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RESEARCH ARTICLE OPEN ACCESS

Real-Time Load Management Methodology with Controlled Co2 emission for Power Deficient Systems

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Abstract:

To present load management methodology that can utilize the available resources in such a way that end-user get maximum benefit while controlling co2 emission. To keep the load under specified power threshold while keeping high priority load connected. Load Manager receives the real time load demand data, check for its value against threshold power and takes decision so that co2 emission is under control.

1. INTRODUCTION

The global energy demand drastically increases on a daily basis, and fossil fuels are limited andbeing exhausted. The smart grid (SG) emerged as a smart solution that accommodates informationcommunication technology (ICT), fossil fuels generation, renewable energy (RE) generation, and hybridgeneration Therefore, it is important to increase the utilization of RE sources(RESs) because of environmental issues and the need to reduce carbon emission.Smart grid technology provide opportunity for enhance the exiting grid and preventing reoccurrences of major incidents. Smart grid technology can improve the reliability, security and efficiency of current electrical grid. Intelligent devices can automatically adjust to changing condition to prevent blackouts and increase capacity

Due to inherent drawbacks of existing/conventional method, an ILS system is necessary to shed minimum amount of load and to maintain system's stability. One possible approach is to shed load according to priority with an online monitoring system that is able to coherently acquire real-time system data. This system is helpful in designing future smart energy cities.

Keywords: Local Load Manager, Central Load Manager, Binary Particle Swarm Optimization, Inclined Block Rate, Analytic Hierarchy Process

2. RELATED WORK

Madhavi S. Bhosale et al. propose a mechanism for load scheduling. Load scheduling is nothing but a smart option for load shedding. A home based mechanism that classifies home appliances into three categories according to their working and powerconsumption mechanisms. Using the power consumption, switch on or off these home appliances. These all things are done byconsidering the hourly load consumption.

Monika et al. High peak demands are common occurrences in electricity market. Recently, reducing electricity demand has been one of the most common objectives for all electricity suppliers, environmental organizations and others at the national and international level. Peak demands make it difficult to meet the increased demand of electricity, to lower prices, to increase quality and to avoid negative impacts on the environment

M. Amin, A. Rasheed et al. propose a load shedding system for future smart cities which can shed load on priority basis. The proposed methodology has the potential to conserve the available energy in an efficient manner and making system immune to intense blackouts and brownouts. The objective is to keep end-user with more reliable and increased power availability and hence keeping higher priority load connected. Load is categorized in flexible manner to provide freedom of priority demarcation. The proposed system consists of two basic controllers: Central Load Manager (CLM) and Local Load Manager (LLM). CLM through sensor receives the real time load demand data, check for its value against threshold power and takes decision accordingly.

MADHAVI S. BHOSALE et al. propose a mechanism for load scheduling. Load scheduling is nothing but a smart option for load shedding.Propose a home based mechanism. Here author classified hone appliances into three categories according to their working andpower consumption mechanisms. Using the power consumption we switch on or off these home appliances.

Jinghuan Ma et al. introduce a novel conceptof cost efficiency-based residential load scheduling frameworkto improve the economic efficiency of the residential electricityconsumption. The cost efficiency is defined as the ratio ofconsumer’s total consumption benefit to its total electricity paymentduring a certain period.

SurajKumhar et al. presents generator maintenance scheduling of a power system based on minimization of the objective function considering the economical and reliable operation of a power system while satisfying the network constraints along with crew/manpower, generation limits, precedence constraints, demanded load, maintenance window, loss of load probability and reliability constraints. Optimization was carried out on a practical thermal power plant consisting of 19 generating units, over a 25 weeks planning horizon.

HusnaSyadli et al. presented an improved load shedding scheduling strategy based on Round Robin method. The method is then illustrated and applied on actual daily load profile of Sumatra electrical system.

Yugandhara G. Wankhade et al. A priority load managementsystem has been developed in order to gain an optimal energy management over system load and battery storage, andtherefore provides better management efficiency and guarantee the energy supply for critical load, by consideringindustrial applications this system makes them self-reliable, at least, to use the appliances to operate automaticallyduring load shedding problems.

Ghulam Hafeez et al. adopted geneticalgorithm (GA), binary particle swarm optimization (BPSO), wind-driven optimization (WDO),and our proposed genetic WDO (GWDO) algorithm, which is a hybrid of GA and WDO, to schedulethe household load. For energy cost estimation, combined real-time pricing (RTP) and inclinedblock rate (IBR) were used. The proposed algorithm shifts load from peak consumption hours tooff-peak hours based on combined pricing scheme and generation from rooftop PV units.

3. PROPOSED WORK

Simulation environment is developed in MATLAB to observe the effectiveness of the proposed methodology. Decision making is at CLM and data handling is done by LLM.

Class A: It is the most critical and important load class, and hence should not be disconnected. For example, hospitals, defence installations, telephony.

Class B: It is an important load class however its disconnection doesn’t result in failure. For example, educational, industrial and financial sectors.

Class C: It consists of domestic load.

Class D: It consists of un-important and non-critical type of load. They are only turned on when excess of bulk generation is available.

When load decreases in the OFF peak regions, forcefully disconnected load needs to be reconnected. While CLM keeps on checking for the power window below threshold equal to the data storage block. It reconnects the disconnected load accordingly and algorithm follows the specified sequence again for disconnection.

Table 3.1: Generator Capacity and Co2 emission

Gen Number	Capacity (MW)	Type	CO2 emission (lb/KWh)
1	5	natural gas	0.993
2	5	natural gas	0.993
3	10	natural gas	0.993
4	20	natural gas	0.993
5	20	natural gas	0.993
6	20	natural gas	0.993
7	40	coal	2.26
8	40	coal	2.26

4. RESULTS AND DISCUSSION

A () matrices built based on customer inputs. The order of the matrix equals number of loads

t1 Comprises the hours at which customer inputs are recorded

t is the time step for which customer inputs are needed

runtime = runtime of loads

wattage = wattage of loads

RRTP = Residential Real time pricing

prices = day ahead hourly prices

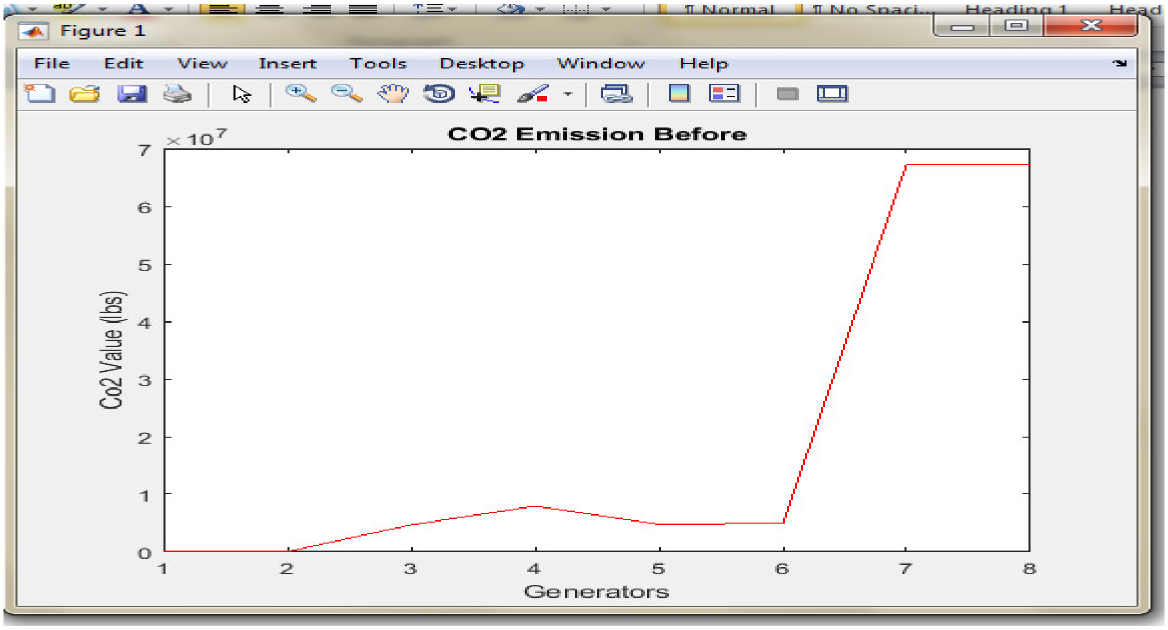

Figure 4.1: Co2 emission before load

Figure 4.1 shows co2 emission for all 8 generators without load

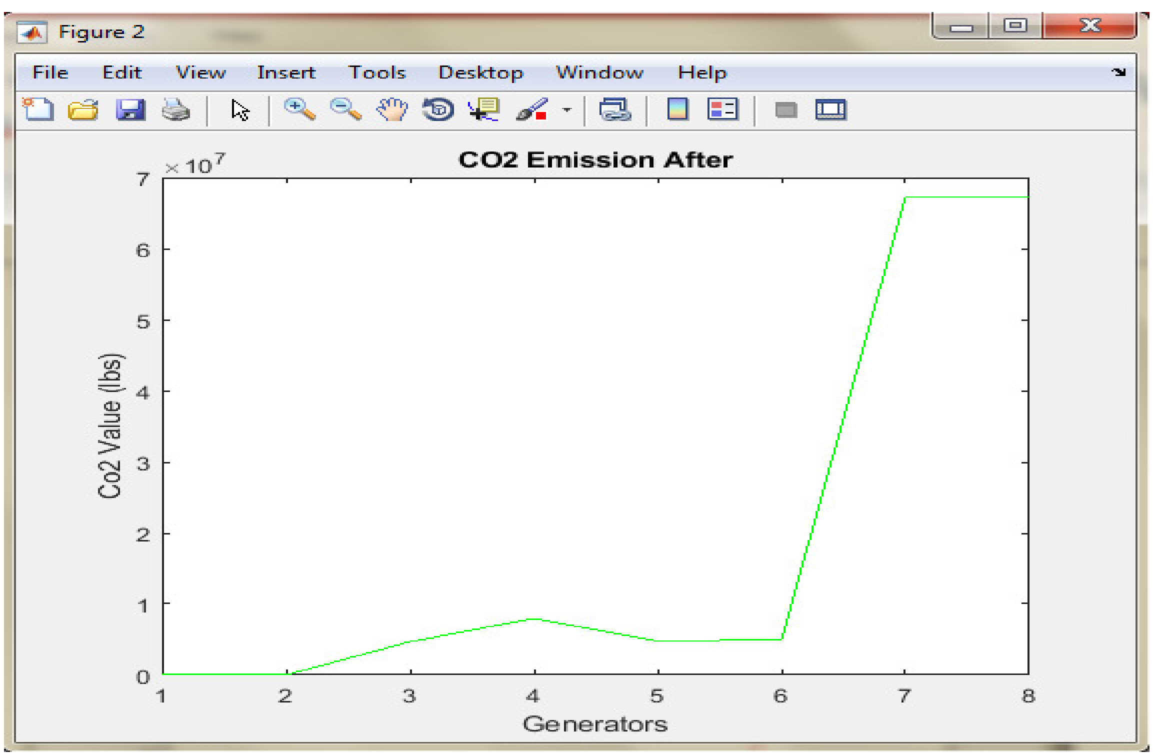

Figure 4.2: Co2 emission after load

Figure 4.2 shows co2 emission for all 8 generators with load

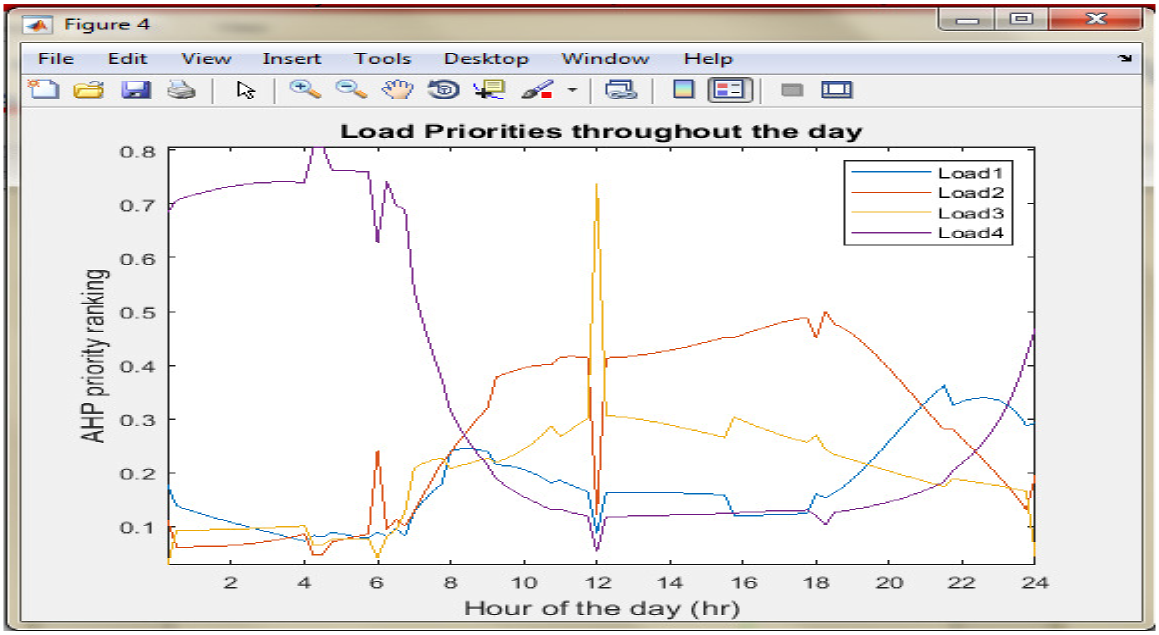

Figure 4.3: Load priorities throughout the day

Figure 4.3 shows load priority ranking for specific hour of the day

4.1 Simulation Output

Load 1 is scheduled to run at hour 22.00, for a runtime of 1.00 hours at a cost of 7.04

Day-ahead cost (Expected earlier) = 6.08

Load 2 is scheduled to run at hour 8.75, for a runtime of 1.00 hours at a cost of 5.12

Day-ahead cost (Expected earlier) = 4.80

Load 3 is scheduled to run at hour 10.75, for a runtime of 1.25 hours at a cost of 11.88

Day-ahead cost (Expected earlier) = 10.94

Load 4 is scheduled to run at hour 4.00, for a runtime of 1.00 hours at a cost of 8.58

Day-ahead cost (Expected earlier) = 6.93

CONCLUSION

The respective load priorities are defined within command matrix A(). Central Load Manager is fed with the initial matrix structure depending on the load categories and number of Local Load Managers connected in the network. It is programmed to monitor the available power's threshold while keeping the track of power consumption in real time. It processes the matrix according to implemented algorithm and transmits the output matrix LLM instructs the load controllers to connect/disconnect the load and saves the value of power being consumed by load before disconnection in data storage block. After processing, LLM generates updated matrix containing load controllers (ON/OFF conditions) and transmit it along with the value stored in data storage block to CLM for further processing. This cycle continues until load is brought into allowable range under the threshold.

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