Operation Optimization of Residential Energy Hubs in Smart Grids Using Bat Algorithm

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Abstract Information technology and a new generation of energy meters, typically referred to as “smart meters,” which not only provide energy consumption readings but can also provide additional information on usage and have two-way communication capabilities, are two key developments that improve the effectiveness and capability of energy management systems (EMSs). In this thesis mathematical optimization models of residential energy hubs has been solved by artificial bat algorithm which can be readily incorporated into automated decision making technologies in smart grids. Mathematical models for major household demand, i.e., fridge, freezer, dishwasher, washer and dryer, stove, water heater, hot tub, and pool pumps are formulated. Also, mathematical models of other components of a residential energy system including lighting, heating, and air-conditioning are developed, and generic models for solar PV panels and energy storage/generation devices are proposed. The developed mathematical models result in optimization problems with the objective functions of minimizing electricity energy consumption cost, while considering end-user preferences. To evaluate the effectiveness of the mathematical model, simulation studies are carried out to a real household in Ontario, Canada. Numerical results show that all devices operate optimally in permissible periods and BAT algorithm case to residential energy hubs by proper convergence characteristic.

Keywords : Residential Energy Hubs Hubs, intelligent algorithms bat BA, energy management system EMS. Solar panels and energy storage PV / ESD