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A Review on Latest Optimization Models and Methods of Demand Side Management

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Abstract: Residential energy consumption is the major contribution to the balance of global energy. The energy demand by these residential consumers is growing day by day and becoming a burden for control of power grid condition. Even though the alternative energy sources are introduced and increased the energy flows, the residential sector have to be provided much flexibility for the ease of efficient utilization and stability of these renewable energy sources. This paper gives a literature study of optimal energy management techniques methods and proposed models for a grid connected photovoltaic system in the benefit of customers on demand side. This paper gives a brief study of Demand side management techniques.
Keywords: Demand side management (DSM), optimal energy management techniques, Residential customers, efficient utilization and stability.

I. INTRODUCTION

DSM is the basic future in smart grid which helps the consumer to know about the energy consumption during the off-peak and peak hour's .This tracking of demand side results in a reliable efficient system. The DSM aims to reduce the cost of electricity which includes many constraints such as power balancing, solar output and battery capacity. This explains the open loop and closed loop optimal methods [1] to dispatch the power flow in real time during uncertain disturbances. Section-2 gives a brief explanation of Optimal Control Methods.[2].Section -3.Model Predictive Control Method and Section-4 Domestic load management technique [3]. In grid connected hybrid PV battery systems, the varying electricity prices, the power transaction timing between the solar power generation and load demand are main challenges. From the DSM, when there is excess solar energy generation, it can be stored for the future economic usage. This concept of grid connected hybrid solar systems with DSM helps in reducing electricity cost, direct load control etc.

II. OPTIMAL CONTROL METHOD

This method is proposed to dispatch power flows of the hybrid system with stability and economically. This dispatch is based on hourly power flow Pi (i=1…6) to minimize the daily electricity cost subjected to constraints [1].
Formula for total electricity cost of the proposed DSM model has three components.
Cost of buying electricity from load used for load demand and charging the battery.

A. Income of selling electricity to the gri
B. Wearing cost of hybrid syst
C. The total cost is given by(Equation 1)

$$J = \sum_{t=0}^{23} \rho(t)[P_3(t) + P_4(t)] - \sum_{t \in T_k} r_k \rho_k P_6(t) + C_h \ldots\ldots\ldots\ldots(1)$$

r_k=Contracted ratio of peak price,
ρ_k= Selling power during peak load period
C_h=Wearing cost of systems.
Power Constraints to be satisfied by the objective function $P_i(t)$

1) *PV's Output Constraint*: The output power of PV generated should always be more than the power required to charge battery and instantaneous usage of customers. This mainly depends upon irradiation and ambient temperature[1].
$$P_1(t) + P_5(t) \leq P_{pv}(t) \ldots\ldots\ldots\ldots\ldots\ldots(2)$$
2) *Power balance constraint:* The load demand of customers should be equal to total power of PV array, grid and the battery[1].
$$P_2(t) + P_4(t) + P_5(t) = P_L(t) \ldots\ldots\ldots\ldots\ldots(3)$$
3) *State of Charge (SOC) boundary constraints*: The charging capacity should be between Smax and Smin [1].
$$S_{min} \leq S(t) \leq S_{max} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

4) *Power Flow Constraints*: Power flow should be non-negative and less than the maximum value[1].

$$0 \leq P_i(t) \leq P_i^{max}, (i=1, 2, 3\ldots6)\ldots\ldots\ldots\ldots(5)$$

5) *SOC terminate state constraint*: The termination SOC of the battery should not be less than the initial SOC[1].

$$S(0) \leq S(24)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

As the electricity cost and constraints are linear, power flow control problem is expressed as linear programming.

D. Control System Model

The parameters of the system are listed as follows.

1) Nominal battery capacity
2) Battery discharge efficiency
3) Battery depth of discharge
4) Initial state of charge
5) PV arrays capacity

The customers demand in four cases is evaluated i.e summer and winter, weekdays and weekends. Generally, the power output in summer is larger than in winter over the daytime. The results give that the operation of hybrid system during the off-peak load period, the PV's power is highly sufficient to meet the demand. During peak loads the stored energy in battery is used to meet the demand. It is observed that the SOC will be increased during off-peak period and the high irradiation period and decreases during the peak period. The SOC constraint is satisfied during the charging and discharging process. Power flow constraints are also satisfied and the system constraints are balanced [1].The results summarize that the overall cost savings are same in both summer and winter ,week days and weekends by using this optimal scheduling method[1]. Table 1 gives the summary of electricity cost with and without hybrid system connection.

Table 1: Electricity Cost With And Without Hybrid Connection[1]

ELECTRICITY COST	WINTER		SUMMER	
	WEEK DAY	WEEK END	WEEK DAY	WEEK END
WITHOUT HYBRID SYSTEM	High	High	High	High
WITH HYBRID SYSTEM	Low	Low	Low	Low

III. MODEL PREDICTIVE CONTROL METHOD

When a disturbance in PV output and load demand occurs the hybrid system will experience disturbance which can't be handled by the open loop control. For this a linear state space model which is a closed loop control is formulated.MPC approach is such a closed loop control model used to schedule the disturbed hybrid system. Before the next control method itself the disturbance experienced in the system is detected and corrected accordingly for the next period by this MPC approach .MPC approach gives better accuracy and robustness and also better cost savings[1].

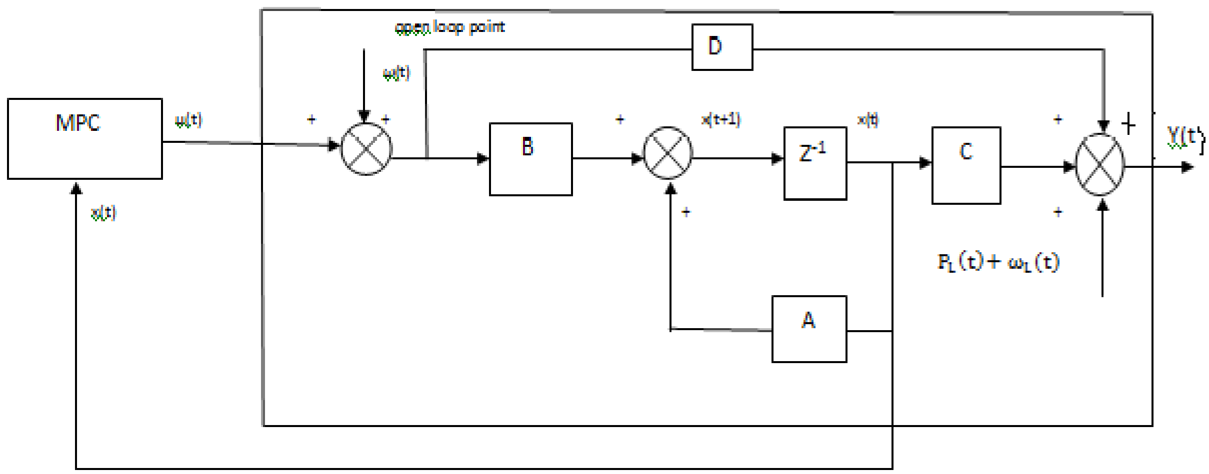

Figure- 1: Schematic Diagram Of Mpc Approach [1]

IV. DOMESTIC LOAD MANAGEMENT TECHNIQUE

DSM encourages the maintenance of load demand in extreme conditions. This results in improved efficiency and production of green energy. This model explains for operating in extreme conditions of blackouts and avoiding the blackouts by Direct Load Control (DLC) and load shifting techniques in residential customers [4].

Domestic loads are three types Basic load(base line load) Regular load(43% of total domestic load)Burst load(runner for specific period of time) Instead of increasing the burden on grid for extra generation of 1w it is better to save 1w of energy. Demand side energy efficiency is improved by integrating information and communication techniques (ICT) techniques. If the present power grid is at least 5% more efficient, it is estimated to avoid the CO_2 emission of 53 million cas. Important factor for improvement of demand side energy efficiency is to replace existing loads by energy efficient loads. This decreases the load shedding problem. Load consumption in summer will be high when compared to winter. This average consumption should be managed for efficient DSM [4].

A. Proposed System

The demand side response program is a incentive based DR program. The consumer is the direct participant who controls the load directly (DLC) during the peak hours and a peak time rebate is offered during hours of critical conditions, if the energy consumption is reduced by the consumer. For the efficient DSM the domestic load management is the top technique. It resolves the problems of load shedding peak shaving and load shifting. This improves the efficiency of the whole system by decreasing the cost of batteries and increasing the reliability of continuous power supply [2].

B. Load Shifting Method For DSM

The effects of load shifts are crucial because for DSM the accurate capacity limits during additional generation and back-up capacities can be reduced. For providing security to energy both annual demand and peak demand should be balanced and smoothened. By shifting the selected loads time to time we can reduce the peak hours and can fill up the off-peak hours. Maintaining the constant usage of generated power equally during all hours of the day helps in increasing base load capacity. This method of load shifting is more economical for Island's where maintaining consistency in base load supply is important instead of depending on storage or battery back-up systems [3].

V. CONCLUSION

In this paper, we discussed about different methods and models for Demand Side Management (DSM).Each method had its own significance in improving the DSM techniques. These DSM techniques need the involvement of consumers for balancing the off loads and peak loads to maintain the supply and demand proportionally without any blackouts. Since, the consumers participation is not expected actively always, we can extend these techniques by automatically shifting the loads, balancing the peak periods and resolving the load shedding problems .Overall, the review say's the domestic load management and load shifting method is an economical method. The open loop and closed loop methods are accurate methods.

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REFFERENCES

[1] Demand side management of photovoltaic-battery hybrid system “Zhou Wu⇑, HenericaTazvinga, Xiaohua Xia Department of Electrical Electronic and Computer Engineering, University of Pretoria, Pretoria, South Afric

[2] Domestic electrical load management using smart grid”S.Rauf,S.Rasool,M.Rizwan,M.Yousuf,N.Khan,Universit of Gujarath,ScienceDirect,CPESE2016.8-12-sepetember 2016,Japan

[3] Impacts of Load Shifting on Renewable Energy Integration” C. Wimmlera, b, c,*, G. Hejazia, b, c, E. de Oliveira Fernandesa, b, C. Moreiraa, c, S. Connorsd 3rd International Conference on Energy and Environment Research, ICEER 2016, 7-11 September 2016, Barcelona, Spain

[4] Ernst D. Solving the fluctuation problems in a land with 100% of renewable energy. Liege, Belgium: University of Liege, 2013.

[5] Rae C, Bradley F. Energy autonomy in sustainable communities—A review of key issues. Renewable and Sustainable Energy Reviews 2012; 16:9: 6497-6506.

[6] Abaravicius J. Demand Side Activities for Electric Load Reduction. Lund: Lund University, 2007.

[7] Breukers SC, Heiskanen E, Brohmann B, Mourik R, Feenstra C. Connecting research to practice to improve energy demand-side management (DSM). Energy 2011; 36:4: 2176-85.

[8] Elliston B, Diesendorf M, MacGill I. Simulations of scenarios with 100% renewable electricity in the Australian National Electricity Market. Energy Policy 2012; 45: 606-13.

[9] Faxas-Guzmán J, García-Valverde R, Serrano-Luján L, Urbina A. Priority load controlalgorithm for optimalenergymanagementinstand-alone photovoltaic systems. Renew Energy 2014;68:156–62

[10] Chen C, Duan S, Cai T, Liu B, Hu G. Smart energy management system for optimal microgrid economic operation. IET Renew Power Gener 2011;5(3):258–67.

[11] Kim SK, Jeon JH, Cho CH, Ahn JB, Kwon SH. Dynamic modeling and control of a grid-connected hybrid generation system with versatile power transfer. IEEE Trans Ind Electron 2008;55(4):1677–88.