Towards Robust Demand Response at Airports

**Background:**
Continuous growth of electric usage in industry and electricity-powered devices is causing an increase of electric power demand, jeopardizing the stability of the local grid. To avoid electricity demand exceeding grid capacity, utility providers encourage customers to reduce demand peak by incentivizing participants for participating Demand Response (DR) programs or changing electricity price over time. Energy cost savings that can be obtained by participating in DR programs are now considered as opportunities for creating a new source of revenue for building owners. Especially, Airports are well poised to take advantage of DR opportunities because of their large energy footprint and availability of at least partly automated energy management and control systems. However, airport facility managers barely tap into DR opportunities because of uncertainties related to occupant comfort and complexities in controlling energy demand. Therefore, this research is initiated to help airport facility managers identify DR opportunities and encourage them to capitalize on DR programs.

**Objectives/Purpose:**
As the first step towards robust demand response at airports, this research focuses on analyzing historical airport energy data to find DR opportunities and investigates different strategies for computing electric energy baselines. A baseline is the estimate of what the load would have been in the absence of curtailment (or any other change in the operation of the facility), which will help identify opportunities for participating in DR programs as well as assess the performance of DR strategies once implemented.

**Methods:**
This research specifically takes a data-driven approach to identify characteristics of airport energy consumption and develop airport specific electric energy baseline for DR assessment. We first introduce some methods to visually inspect the airport power demand-related data and understand the relationship between explanatory variables and power demand. Then, we investigate different strategies for computing electric energy baselines using regression analysis and calculate the accuracy of each strategies to find the most accurate baseline model. Finally, we analyze the regression coefficients to understand the isolated impact of each variables on the airport power demand.

**Results & conclusion:**
The model validation result shows that the model with time-of-week and outside temperature has the lowest error of and 2.72% (305.87 kW) of maximum demand at the airport, which is high performance to be used as a baseline. Development of airport-specific baseline models will help airport facility mangers to better utilize DR days by preparing shedding or shifting electricity use to lower demand peak before DR event days. Moreover, it will help assess how effective such DR strategy was after the DR events. Robust baseline development will not only make DR program more reliable but also motivate more airport facility managers to participate in DR programs.