**Definition of Variables:**

= the resident’s energy cost ($) during time period, t

= the resident’s energy demand (kWh) during time period, t

= the resident’s solar generation (kWh) during time period, t

= the energy charged or discharged (kWh) by the resident’s battery during time period, t

= the residential energy price ($/kWh) during time period, t

= the charge or discharge power rate (kW) of the battery during time period, t

= the State of Charge of a resident’s battery during time period, t

= the one-way charge or discharge efficiency rating

N = number of intervals in a 24 hour day

= interval duration, i.e. for 30-minute intervals

**Cost Function**

**Objective function: minimize the daily electricity cost for a homeowner**

Load and solar data are 30-minute kWh intervals. There are 48 half-hour intervals in a day. N = 48

**Subject to the following constraints.**

Equations 2 - 4 are constraints that en sure the Approximate Dynamic Programming Algorithm does not choose actions that violate the energy storage battery’s physical requirements.

Equations 5 and 6 define positive Power means battery charging, and negative Power means battery discharging.



Equations 7 and 8 do not allow the battery to be used for selling electricity back to the grid. Equation 7 limits the battery to supply the energy that the solar cannot provide. Equation 8 allows the battery to charge only when there is extra solar energy available.

Equations 9 and 10 limit how much energy that the battery can charge during times when solar is greater than the load.

Equations 11 and 12 limit how much energy that the battery can discharge during times when load is greater than solar.