**Sample-1:**

#### National Need and Infrastructure Gap

Bangladesh’s energy and power sector is undergoing a critical phase of transformation, driven by growing industrial demand, rapid urbanization, and the need for reliable electricity access across both urban and rural regions. With increasing emphasis on renewable energy integration, energy efficiency, and modernization of the national grid, the need for technical innovation and applied research has become more urgent than ever. However, one of the most significant barriers to this progress is the lack of comprehensive, high-capacity research infrastructure that can support the development, testing, and validation of modern power technologies under real-world conditions.

Most existing laboratories in the country’s academic and research institutions are limited to basic experimentation and component-level analysis. They typically lack the systems-oriented capabilities required for real-time digital simulation, hardware-in-the-loop (HIL) testing, smart grid prototyping, and large-scale integration studies. These limitations hinder both innovation and the development of a skilled workforce trained in contemporary technologies such as smart grid control, renewable energy hybridization, advanced protection systems, and energy storage integration. Without access to such infrastructure, students, researchers, and engineers are constrained in their ability to conduct high-impact research or contribute to national innovation priorities.

To bridge this gap, a dedicated national facility is essential—one that is capable of addressing system-level challenges and enabling experimental validation of advanced technologies. The proposed Bangladesh Advanced Laboratory for Energy and Power Research is envisioned as a strategic response to this need, aiming to create a platform that not only enhances technical capability but also accelerates energy-sector innovation across the country.

#### Purpose of the Proposed Laboratory

The proposed Bangladesh Advanced Laboratory for Energy and Power Research is envisioned as a national center of excellence dedicated to advancing applied research, innovation, and capacity building in the fields of power systems, renewable energy integration, smart grid technologies, and energy efficiency. Its primary purpose is to support the country’s transition to a more sustainable, reliable, and modern energy infrastructure through the development of indigenous solutions, technology localization, and skill enhancement.

This laboratory will provide a multidisciplinary platform where researchers, students, and professionals can explore real-world energy challenges in a controlled and well-equipped environment. By enabling system- level experimentation, performance analysis, and solution prototyping, the lab will facilitate the development of advanced techniques in grid automation, energy monitoring, distributed generation control, and power system stability. Furthermore, it will allow academic researchers to translate theoretical knowledge into practical outcomes, bridging the gap between classroom learning and industry needs.

Beyond academic utility, the lab is designed to serve as a collaborative resource for industry stakeholders, utilities, and government agencies. It will support activities such as energy audits, technical training, performance benchmarking, and demonstration of new energy technologies. The facility will also contribute to national policy goals by supporting innovation in clean energy integration, demand-side management, and digital energy systems.

Importantly, the lab will play a vital role in preparing the next generation of energy engineers, researchers, and entrepreneurs through hands-on training, project-based learning, and research engagement. Its establishment reflects CUET’s commitment to supporting national development through technical excellence and is expected to make a lasting contribution to Bangladesh’s self-reliance in the energy and

power sectors.

#### CUET’s Strategic Readiness

Chittagong University of Engineering & Technology (CUET) is strategically positioned to lead the establishment and long-term operation of the Bangladesh Advanced Laboratory for Energy and Power Research. With a strong academic foundation, experienced faculty, and existing technical infrastructure, CUET has demonstrated institutional readiness to implement advanced, multidisciplinary research initiatives in the energy and power domain.

The Department of Electrical and Electronic Engineering (EEE) at CUET currently hosts multiple laboratories—including the Advanced Power System Laboratory and the Renewable Energy Lab—which support both undergraduate and postgraduate education and applied research in power systems, smart grids, and renewable energy technologies. These facilities are staffed by trained technical officers and supported by research-active faculty members who are engaged in externally funded projects and industrial collaboration through the Bureau of Research, Testing, and Consultation (BRTC). The department also enrolls a significant number of Master’s and Ph.D. students, who form a strong talent pipeline for research, innovation, and development.

CUET’s strategic plan clearly identifies sustainable energy research as a core priority. The university aims to integrate emerging technologies into academic programs while expanding its research capabilities to address both national challenges and global sustainability goals. In support of this vision, CUET has committed to providing dedicated laboratory space, institutional manpower, and long-term operational support for the proposed facility. This commitment is further reinforced by administrative experience in managing government-funded projects, compliance with national procurement policies, and successful engagement with industry.

Through its combination of technical expertise, academic excellence, and institutional commitment, CUET offers a robust foundation for the successful implementation, utilization, and expansion of the proposed laboratory. The university’s leadership in energy research not only ensures immediate project viability but also positions CUET as a national hub for innovation, capacity building, and technology-driven development in Bangladesh’s energy sector.

**Sample-2:**

Bangladesh stands at a crucial moment in its energy sector, struggling with the dual challenges of

meeting rapidly growing energy demand and transitioning to a sustainable, low-carbon future.

With a population exceeding 180 million and an economy growing at over 6% annually, the

country’s energy consumption has surged, driven by industrialization, urbanization, and increasing

electrification [1]. As of 2025, Bangladesh’s installed power capacity is approximately 25,000

MW, with fossil fuels, primarily natural gas and coal, accounting for nearly 60% of the energy mix

[2]. However, depleting domestic gas reserves, volatile global fuel prices, and environmental

concerns underscore the urgent need to diversify energy sources and prioritize renewables [3]. The

Energy Vision of Bangladesh aims to achieve 40% renewable energy in the power mix by the next

decade[4], while the Sustainable Development Goals (SDGs) emphasize universal access to

affordable, reliable, and modern energy [5]. Despite these ambitious targets, significant barriers

remain, including limited research infrastructure, insufficient technical expertise, and inadequate

investment in innovative energy solutions.

However, the energy challenges in Bangladesh are multifaceted. A large part of the population,

particularly in rural and coastal areas, still lacks reliable electricity access, with frequent power

outages disrupting economic activities. Rural communities in regions like Khulna Division, where

agriculture and fisheries dominate, rely heavily on diesel generators, which are costly and

environmentally harmful [6]. Additionally, Bangladesh is highly vulnerable to climate change,

with rising sea levels and extreme weather events threatening energy infrastructure, particularly in

coastal zones [7]. The southwestern region, including Khulna, experiences abundant solar

irradiation (4.5–5 kWh/m²/day) and moderate wind speeds (4–6 m/s), offering significant potential

for renewable energy development [8-10]. However, the absence of dedicated research facilities

to optimize these resources for local conditions limits their adoption. Furthermore, energy

efficiency remains under-addressed, with industrial and residential sectors losing significant

energy due to outdated technologies and practices. Grid modernization, including smart grids and

energy storage, is also critical to integrate intermittent renewable sources and enhance system

reliability.

Khulna University of Engineering and Technology (KUET), as a technical institution, has a strong

track record in engineering education and research, with 7500 students and 205 faculty members

across disciplines such as Electrical and Electronic Engineering, Mechanical Engineering, and

Energy Science and Engineering. The university’s strategic location in the southwestern region, a

hub for renewable energy potential, makes it an ideal site for an advanced energy research

laboratory. Khulna’s proximity to coastal areas facilitates solar, wind and tidal energy studies,

while its agricultural base supports bioenergy research using crop residues and organic waste.

KUET’s existing infrastructure, including specialized laboratories like the Heat Tranfer,

Thermolfuid, Structural and Materials Engineering Laboratory, provides a strong foundation for

interdisciplinary energy research. Also, the university currently lacks a dedicated facility equipped

with state-of-the-art tools to conduct cutting-edge studies in renewable energy, energy storage, and

grid technologies.

The proposed Energy Research Laboratory at KUET aims to fill this gap by establishing a worldclass

facility to drive innovation, capacity building, and policy development. The laboratory will

focus on developing scalable solutions tailored to Bangladesh’s unique socio-economic and

environmental context, such as low-cost solar PV systems for rural electrification, wind turbines

optimized for coastal wind profiles, and bioenergy systems leveraging local biomass resources. It

will also address energy efficiency through advanced thermal and electrical analysis, supporting

industries and households in reducing energy waste. By integrating innovative grid technologies

and energy storage solutions, the laboratory will enhance the resilience and reliability of

Bangladesh’s power infrastructure, particularly in climate-vulnerable regions like Khulna.

Additionally, the laboratory will serve as a training hub, equipping students, researchers, and

professionals with the skills needed to lead the energy transition.

This initiative aligns closely with national and international energy priorities. The Bangladesh

Energy and Power Research Council (BEPRC) emphasizes the promotion of sustainable energy

technologies. At the same time, the government’s Renewable Energy Policy and Power System

Master Plan underscore the need for research-driven solutions to achieve energy security.

Undoubtedly, this laboratory supports help to reduce greenhouse gas emissions and the UN’s SDG

framework for sustainable development. By fostering collaborations with industry, government,

and academic institutions, the laboratory will facilitate technology transfer, pilot project

deployment, and policy advocacy, ensuring tangible socio-economic benefits [11-12]. For

example, pilot microgrid projects in rural Khulna can improve energy access for underserved

communities, while policy recommendations can guide national strategies for renewable energy

integration.

The lack of advanced energy research facilities in Bangladesh has hindered progress toward

sustainable energy goals. Existing research is often fragmented, with limited access to specialized

equipment and computational tools needed for high-impact studies. KUET’s Energy Research

Laboratory will address these shortcomings by providing a centralized platform for

interdisciplinary research, leveraging the university’s expertise and regional advantages. The

laboratory’s establishment will not only advance scientific knowledge but also create jobs, train a

skilled workforce, and promote equitable energy access, contributing to Bangladesh’s vision for

becoming a sufficiently developed nation. Finally, this project represents a critical step toward

building a resilient, sustainable, and inclusive energy future for Bangladesh.

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