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| **Sl. No** | **Hardware Name** | **Features** | **Application** |
| 1 | Solar Photovoltaic (PV) Testing Platform | 10 kW solar panels (monocrystalline, efficiency >20%), solar inverters, and a solar simulator (Class AAA) for indoor testing of PV performance under varying conditions | Research on solar cell efficiency, degradation, and hybrid PV systems |
| 2 | Wind Energy Test Rig | A small-scale wind turbine (5 kW) with variable-speed blades and a wind tunnel for aerodynamic studies | Research on wind energy potential in coastal regions and turbine optimization |
| 3 | Biomass Energy Conversion Unit | A lab-scale biomass gasifier and anaerobic digester for testing bioenergy production | Research on energy production from agricultural residues and organic waste, addressing rural energy needs. |
| 4 | i. Battery Testing and Storage System | Lithium-ion and flow battery modules (total capacity 50 kWh) with a battery management system (BMS) for studying energy storage solutions | Research of Battery Performance, Battery health monitoring |
| 5 | Power Quality Analyzers | High-precision analyzers (e.g., Fluke 435 Series II) for measuring voltage, current, and harmonics in grid-connected and off-grid systems, ensuring reliable power delivery | To analyze power quality |
| 6 | Thermal Performance Analyzers | Infrared thermography cameras and heat flux sensors for studying energy losses in buildings and industrial processes, supporting efficiency improvements | To measure energy efficiency and assessment |
| 7 | High-Performance Computing (HPC) Cluster | A cluster with 4 nodes (each with 32-core CPUs, 128 GB RAM, and NVIDIA GPUs) for  running complex simulations | Research on computational fluid dynamics for wind turbines and machine learning for energy forecasting |
| 8 | Data Acquisition Systems (DAQ) | National Instruments DAQ modules with sensors for real-time monitoring | Analysis on monitoring of temperature, pressure, voltage, and current in experimental setups. |
| 9 | Workstations | 5 high-end workstations (Intel i9, 64 GB RAM, 1 TB SSD) | Research to perform data analysis, modeling, and software development |

Title: Establishment of an IoT-Enabled Renewable Energy Research Laboratory and Acceleration of Minimum Viable Product (MVP) Development for the Energy Industry in Bangladesh

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| **Sl. No** | **softwareName** | **Features** | **Application** |
| 1 | PV\*SOL Premium | For designing and simulating solar PV systems, optimizing panel placement, and predicting energy yields under local climatic conditions | Research on Energy yield for various climactic condition |
| 2 | BioWin | Waste process simulator | For modeling and optimizing anaerobic digestion and biogas production processes, supporting bioenergy research |
| 3 | MATLAB/Simulink software with life time license | For modeling and simulating power systems, control algorithms, and energy storage integration. Includes toolboxes for renewable energy and machine learning | Research on Energy system simulation |
| 4 | HOMER Pro | For designing and optimizing hybrid microgrids, enabling techno-economic analysis of renewable-based systems for rural electrification | Research on Technoeconomic analysis of micro hybrid grid |
| 5 | Data Analysis and Machine Learning software | o Python with Libraries (NumPy, Pandas, Scikit-learn, TensorFlow, R | For data processing, statistical analysis, and developing machine learning models for energy demand forecasting and fault detection. |
| 6 | ANSYS Fluent | : For simulating fluid flow and heat transfer in wind turbines, solar thermal systems, and biomass reactors, optimizing design and performance | Research on thermofluid system |
| 7 | COMSOL Multiphysics | For coupled simulations of electrical, thermal, and mechanical systems in energy devices | Research on energy system simulation |
| 8 | LEAP (Long-range Energy Alternatives Planning System) | For modeling energy scenarios and developing policy recommendations to support Bangladesh’s energy transition | Research on policy and Economic Analysis |
| 9 | LabVIEW | For real-time data acquisition and control of experimental setups, integrated with DAQ hardware | For Laboratory Management and Collaboration |
| 10 | RETScreen Expert | For techno-economic feasibility studies of renewable energy projects, aiding in pilot project planning | For energy policy and Economic Analysis |

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| **Sl. No** | **hardwareName** | **Features** | **Application** |
| 1 | Transformer Multi-function Testing Instrument | * Winding resistance with OLTC continuity   + Up to 100 A single-phase & 16 A three- phase • Adaptive demagnetization • Turns   ratio & excitation current tests • Short- circuit impedance • OLTC dynamic tests, FRSL, magnetic balance • CT/VT testing capabilities • Circuit breaker, phase angle, grounding, and injection tests • Remote Access | * Transformer diagnostics • Substation equipment testing • OLTC analysis and   instrument transformer testing |
| 2 | Acoustic Imaging Camera | * Phase Resolved Partial Discharge (PRPD) * Gas, pressure, and vacuum leak detection * Leak rate quantification • Remote Access | * Partial discharge localization • Maintenance of pressurized systems • Leak detection in substations and gas   pipelines |
| 3 | Battery Impedance Tester | * Tests VLA, VRLA, NiCD, lithium-ion batteries • Measures impedance, voltage, temperature, AC/DC ripple • Discharge testing with voltage up to 1000V DC &   600V AC • Remote Access | * Battery health monitoring • UPS and critical backup power systems   maintenance |
| 4 | Battery Testing System for Charging, Discharging, Life Cycle Test | * Multi-channel testing • Automated charge/discharge cycles • Real-time data logging • Safety protections • Wide battery   compatibility | * Battery research and development • Quality control in manufacturing • Life cycle and endurance testing • Electric vehicle battery evaluation • Renewable   energy storage testing |
| 5 | Rotating Machine Insulation Diagnosis | * Power frequency insulation tests (tan delta, PF) • Excitation current, watts loss • Capacitance, inductance, HV TTR, CCVT   phase | * Insulation condition assessment of rotating machines • Predictive   maintenance and fault detection in motors and generators |
| 6 | Power Quality Analyzer | * Measure all three voltage and current phases plus the neutral current •   Comprehensive logging • Measure with premium accuracy • Capture dips, swells and interruptions • Measure key power quality parameters • Optimized user interface • Flexible power supply • Rugged and reliable • Two external USB ports • | * Power quality diagnostics in industrial, commercial, and utility systems •   Identifying sources of voltage disturbances (e.g., sags, transients) • Energy audits and load profiling • Preventive maintenance of sensitive equipment • Detection of harmonic distortion that can damage transformers, |