

# Advancing Green Transition Through a Micro-grid with an Optimized Energy Management System

**Anas Hassari<sup>\*</sup>, Mohammed Rhiat, Kamal Hirech**

Higher School of Education and Training, Mohammed First University, Oujda, Morocco

## Email address:

a.hassari@ump.ac.ma (Anas Hassari), mohammed.rhiat@ump.ac.ma (Mohammed Rhiat),  
k.hirech@ump.ac.ma (Kamal Hirech)

<sup>\*</sup>Corresponding Author

## Abstract

The global drive towards sustainable energy and reducing carbon footprints has accelerated the adoption of green technologies. Among these, micro-grids represent a promising solution for decentralizing energy production while integrating renewable energy sources. Since Morocco is characterized by high solar radiation and high wind speed in a lot of area, this paper will conduct a study of a Micro-grid combining PV, Wind turbine installation and MPPT controllers, Energy Storage system and Energy Management System. This study covers in detail the implemented algorithm within MPPT controllers to extract maximum power from PV and Wind turbine and the approach applied to Energy management system to ensure optimal use of the energy produced from the hybrid system based on the load demand, the state of charge of the battery while guaranteeing the sustainability of energy for the load. Simulation results demonstrate significant improvements in energy efficiency, reduction in CO<sub>2</sub> emissions, and cost-effectiveness, thus making a substantial contribution to the green energy transition. This study highlights the potential of optimized Micro-grid systems as a key enabler of future sustainable energy frameworks.

## Keywords

Hybrid System, Micro-grid, Solar PV, Wind Farm, Battery, Renewable Energy, Energy Management System, MPPT Controller