPI development strengthened their commitment and sense of responsibility toward environmental improvements.

- Technical staff and management jointly set practical KPIs, focusing on achievable goals that are actually aligned with factory's long-term plan.

- Knowledge retention was ensured through consistent awareness raising by integrating environmental messages in daily operations through IEC materials, audio songs and training

- Senior leadership emphasised environmental priorities, creating a sense of urgency and helping staff focus on sustainability efforts.

- Workers prioritise wages as their immediate concern. Though they recognize climate change and environmental issues, these are often seen as distant rather than urgent. Sensitisation efforts have raised awareness of green initiatives, yet daily survival needs still take precedence.

- A well-structured Environmental and Social Management System (ESMS) can improve programme effectiveness and long-term sustainability.

- Implementing environmental practices such as green energy, recycling, and energy conservation can be challenging, as they require significant additional investment.

Appendix:
Definition of Key Terms

1. ISO Certificates: It is a certification granted by the International Organisation for Standardisation (ISO), which signifies that a company meets the specific, internationally-recognised standards for quality, safety or efficiency.

2. LED light: LED lighting products produce light up to 90% more efficiently than incandescent light bulbs. They are known for their energy efficiency, long lifespan and versatility, making them a popular choice for various lighting applications and electronic displays.

3. EGB: Exhaust Gas Boilers refer to a type of heat recovery system that recovers waste heat to produce steam—powering other systems within a building/infrastructure.

4. ISO/IEC 17020: It is an international standard that specifies the requirements for bodies performing inspections by outlining competence, impartiality and consistency to operate effectively and reliably.

5. GHE: GHE stands for the "Greenhouse Effect," a process that contributes to global warming.

6. HVAC Systems: The Heating, Ventilation and Air Conditioning system refers to the technology and systems used to provide thermal comfort and acceptable indoor air quality within enclosed spaces. Simply put, it is a system which regulates temperature, humidity and air purity in homes and buildings.

7. Compressed Air Systems: A system that utilises compressed air as a source of energy to perform various tasks. It involves mechanically compressing atmospheric air to a higher pressure and then using it to power tools, machinery and other equipment.

8. CPPA: Corporate Power Purchase Agreements refer to a long-term contract between a corporate entity (i.e. a business) and a renewable energy generator (i.e. solar or wind farm).

9. RCC: Reinforced Cement Concrete refers to a composite, strong and durable building material used in construction.

10. Captive Power Plants: A power generation facility owned and operated by an energy consumer, such as an industrial or commercial facility, to meet their own electricity needs. These plants operate independently of the main electricity grid (potentially selling excess power back to the grid).

11. Grid Emission Factor (GEF): It refers to the average amount of carbon dioxide (CO2) emissions produced per unit of electricity generated and delivered by a power grid.

12. Nationally Determined Contribution (NDCs): The climate action plans submitted by countries under the Paris Agreement. They outline each nation's efforts to reduce greenhouse gas emissions and adapt to the impacts of climate change.

13. Three-phase connection: A three-phase connection is a type of electrical setup used by large factories and industries that need a lot of power

14. Single-phase connection: A single-phase connection is a type of electrical setup commonly used by residential and light commercial settings—powering household appliances and lighting.

15. HIGG: The Higg Index is a suite of self-assessment tools used in the apparel, footwear and consumer goods industries to measure and improve sustainability performance.

16. These tools include: Higg Facility Environmental Module (FEM), Higg Facility Social & Labour Module (FSLM), Higg Brand & Retail Module (BRM), Higg Materials Sustainability Index (MSI) and Higg Product Module (PM)

17. Solar Irradiance Rate: It refers to the power per unit area (surface power density) received from the Sun in the form of electromagnetic radiation.

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ETI is a multi-stakeholder initiative (MSI), that brings businesses, NGO's and trade unions together, to develop the private sector to be a positive force that enables inclusive, sustainable growth that helps reduce poverty whilst respecting worker rights.

Our vision is of a world where all workers are free from exploitation and discrimination, and enjoy conditions of freedom, security and equity.

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