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REVISITING INCENTIVE-BASED LOAD MANAGEMENT: A MODEL OF SUPPLY INTERRUPTIONS AND CONSUMER COMPENSATION IN AN ELECTRIC POWER SYSTEM.

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Abstract

Incentive-based load management (LM) schemes offer consumers explicit incentives in compensation for the right to interrupt power supplies whenever the stability of a power system is threatened. The proper design of such schemes however requires that a number of fundamental issues be first addressed, principal amongst which are: (1) How consumer demands will change consequent upon a scheme's introduction. (2) How to price the service. (3) How to define an adequate compensation, and (4) How a scheme would depend upon or influence the reliability of power deliveries. In providing needed insight into these issues, this paper proposes an incentive-based LM framework that combines the occurrence of equi-proportional supply interruptions with financial compensations. Consumers pre-select demands which are fixed for the designated period, except during interruptions when all demands are equally rationed in proportion to the available supply and compensation is paid for any unserved demand.

For a homogeneous population, it is identifiable that while the size of a consumer's demand will be decreasing in the reliability of power deliveries, it will be increasing in the expected compensation and in the consumer's distaste for interruptions (the interruption aversion). If the consumer's measure of prudence and interruption aversion exceed two and one respectively, then an increase in the risk of interruptions following the scheme's introduction will unambiguously expand demand.

It is also identifiable that pricing by an expected profit maximising monopolist with strictly positive service costs, would require that the consumer interruption aversions understate one. This will however be relaxed when pricing maximises expected consumer welfare subject to a budget restriction. An implication is that within a broader setting having heterogeneous consumers, profit maximisation may result in the exclusion of some consumer groups, relative to a situation with welfare maximisation.

Finally, assuming that the consumer's and the Utility's objective functions are linear in the power price and compensation makes it difficult to distinguish between the optimal policy for both variables. An amendment to the proposed framework in which the objective functions are non-linear in both variables would therefore be desirable.