Controlling the Cost of Distributed Generation Operation

OVERVIEW

The practicality of any particular distributed generation (DG) installation depends upon its ability to reduce overall energy costs. An economic dispatch strategy that reduces overall energy costs is developed in this work. Various electric rate structures are considered and applied with the economic dispatch strategy to simulate meeting various measured building demand dynamics for heat and power. The economic dispatch strategy is compared to more traditional dispatch strategies, highlighting the improved financial performance under the proposed strategy.

Utility Cost and Building Energy Models

Electric and natural gas utility cost models are based on Southern California Edison (SCE) and Southern California Gas (SCG) rates for large customers. Charges include a seasonal time of use and fixed energy and demand charges, and standby charges for customers with DG. Natural gas cost are base on a declining block rate structure.

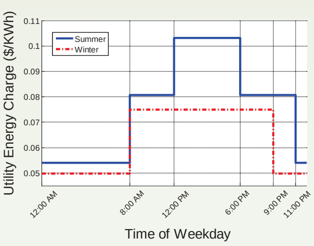

Figure 1: Southern California Edison Energy Charges

Table 1: Southern California Edison Demand Charges

SCE Demand Charges ($/kW)	
Fixed	$11.88
Summer On-Peak	$19.49
Standby Summer On-Peak	$10.26
Summer Mid-Peak	$5.46
Standby Summer Mid-Peak	$2.67

Table 2: Southern California Gas Co. Natural Gas Charges as of June 10th

Commodity Charge (₵/therm)	
Tier I - <250 therms	79.052
Tier II - <4167 therms	54.559
Tier III - >4167 therms	38.137

Building energy models were developed using electrical and thermal demand data for 12 buildings. Four of these buildings, with disparate dynamic demand characteristics, are used to highlight the response of the economic dispatch strategy to different building energy demand.

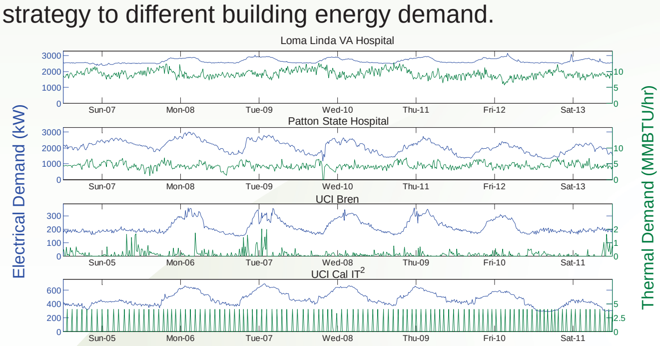

Figure 2: Representative week of electrical and thermal demand for Loma Linda VA Hospital, Patton State Hospital, UCI Bren, and UCI Cal IT2

Economic Dispatch Strategy

The economic dispatch strategy minimizes cost of energy by simultaneously reducing electricity demand and replacing electrical and thermal energy demand. All examples use a generator sized to approximately half the building electrical demand.

Demand reduction: Demand charges are minimized by only replacing electricity demand that can increase maximum utility demand

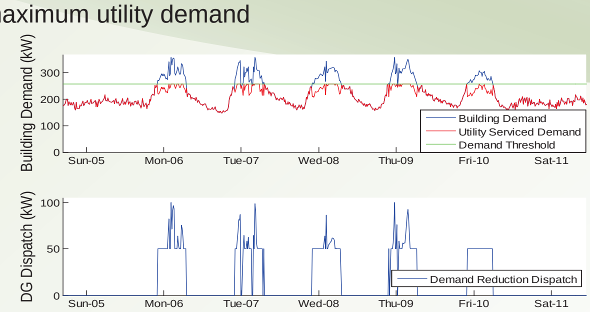

Figure 3: Demand reduction dispatch for UCI Bren during a summer month

Energy replacement: DG operation occurs only if electricity produced onsite is less expensive than grid electricity. If this is not possible, DG operations occurs if electricity and thermal energy produced onsite is less expensive than grid electricity and utility natural gas.

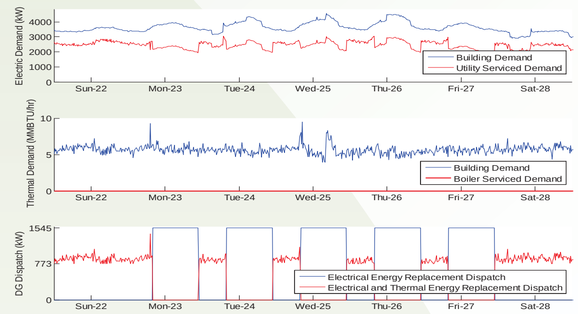

Figure 4: Electrical and Thermal Energy Replacement for Loma Linda VA Hospital during a summer month

Dispatch Strategy Performance

The economic dispatch strategy outperforms simple strategies due to the capability to adjust DG operation to ensure that the building energy demand is met in an economically efficiency manner. Larger DG capital cost can be absorbed by DG operating under the proposed economic dispatch strategy while maintaining high economic performance.

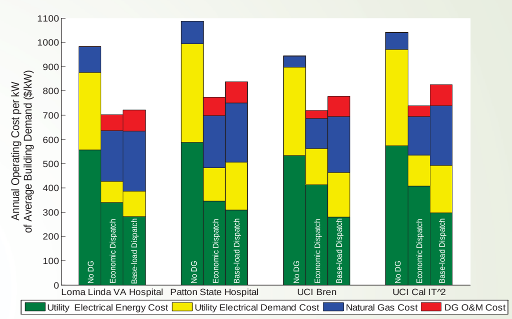

Figure 5:Annual operating cost of building energy per kW of average building electrical demand for the four buildings for no DG installed onsite, DG operated using the economic dispatch strategy, and DG operated using the base-load dispatch strategy.

PERSONNEL

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