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AN INTELLIGENT AND ECONOMIC LOAD SHIFTING APPROACH FOR DISTRIBUTION SYSTEM

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Abstract
This paper proposes an optimization technique connected with demand side management(DSM).In this paper genetic algorithm is involved with various types of distributed energy resources(DER). The proposed topic formulated as bi - objective optimization problem according to the concept of demand side management (DSM). This paper mainly analyzes comparison of DSM i.e. Total DSM is the same as total DSM after reduction in different levels and also analyzes that there is a change in reduction at different levels of percentage of DSM. And also there is an increase in LOAD FACTOR at every change of DSM level. Micro grid is a group of inter connected loads and distributed energy resources that act as a single controllable entity with respect to the grid.

Keywords: Demand-side side management, Genetic algorithm, micro grid, energy management.

Introduction: Connected units of the power system do not produce equal amounts of power for a specific load. So according to the dynamic economic dispatch [1] optimization problem some of the loads are involved for the same cost for equal load. Otherwise some of the loads are cost expensive. So DER (Distributed energy resources) faces more problems [2][3]. Renewable energy sources are the main functional unit of economic load dispatch for cost of production.DSM [4] is focused on reduction of the grid's peak load requirements. So the multiple link between the utility and the end user, as well as the end user's normally change their electricity services, in fact it is crucial for the successful implementation of the particular DSM algorithm [5]. By shifting electricity use from peak to off-peak hours, highly cost effective power generation may be avoided and the cost of production is also decreased. Hence Smart meters and a sophisticated communications network can allow for multiple communications between the utility and the end user, and the end user's will alter their use will enable DSM to face the reality [3]. Choosing Utility firms today have implemented a number of measures for the optimal use of electricity in a safe manner. This makes a possible format for the utility company and the end user to communicate directly. By providing the end user with real-time information on the basis of their respective consumption rates, the energy management system optimizes the use of energy. So The smart grid places a strong emphasis on off-peak energy consumption as utility companies will charge more for electricity during peak times [2]. The use of energy management systems in a residential area lowers peak demands and energy costs. Hence Both DR and DSM are made possible by a home energy management system in a particular smart grid. All the DR action might either be a time-based programmed or a direct load control. Despite widespread agreement that the use of a particular fossil fuel in energy production may be reduced in order to slow the rate of global warming, energy consumption is fast increasing as a result of developments in a number of technological fields[23]. A widespread use of plug-in hybrid electric vehicles (phevs), and data centers for the storage and processing of large amounts of data, [23] and also pervasive artificial intelligence applications will all result in an increase in the given amount of energy needed; so as one specific illustration, the initial household energy load for PHEV (plug-in hybrid electric vehicle) charging should be doubled in a given range. The development of new things

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like smart factories and data centers thanks to information and communication technologies (ICTs) and cloud computing has resulted in a significantly increased load demand in A precise manner.

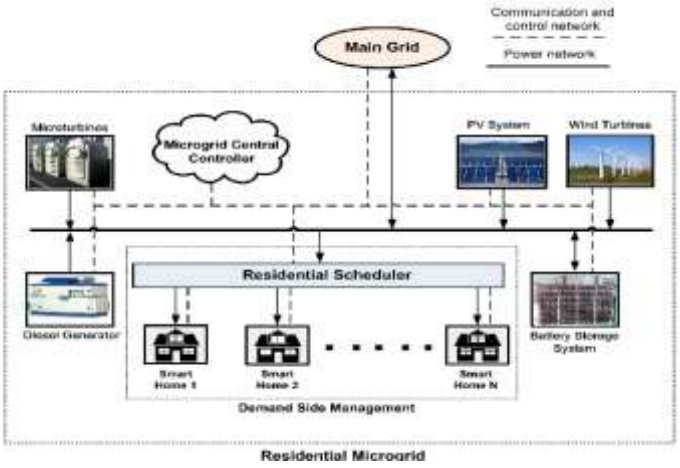

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Figure 1: MG architecture for homes that incorporates DSM

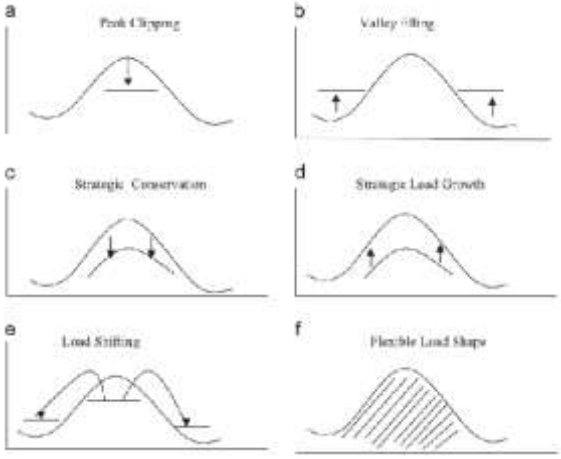

Figure- 2: DSM procedures

Literature: Different research papers have been published in order to meet the most cost effective distribution for various renewable energy generations. The primary goal is to provide a specific reference not only towards the economy of our power generation process but also the competitiveness of renewable energy sources (RES). Hence RES is one of the main solutions of the Government's for the fuel price and more important for the environment. Whenever the cost function is continuous, smooth, no convex and differentiable, then computational methods have been used to solve the problem. But these processes are not recommended in cases where actual physics constraints are present, hence for such a dynamic non-smooth and convex problem classical optimization algorithms are used to solve ELD over time, but lambda, gradient methods and dynamic programming are used in smooth ELD [1]. It has spawned a large no of research papers on micro grid [2] [17] energy

management, which includes the article, used the imperialist competitive algorithm (ICA) and matrix real coded genetic algorithm (GA) to reduce the cost of generation of a grid connected to micro grid (MRCGA). They can apply the algorithm through rigorous testing in various scenarios, including DERs with narrow operational ranges that change power prices and variable loads. [16]The authors also studied a single utility company with various residential energy uses for DSM by using a game theory approach, whereas day ahead pricing scheme and an energy consumption game were used to implement the day load shifting DSM approach. The multiple objectives of particle swarm optimization technique were used by the authors thereby to deal with the multiobjective dynamic economics and emission dispatch problem with demand side management called DSM strategy. Usually under the centralized energy system customers are normally bought electricity for fixed prices and assured for quantities. Hence in contrast to that distributed energy system and micro grid, which gives an adversary of generation, storage, and monitoring and control solutions such as renewable generation sources from solar and wind [22].

.**2.1**: **Contribution of the paper**

1. Different Load Demands have been performed based on various levels of DSM.
2. Genetic algorithms have been applied.
3. Different types of DSM Participation have been done.
4. Different types of DSM Participation have been done.

2.2: .Motivation

References are carried out for an intriguing study in which several Methods for CEED (Combined economic and emission dispatch) were assessed on various types of dynamic test to identify the one that provides an appropriate difference between the cost of generation and pollutant emission. By doing the comparable investigation on a grid-connected micro grid system, this paper fills the knowledge gap left [21]. In order to increase the complexity of the work, two distinct grid pricing algorithms of balancing trade-off were used.[27] The generation cost as well as pollutant emission magnitudes were determined. Hence, additionally, the DSM technique is used to restructure the load model, and also the effects on the generation costs and also pollutants released were carefully done [7]. The main aim of this given work is to reduce computational costs and efficiency in order to address pollution-related cost-effective micro grid challenges. However different, methods like the sine cosine algorithm (SCA), GWO (Grey wolf optimization), [19] and CSA (crow search algorithm),[25] [26], others, have been used in big dimension difficult constrained optimization situations in a particular problem[5][18].Additionally, the CSA [20] is more likely than many other algorithms with minimum solutions. Because it can handle all enormous population sizes [8]. Each iteration of GWO has a sizable number of equations and phases, which is one disadvantage.[14] The method described in the given paper tries to avoid it in order to lower the computing cost.

2.3 Mathematical modeling of fitness function

Objective function

The main goal of this function is to lower the micro grid's generation costs and emissions, which can be mathematically represented as

$$ECD = \sum_{t}^{24} \sum_{j=1}^{n} (F_j * G_{j.t} + C_{grid,t} * G_{Grid,t}) \qquad (1)$$

Where F_j is the power output of the j^{th} distributed generating unit and F_j is the fuel cost coefficient. The electrical market pricing known as C_{grid} is used by the grid to purchase and sell energy. [11] Micro grid system emission dispatch [12][13].

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For calculating the amount of carbon dioxide released in the atmosphere at the end of the day from the fossil fuelled conventional generating sources, Where EMD is the total amount of carbon dioxide emission coefficient. Combination economic emission dispatch based on FPThis method primarily solves two competing and conflicting goal functions as a ratio consisting of the same choice and control variables. Whereas EMD stands for emission dispatch and is expressed quantitatively via equation, ECD stands for the economic dispatch equation, which is represented by a technical equation. Using the FP technique, a compromised solution may be found by decreasing the END, ECD ratio. [9]]10]

$CEED_{fp} = \frac{EMD}{ECD}$ (2)

CEED= Combined economic emission dispatch.
EMD= Empirical mode decomposition
ECD= Energy conversion devices

C. Operating constraints

The operating restrictions provided by. Equations are bound to be the DER_s and grid

$\sum_{j=1}^{n} Gjt = D_t$ (3)

$\sum_{j=1}^{n} Gjt + P_{rest = D_t}$ (4)

$G_{J\ min} \leq G_J \leq G_{J\ max}$ (5)

Were
D_t = Demand for t hours
$P_{RES,t}$ = RES output

Demand side management

Various utility companies are used to lower their system's peak load and also save money; hence, utility companies usually provide incentives to its consumers in exchange for their participation in a certain process.

Filling of valleys, pick clipping, shifting of loads, and increase in first three are often major level kinds in static load demand strategic conversion and variable load shaping , while the final three are secondary level type that use system planning and operation to regulate total load demand by limiting or extending it. The load shifting approach, which combines peak clipping and valley falling, is the most significant load control method. Load shifting at the consumer level is possible with specific uses of adjustable loads with no change in energy consumption; the load shifting strategy also moves the controllable loads from peak to peak offtimes.Of the key components of the load demand model restructuring utilizing DSM techniques as follows:

a. The original anticipated peak load of the power system is not exceeded by the peak load demand following the given application for the DSM approach.

b. At the conclusion of the day both with and without DSM the systems total load and average load are same.

DSM urges for preventing consumers from using less energy during peak hours or from transferring their energy use to off-peak hours like the weekend or at night. This may not be actually resulting in less energy being used overall. DSM also refers to programmers and tools that nudge people into maximizing their use of energy. Potentially, a specific DSM [6] has two advantages. First, by modifying when and how much electricity is used, consumers can lower their monthly electricity costs.

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Hence, in order to match the energy supplied by the utility, the demand side management plan is developed to determine the instantaneous tariff and the combined power (P) of two consumers. The choice value, the utility's maximum value provided (Z). [15]The different values determine how load control works. Loads are following types

- Shift able loads
- Non-shift able loads

Shift able loads are priorities for being curtailed. To facilitate automated shedding, loads can be divided as non-shift-able loads and shift-able loads.

2.4. Descriptive case study

A. Result and discussion

In this paper 10%, 20%, 30%, 40% of reduction of Demand side management has been done.

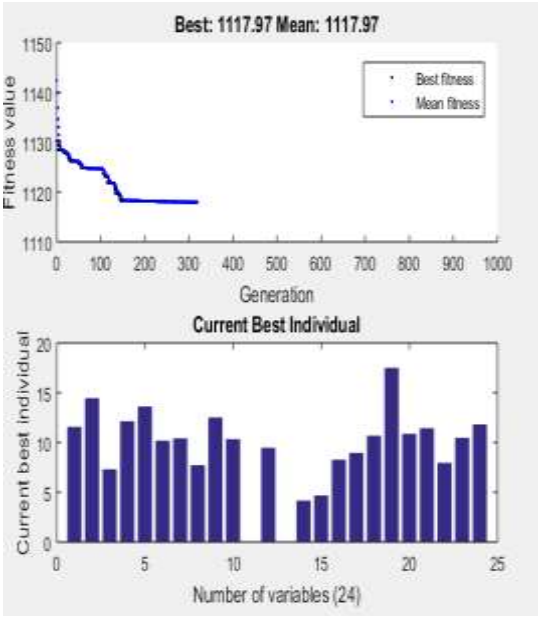

Figure-3: 10%DSM

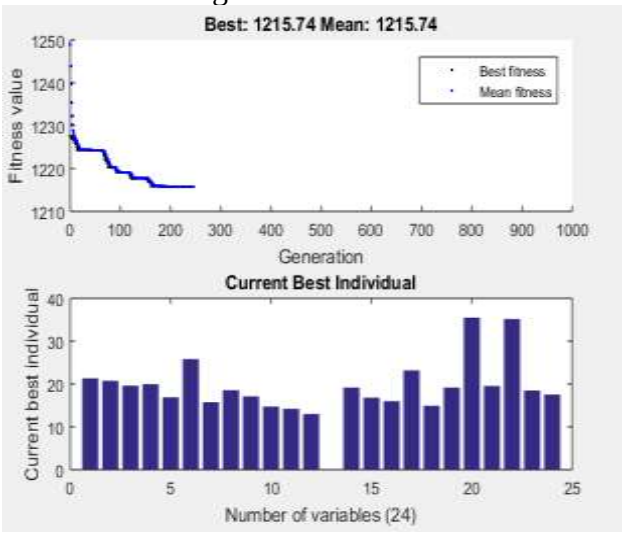

Figure-4: 20%DSM

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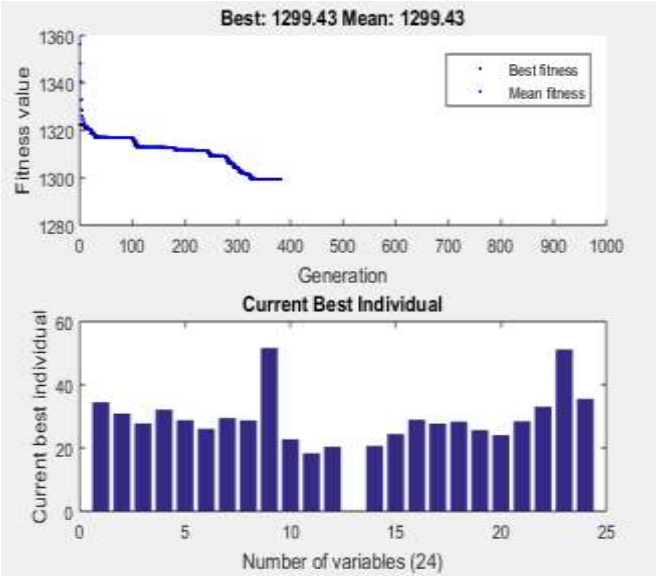

Figure- 5: 30% DSM

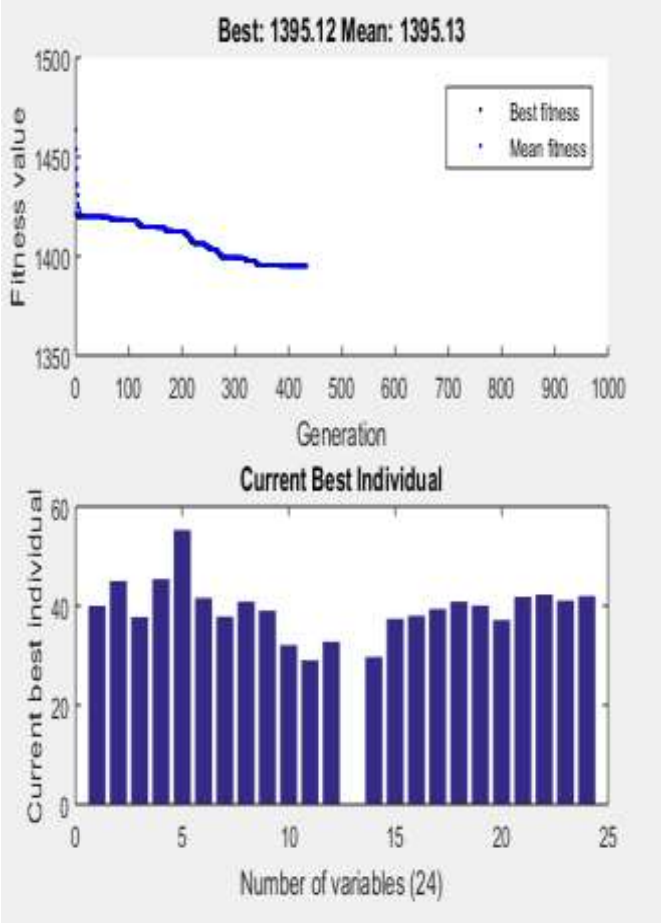

Figure-6: 40%DSM

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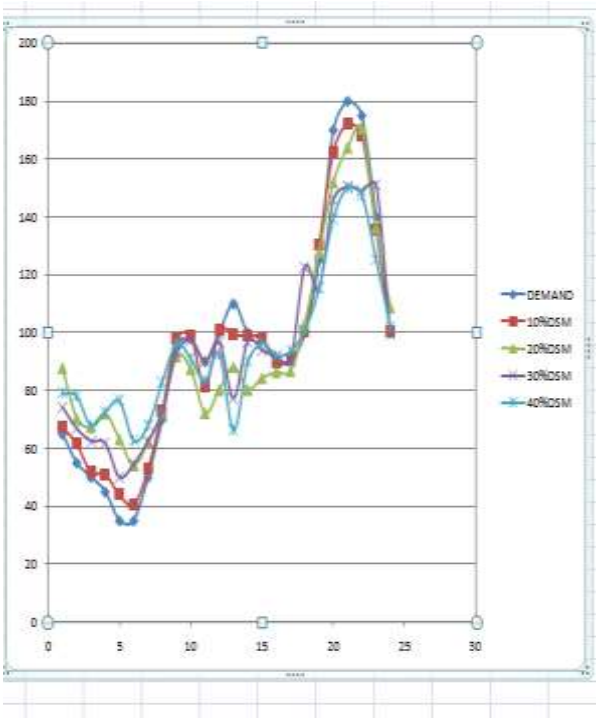

Figure- 7: DSM LOAD GRAPH

Table-1: Final output of DSM

TOTAL	2266	2265.9998	2265.999	2266.000	2266.001
PEAK	180	170.23438	170.4204	151.230616 1	149.804433 6
AVERAGE	94.4167	94.41665 8	94.41662 5	94.41666667	94.41670833
REDUCTION %	Ref	3.17	3.495	4.41	8.33
LF	0.524	0.5481	0.554	0.624	0.63

Conclusion

In this paper DSM strategy was applied. Different load demand levels have been performed on the basis of DSM level and the fundamental concepts and general ideas and practical procedure of genetic algorithm were viewed .The concept of DSM have been clearly defined from the power system point of view .However DSM loads are generated according to the procedure of genetic algorithm. Different types of DSM Participation also have been done. Different types of DSM Participation were done. From the output of DSM following observations are concluded.

1. Reduction of DSM and DSM before reduction is the same.

2. Reduction percentage is increasing for different percentages of loads.
3. The Load Factor of DSM is also increasing.

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