TRANSITION TO A SMARTER ENERGY GRID: INSIGHT ON RESIDENTIAL ENERGY CONSUMER'S INTENTIONS TO ADOPT DEMAND SIDE MANAGEMENT AND DISTRIBUTED ENERGY RESOURCES

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ABSTRACT

Growing concerns over climate change, increasing energy demand, security and accessibility of energy supply and the socio-environmental risks following the Fukushima Daiichi nuclear disaster, have heighted the need to upgrade the currently unsustainable electrical infrastructure. As the 21st century progresses, these concerns increasingly applied social and regulatory pressure on the electric power industry to replace the traditional energy distribution paradigm. As such, the electric industry is poised to transform the current, centralized distribution network to one that allows the integration of distributed technologies into the energy infrastructure. This future electricity system is also known as smart grid, allowing the integration of information and communication technologies into the grid, which will enable a bidirectional flow of communication and electrical power between suppliers and end-users that will ultimately transform the passive residential energy consumers into active prosumers.

Moreover, it is believed by a number of researchers that the realization of the full potential of a smart grid is contingent on the residential electricity consumer's acceptance of new technologies and the behavioural changes that innately follow their implementation. As a consequence, this thesis employed a user-centric perspective in an attempt to gain an insight into the perceived and subconscious factors that drive residential electricity consumers, particularly

(but not exclusively) those with low income, towards or away from demand side management and distributed energy resources.

A consumer survey from over 200 Japanese households (43 of which are considered as low-income households) was conducted in Kashiwa-no-ha district in Kashiwa City, Japan. This revealed that there is a clear correlation between low-household income and the need to reduce energy related expenditures through energy generation and conservation practices. In contrast, the results indicate that the respondents believe that they do not have enough information or support from the utility company with respect to how they can go about implementing this type of technologies in their household. Additionally, the majority of respondents expressed their fear with respect to the cost of the implementation and maintenance of these technologies.

Further, the comparative analysis conducted by the author demonstrates that the reputation of the utility company that operates within the boundaries of Kashiwa-no-ha is higher among the respondents residing in Kashiwa-no-ha Smart City than those residing in Kashiwa-no-ha districts 1-2-3. Remarkably, the analysis also suggested that both groups ("traditional" and "smart grid" electricity users) displayed a similar score in the variable associated with the "affinity with technology".

Lastly, the K-means clustering algorithm and hierarchical cluster analysis provided the author with three heterogenous groups. Segment A included young respondents with low income, Segment B contained middle aged respondents with high income and Segment C was comprised of elderly respondents with average income. The results of the analysis indicate that while Segment A had the highest motivation to adopt new technologies, they also faced the most

barriers which prevented them from doing so. In contrast, Segment B displayed an average intention to adopt such technologies but had the least barriers that prevented them from doing so.

Key words: Smart grid, Demand side management, Distributed energy resources