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Designing Efficient Electricity Infrastructure: Load Assignment and Transformer Location Optimization

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Abstract

As new settlement areas emerge, it is crucial to design the necessary electricity infrastructure effectively. These areas are divided into grids, each defined as a rectangle or square of uniform dimensions. This study focuses on optimizing the placement and assignment of low voltage distribution transformers (DTRs) based on forecasted electricity consumption for each grid. Key constraints include ensuring that forecasted loads are allocated to one or more DTRs, that DTR capacities are not exceeded, that assignments remain within a limited range of grids, and that all loads within a grid are fully assigned. We develop a mathematical programming model aimed at identifying the cost-minimizing solution for DTR placement and load assignment.

Keywords

Electricity infrastructure, load assignment, optimal location, low voltage distribution transformers.

Biographies

Benhür SATIR has been working as Executive Consultant at MRC Türkiye since 2024. He holds a Bachelor of Science, Master of Science and PhD degrees from the Middle East Technical University, Department of Industrial Engineering; he also holds a Master's Degree in Economics from the same university. Dr. Satır, an associate professor in Industrial Engineering, previously served as a faculty member in the Department of Industrial Engineering at Çankaya University, where he worked for 24 years. His academic interests include: Optimization, combinatorial optimization, supply chain optimization and management models, scheduling, meta-heuristic methods, mathematical modeling, inventory control systems, logistics, decision support systems, technology policies, microeconomics, game theory applications, agricultural economics.

Arda SARI has been working as Consultant at MRC Türkiye since 2024. He holds Bachelor of Science degree in Industrial Engineering obtained from TOBB University of Economics and Technology. He supports strategic consulting processes in the energy sector by using data analytics solutions. He conducts analyses to improve operational efficiency and develop data-driven solutions. He contributes as part of a team in innovative projects.

Burak ÖZSOY has been working as Executive Power System Expert at MRC Türkiye since 2021. He holds Bachelor of Science and Master's degree in Electrical and Electronics Engineering from Middle East Technical University and is now doing PhD. in the same field at the same university. He has worked as senior researcher at the Scientific and Technological Research Council of Türkiye (TÜBİTAK) prior to his works at MRC Türkiye and had performed power system analyses and plannings in Turkish grid; carried out R&D studies to implement innovative technologies associated with Energy Management System in Turkish power grid; developed web-based dispatcher information system; and developed a web-based protection relay information system. He has worked with power system analysis programs such as DIgSILENT PowerFactory, PSSE, MATLAB and programming such as C++, DIgSILENT Programming Language, Python, and Java. His works at MRC Türkiye encompass network development plans for power systems, integrating renewable energy sources (RES) to enhance grid stability and sustainability; monitoring and analysis of electricity transmission grid, modelling and analysis of the protection system of electricity grid, TRV analysis, transmission planning and static analysis.