Economic Dispatch model for Energy Storage

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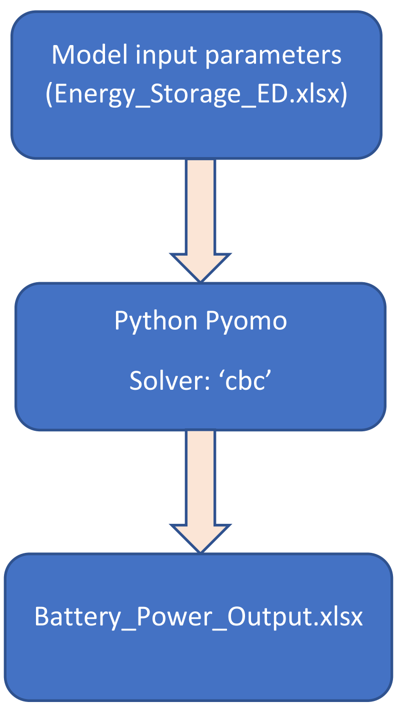
1. Description:

The objective of the model is to develop an economic dispatch model for energy storage (batteries). The values of the parameters of the model, which are defined in section 3, are randomly simulated values. Should you want to model a realistic case, values in the input files should be changed accordingly. We are simulating for 5 periods using 20 batteries. Python pyomo and 'cbc' solver were used to code and solve the model. We are assuming the batteries are fully charged before dispatch.

2. Data flow diagram:



3. Model:

Parameters:

Cd: Discharge unitary cost ($/MWh)
SE: Installed energy capacity (MWh)
SP: Rated Power (MW)
MD: Discharge rate (%)
EFD: Discharge efficiency (%)

__Decision Variables:__ $ED_{b,t}$ = Energy discharged by battery b at time t

$E_{b,t}$ = Energy present by battery b at time t

__Bounds:__ $b \in \{1, 2, 3, \ldots, 20\}$

$t \in \{0, 1, 2, 3, 4\}$

$t_1 \in \{1, 2, 3, 4\}$

__Objective function:__ $\sum_b^B \sum_t^T \mathrm{Cd_b} * \mathrm{ED_{b,t}}$

__Constraints:__

a. Relationship constraint (Energy at time t = Energy at time t-1 – Discharge):

$E_{b,t1} = E_{b,t1-1} - ED_{b,t1}\ \forall\ b\ \forall\ t_1$

b. Capacity constraint: $E_{b,t} \leq SE_b\ \forall\ b\ \forall\ t$

c. Energy leaving is constrained by discharge capacity: $ED_{b,t} \leq MD_b * SP_b\ \forall\ b\ \forall\ t$

d. Energy balance constraint: $\sum_b^B \mathrm{EFD_b} * \mathrm{ED_{b,t}}$ = $Demand_t\ \forall\ b\ \forall\ t$