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Balancing Electricity Demand and Supply to Protect a Company from Load Shedding: A Review

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Abstract : South Africa finds itself at a confluence of forces where the national electricity supply system is constrained with under-supply primarily from old and failing coal-fired power stations and congested and inadequate transmission and distribution systems. Simultaneously the country attempts to meet carbon reduction targets driven by both an alignment with international goals and a consumer-driven requirement. The constrained electricity system is an aspect of an economy characterized by very low economic growth, high unemployment, and frequent and significant load shedding. The fiscus does not have the funding to build new generation capacity or strengthen the grid. The under-supply is increasingly alleviated by the penetration of wind and solar generation capacity and embedded roof-top solar. However, this increased penetration results in less inertia, less synchronous generation, and less capability for fast frequency response, with resultant instability. The renewable energy facilities assist in solving the under-supply issues, but merely 'kick the can down the road' by not contributing to grid stability or by substituting the lost inertia, thus creating an expanding issue for the grid to manage. By technically balancing its electricity demand and supply a company with facilities located across the country can be spared the effects of load shedding, and thus ensure financial and production performance, protect jobs, and contribute meaningfully to the economy. By treating the company's load (across the country) and its various distributed generation facilities as a 'virtual grid' which by design will provide ancillary services to the grid one is able to create a win-win situation for both the company and the grid. This paper provides a review of the technical problems facing the South African electricity system and discusses a hypothetical 'virtual grid' concept that may assist in solving the problems. The proposed solution has potential application across emerging markets with constrained power infrastructure or for companies who wish to be entirely powered by renewable energy.

Keywords : load shedding, renewable energy integration, smart grid, virtual grid
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