A NOVEL REAL-TIME DEMAND SIDE MANAGEMENT SCHEME FOR THE ADDITION OF ELECTRICAL VEHICLES TO THE FUTURE GRID

NAILA ZAREEN

UNIVERSITI TEKNOLOGI MALAYSIA

A NOVEL REAL-TIME DEMAND SIDE MANAGEMENT SCHEME FOR THE ADDITION OF ELECTRICAL VEHICLES TO THE FUTURE GRID

NAILA ZAREEN

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I declare that this thesis entitled "*A Novel Real-Time Demand Side Management Scheme for the Addition of Electrical Vehicles to the Future Grid*" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ....

Name : Naila Zareen

Date : April 10, 2016

This thesis is dedicated to my parents and kids for their love, patience and understanding during my study.

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ABSTRACT

Electric Vehicles (EVs) as the alternative to the current fossil fuel vehicles represent the most promising green approach to the electrification of a significant portion of the transportation sector. Taking the randomness of EVs' charging/ discharging characteristics into consideration, a significant uncertainty will be added to the grid. Consequently, charging/discharging management of EVs in the presence of large scale intermittent Renewable Energy Resources is considered as the most significant challenge for the future smart grid. Tackling the challenges of stable operation, this thesis proposes a novel approach of micro-grid stability by exploiting the demand side management. In this context, a comprehensive interactive hierarchical based architecture for the electricity supply and demand interaction in a smart grid environment is proposed to encourage the high participation of residential customers in a new deregulated electricity market. A novel market-oriented energy imbalance management scheme is also proposed for the seamless integration of EVs to the grid in the presence of intermittent resources. The proposed scheme which, unlike previous works, utilizes the grid's operating characteristics model within the signaling game-theoretic approach for the successful operation of electricity market. Optimal decision strategies for both EV owners and utility are devised by capturing the conflicting economic interests of players together under load/generation uncertainties. Thus, this thesis presents a planning tool for electric utilities that can provide an insight into the implementation of demand response at the end-user level in an automated way to bridge the gap between scheduling EVs and its benefits. The efficacy of the proposed approach in reducing peak loads while satisfying customers' needs are demonstrated and compared with other schemes. Results show that the proposed methodology can successfully alleviate more than 53% of the peaks caused by the mass adoption of EVs with the better utilization of intermittent resources and substantial amount of profit.

ABSTRAK

Kenderaan Elektrik (EV) yang merupakan alternatif kepada kenderaan jenis bahan api fosil semasa adalah suatu pendekatan yang menjanjikan penggunaan teknologi hijau dalam sebahagian besar sektor pengangkutan. Dengan mempertimbangkan kerawakan ciri-ciri pengecasan/penyahcasan EV, ciri-ciri ketidakpastian ketara akan ditambah ke dalam grid. Akibatnya, pengurusan pengecasan/penyahcasan EV di dalam Sumber Tenaga Boleh Diperbaharui berskala besar terputus-putus dianggap sebagai satu cabaran yang paling ketara untuk grid pintar masa hadapan. Bagi menangani cabaran kestabilan operasi, tesis ini mengusulkan satu kaedah baharu dalam kestabilan grid mikro dengan cara mengeksploitasikan pengurusan permintaan. Di dalam konteks ini, satu seni bina berasaskan hierarki interaktif secara menyeluruh untuk bekalan dan interaksi permintaan lebih banyak pelanggan kediaman di dalam pasaran baru elektrik ternyahkawalselia. Satu skim pengurusan ketidakseimbangan berorientasikan pasaran baharu juga turut diusulkan bagi kelancaran integrasi EV ke grid dalam keadaan sumber terputus-putus. Berbanding kajian sebelum ini, skim yang dicadangkan ini menggunakan model bercirikan operasi grid dalam lingkungan kaedah pengisyaratan teori-permainan bagi memastikan kelancaran operasi pasaran bekalan elektrik. Strategi keputusan optimum bagi kedua-dua pemilik dan penggunaan EV dirangka dengan mengambilkira percanggahan dalam keperluan ekonomi antara pihak-pihak yang terlibat di bawah keadaan ketidaktentuan beban/penjanaan. Maka, tesis ini membentangkan satu kaedah merancang utiliti elektrik yang dapat memberikan gambaran tentang pelaksanaan tindakbalas permintaan di peringkat pengguna secara automatik bagi merapatkan jurang antara penjadualan EV dan manfaatnya. Keberkesanan kaedah yang dicadang dalam mengurangkan beban puncak di samping memenuhi keperluan pelanggan ditunjukkan serta dibandingkan dengan skim-skim yang lain. Hasil kajian menunjukkan bahawa kaedah yang dicadangkan berjaya menurunkan lebih dari 53% nilai puncak yang disebabkan oleh penggunaan massa EV dengan memanfaatkan penggunaan sumber terputus-putus dengan lebih baik yang turut memberikan jumlah keuntungan yang besar.

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LIST OF ABBREVIATIONS

CERTS	-	Consortium for Electric Reliability Technology Solutions
CPP	-	Critical Peak Pricing
DA	-	Demand Agent
DG	-	Distributed Generation
DLC	-	Direct Load Control
DOE	-	Department Of Energy
DR	-	Demand Response
DRPs	-	Demand Response Programs
DSM	-	Demand Side Management
EU	-	European Union
EVs	-	Electrical Vehicles
Fi-Wi	-	Fiber-Wireless
G2V	-	Grid-to-Vehicle
GHG	-	Green House Gases
GT	-	Game Theory
HEMS	-	House Energy Management System
IEEE	-	Institute of Electrical and Electronics Engineers
IMGN	-	Independent Micro Grid Network
IMGNC	-	Independent Micro Grid Network Controller
IMGNO	-	Independent Micro Grid Network operator
kW	-	Kilo Watts
LAN	-	Local Area Network
LV	-	Low-Voltage
NE	-	Nash Equilibrium

OC	-	Optimal Curve
PSO	-	Particle Swarm Optimization
RA	-	Resource Agent
RC	-	Restrictive Curve
RCB	-	Reliability-Cost-Benefit
RCB-DRPs	-	Reliability-Cost-Benefit based Demand Response Programs
RER	-	Renewable Energies Resources
RTP	-	Real-Time Pricing
SG	-	Smart Grid
SGT	-	Signaling Game Theory
SoC	-	State-of-Charge
THD	-	Total Harmonic Distortion
ToU	-	Time-of-Use
ToU-DRPs	-	Time-of-Use Demand Response Programs
V2G	-	Vehicle-to-Grid

LIST OF SYMBOLS

δ_k	-	Bargain probability
∂D_k	-	Change in demand at time k
∂F_k	-	Change in price
$i_{charging}$	-	Charging efficiency
$F^{bargain}_{k,CB}$	-	Cost-Benefit Price at time k
C^{k}_{EV}	-	Cost of energy at time 'k' Hr
τ_{c-i}	-	Cut-in wind speeds
τ_{N}	-	Cut-out wind speeds
PF_{B}	-	DA's profit expectation at time k
$\varphi^{k}_{RCB-DRP}$	-	DA's net outcome
$i_{discharging}$	-	Discharging efficiency
$\emptyset^{k}_{travel}$	-	Distance travelled at time 'k'
F^{k}_{vel}	-	Electricity Price at time k given by RA
E^{k}_{k}	-	Energy Stored in EV battery at time 'k' Hr
E_{k+1}	-	Energy stored in EV battery at time 'k+1' Hr
q	-	Ending time of charging/discharging
E^{q}_{cons}	-	Energy consumed in driving/km
E_{d}	-	Energy at the time of driving
$P_{(r^{k} \mid P^{k}_{CB})}$	-	Estimation probability
$F^{k}_{RCB-DRP}$	-	Financial gain at time k
D^{DRP}_{k}	-	Final demand
F^{k}_{ini}	-	Initial price
β	-	Maximum Customer's gain of profit in the bidding

γ	-	Maximum Customer's loss in the bidding
[illegible]	-	Mean wind speed
C	-	Optimal curve of market grid operation
ν	-	Percentage participation of customers in RCB-DRP
$E(k, k)$	-	Price oriented Demand Elasticity
PF	-	RA's profit expectation at time k
r	-	Reliability of the MGN at time *k*
C	-	Restriction curve of market grid operation
τ	-	Speed of wind in meter/s
p	-	Starting time of charging/discharging
λ	-	Total incentive gain
P	-	Wind power output average

APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

The target of reducing fossil fuel consumption with improved efficiency, as well as environmental protection, has focused the world's attention towards the electrification of vehicles [1,2]. As a promising future of the transportation sector, Electrical Vehicle (EV) is the best alternative that not only decreases the dependency on fossil fuels with low energy cost but also increases the efficiency of the grid [3,4]. EV has two types of operational mode when connected to the network: a) Charging or Grid-to-Vehicle (G2V) mode and b) Discharging or Vehicle-to-Grid (V2G) mode [5,6]. In charging mode, EV is considered as a special connected load to the grid that has the unique characteristic of a controllable charging process for its batteries [7]. The extensive deployment of EVs and their random charging will lead to a significant new unknown load on the existing distribution grids [8,9]. With the fact that many of these networks do not have any spare capacity, resulting in grid failure, voltage/frequency degradation and bringing down the power quality[10]. V2G is another important mode of operation of EVs [11] that can be seen as the distribution generation plants or the energy-stored devices. It allows modern innovation to supply electric power to the stressed grid for ancillary services such as supply/demand matching, etc. [12,13].

EVs can effect generation, transmission and distribution networks of power systems [14] but the most stressful challenging aspect is the distribution networks supplied by Renewable Energy Resources (RERs) [15], called micro-grid network (MGN).

Although RER is familiar as environmentally friendly, but not all of them are reliable, efficient and cost effective [16]. There will be notable consequences in the electric power distribution grid due to the fluctuating nature supply from RERs and the unpredictable but high power demand from the EVs' integration [17,18]. Mass adoption of EVs to such systems adds further complexities in planning and operation of the grid, especially in the domain of market-oriented tasks [19-21]. Therefore, stability and reliability aspects of future distribution grid are getting importance day by day as the share of RER increases in power systems [22,23].

More researches are needed to limit the impact of the integration of EVs and RERs into the existing electric power networks. Previously, the problem of grid stability is addressed mostly from the perspective of supply-side management. However, this work explores a new dimension of tackling the challenging issue of the stable operation of the power grid by exploiting market-oriented Demand Side Management (DSM). DSM can simply be described as any action taken on consumer's side to optimize energy consumption. DSM facilitates the efficient use of energy by means of energy conservation through both behavioral and operational changes in the customer premises. The main advantage of using DSM is that it does not require expensive additional resources (like new generation) to be erected. All this makes the option of DSM advantageous and, therefore, attractive to cope with the problems of Smart Grid (SG) stability. Thus, the primary objective of this thesis work is to address the changing scenario of the future grid and explore ways to help in smooth integration of EVs into the power system in the presence of RERs. Focus has been paid on proposing a smart way of utilizing the EVs to enhance the quality and stability of the grid.

1.2 Problem Statement

The problem of reliable and consistent energy supply is increasing very rapidly throughout the world that is facing an alarming shortage of electrical energy. Due to the rising energy demand and limited generation, it is very challenging to supply sufficient amount of reliable power. Along with the growth of electricity demand and the penetration of intermittent RERs, electric power distribution networks will face more stressed conditions, especially as EV is getting more popularity worldwide and take a greater share of the personal automobile market. The wide deployment of EVs and their charging process will lead to a significant new unknown load on the power grids [24-27][28], with the fact that many of these networks do not have any spare capacity, resulting in grid failure and bringing down the power quality [29].

Effects of EVs on the power systems include the generation, transmission and distribution networks but the most stressful challenging aspect is the MGN supplied by RERs [30]. Mass adoption of EVs to such systems adds further complexity in planning and operation of MGN, especially in the domain of market-oriented tasks [31-35]. This scenario motivates to investigate the potential of SG [36-38] technologies by integrating a novel market-oriented DSM scheme to obtain a stable and self-organizing power distribution grid (i.e. smart MGN) in the presence of renewable energies and future upcoming loads of EVs with increased power availability and quality [41-44].

Although a number of technological elements of SG are available in the market but still there is lack of a detailed structural framework for SG which is necessary for combining the conventional infrastructure to the promising control, communication and information systems of the power grid [45]. In the absence of a comprehensive framework, it is quite difficult to resolve the problems of designing the market oriented DRPs techniques to provide the vast grid flexibility, to improve the consumer’s responsiveness and to enhance the power delivery [46].

Enormous opportunities for DRPs among residential customers exit and therefore, they represent a vast untapped potential for DRPs [47,48].The critical issue faced by all players participating in the MGN electricity market is how to take the decision to optimize their bidding decision strategies according to the limited information available to maximize their profits [49,50]. Since electricity markets are liberalized [51], residential customers are exposed to more volatile prices and may have to decide to modify their demand accordingly to reduce electricity usage costs [52,53]. The primary difficulty in this problem arises from the lack of information about electricity prices and adjustment markets [54-63]. Residential customers have neither expertise nor motivation due to the associated discomfort to negotiate themselves in the market. Therefore, they usually do not effectively participate in power markets, thus influencing the residential customers' participation in trade of the electricity market and tends to the failure of DRPs [64,65].Our work aims to bridge this gap among the existing researches. This has motivated us not only propose an automated market-oriented DSM scheme but also develop a new decision support framework in order to help customers as well as utility to make their decision. In contrast to current researches, this thesis intends to comprehensively address the decision-making strategies by joint consideration of the economic optimization problems of the response of residential customers and utility under the MGN uncertainties for incorporating RERs.

1.3 Research Objectives

The primary objective of this thesis is to develop a smart MGN that can tackle the future upcoming challenges of stochastic integration of EVs in the presence of intermittent resources to the power grid. The proposed planning tool comprise of a control algorithm for both utility-customers as well as a simulation platform that are designed to intelligently managing the load-supply balance in RERs based MGN via deregulated electricity market and successfully integrate the unknown load of EVs. The proposed system would be efficient enough to manage itself for power balance by taking measures on DSM. Hence, the summary of objectives is as follow:

i. To build a comprehensive interactive hierarchical based architecture for the electricity supply and demand interaction in a smart MGN environment.
ii. To propose optimal strategies modeling in electricity market for the smooth integration of EVs in the presence of intermittent resources.
iii. To develop a novel, real-time, user-aware Cost-Benefit based DSM scheme in order to control the growth rate of EVs and reduce the peak load in the presence of RERs.

iv. To perform the evaluation and validation of proposed real-time decision strategies based DSM schemes.

1.4 Scope

The scope of this research work includes the following.

i. This study concentrates on the modeling of DSM scheme for the successful integration of EVs to the RERs based MGN. Therefore, it is conducted on the residential customers only, but the research findings can also be used for the other type of customers.
ii. The proposed method can be used for both grid-connected and isolated MGNs. However, only the independently operated isolated MGNs are considered for current study.
iii. Network load flow calculations and other related aspects like frequency variation, voltage variations etc. are not considered in this study. The frequency and voltage of MGN are assumed to be constant and no frequency/voltage control mechanism is adopted exclusively for the network that are supposed to be control by DGs controller.
iv. This project has focused only on the wind and solar generation for simulation purposed. Other types of DGs are not considered in the simulation.
v. Only one type of EV’s charging is considered for this study.
vi. The modeling of communication system is out of the scope the thesis.

1.5 Research Contribution

The contributions of the research are:

i. A comprehensive interactive hierarchical based modeling architecture for the electricity supply and demand interaction (i.e. the utility company and EV owners) in a smart MGN environment is developed. The proposed architecture design combines the features of centralized control with distributed control to achieve an excellent system performance and enough flexibility. Meanwhile, it has a low system complexity and thus easy to realize in power systems and suitable for the implementation of proposed automated DSM scheme.

ii. Real-time, market-oriented strategies are proposed for the smooth integration of EVs to the grid in the presence of intermittent resources. Conflicting economic interests of both players are captured together by using the economo-SGT within the regulatory framework of MGN. The proposed approach is based on realistic price function rather than resorting to models that arbitrarily choose demand elasticity or consumer benefits functions. The profit maximization function for both the stakeholders is incorporated in the model. The dynamics of demand response is rigorously accounted by using a MGN characteristics model within a game-theoretic approach. Previously, it is often heuristically tackled.

iii. A real-time, user-aware Cost-Benefit based DSM scheme is developed. It comprised of

    (a) A state-of-art load responsive model of EVs for the evaluation of the impact of customer's participation in the proposed scheme.

    (b) Since it is also important to analyze how EV owners operate their EV batteries optimally to receive the maximum benefit; a dynamic optimal operation model of EVs representing the hybrid V2G-G2V systems is developed for the optimal operation of EVs batteries into the deregulated electricity market.

Hence, the problem of a deregulated market with real-time pricing for the utility, elastic demand responsiveness, and inter-regional balance is formulated and solved at one stage. This analysis can benefit utilities by helping design proper incentives to encourage residential customers to participate in market-oriented DRPs, and provide EV owners better understandings of trade-offs to enroll in a DRPs so that they can manage their electricity usage accordingly.

iv. A simulation modeling framework has been developed, which facilitates evaluation of the DRPs strategies in the electric power system. It has the capability of integrating all the potential components and capturing the intricate interdependency among those components.

1.6 Thesis Outlines

This thesis is arranged as follows:

The current chapter presents a brief introduction of the background information, highlight the problem statement, research motivation and the objectives of the research.

Chapter 2 gives a review of techniques, methods and algorithms of DSM/ DRPs used for the integration of EVs into the power grid were carried out. Also, the merits and demerits of the previous approaches are presented. Knowledge gaps are identified and given at the end of this chapter.

Chapter 3 presents a comprehensive interactive hierarchical based architecture for the electricity supply and demand interaction (i.e. utility company and EV owners) in a smart MGN environment for real-time energy imbalance scheme. A framework is proposed in this chapter to address various problems of market-oriented DSM schemes.

The derivations of the proposed novel real-time DSM system to address the problems of sophisticated energy management at the residential household level with the incorporation of EVs and RER is described in Chapter 4.

To evaluate the performance of proposed real-time DSM scheme, a comprehensive simulation modeling with variable load demand of EVs and stochastic generations has been presented in detail in Chapter 5.

Chapter 6, the practical investigation of the proposed work is presented. Under different loading condition and system configurations, the effectiveness and the performance of the proposed DSM scheme are evaluated and validated.

Chapter 7 presents the overall conclusions of the significant achievements of this work, and the general conclusion is drawn. Suggestions for further studies are also presented.

several possible future work paths along the same line of DSM scheme to alleviate the stress conditions of grid and to accommodate higher levels of EV loads into the RER based distribution network.

The thesis reviews the existing work on the grid-integration of EVs and various DRPs schemes in context of SG in chapter 2. Optimal real-time market-oriented DRPs strategies based on economo-SGT are proposed to manage the stochastic load of EVs by taking into account the operational constraint of intermittent generation based MGN in chapter 3 and 4. This proposed scheme is set to make the upcoming EV load transparent to the MGN. This study has also analyzed the use of battery storage of EVs, which is represented as V2G systems to provide power balancing reserves in the market-oriented operation of the future grid. Stochastic RER generation, residential loads as well as EVs, are modeled in chapter 5. Various scenarios and case studies are performed with different penetration levels of EV for validation of the proposed DSM in chapter 6.

7.2 Recommendations for Future Studies

The dissertation has made a contribution in defining a methodology regarding optimal DSM scheme for EV integration into the SG in the presence of intermittent resources. However, there are many areas of future work that could be built on the contributions of this dissertation. The important research topics that could be considered for further investigation are listed as follows:

i. In addition, without specification, the methodology presented in this dissertation can be readily extended to integrating other electricity appliances into the market oriented DSM scheme in SG environment.

ii. After obtaining the simulation results with increased number of real-world appliances, the prototype of the proposed system must be deployed on the laboratory level.

iii. This study can be extended by integrating the other type of customers i.e. industrial customer and bulk electricity users.

iv. Extension of study to the other levels of the hierarchal architecture of SG.

Although this research achieved promising results in analyzing dynamic EVs impact and utilization in power systems, the work does not end here. It is the starting point of a new era of using EV in various ways. It is believed that any of the above suggestion is challenging and need to be given immediate consideration.

REFERENCES

1. Amjad, S., Neelakrishnan, S., Rudramoorthy, R. 2010. Review of design considerations and technological challenges for successful development and deployment of plug-in hybrid electric vehicles. *Renewable and Sustainable Energy Reviews*, 14(3), 1104–1110.
2. Dallinger, D., Wietschel, M. 2012. Grid integration of intermittent renewable energy sources using price-responsive plug-in electric vehicles. *Renewable and Sustainable Energy Reviews*, 16(5), 3370–3382.
3. Papadopoulos, P., Skarvelis-Kazakos, S., Grau, I., Cipcigan, L.M., Jenkins, N. 2012. Electric vehicles' impact on British distribution networks. *IET Electrical Systems in Transportation*, 2(3), 91.
4. Tie, S.F., Tan, C.W. 2013. A review of energy sources and energy management system in electric vehicles. *Renewable and Sustainable Energy Reviews*, 20, 82–102.
5. Khayyam, H., Ranjbarzadeh, H., Marano, V. 2012. In Intelligent control of vehicle to grid power. *Journal of Power Sources*, 201, 1–9.
6. Xu, H., Miao, S., Zhang, C., Shi, D. 2013. Optimal placement of charging infrastructures for large-scale integration of pure electric vehicles into grid. *International Journal of Electrical Power & Energy Systems*, 53, 159–165.
7. Iversen, E.B., Morales, J.M., Madsen, H. 2014. Optimal charging of an electric vehicle using a Markov decision process. *Applied Energy*, 123, 1–12.
8. Akhavan-Rezai, E., Shaaban, M.F., El-Saadany, E.F., Zidan, A. 2012. Uncoordinated Charging Impacts of Electric Vehicles on Electric Distribution Grids : Normal and Fast Charging Comparison. *IEEE Power and Energy Society General Meeting*, 1–7.
9. Vaya, M.G., Andersson, G. 2012. Centralized and decentralized approaches to smart charging of plug-in Vehicles. *IEEE Power and Energy Society General Meeting*. 1–8.

10. Hannan, M. A., Azidin, F. A., Mohamed. 2014. Hybrid electric vehicles and their challenges: A review. *Renewable and Sustainable Energy Reviews*, 29, 135–150.

11. Galus, M.D., Zima, M., Andersson, G. 2010. On integration of plug-in hybrid electric vehicles into existing power system structures. *Energy Policy*. 38, 6736–6745.

12. Peng, M., Liu, L., Jiang, C. 2012. A review on the economic dispatch and risk management of the large-scale plug-in electric vehicles (PHEVs)-penetrated power systems. *Renewable and Sustainable Energy Reviews*, 16(3), 1508–1515.

13. Green, R.C., Wang, L., Alam, M. 2012. The impact of plug-in hybrid electric vehicles on distribution networks: A review and outlook. *Renewable and Sustainable Energy Reviews*, 15(1), 544–553.

14. Srivastava, A.K., Annabathina, B., Kamalasadan, S. 2010. The Challenges and Policy Options for Integrating Plug-in Hybrid Electric Vehicle into the Electric Grid. *The Electricity Journal*, 23(3), 83–91.

15. Masoum, A.S., Deilami, S., Moses, P.S., Masoum, M. a. S., Abu-Siada, A. 2011. Smart load management of plug-in electric vehicles in distribution and residential networks with charging stations for peak shaving and loss minimisation considering voltage regulation. *IET Generation, Transmission & Distribution*, 5(8), 877.

16. Amirioun, M.H., Kazemi, A. 2014. A new model based on optimal scheduling of combined energy exchange modes for aggregation of electric vehicles in a residential complex. *Energy*. 69, 186–198.

17. Foley, A., Tyther, B., Calnan, P., Ó Gallachóir, B. 2013. Impacts of Electric Vehicle charging under electricity market operations. *Applied Energy*, 101, 93–102.

18. Varga, B.O. 2013. Electric vehicles, primary energy sources and CO_2 emissions: Romanian case study. *Energy*, 49, 61–70.

19. Brown, S., Pyke, D., Steenhof, P. 2010. Electric vehicles: The role and importance of standards in an emerging market. *Energy Policy*, 38(7), 3797–3806.

20. Yang, S., Yao, J., Kang, T., Zhu, X. 2014. Dynamic operation model of the battery swapping station for EV (electric vehicle) in electricity market. *Energy*, 65, 544–549.

21. Rotering, N., Ilic, M. 2011. Optimal charge control of plug-in hybrid electric vehicles in deregulated electricity markets. *IEEE Transactions on Power Systems*, 26(3), 1021–1029.

22. Kempton, W., Tomić, J. 2005. Vehicle-to-grid power implementation: From stabilizing the grid to supporting large-scale renewable energy. *Journal of Power Sources*, 144, 280–294.

23. Masoum, A.S., Deilami, S., Moses, P.S., Abu-Siada, A. 2010. Impacts of Battery Charging Rates of Plug-in Electric Vehicle on Smart Grid Distribution Systems. *IEEE PES Innovative Smart Grid Technologies Conference Europe, ISGT Europe*. pp. 1–6.

24. Dallinger, D., Wietschel, M. 2012. Grid integration of intermittent renewable energy sources using price-responsive plug-in electric vehicles. *Renewable and Sustainable Energy Reviews*, 16(5), 3370–3382.

25. Asmus, P. 2010. Microgrids, Virtual Power Plants and Our Distributed Energy Future. *The Electricity Journal*, 23(10), 72–82.

26. Ustun, T.S., Ozansoy, C., Zayegh, A. 2011. Recent developments in microgrids and example cases around the world — A review. *Renewable and Sustainable Energy Reviews*, 15(8), 4030–4041.

27. Karfopoulos, E.L., Papadopoulos, P., Skarvelis-Kazakos, S., Grau, I., Cipcigan, L.M., Hatziargyriou, N., Jenkins, N. 2011. Introducing electric vehicles in the microgrids concept. *16th International Conference on Intelligent System Applications to Power Systems*, ISAP 2011.

28. Tushar, M.H.K., Assi, C., Maier, M., Uddin, M.F. 2014. Smart Microgrids: Optimal Joint Scheduling for Electric Vehicles and Home Appliances. *IEEE Transactions on Smart Grid*, 5(1), 239–250.

29. Lu, S., Elizondo, M., Samaan, N. 2011. Control strategies for distributed energy resources to maximize the use of wind power in rural microgrids. *Power and Energy*, 1–8.

30. Lopes, J.A.P., Madureira, A.G., Moreira, C.C.L.M.2013. A view of microgrids. *Wiley Interdisciplinary Reviews: Energy and Environment*, 2, 86–103.

31. Hernandez-Aramburo, C. A., Green, T.C., Mugniot, N. 2005. Fuel Consumption Minimization of a Microgrid. *IEEE Transactions on Industry Applications*, 41(3), 673–681.

32. Clement-Nyns, K., Haesen, E., Driesen, J. 2010. The impact of Charging plug-

in hybrid electric vehicles on a residential distribution grid. *IEEE Transaction on Power System.* 25(1), 371–380.

33. Procter, R.J. 2013. Integrating Time-Differentiated Rates, Demand Response, and Smart Grid to Manage Power System Costs. *The Electricity Journal*, 26(3), 50–60.
34. Casey, C., Jones, K.B. 2013. Customer-Centric Leadership in Smart Grid Implementation: Empowering Customers to Make Intelligent Energy Choices. *The Electricity Journal*, 26(7), 98–110.
35. Broeer, T., Fuller, J., Tuffner, F., Chassin, D., Djilali, N. 2014. Modeling framework and validation of a smart grid and demand response system for wind power integration. *Applied Energy*, 113, 199–207.
36. Ipakchi, A. 2012. Issues, challenges and opportunities for utilization of demand-side resources in support of power system operations. *2012 IEEE PES Innovative Smart Grid Technologies (ISGT)*, 1–1.
37. Wu, H., Al-Abdulwahab, A., Shahidehpour, M. 2013. Hourly demand response in day-ahead scheduling for managing the variability of renewable energy. *IET Generation, Transmission & Distribution*, 7(3), 226–234.
38. Garcia-Valle, R., da Silva, L.C.P., Xu, Z., Ostergaard, J. 2009. Smart demand for improving short-term voltage control on distribution networks. *IET Generation, Transmission & Distribution*, 3(8), 724.
39. Grünewald, P., Torriti, J. 2013. Demand response from the non-domestic sector: Early UK experiences and future opportunities. *Energy Policy*, 61, 423–429.
40. Rastegar, M., Fotuhi-Firuzabad, M., Choi, J. 2014. Investigating the impacts of different price-based demand response programs on home load management. *Journal. Electrical. Engineering. Technology,* 9(3), 1125–1131
41. Papagiannis, G., Dagoumas, A., Lettas, N., Dokopoulos, P. 2008. Economic and environmental impacts from the implementation of an intelligent demand side management system at the European level. *Energy Policy*, 36(1), 163–180.
42. Medina, J., Muller, N., Roytelman, I. 2010. Demand response and distribution grid operations: Opportunities and challenges. *IEEE Transaction on Smart Grid*, 1(2), 193–198.
43. Doolla, S., Nunna, H.S.V.S.K. 2012. Demand Response in Smart Distribution System With Multiple Microgrids, *IEEE Transactions on Smart Grid*, 1–9.

44. Strbac, G. 2008. Demand side management: Benefits and challenges. *Energy Policy*, 36(12), 4419–4426.

45. Darby, S.J., Mckenna, E. 2012. Social implications of residential demand response in cool temperate climates. *Energy Policy*, 49, 759–769.

46. Chao, H. 2010. Price-Responsive Demand Management for a Smart Grid World. *Electricity Journal*, 23, 7–20.

47. Strengers, Y. 2012. Peak electricity demand and social practice theories: Reframing the role of change agents in the energy sector. *Energy Policy*, 44, 226–234.

48. Kinhekar, N., Prasad, N., Om, H. 2014. Electrical Power and Energy Systems Multiobjective demand side management solutions for utilities with peak demand deficit. *International Journal of Electrical Power and Energy Systems*, 55, 612–619.

49. Stein, E., Carrigan, B., Deese, A.S., Klein, E. 2013. Automation of residential load in power distribution systems with focus on demand response. *IET Generation, Transmission & Distribution*, 7(4), 357–365.

50. Faria, P., Soares, T., Vale, Z., Morais, H. 2014. Distributed generation and demand response dispatch for a virtual power player energy and reserve provision. *Renewable Energy*, 66, 686–695.

51. Karnouskos, S. 2011. Demand Side Management via Prosumer Interactions in a Smart City Energy Marketplace. *2011 2nd IEEE PES International Conference and Exhibition on Innovative Smart Grid Technologies*, 1–7.

52. Lim, K.-M., Lim, S.-Y., Yoo, S.-H. 2014. Short- and long-run elasticities of electricity demand in the Korean service sector. *Energy Policy*, 67, 517–521.

53. Poudineh, R., Jamasb, T. 2014. Distributed generation, storage, demand response and energy efficiency as alternatives to grid capacity enhancement. *Energy Policy*, 67, 222–231.

54. Driscoll, Á., Lyons, S., Mariuzzo, F., Tol, R.S.J. 2013. Simulating demand for electric vehicles using revealed preference data. *Energy Policy*, 62, 686–696.

55. Falsafi, H., Zakariazadeh, A., Jadid, S. 2014. The role of demand response in single and multi-objective wind-thermal generation scheduling: A stochastic programming. *Energy*, 64, 853–867

56. Paulus, M., Borggrefe, F. 2011. The potential of demand-side management in energy-intensive industries for electricity markets in Germany. *Applied Energy*,

88(2), 432–441.

57. Yousefi, A., Nguyen, T.T., Zareipour, H., Malik, O.P. 2012 Congestion management using demand response and FACTS devices. *International Journal of Electrical Power & Energy Systems*, 37(1), 78–85.

58. Gyamfi, S., Krumdieck, S. 2012. Scenario analysis of residential demand response at network peak periods. *Electric Power Systems Research*, 93, 32–38.

59. Baharlouei, Z., Hashemi, M., Narimani, H., Mohsenian-Rad, H. 2013. Achieving Optimality and Fairness in Autonomous Demand Response: Benchmarks and Billing Mechanisms. *IEEE Transactions on Smart Grid*, 4(2), 968–975.

60. Wang, J., Bloyd, C.N., Hu, Z., Tan, Z. 2010. Demand response in China. *Energy*, 35(4), 1592–1597.

61. Mahmoudi, N., Saha, T.K., Eghbal, M. 2014. A new demand response scheme for electricity retailers. *Electric Power Systems Research*, 108, 144–152.

62. Qureshi, J.A., Gul, M., Faruqi, M.A., Qureshi, W.A. 2012. Intelligent Demand Management for End User Benefits. *IEEE PES International Conference and Exhibition on Innovative Smart Grid Technologies*, 1–7

63. Fathi, M., Bevrani, H. 2013 Adaptive energy consumption scheduling for connected microgrids under demand uncertainty. IEEE Transaction on Power Delivery, 28(3), 1576–1583.

64. Gyamfi, S., Krumdieck, S., Urmee, T. 2013. Residential peak electricity demand response—Highlights of some behavioural issues. *Renewable and Sustainable Energy Reviews*, 25, 71–77.

65. Dupont, B., De Jonghe, C., Olmos, L., Belmans, R. 2014. Demand response with locational dynamic pricing to support the integration of renewables. *Energy Policy*, 67, 344–354.

66. Denholm, P., Short, W. 2006. An Evaluation of Utility System Impacts and Benefits of Optimally Dispatched Plug-In Hybrid Electric Vehicles. *NREL Report noTP-620*

67. Sufen, T., Youbing, Z., Jun, Q. 2012. Impact of electric vehicles as interruptible load on economic dispatch incorporating wind power. *International Conference on Sustainable Power Generation and Supply (SUPERGEN 2012)*, (1), 117–117.

68. Talebizadeh, E., Rashidinejad, M., Abdollahi, A. 2014. Evaluation of plug-in

electric vehicles impact on cost-based unit commitment. *Journal of Power Sources*, 248, 545–552.

69. Lee, S.-J., Kim, J.-H., Kim, D.-U., Go, H.-S., Kim, C.-H., Kim, E.-S., Kim, S.-K. 2014. Evaluation of Voltage Sag and Unbalance due to the System Connection of Electric Vehicles on Distribution System. *Journal of Electrical Engineering and Technology*, 9(2), 452–460.

70. Hennings, W., Mischinger, S., Linssen, J. 2013. Utilization of excess wind power in electric vehicles. *Energy Policy*, 62, 139–144.

71. Hartmann, N., Özdemir, E.D. 2011. Impact of different utilization scenarios of electric vehicles on the German grid in 2030. *Journal of Power Sources*, 196(4), 2311–2318.

72. Baumhefner, M., Pike, E., Klugescheid, A. 2013. Plugging Vehicles into Clean Energy. *The Electricity Journal*, 26(3), 72–80.

73. Jenkins, S.D., Rossmaier, J.R., Ferdowsi, M. 2008. Utilization and effect of plug-in hybrid electric vehicles in the United States power grid. *IEEE Vehicle Power and Propulsion Conference*,1-6

74. Xi, J., Li, M., Xu, M. 2014. Optimal energy management strategy for battery powered electric vehicles. *Applied Energy*, 134, 332–341.

75. Camus, C., Silva, C.M., Farias, T.L., Esteves, J. 2009. Impact of Plug-in Hybrid Electric Vehicles in the Portuguese electric utility system. *2009 International Conference on Power Engineering, Energy and Electrical Drives*, 285–290.

76. Yao, Y., Gao, D.W. 2013. Charging load from large-scale plug-in hybrid electric vehicles: Impact and optimization. 2013 *IEEE PES Innovative Smart Grid Technologies Conference (ISGT)*, 1–6.

77. Masoum, M.A.S., Moses, P.S., Smedley, K.M. 2011. Distribution transformer losses and performance in smart grids with residential plug-in electric vehicles. *IEEE PES Innovative Smart Grid Technologies Conference Europe, ISGT Europe*. 1–7.

78. Wu, D., Aliprantis, D., Gkritza, K. 2011. Electric energy and power consumption by light-duty plug-in electric vehicles. *IEEE transactions on power systems*, 26(2), 738–746.

79. Mohsenian-Rad, H., Ghamkhari, M. 2015. Optimal Charging of Electric Vehicles With Uncertain Departure Times: A Closed-Form Solution. *IEEE Transactions on Smart Grid*, 6(2), 940–942.

80. Zakariazadeh, A., Jadid, S., Siano, P. 2014. Multi-objective scheduling of electric vehicles in smart distribution system. *Energy Conversion and Management*, 79, 43–53.

81. Sundstrom, O., Binding, C. 2012. Flexible charging optimization for electric vehicles considering distribution grid constraints. *IEEE Transactions on Smart Grid*, 3(1), 26–37.

82. Richardson, D.B. 2013. Electric vehicles and the electric grid: A review of modeling approaches, Impacts, and renewable energy integration. *Renewable and Sustainable Energy Reviews*, 19, 247–254.

83. Wang, J., Liu, C., Ton, D., Zhou, Y., Kim, J., Vyas, A. 2011. Impact of plug-in hybrid electric vehicles on power systems with demand response and wind power. *Energy Policy,* 39, 4016–4021.

84. Collin, A.J., Hernando-Gil, I., Acosta, J.L., Ilie, I.S., Djokic, S.Z. 2011. Realising the potential of smart grids in LV networks. Part 1: Demand-side management. *IEEE PES Innovative Smart Grid Technologies Conference Europe*. 1–7.

85. Keirstead, J., Jennings, M., Sivakumar, A. 2012. A review of urban energy system models: Approaches, challenges and opportunities. *Renewable and Sustainable Energy Reviews*, 16(6), 3847–3866.

86. Mah, D.N., Marinus, J., Vleuten, V. Der, Hills, P., Tao, J. 2012. Consumer perceptions of smart grid development : Results of a Hong Kong survey and policy implications. *Energy Policy*, 49, 204–216.

87. Byun, J., Hong, I., Kang, B., Park, S. 2011. A smart energy distribution and management system for renewable energy distribution and context-aware services based on user patterns and load forecasting. *IEEE Transactions on Consumer Electronics*, 57(2), 436–444.

88. Amin, M. 2008. Challenges in reliability, security, efficiency, and resilience of energy infrastructure: toward smart self-healing electric power grid. *2008 IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century*, 1–5.

89. Zareen, N., Mustafa, M.W., Gizi, A.J.H. Al, Alsaedi, M.A. 2012. Worldwide Technological Revolutions and Its Challenges under Smart Grid Paradigm : A Comprehensive Study. *International Journal of Scientific & Engineering Research*, 3(11), 2229-5518.

90. Soliman Qudaih, Y., Mitani, Y. 2011. Power Distribution System Planning for Smart Grid Applications using ANN. *Energy Procedia*, 12, 3–9.

91. Fadaeenejad, M., Saberian, a. M., Fadaee, M., Radzi, M. a. M., Hizam, H., AbKadir, M.Z. a. 2014. The present and future of smart power grid in developing countries. *Renewable and Sustainable Energy Reviews*, 29, 828–834.

92. IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads. *IEEE Std 2030-2011 (IEEE)*. ISBN 9780738167282.

93. Samadi, P., Mohsenian-Rad, H., Wong, V.W.S., Schober, R. 2013. Tackling the load uncertainty challenges for energy consumption scheduling in smart grid. IEEE Transactions on Smart Grid, 4(2), 1007–1016 .

94. Ruihua, Z.R.Z., Yumei, D.Y. Du, Liu, Y.L.Y. 2010. New challenges to power system planning and operation of smart grid development in China. *Power System Technolology (POWERCON), 2010 Int. Conf.* 1–8.

95. Dagdougui, H., Sacile, R. 2013. Decentralized Control of the Power Flows in a Network of Smart Microgrids Modeled as a Team of Cooperative Agents. *IEEE Transactions on Control Systems Technology*, 1–1.

96. Zeng, Z., Zhao, R., Yang, H., Tang, S. 2014. Policies and demonstrations of micro-grids in China: A review. *Renewable and Sustainable Energy Reviews*, 29, 701–718.

97. Farzan, F., Lahiri, S., Kleinberg, M., Gharieh, K., Farzan, F., Jafari, M. 2013. Microgrids for fun and profit: The economics of installation investments and operations. *IEEE Power Energy Management.* 11, 52–58.

98. Bracco, S., Delfino, F., Pampararo, F., Robba, M., Rossi, M. 2014. A mathematical model for the optimal operation of the University of Genoa Smart Polygeneration Microgrid: Evaluation of technical, economic and environmental performance indicators. *Energy*, 64, 912–922.

99. Xiao, Z., Wu, J., Jenkins, N. 2013. An overview of microgrid control. *Soft Computing*, 3,37–41.

100. Logenthiran, T., Srinivasan, D., Khambadkone, A.M. 2011. Multi-agent system for energy resource scheduling of integrated microgrids in a distributed system. *Electric Power Systems Research*, 81(1), 138–148.

101. Zhang, Y., Gatsis, N., Giannakis, G.B. 2013. Robust energy management for microgrids with high-penetration renewables. *IEEE Transaction on Sustain. Energy*, 4, 944–953.

102. Jiang, B., Fei, Y. 2011. Dynamic Residential Demand Response and Distributed Generation Management in Smart Microgrid with Hierarchical Agents. *Energy Procedia*, 12, 76–90.

103. Kumar Nunna, H.S.V.S., Doolla, S. 2013. Energy Management in Microgrids Using Demand Response and Distributed Storage—A Multiagent Approach. *IEEE Transactions on Power Delivery*, 28(2), 939–947.

104. Lidula, N.W.A., Rajapakse, A.D. 2011. Microgrids research: A review of experimental microgrids and test systems. *Renewable and Sustainable Energy Reviews*, 15(1), 186–202.

105. Millar, R.J., Kazemi, S., Lehtonen, M., Saarijärvi, E. 2012 Impact of MV connected microgrids on MV distribution planning. *IEEE Transactions on. Smart Grid*, 3(4), 2100–2108.

106. Ahn, S.-J., Nam, S.-R., Choi, J.-H., Moon, S.-I. 2013. Power Scheduling of Distributed Generators for Economic and Stable Operation of a Microgrid. *IEEE Transactions on Smart Grid*, 4(1), 398–405.

107. Goleijani, S., Ghanbarzadeh, T., Sadeghi Nikoo, F., Parsa Moghaddam, M. 2013. Reliability constrained unit commitment in smart grid environment. *Electric Power Systems Research*, 97, 100–108.

108. Lasseter, R.H. 2011. Smart distribution: Coupled microgrids. *Proceedings of the IEEE*, 99(6), 1074–1082.

109. Su, W., Yuan, Z., Chow, M.Y. 2010 Microgrid planning and operation: Solar energy and wind energy. *IEEE PES General Meeting, PES 2010,* 1–7 .

110. Shafiullah, G.M., Shawkat Ali, B.M., Wolfs, P. 2013. Potential challenges of integrating large-scale wind energy into the power grid–A review. *Renewable and Sustainable Energy Reviews*, 20, 306–321.

111. Mohammed, Y.S., Mustafa, M.W., Bashir, N. 2014. Hybrid renewable energy systems for off-grid electric power : Review of substantial issues. Renewable *and Sustainable Energy Reviews*, 35, 527–539.

112. Passey, R., Spooner, T., MacGill, I., Watt, M., Syngellakis, K. 2011. The potential impacts of grid-connected distributed generation and how to address them: A review of technical and non-technical factors. *Energy Policy*, 39(10),

6280–6290.

113. Saad, W., Han, Z., Poor, H.V., Başar, T. 2012. Game-theoretic methods for the smart grid: An overview of microgrid systems, demand-side management, and smart grid communications. *IEEE Signal Process. Mag*, 29, 86–105.

114. Nunna, H.S.V.S.K., Doolla, S. 2011. Demand response in smart microgrids. *2011 IEEE PES International Conference on Innovative Smart Grid Technologies-India, ISGT India 2011*. 131–136.

115. Ahn, C., Peng, H. 2013. Decentralized Voltage Control to Minimize Distribution Power Loss of Microgrids. *IEEE Transactions on. Smart Grid,* 4, 1297–1304.

116. Wu, T., Yang, Q., Bao, Z., Yan, W. 2013. Coordinated Energy Dispatching in Microgrid With Wind Power Generation and Plug-in Electric Vehicles. *IEEE Transactions on Smart Grid*, 4(3), 1453–1463.

117. Bayod-Rújula, A. a. 2009. Future development of the electricity systems with distributed generation. *Energy*, 34(3), 377–383.

118. Richardson, P., Flynn, D., Keane, A. 2012. Optimal charging of electric vehicles in low-voltage distribution systems. IEEE Transactions on Power System, 27(1), 268–279.

119. Shao, S., Pipattanasomporn, M., Rahman, S. 2011. Demand Response as a Load Shaping Tool in an Intelligent Grid With Electric Vehicles. *IEEE Transactions on Smart Grid*, 2(4), 624–631.

120. Hoang, B., 2012. Plug-in Hybrid Electric Vehicles (PHEVs) _ IA-HEV.pdf. , pp.1–3. Available at: http://www.ieee.org/go/emergingtech.

121. Clement, K., Haesen, E., Driesen, J. 2009. Coordinated charging of multiple plug-in hybrid electric vehicles in residential distribution grids. *2009 IEEE/PES Power Systems Conference and Exposition, PSCE 2009.* 1–7.

122. Rutherford, M.J., Yousefzadeh, V. 2011. The impact of Electric Vehicle battery charging on distribution transformers. *2011 Twenty-Sixth Annu. IEEE Appl. Power Electron. Conf. Expo.* 396–400.

123. Shortt, A., O'Malley, M. 2014. Quantifying the long-term impact of electric vehicles on the generation Portfolio. *IEEE Transactions on Smart Grid*, 5, 71–83.

124. García-Villalobos, J., Zamora, I., San Martín, J.I., Asensio, F.J., Aperribay, V. 2014. Plug-in electric vehicles in electric distribution networks: A review of

smart charging approaches. *Renewable and Sustainable Energy Reviews*, 38, 717–731.

125. Liu, H., Hu, Z., Song, Y., Lin, J. 2013 Decentralized vehicle-to-grid control for primary frequency regulation considering charging demands. *IEEE Transactions on Power System*, 28, 3480–3489.

126. Roche, M.Y., Mourato, S., Fischedick, M., Pietzner, K., Viebahn, P. 2010. Public attitudes towards and demand for hydrogen and fuel cell vehicles: A review of the evidence and methodological implications, *Energy Policy*, 38, 5301–5310.

127. Bevis, T., Hacker, B., Edrington, C.S., Azongha, S. 2009. A review of PHEV grid impacts. *41st North American Power Symposium, NAPS 2009*.1-6

128. Pillai, J.R., Bak-Jensen, B. 2010. Impacts of electric vehicle loads on power distribution systems. *2010 IEEE Vehicle Power and Propulsion Conference*, 1–6.

129. Leou, R.-C., Su, C.-L., Lu, C.-N. 2013 Stochastic Analyses of Electric Vehicle Charging Impacts on Distribution Network. *IEEE Transactions on Power System*, 29, 1055–1063.

130. Schulze, M., Member, S., Riveros, J.Z. 2010. Impact of Electrical Vehicles on Strategic Planning of Energy Infrastructure. *IEEE International Conference on Power System Technology*,1-7

131. Putrus, G.A., Suwanapingkarl, P., Johnston, D., Bentley, E.C., Narayana, M. 2009. Impact of electric vehicles on power distribution networks. *2009 IEEE Veh. Power Propuls. Conf.* 1618–1622.

132. Pieltain Fernández, L., Gómez San Román, T., Cossent, R., Mateo Domingo, C., Frías, P. 2011. Assessment of the impact of plug-in electric vehicles on distribution networks. *IEEE Transactions on Power System*, 26, 206–213.

133. Zhang, C., Huang, Q., Tian, J., Chen, L., Cao, Y., Zhang, R. 2011. Smart Grid Facing the New Challenge: The Management of Electric Vehicle Charging Loads. *Energy Procedia*, 12, 98–103.

134. Rutherford, M.J. 2011. The Impact of Electric Vehicle Battery Charging on Distribution Transformers. *2011 Twenty-Sixth Annual IEEE Applied Power Electronics Conference and Exposition (APEC)*. pp. 396–400 .

135. Tushar, W., Saad, W., Poor, H.V., Smith, D.B. 2012. Economics of electric vehicle charging: A game theoretic approach. *IEEE Transactions on Smart*

Grid, 3, 1767–1778.

136. Farmer, C., Hines, P., Dowds, J., Blumsack, S. 2010. Modeling the Impact of Increasing PHEV Loads on the Distribution Infrastructure. *2010 43rd Hawaii International Conference on System Sciences*, 1–10.

137. Taylor, J., Maitra, A., Alexander, M., Brooks, D., Duvall, M. 2010. Evaluations of plug-in electric vehicle distribution system impacts. *IEEE PES General Meeting*, 1–6.

138. Rahman, S., Shrestha, G.B. 1993. An investigation into the impact of electric vehicle load on the electric utility distribution system. I *IEEE Transactions on Power Delivery*, 8(2), 591–597.

139. Paudyal, S., Dahal, S. 2011. Impact of Plug-in Hybrid Electric Vehicles and Their Optimal Deployment in Smart Grids. *Proceedings of the AUPEC 2011*.

140. Haidar, A.M.A., Muttaqi, K.M., Sutanto, D. 2014. Technical challenges for electric power industries due to grid-integrated electric vehicles in low voltage distributions: A review. *Energy Conversion and Management*, 86, 689–700.

141. Hota, A.R., Juvvanapudi, M., Bajpai, P. 2014. Issues and solution approaches in PHEV integration to smart grid. *Renewable and Sustainable Energy Reviews*, 30, 217–229.

142. Putrus, G.A., Suwanapingkarl, P., Johnston, D., Bentley, E.C., Narayana, M. 2009. Impact of electric vehicles on power distribution networks. *2009 IEEE Veh. Power Propuls. Conf.* 827–831.

143. Sortomme, E., El-Sharkawi, M. a. 2011. Optimal Charging Strategies for Unidirectional Vehicle-to-Grid. *IEEE Transactions on Smart Grid*, 2(1), 131–138.

144. Sortomme, E., El-Sharkawi, M. a. 2012. Optimal Scheduling of Vehicle-to-Grid Energy and Ancillary Services. *IEEE Transactions on Smart Grid*, 3(1),, 351–359 .

145. Taylor, J., Maitra, a., Alexander, M., Brooks, D., Duvall, M. 2009. Evaluation of the impact of plug-in electric vehicle loading on distribution system operations. *2009 IEEE Power & Energy Society General Meeting*, 1–6.

146. Papadopoulos, P., Jenkins, N., Cipcigan, L.M., Grau, I., Zabala, E. 2013 Coordination of the Charging of Electric Vehicles Using a Multi-Agent System. *IEEE Transactions on Smart Grid*, 4(4), 1802–1809.

147. Siano, P. 2014. Demand response and smart grids - A survey, *Renewable and*

Sustainable Energy Reviews, 30, 461–478.

148. Ali, M., Zaidi, Z.A., Zia, Q., Haider, K., Ullah, A., Asif, M. 2012. Intelligent Load Management Scheme for a Residential Community in Smart Grids Network Using Fair Emergency Demand Response Programs, *Energy and Power Engineering*, 04, 339–348.

149. Siano, P. 2014. Demand response and smart grids—A survey. *Renewable and Sustainable Energy Reviews*, 30, 461–478.

150. Senate and House of Representatives of the United States of America, 2005. *Energy policy act of 2005*, 1-151

151. Prüggler, N. 2013. Economic potential of demand response at household level—Are Central-European market conditions sufficient? *Energy Policy*, 60, 487–498 .

152. Vassileva, I., Wallin, F., Dahlquist, E. 2012. Understanding energy consumption behavior for future demand response strategy development. *Energy*, 46, 94–100.

153. Muratori, M., Schuelke-Leech, B.-A., Rizzoni, G. 2014. Role of residential demand response in modern electricity markets. *Renewable and Sustainable Energy Reviews*, 33, 546–553.

154. Nuno, P. 2011. Demand Response in future power systems management – A conceptual framework and simulation tool.

155. Cappers, P., Mills, A., Goldman, C., Wiser, R., Eto, J.H. 2012. An assessment of the role mass market demand response could play in contributing to the management of variable generation integration issues. *Energy Policy*, 48, 420–429 .

156. Li, S., Zhang, D., Roget, A.B., O'Neill, Z. 2013. Integrating Home Energy Simulation and Dynamic Electricity Price for Demand Response Study. *IEEE Trans. Smart Grid*. 5, 779–788 .

157. Dave, S., Sooriyabandara, M., Yearworth, M. 2013. System behaviour modelling for demand response provision in a smart grid. *Energy Policy*, 61, 172–181.

158. Borlick, R. 2011. Paying for Demand-Side Response at the Wholesale Level: The Small Consumers' Perspective. *Electricity. Journal.* 24, 8–19.

159. Choi, S., Park, S., Kang, D., Han, S., Kim, H. 2011. Inducing Optimal Demand Response. *IEEE International Conference on Smart Grid Communications*

SmartGridComm. pp. 19–24.

160. Thiruvedhi, C.P.T., Sankaramoorthy, S.N., Venkataramani, G., Suresh, S. 2011. Demand response: A decisive approach for regulated market. 2*011 IEEE PES International Conference on Innovative Smart Grid Technologies-India, ISGT India 2011*, 187–197.

161. Yanine, F.F., Sauma, E.E. 2013. Review of grid-tie micro-generation systems without energy storage: Towards a new approach to sustainable hybrid energy systems linked to energy efficiency. *Renewable and Sustainable Energy Reviews*, 26, 60–95 .

162. Storey, H.L. 2011. Implementing an integrated centralized model-based distribution management system. *2011 IEEE Power and Energy Society General Meeting*, 1–2..

163. Tsikalakis, A.G., Hatziargyriou, N.D. 2008. Centralized control for optimizing microgrids operation. *IEEE Transactions on Energy Converstion*, 23, 241–248.

164. Vrettos, E., Oldewurtel, F., Vasirani, M., Andersson, G. 2013. Centralized and decentralized balance group optimization in electricity markets with demand response, 2*013 IEEE Grenoble Conference*,1–6.

165. Lu, S., Samaan, N., Diao, R., Elizondo, M., Jin, C., Mayhorn, E., Zhang, Y., Kirkham, H. 2011. Centralized and decentralized control for demand response. *ISGT 2011*, pp. 1–8.

166. Alwakeel, S.S., Alhussein, M. A., Ammad-uddin, M. 2013. Performance analysis of centralized, distributed and hybrid demand load control architecture for smart power grid. *IEEE International Conference on Electro-Information Technology , EIT 2013*, 1–6

167. Arai, R., Yamamoto, K., Morikura, M. 2013. Differential game-theoretic framework for a demand-side energy management system. *2013 IEEE International Conference on Smart Grid Communications (SmartGridComm)*, 768–773.

168. Chen, Y., Lin, W.S., Han, F., Yang, Y.-H., Safar, Z., Liu, K.J.R. 2012. A cheat-proof game theoretic demand response scheme for smart grids, *IEEE International Conference on Communications (ICC)*,3362–3366.

169. Bu, S., Yu, F.R., Liu, P.X. 2011. Dynamic pricing for demand-side management in the smart grid. *2011 IEEE Online Conference on Green Communications*, 47–51.

170. Saebi, J. 2013. Implementation of Demand Response in Different Control Strategies of Smart Grids. *IEEE International Conference on Communications*,61-67.

171. Abdollahi, A., Parsa Moghaddam, M., Rashidinejad, M., Sheikh-El-Eslami, M.K. 2012. Investigation of Economic and Environmental-Driven Demand Response Measures Incorporating UC. *IEEE Transactions on Smart Grid*, 3(1), 12–25 .

172. Pillai, J. 2010. Electric vehicle based battery storages for large scale wind power integration in Denmark.

173. Faria, P., Vale, Z. 2011. Demand response in electrical energy supply: An optimal real time pricing approach. *Energy*, 36(8), 5374–5384.

174. Logenthiran, T., Srinivasan, D., Shun, T.Z. 2012. Demand Side Management in Smart Grid Using Heuristic Optimization. *IEEE Transaction on Smart Grid*, 3, 1244–1252.

175. Conejo, A.J., Morales, J.M., Baringo, L. 2010. Real-Time Demand Response Model. *IEEE Transactions on Smart Grid*, 1(3), 236–242.

176. Chen, C., Nagananda, K.G., Xiong, G., Kishore, S., Snyder, L. V. 2013. A Communication-Based Appliance Scheduling Scheme for Consumer-Premise Energy Management Systems. *IEEE Transactions on Smart Grid*, 4(1), 56–65 (2013).

177. Xiao-hong, Z. 2009. Electricity Demand Side Management and its Different Promotion Measures. *EIT 2013*, 1-6.

178. Ravindra, K., Iyer, P.P. 2014. Decentralized demand–supply matching using community microgrids and consumer demand response: A scenario analysis. *Energy*, 76, 32–41 179.

179 Fakham, H., Colas, F., Guillaud, X. 2011. Real-time simulation of multi-agent system for decentralized voltage regulation in distribution network. *2011 IEEE Power and Energy Society General Meeting*, 1–7.

180. Luo, T.L.T., Ault, G., Galloway, S. 2010. Demand Side Management in a highly decentralized energy future. *2010 45th International Universities Power Engineering Conference (UPEC)*, 1-7.

181. Valenzuela, J., Thimmapuram, P.R., Kim, J. 2012. Modeling and simulation of consumer response to dynamic pricing with enabled technologies. *Applied Energy*, 96, 122–132 .

182. Sioshansi, R. 2010. Evaluating the impacts of real-time pricing on the cost and value of wind generation. IEEE Transaction on Power System, 25(1), 741–748.

183. Roscoe, A., Ault, G. 2010. Supporting high penetrations of renewable generation via implementation of real-time electricity pricing and demand response. *IET Renewable Power Generation*, 369–382.

184. Wei, W., Liu, F., Mei, S., Member, S. 2014. Energy Pricing and Dispatch for Smart Grid Retailers Under Demand Response and Market Price Uncertainty, *IEEE Transaction on Smart Grid*, 6,1–11.

185. Thiam, D.R. 2011. An energy pricing scheme for the diffusion of decentralized renewable technology investment in developing countries. *Energy Policy*, 39(7), 4284–4297.

186. Bai, L., Xu, G. 2014. A Game Theoretical Approach to Modeling Energy Consumption with Consumer Preference. *IEEE International Conference on Smart Grid Communications*, 1–6 .

187. Belhaiza, S., Baroudi, U. 2014. A Game Theoretic Model for Smart Grids Demand Management. *IEEE Transactions on Smart Grid*, 1–1.

188. Chakraborty, P. 2014. A Demand Response Game and its Robust Price of Anarchy *. 2014 *IEEE International Conference on Smart Grid Communications (SmartGridComm)*, 644–649.

189. Li, R., Wu, Q., Oren, S.S. 2014. Distribution Locational Marginal Pricing for Optimal Electric Vehicle Charging Management. *IEEE Transactions on Power Systems*, 29(1), 203–211.

190. Vlachos, A.G., Biskas, P.N. 2013. Demand Response in a Real-Time Balancing Market Clearing With Pay-As-Bid Pricing. *IEEE Transactions on Smart Grid*, 4(4), 1966–1975 (2013).

191. Bahrami, S., Parniani, M.N.I.S. 2014. Game Theoretic Based Charging Strategy for Plug-in Hybrid Electric Vehicles. *IEEE Transactions on Smart Grid*, 5(5), 2368–2375.

192. Couillet, R., Perlaza, S.M., Tembine, H., Debbah, M. 2012. Electrical Vehicles in the Smart Grid: A Mean Field Game Analysis. *IEEE Journal on Selected Areas in Communications*, 30(6), 1086–1096.

193. Hämäläinen, R.P., Mäntysaari, J., Ruusunen, J., Pierre-Olivier Pineau. 2000. Cooperative consumers in a deregulated electricity market - dynamic consumption strategies and price coordination. *Energy*, 25, 857–875.

194. Sun, D., Zheng, J., Zhang, T., Zhang, Z., Liu, H., Zhao, F., Qiu, Z. 2010. The Utilization and Development Strategies of Smart Grid and New Energy. *2014 IEEE International Conference on Smart Grid Communications,*1-4.

195. Harikumaran, J. 2012. Sizing and Charge Control Strategies for a Grid-Connected Micro-grid with Electric Vehicles.

196. Wang, J., Zhou, Z., Botterud, A. 2011. An evolutionary game approach to analyzing bidding strategies in electricity markets with elastic demand. *Energy*, 36(5), 3459–3467.

197. Dursun, E., Kilic, O. 2012. Electrical Power and Energy Systems Comparative evaluation of different power management strategies of a stand-alone PV / Wind / PEMFC hybrid power system. *International Journal of Electrical Power and Energy Systems*, 34(1), 81–89.

198. Stroehle, P., Becher, S., Lamparter, S., Schuller, A., Weinhardt, C. 2011. The impact of charging strategies for electric vehicles on power distribution networks. *2011 8th International Conference on the European Energy Market (EEM)*, 51–56.

199. Khan, H.A., Xu, Z.X.Z., Iu, H., Sreeram, V. 2009. Review of technologies and implementation strategies in the area of Smart Grid, 1–6.

200. Amoroso, F.A., Cappuccino, G. 2011. Potentiality of variable-rate PEVs charging strategies for smart grids. *2011 IEEE PES Trondheim PowerTech: The Power of Technology for a Sustainable Society, POWERTECH 2011*, 1–6.

201. Lu, S., Elizondo, M.A., Samaan, N., Kalsi, K., Mayhorn, E., Diao, R., Jin, C., Zhang, Y. 2011. Control strategies for distributed energy resources to maximize the use of wind power in rural microgrids. *IEEE Power and Energy Society General Meeting*, 1–8.

202. Arefifar, S.A., Mohamed, Y.A.R.I., El-Fouly, T.H.M. 2013. Optimum microgrid design for enhancing reliability and supply-security. *IEEE Transaction on Smart Grid*, 4, 1567–1575.

203. Abido, M. a., Al-Ali, N. a. 2012. Multi-Objective Optimal Power Flow Using Differential Evolution. *Arabian Journal for Science and Engineering*, 37(4), 991–1005.

204. Greening, L.A. 2010. Demand response resources : Who is responsible for implementation in a deregulated market ? *Energy*, 35, 1518–1525.

205. O'Mahoney, A., Denny, E. 2013. Electricity prices and generator behaviour in

gross pool electricity markets. *Energy Policy*, 63, 628–637.

206. Zibelman, A., Krapels, E. 2008. Deployment of demand response as a real-time resource in organized markets. *The Electricity Journal*, 21(5), 51–56.

207. Dhillon, J., Kumar, A., Singal, S.K. 2014. Optimization methods applied for Wind–PSP operation and scheduling under deregulated market: A review. *Renewable and Sustainable Energy Reviews*, 30, 682–700.

208. Lee, K.-H. 2014. Strategy Equilibrium in Stackelberg Model with Transmission Congestion in Electricity Market. *Journal of Electrical Engineering and Technology*, 9(1), 90–97

209. Wu, C., Wen, F., Lou, Y. 2008. The existed problems and possible solutions of micro-grid based on distributed generation. *DRPT2008 Nanjing China*, 2763–2768.

210. Wu, H., Shahidehpour, M., Khodayar, M.E. 2013. Hourly Demand Response in Day-Ahead Scheduling Considering Generating Unit Ramping Cost. *IEEE Transactions on Power Systems*, 28(3), 2446–2454.

211. Qian, L.P., Jun, Y., Zhang, A., Member, S.: Demand Response Management via Real-Time Electricity Price Control in Smart Grids. *Energy*, 31(7), 1268–1280.

212. Mohsenian-Rad, A.H., Leon-Garcia, A. 2010. Optimal residential load control with price prediction in real-time electricity pricing environments. *IEEE Transactions on Smart Grid*, 1(2), 120–133.

213. Yousefi, S., Moghaddam, M.P., Majd, V.J. 2011. Optimal real time pricing in an agent-based retail market using a comprehensive demand response model. *Energy*, 36(9), 5716–5727.

214. Mohsenian-Rad, H., Davoudi, A. 2014. Towards Building an Optimal Demand Response Framework for DC Distribution Networks. *IEEE Transactions on Smart Grid*, 5(5), 2626–2634.

215. Çelebi, E., Fuller, J.D.: Time-of-use pricing in electricity markets under different market structures. IEEE Trans. Power Syst. 27, 1170–1181 (2012).

216. Ehlen, M. a., Scholand, A.J., Stamber, K.L. 2007. The effects of residential real-time pricing contracts on transco loads, pricing, and profitability: Simulations using the N-ABLE^{TM} agent-based model. *Energy Econ*. 29, 211–227.

217. Strengers, Y. 2010. Air-conditioning Australian households : The impact of

dynamic peak pricing. *Energy Policy*, 38(11), 7312–7322.

218. Samadi, P., Mohsenian-Rad, H., Wong, V.W.S., Schober, R. 2014. Real-Time Pricing for Demand Response Based on Stochastic Approximation. *IEEE Transactions on Smart Grid*, 5(2), 789–798.

219. Mathieu, J.L., Member, S., Callaway, D.S., Kiliccote, S. 2011. Examining Uncertainty in Demand Response Baseline Models and Variability in Automated Responses to Dynamic Pricing. *Proceedings of the IEEE Conference on Decision and Control*, 4332–4339.

220. Mahmoudi-Kohan, N., Moghaddam, M.P., Sheikh-El-Eslami, M.K. 2010. An annual framework for clustering-based pricing for an electricity retailer. *Electric Power Systems Research*, 80(9), 1042–1048.

221. Richardson, I., Thomson, M., Infield, D., Delahunty, A. 2009. A modelling framework for the study of highly distributed power systems and demand side management. *2009 International Conference on Sustainable Power Generation and Supply*, 1–6.

222. Jia, W., Kang, C., Chen, Q. 2012. Analysis on demand-side interactive response capability for power system dispatch in a smart grid framework. *Electric Power Systems Research*, 90, 11–17.

223. Han, Z., Niyato, D., Saad, W., Basar, T., Hjorungnes, A. 2011. Game Theory in Wireless and Communication Networks. *Cambridge University Press*, Cambridge.

224. Michael Spence 1973. Job Market Signaling. *The Quarterly Journal of Economics*, 87(3), 355–374.

225. Rosen, J.B. 1965. Existence and Uniqueness of Equilibrium Points for Concave N-Person Games. *Econometrica*, 33(3), 520–534.

226. Pillai, J.R. 2010. Electric Vehicle Based Battery Storages for Large Scale Wind Power Integration.

227. Seaman, A., Dao, T.S., McPhee, J. 2014. A survey of mathematics-based equivalent-circuit and electrochemical battery models for hybrid and electric vehicle simulation. *Journal of Power Sources*, 256, 410–423.

228. Wade, N.S., Taylor, P.C., Lang, P.D., Jones, P.R. 2010. Evaluating the benefits of an electrical energy storage system in a future smart grid. *Energy Policy*, 38(11), 7180–7188.

229. Taylor, J., Smith, J.W., Dugan, R. 2011. Distribution modeling requirements

for integration of PV, PEV, and storage in a smart grid environment. *2011 IEEE Power and Energy Society General Meeting*, 1–6.

230. Sharma, I. 2014. Operation of Distribution Systems with PEVs and Smart Loads.

231. Aalami, H. A., Moghaddam, M.P., Yousefi, G.R. 2010. Modeling and prioritizing demand response programs in power markets. *Electric Power Systems Research*, 80(4), 426–435.

232. Aalami, H. a., Moghaddam, M.P., Yousefi, G.R. 2010. Demand response modeling considering Interruptible/Curtailable loads and capacity market programs. *Applied Energy*, 87(1), 243–250.

233. Baboli, P.T., Moghaddam, M.P. 2010. Allocation of Network-Driven Load-Management Measures Using Multiattribute Decision Making. *IEEE Transactions on Power Delivery*, 25(3), 1839–1845.

234. Baboli, P.T., Eghbal, M., Moghaddam, M.P., Aalami, H. 2012. Customer Behavior Based Demand Response Model. *International Universities Power Engineering Conference IEEE*, 1–7.

235. Aalami, H., Yousefi, G.R., Parsa Moghadam, M. 2008 A MADM-based support system for DR programs. *2008 43rd International Universities Power Engineering Conference IEEE*, 1–7.

236. Blanco, M.I. 2009. The economics of wind energy. Renew. Sustain. *Energy Rev*. 13, 1372–1382.

237. Islam, M.R., Guo, Y., Zhu, J. 2014. A review of offshore wind turbine nacelle: Technical challenges, and research and developmental trends. *Renewable and Sustainable Energy Reviews*, 33, 161–176.

238. Mokryani, G., Siano, P. 2013. Evaluating the integration of wind power into distribution networks by using Monte Carlo simulation. *International Journal of Electrical Power & Energy Systems*, 53, 244–255.

239. Akinci, T.C., Nogay, H.S. 2012. Wind Speed Correlation Between Neighboring Measuring Stations. *Arabian Journal for Science and Engineering*, 37(4), 1007–1019.

240. Akyuz, E., Demiral, D., Coskun, C., Oktay, Z. 2012. Estimation of the Monthly Based Hourly Wind Speed Characteristics and the Generated Power Characteristics for Developing Bidding Strategies in an Actual Wind Farm: A Case Study. *Arabian Journal for Science and Engineering*, 38(2), 263–275.

241. Babar, M., Rizvi, A. a., Al-Ammar, E. a., Malik, N.H. 2014. Analytical Model of Multi-junction Solar Cell. *Arabian Journal for Science and Engineering*, 39, 547–555.

242. Awan, A.B., Khan, Z.A. 2014. Recent progress in renewable energy - Remedy of energy crisis in Pakistan. *Renewable and Sustainable Energy Reviews*, 33, 236–253.

243. Shao, S., Pipattanasomporn, M., Rahman, S.: Demand Response as a Load Shaping Tool in an Intelligent Grid With Electric Vehicles. IEEE Trans. Smart Grid. 2, 624–631 (2011).

244. Shao, S., Pipattanasomporn, M., Rahman, S. 2012. Grid Integration of Electric Vehicles and Demand Response With Customer Choice. IEEE Transactions on Smart Grid. 3, 543–550.

245. Shao, S., Pipattanasomporn, M., Rahman, S. 2009. Challenges of PHEV penetration to the residential distribution network. *2009 IEEE Power & Energy Society General Meeting*, 1–8.

246. Shao, S., Pipattanasomporn, M., Rahman, S. 2013. Development of physical-based demand response-enabled residential load models. *IEEE Transactions on Power Systems*, 28(2), 607–614.

247. Bak-Jensen, B. 2013. Optimal Operation of Plug-In Electric Vehicles in Power Systems With High Wind Power Penetrations. *IEEE Transactions on Sustainable Energy*, 4(3), 577–585.

248. Shao, S., Member, S., Zhang, T. 2010. Impact of TOU Rates on Distribution Load Shapes in a Smart Grid with PHEV Penetration. *IEEE Power & Energy Society General Meeting*,, 1-6.