جامعة الإسراء
Isra University

Energy Demand Side Management System for Smart Houses and Buildings

(Case Study: Sultanate of Oman)

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AUTHORIZATION FORM

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COMMITTEE DECISION

This Thesis (ENERGY DEMAND SIDE MANAGEMENT SYSTEM FOR SMART HOUSES AND BUILDINGS, (Case study: Sultanate of Oman)) Was Successfully Defended and Approved on ---Sunday 25/08/2019

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DEDICATION

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LIST OF ABBREVIATIONS OR SYMBOLS

DSM	DEMAND SIDE MANAGEMENT
TOU	TIME-OF-USE
CPP	CRITICAL-PEAK PRICING
RTP	REAL-TIME PRICING
DER	DEMAND ENERGY REPONSE
HVAC	HEATING, VENTILATION AND AIR-CONDITIONING
LAN	LOCAL AREA NETWORK
GCC	GULF COOPERATION COUNCIL
OPWP	OMAN POWER AND WATER PROCUREMENT
IRENA	INTERNATIONAL RENEWABLE ENERGY AGENCY
WPAN	WIRELESS PERSONAL AREA NETWORK
MPC	MODEL PREDCTIVE CONTROL
LED	LIGHT EMITTING DIODE
AEE	ARAB ENERGY EFFICIENCY OFFICE
BTU	BRITISH THERMAL UNIT OF HEAT

ENERGY DEMAND SIDE MANAGEMENT SYSTEM FOR SMART HOUSES AND BUILDINGS (CASE STUDY: SULTANATE OF OMAN)

Abstract

Energy saving is a very important issue that affects the end users, power system quality and the global environment. Through the periodic energy bills of various energy agencies in Oman, it is possible to search for the causes of excessive consumption to reduce it with the search for the optimal solution with alternative energy sources.

The main task of this thesis is to help reducing the electricity and energy costs by using Demand Side Management (DSM) approaches, such as Demand Response (DR) and Energy Efficiency through an intelligent network with an adequate electricity tariff. This paper focuses on using electricity prices that vary over time to change the intensity of energy from peak hours to off-peak hours. Therefore, it discusses the promotion of the modern electricity tariffs such as Time-of-Use (TOU), Critical-Peak Pricing (CPP) and Real-Time Pricing (RTP), also enlarges the demands of customers in managing the loads and DERs within the smart homes and buildings from both financial and environmental points of view.

The main goal of the research was to understand the basic metrics and interactions of the residential customer and the energy industry, which led to a reduction in peak demand. This research sought to identify the motivational and contextual factors involved in decision-making in order for a resident consumer to accept or not to take interventions to reduce demand at peak times.

The main research question for this work was:

What are the important factors, principles and action steps from the perspective of residential customers that should be taken to influence their change in electricity consumption during peak demand?

This research examined Sultanate of Oman as a case study and used a qualitative methodology to investigate the effectiveness of interventions of residential customers to reduce electricity demand as the descriptive study of this thesis.

The proposed energy side management method is the formulation and subsequent optimization of the energy side management using a model predictive control (MCP) to the problem of controlling the load shedding and peak demand reduction. As a result of that, an optimization algorithm for large-scale dynamic systems that take account of electricity costs, the work cycle, user requirements, system constraints and other input information is developed.

The work used data from the perspective of the consumer, which was collected directly by the researcher, or obtained from various sources related to the problem. These data were used to study the benefits of using demand side management.

This research examined a successful interdisciplinary approach from a consumer perspective and contributed significantly to understanding the fundamental dimension of socio-technical approaches to minimizing peak demand.

The experience of conducting a case study on achieving a steady decline in energy consumption during peak periods is rare, and thus provides a unique opportunity to explore this phenomenon in the Omani context. The results of the study have important implications for addressing issues related to peak demand reduction interventions and demand reduction policy tools, not only for energy providers but also for consumers.