Centralised Optimal Joint Scheduling For Electric Vehicles And Home Appliances Using Smart Microgrids

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Abstract : The integration of renewable energy sources and elec- trical vehicles (EVs) reduces greenhouse gas emissions. micro grids become more reliable, stable, and cost-effective Micro grids become more reliable, stable, and cost-effective by using EVs as electricity storage and renewable energy sources as distributed generators (DGs),. In this paper, we propose centralized optimal joint scheduling to control the electricity consumption of home appliances and plug-in EVs using smart microgrids to improve the reliability and stability of micro grids and to reduce the electricity prices to customers. We formulate the scheduling method using neural network method. Finally we compare the optimal solution obtained from a scheduling framework, where EVs do not have discharge capabilities, decentralized charge control using game theory and a solution obtained from a naive scheduling framework.

Keywords **- Scheduling, Neural networks, smart micro grids,V2G.**

I. INTRODUCTION

Long distance transmission and distribution cause a substantial amount of power losses in the existing power grid. Almost 90% of the power outages are caused due to the failures on the transmission and distribution lines of grid. In world green house gases 41% are emitted by Electric power generators, 23% by transportation system and 6% by residential houses. Smart grids will provide more electricity to meet rising demand, increase reliability and quality of power supplies, nicrease energy efficiency, be able to integrate low carbon energy sources into power networks. A smarter grid will provide greater control over energy costs and a more reliable energy supply for consumers. Environmental benefits of a smarter grid include reduced peak demand, integration of more renewable power sources, and reduced CO2 emissions and other pollutants. Smart grids possess demand response capacity to help balance electrical consumption with supply, as well as the potential to integrate new technologies to enable energy storage devices and the large-scale use of electric vehicles[1].

The performance of EV scheduling is done with load bidding that includes optimal EV charging results in maximum utilisation of wind and solar power and optimized discharge of EV results in minimum operational cost of microgrid. The expectations of charging power, battery capacity of EV are technical limits of charging power of battery and battery capacity and users expectation limits. Due to the increase in load demand the utilisation of renewable energy has become more important[2]. The electrification of vehicle creates an impact on grid due high consumption of electricity. The charging and discharging of will change the load profile of electrical system. The load profile of the electrical system is flattened by the charging patterns of EV which is scheduled optimally. So that the operational cost and potential capital costs are minimized. The load profile is reshaped by intelligent scheduling of charging and discharging of EV.

During the low demand condition EV is charged from the grid and it is discharged to grid during the high demand condition. Globally minimal total cost is provided by global optimal scheduling. The information on the future base loads, charging periods of EV in future time of the day are required for global optimal scheduling and it is impractical [3]. Depending on the power level, timing, and duration of the EV connection to the grid, there could be a wide variety of impacts on grid constraints, capacity needs, fuel types used, and emissions generated. Some areas that could be more fully explored include: The relative emissions, gasoline use, electrical primary fuels use, and added generation needed to meet PHEV needs.The impact of alternative vehicle operation schemes (longer distance batteries, partial charging, employer-provided daytime charging, vehicle to grid generation. Expansion of the analysis to areas besides the VACAR region. Transmission and distribution impacts from EV. Options for utilities to

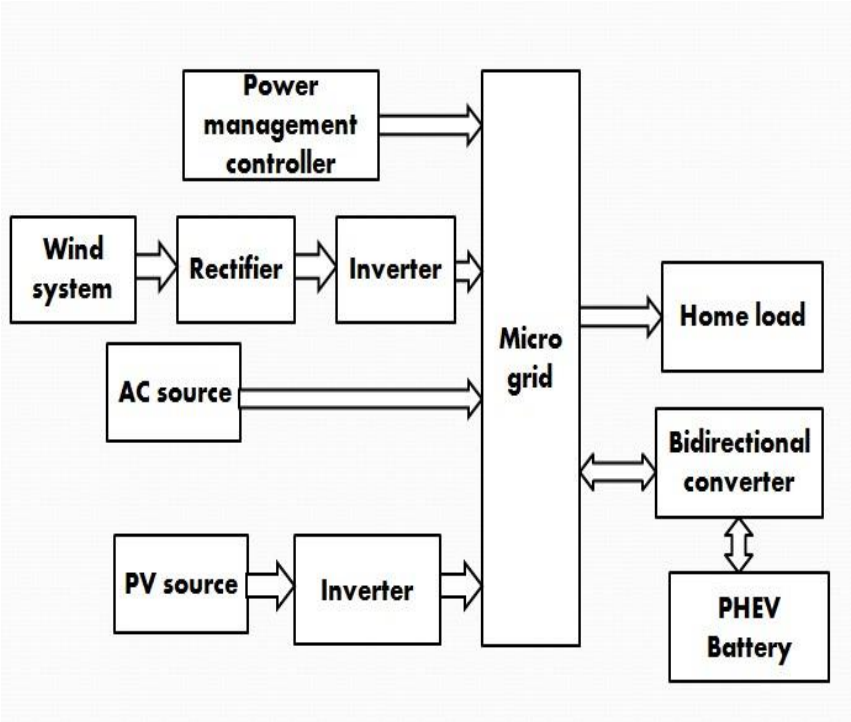


Fig.2 Block diagram

modify customer behaviour.Options for utilities and EV manufacturers to improve the vehicle/grid system. Options for utilities to take advantage of PHEV characteristics to improve grid reliability[4].The operation of electric power will become complex as the population of EV increases. The strategies of decentralisation permits the EV to choose their own charging pattern[5].The decentralised EV charging protocol is used toshiftthe EV charging to off peak hours from peak hours. Different prices for different hours of the day are considered andpeak hour load is minimised by imposing penalties on EV[6].In V2G (vehicle-to-grid) operation, one millionEVswith16kWh battery capacity can supply 2000 MWtothe grid for a time pe- riod of up to two hours while discharging at a rate of 2 kWh.

EVs may play a dual role in microgrids; they act as loads to themicro grid when plugged in for charging and as storage for electricity in the stationary state. Alongwith charging infrastructure, investment required to develop intelligent IT infrastructure for smart charging of EVs and reliable services tohome [6]. Currently,most of the homeappliances consume electricity in a continuous fashionwithtight scheduling [8].Some of them consume electricity continuously while others operate in a distributed fashion with flexible scheduling. An intelligent scheduling strategy can optimally determine the schedule of EV charging and discharging and the schedule of home appliance electricity consumption. The resultant scheduling pattern is such that the load profile of the electricity system follow the renewable energy generation pattern. This reduces the amount of imported electricity from the neighboring grid as well as the capital and operational costs of the micro grid. Further, the optimal scheduling improves the service availability, stability, and reliability of the micro grid operations. Keys to achiev the Smart Grid are architecture communications and technology an integrated approach to deploy technology.It should allow for efficient and economic development of new applications.Effective, two-way communication with all parts of the electric grid are essential to achieving the visionand to handle very large amounts of data points to glean information.It utilize technological enhancements in equipment and methodologies that are cost effective, innovative, interchangeable and reliable to provide the performance enhancing capabilities throughout the electric grid.

Our scheduling method results in the optimal use of electricity generated from renewable energy sources and minimizes the amount of imported electricity from the grid. Consequently, it reduces the electricity price for the microgrid customers.

II.SYSTEM MODEL

A. PV PANEL

The solar panel is the power source of all photovoltaic installation. It is the result of a set of photovoltaic cells in series and parallel. In order to undertake its analysis, we begin from the study of a photovoltaic cell, main nucleus of the conversion of light to electrical current). Beginning from the electrical circuit that describes a cell, problems due to its association are analyzed. Photovoltaic (PV) are solid-state, semi-conductor type devices that produce electricity when exposed to light. keep them facing the wind, and also because in high winds the blades can turn out of the wind thereby increasing drag and coming to a stop. Most of the HAWT are upwind as downwind systems cause regular turbulence which may lead to fatigue. The word photovoltaic‟s actually mean "electricity from light." Many hand-held calculators run off power from room light, which would be one example of this phenomenon. Larger power applications for this technology are also possible. Photovoltaic are the direct

conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons.

B .WIND TURBINE

A wind turbine is a rotating machine which converts the wind kinetic energy into mechanical energy. If the mechanical energy is then converted to electricity, the machine is called a wind generator, wind turbine. Wind turbines can be separated into two types based by the axis in which the turbine rotates as Horizontal Axis Wind Turbines and Vertical Axis Wind Turbines. The former are more commonly used due to several inherent advantages, the latter being used in small scale.

Turbine subsystems include Rotors which convert wind energy into mechanical energy of the shaft ,Nacelle (enclosure) which contains all the conversion equipment, generator, gear shaft etc. Tower to increase the height of the turbine systems so that higher wind speeds are captured. Control equipment, Cables and other civil works. They have the main rotor shaft and electrical generator at the top of a tower, and are pointed into the wind. The variability of wind distribution and speed brings up the requirement of a gear system connected to the rotor and the generator. The gear system enables a constant speed of rotation to the generator thus enabling constant frequency generation. Turbine blades are made stiff in order to prevent the blades from being pushed into the tower by high winds. Downwind machines have also been built, as they no longer require a yaw mechanism to keep them facing the wind, and also because in high winds the blades can turn out of the wind thereby increasing drag and coming to a stop. Most of the HAWTs' are upwind as downwind systems cause regular turbulence which may lead to fatigue.

C . PHEV

Plug-in Hybrid-Electric Vehicles (PHEVs), are hybrids with high-capacity batteries that can be charged by plugging them into an electrical outlet or charging station. They can store enough electricity from the power grid to significantly reduce their petroleum consumption under typical driving conditions.There are two basic plug-in hybrid configurations:Series plug-in hybrids, also called Extended Range Electric Vehicles (EREVs). Only the electric motor turns the wheels; the gasoline engine is only used to generate electricity. Series plug-ins can run solely on electricity until the battery needs to be recharged. The gasoline engine then generates electricity to power the electric motor. For shorter trips, these vehicles might use no gasoline at all.Parallel or Blended Plug-in Hybrids. Both the engine and electric motor are mechanically connected to the wheels, and both propel the vehicle under most driving conditions. Electric-only operation usually occurs only at low speeds.Plug-in hybrids also have different battery capacities, allowing some to travel farther on electricity than others. Their fuel economy, like that of electric vehicles and regular hybrids, can be sensitive to driving style, driving conditions, and accessory use.

Benefits and Challenges are less petroleum use. Plug-in hybrids are expected to use about 40% to 60% less petroleum than conventional vehicles.[1] Since electricity is produced mostly from domestic resources, plug-in hybrids reduce oil dependence.Less greenhouse gas emissions Plug-in hybrids typically emit less greenhouse gas than conventional vehicles, but the amount generated depends partly on the fuel used at electrical power plants—nuclear and hydroelectric plants are cleaner than coal-fired power plants. Higher Vehicle Costs, Lower Fuel Costs. A plug-in hybrid can cost roughly $4 to $8 thousand more than a comparable non-plug-in hybrid. Using electricity is much cheaper than using gasoline, but whether fuel savings will offset the higher vehicle cost depends on the vehicle purchased, the percentage of miles operating on electricity, fuel costs, and ownership length. Federal tax incentives up to $7,500 are currently available for qualifying plug-ins. Re-charging takes time. re-charging the battery using a 120-volt household outlet can take several hours; re-charging using a 240-volt home or public charger can take roughly 1 to 4 hours; while a "quick charge" to 80% capacity may take as little as 30 minutes. However, these vehicles don't have to be plugged in. They can be fueled solely with gasoline but will not achieve maximum range or fuel economy without charging.Estimating fuel economy. Since a plug-in can operate on electricity alone, gasoline alone, or a mixture of the two, EPA provides a fuel economy estimate for gasoline-only operation and an estimate for electric-only or gas-and-electric operation both for combined city-highway driving.

D. NEURAL NETWORK

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true of ANNs as well.Advantages are adaptive learning that is an ability to learn how to do tasks based on the data given for training or initial experience.Self-Organisation, an ANN can create its own organisation or representation of the information it receives during learning time. Real Time Operation, ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability. Fault Tolerance via Redundant Information Coding, Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

III. SIMULATION RESULTS

In this section, we simulate our proposed algorithm and compare the results with our optimal results with those obtained from naive scheduling. For simulation purpose we have taken data from a small community residential subscribers. These datas are prepared as energy data sheet which is loaded in the neural network for simulaton. The fig 3 represents the load at the system with respect to time. The fig 4 represents the load forecated by regression algorithm which used in naïve scheduling. The fig 5 represents the load forecasted by our proposed algorithm, neural network.

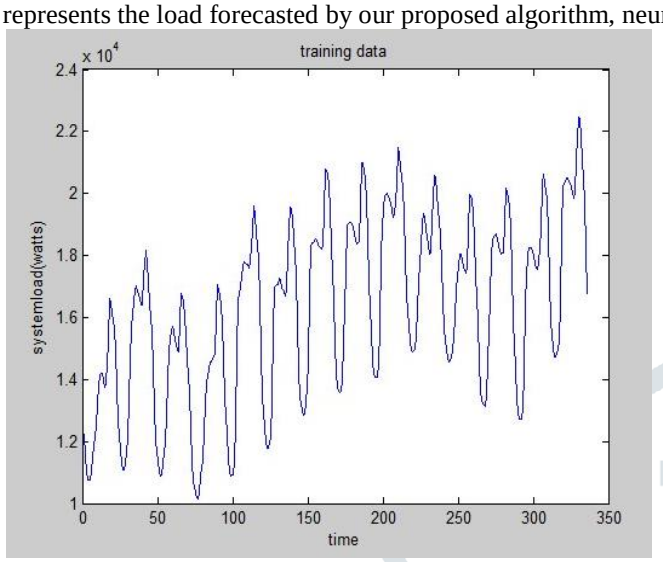


Fig.3 System load with time

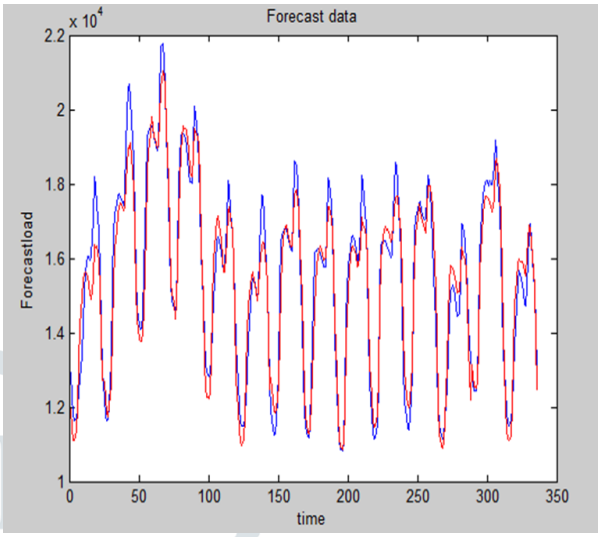


Fig.4 forecasted data by regression algorithm

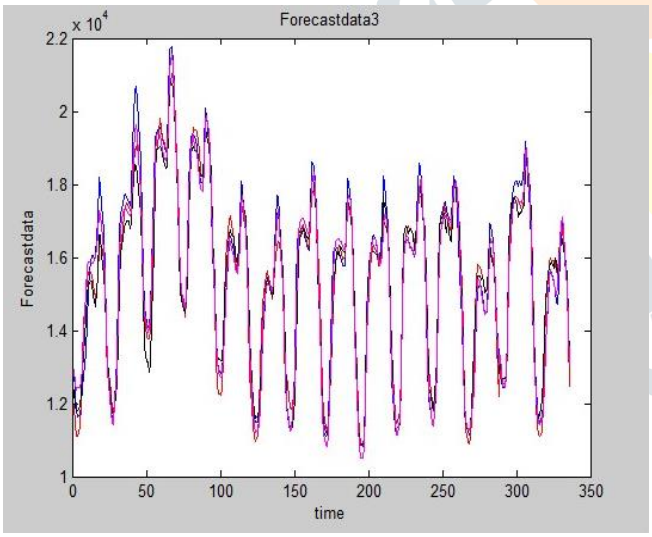


Fig.5 Forcasted data by Neural networks

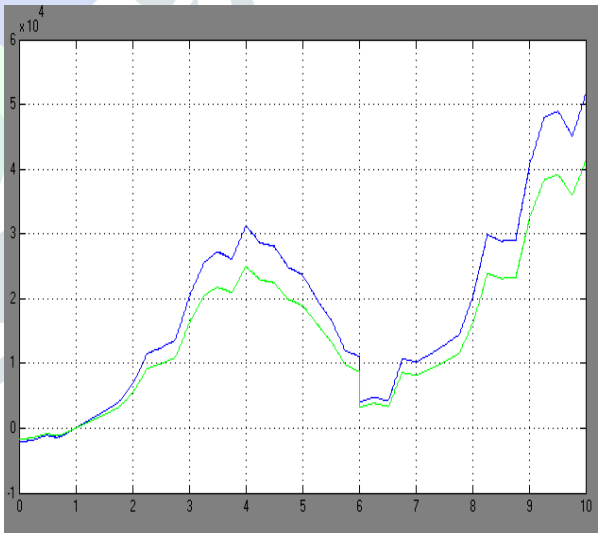


Fig.6 Energy consumption in scheduling by regression algorithm

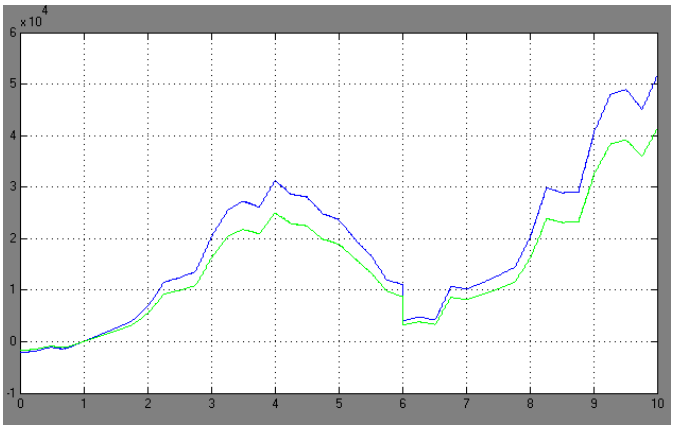


Fig.6 Energy consumption comparison in scheduling by regression algorithm and neural netork

The fig.5 represents the energy consumed by loads during the scheduling done by regression algorithm. The fig.6 represents the energy consumed by loads during the scheduling done by neural network. It shows that the energy consumed in scheduling done by neural network is less then the scheduling done by regression algorithm.

IV. CONCLUSION

In this paper, we have proposed joint centralized optimal scheduling schemes for home appliances and EVs in a grid-connected microgrid powered by renewable energy sources.The microgrid uses EVs as electricity storage to improve the efficiency and reliability of the system. Neural network forecast and schedule the load from high demand periods to low demand periods accurately. Neural network technique done scheduling in efficient manner than the regression algorithm method.

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