

Problem Formulation

Sets

$I = \{i \mid i \text{ is an integer, and } 0 \leq i \leq 96\}$. Set of time chunks in a given day

$J = \{j \mid j \text{ is an integer, and } 0 \leq j \leq 3\}$. Set of cars/chargers.

Parameters

t_i : Time interval for a given chunk of the day, which is 15 min = 1/4 hr.

Trf_i : Customer's electricity tariff at a given 15 min chunk (\$/kWh).

BL_i : Building load at a given 15 min chunk (kW).

Eff_j : Efficiency of the AC/DC converter in each car.

B_j : Battery capacity of each car (kWh).

E_j : Energy demand of each car (kWh).

DC : Demand cost for the maximum power used during the day, which is given as 16 \$/kW.

Variables

$P_{i,j}$: Load on a charger at a given 15 min chunk (kW).

Objective

$$\text{minimum} \left(\text{Bill} = \left(\sum_{i=0}^{95} \sum_{j=0}^3 (P_{i,j} + BL_i) \cdot Trf_i \cdot t_i \right) + \text{max} \left(\sum_{j=0}^3 P_{i,j} + BL_i \right) \cdot DC \right) \quad (1)$$

Constraints

$$Trf_i = \begin{cases} 0.4 & \text{if } 9AM < Time < 4PM \\ 0.1 & \text{otherwise} \end{cases} \quad (2)$$

$$Eff_{i,j} = \begin{cases} 0.7 & \text{if } P_i \leq 5 \\ 0.9 & \text{if } P_i > 5 \end{cases} \quad (3)$$

$$E_j = \sum_{i=0}^{55} P_{i,j} \cdot Eff_{i,j} \cdot t_i = U(15, 35)_j - 5 \quad (4)$$

$$U(15, 35)_j + 5 < B_j = 40 \quad (5)$$

$$P_{i,j} = \begin{cases} 0 & \text{if } 10AM < Time < 12PM \\ P_{i,j} & \text{otherwise} \end{cases} \quad (6)$$

Boundaries

$$P_{i,j} = \begin{cases} 0 & \text{if } 12AM < Time < 10AM \\ [0, 7] & \text{otherwise} \end{cases} \quad (7)$$