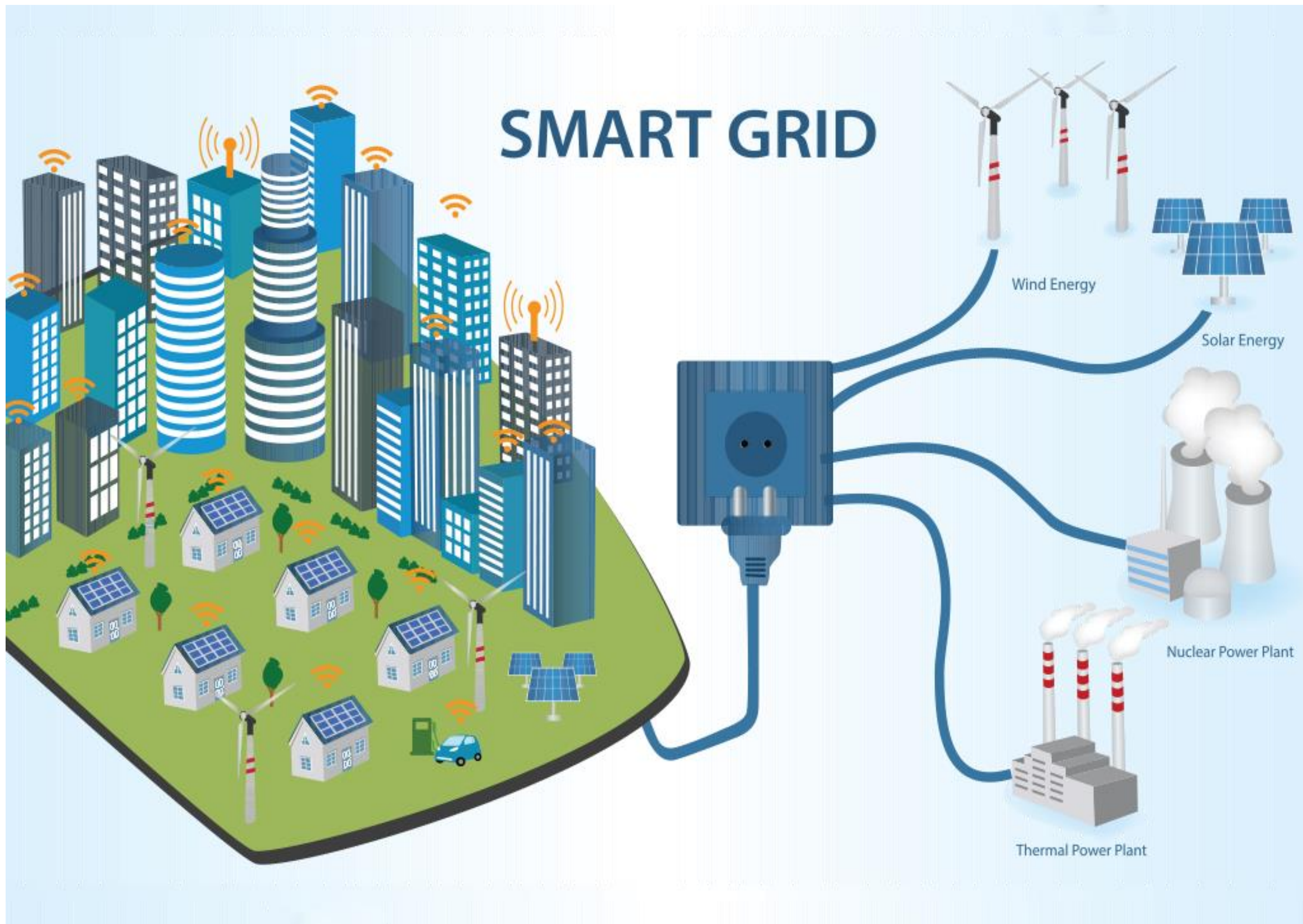
Advanced control strategies for grid-connected converters

Abstract

This project aims to evaluate the impact of different control strategies used by grid-connected converters on grid stability. The study employs mathematical modeling techniques, particularly impedance-based modeling, to analyze the complex nature of the grid with multiple interconnected converters The research contributes to the development of reliable control strategies for grid-connected converters, ensuring stability during the transition to sustainable energy sources.

Introduction

In modern times, renewable energy sources such as wind and solar power are integrated into the electrical grid through power electronics converters. These converters facilitate the efficient operation of renewable sources. However, it is important to acknowledge that converters can also introduce instabilities into the grid. Unlike traditional power generation systems that rely on large synchronous generators with substantial inertia and slow dynamics, power electronics converters lack these characteristics. Consequently, in future grids dominated with converters, it is crucial to exercise caution when designing the control mechanisms for converters to ensure grid stability is maintained.



Objective

The objective of this project is to evaluate the effects of various control strategies employed by grid-connected converters on grid stability.

Multiple control strategies exist, some synchronizing with grid voltage and injecting current, while others aim to emulate synchronous generator behavior. Each control strategy can have a distinct impact on grid stability. Additionally, as multiple converters are connected to the grid, interactions between them can influence overall grid stability.

Methodology

- Utilize mathematical modeling techniques to represent grid-connected converters for stability analysis.
- Employ impedance-based modeling to deal for the complex nature of the grid, considering multiple converters and changing interconnections.
- Derive stability assessment methods based on impedance modeling to evaluate the stability of the grid-connected converters.
- Capability of real-time impedance measurements to enable real-time stability monitoring of the grid.

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