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EVALUATION OF THE MANEUVERING OF ELECTRICAL CAPACITIES OF AN INDUSTRIAL ENTERPRISE

The energy sector faces significant challenges, including grid stability issues, demand management complexities, accurate load forecasting, and effective energy management in industrial processes. As the share of renewable energy sources increases, traditional generators, known for their inertia and frequency regulation capabilities, are being displaced, potentially raising concerns about grid frequency stability. In response to this, innovative solutions and technologies are being developed to address these challenges and transition to more sustainable and reliable energy supply. Load aggregators are proposed as a solution, coordinating flexible demand resources to provide frequency regulation services.

The proposed concept emphasizes that load aggregators use complex mathematical models for optimal resource management and determining the optimal contribution to network stabilization, considering various factors such as variable prices on the balancing market, power constraints, and renewable energy volumes.

An analysis of studies conducted on Rwanda's energy system illustrates the effectiveness of load aggregator participation in restoring network frequency to nominal levels, even in the event of generation loss, despite the reduced system inertia caused by increased renewable energy integration.

Energy communities leverage Information and Communication Technologies (ICT) for greater decentralization, diverging from traditional paradigms. ICT integration enables the synchronization of distributed energy resources, turning them into virtual power plants, thereby improving collective efficiency and expanding participation in energy markets.

Load forecasting and deep learning models are implemented to forecast short-term electricity demand using deep learning models. The Temporal

Fusion Transformer (TFT) model integrates weather variables and temporal characteristics for accurate forecasting.

Empirical data demonstrate the superiority of such a model over traditional statistical models in terms of key performance metrics, confirming the need for its application in short-term load forecasting.

In conclusion, load aggregators emerge as a promising solution to frequency stability issues arising from the growing integration of renewable energy sources into the energy system. The integration of distributed energy resources into virtual power plants improves collective efficiency, although technical challenges such as compatibility standards may arise.

In the field of load forecasting, innovative methods such as the Temporal Fusion Transformer (TFT) model and integrated energy management systems with predictive models for industrial batch processes demonstrate superior accuracy and efficiency, paving the way for a more sustainable and reliable energy supply.