APPLICATION OF DEMAND SIDE MANAGEMENT STRATEGIES TO REDUCE ENERGY CONSUMPTION IN UNIVERSITY BUILDINGS

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Dedicated to my parents for their unwavering love, patience and support.
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Demand Side Management (DSM) refers to actions that change the quantity or pattern of electrical energy consumed by end users to change its load profile. There are many available DSM measures that can be implemented, however this thesis analyses the effects of two DSM methods as strategic options to reduce energy consumption in university buildings, specifically the Faculty of Electrical Engineering at Universiti Teknologi Malaysia, Johor. The first considered option is the combination of peak clipping and load shifting, which is the process of shifting clipped peak loads away from peak periods to off-peak periods. This thesis addresses the challenge in performing peak clipping and load shifting which is determining the right time to perform peak clipping and load shifting, followed by an assessment of estimated savings in energy usage and electricity bill through these selected methods. Through careful assessment and implementation of time selection, the combined method of peak clipping and load shifting contributes up to 10% savings of energy consumption and electricity bill. Another DSM option is retrofitting which is a process that requires direct change on the existing physical or electrical system of old or already occupied buildings to achieve reduction in energy consumption and electricity bills. In this study, the potential savings by retrofitting the currently installed fluorescent T8 and T5 lighting systems with more recent LED technology in the selected buildings were examined and proved to reduce up to 64% of estimated annual energy consumption and electricity bill. Also, the payback period for which the initial investment will be recovered was evaluated to be approximately 3.03 years.
ABSTRAK

*Demand Side Management* (DSM) merujuk kepada aktiviti yang mengubah kuantiti atau bentuk penggunaan tenaga oleh pengguna untuk mengubah profil bebannya. Terdapat pelbagai jenis aktiviti DSM yang boleh digunakan, namun tesis ini hanya menilai kesan penggunaan dua jenis kaedah DSM sebagai langkah strategik untuk mengurangkan penggunaan tenaga dalam bangunan-bangunan universiti, terutamanya Fakulti Kejuruteraan Elektrik di Universiti Teknologi Malaysia, Johor. Kaedah pertama yang dipertimbangkan ialah gabungan penghad puncak (*peak clipping*) dan anjakan beban (*load shifting*), iaitu proses memindahkan beban puncak yang telah dihadkan daripada waktu puncak ke luar waktu puncak. Tesis ini membincangkan cabaran dalam mengaplikasikan penghad puncak dan anjakan beban iaitu menentukan masa yang tepat untuk melakukan kaedah ini, diikuti oleh penilaian penjimatan penggunaan tenaga dan bil elektrik yang boleh dicapai menerusi pengaplikasian kaedah yang dipilih ini. Melalui penilaian yang teliti dan pemilihan masa yang tepat, kaedah gabungan ini mampu menyumbangkan penjimatan sebanyak hampir 10% pada penggunaan tenaga dan bil elektrik. Satu lagi kaedah DSM ialah penaiktaraan (*retrofit*) iaitu proses yang memerlukan perubahan terus pada sistem fizikal atau elektrikal bangunan yang lama mahupun yang telah digunapakai untuk mencapai pengurangan dalam penggunaan tenaga dan bil elektrik. Di dalam kajian ini, potensi penjimatan menerusi kaedah retrofit dari lampu kalimantang T8 dan T5 kepada teknologi LED pada bangunan terpilih ialah sebanyak 64% daripada anggaran penggunaan tenaga dan bil elektrik tahunan. Selain itu, tempoh pulangan nilai pelaburan hasil daripada kaedah penaiktaraan ini dinilai hampiri selama 3.03 tahun.