

# **Revolutionizing the Electrical Energy Sector in Lebanon from Private Microgrids to a Dynamic Clean-Energy Market: Lebanese Grid 3.0**

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This research project aims at revolutionizing the electrical energy sector in Lebanon, which has suffered for decades, to achieve the Lebanese grid 3.0. The proposed solution integrates distributed clean energy resources (DCERs) and gas turbines into existing microgrids as the first stage, but goes beyond to establish an energy market that eventually allows end users to deal with a national grid operator. As other researchers have proposed microgrids as a solution for Lebanon, there is no systematic plan yet to achieve a win-win-win situation for the utility operator, microgrid owners, and end users. Therefore, the project starts with a plan to upgrade existing private microgrids, owned by municipalities or the private sectors, to diversify their energy portfolio from diesel to natural gas, DCERs, and energy storage, with gradual transitioning and funding plans. In parallel, these microgrids are tied to the utility grid, not to end users, where they bill the utility grid for energy they sell. Eventually, this creates an energy market, where private microgrids supply energy at their profitable price, and the utility operator selects the most attractive pricing in a dynamic market. To enable such supply and demand, power electronic interfacing of DCERs will be utilized to control active and reactive power flow into the utility grid from these microgrids. With such versatile control, microgrid owners can innovate by investing in a diverse portfolio of energy resources, which makes them dispatchable and robust to energy demands. DCERs are expected to yield immediate positive impact on reducing greenhouse gas emissions and pollutants, with low maintenance and operating costs; gas turbines will allow for rapid energy supply to meet demand; diesel can still be used in a transitional phase but will be subjected to hard environmental requirements; energy storage can be integrated for faster demand response; and, existing and upgraded utility-scale generation, transmission, and distribution will serve as the backbone of the proposed solution. This project will thus propose a comprehensive electrical energy solution for Lebanon, will help significantly reduce emissions and pollutants from burning fossil fuels, and will be profitable for all involved entities, especially consumers.