Unit Characteristics

Unit Type	Capacity (MW)	Investment Cost(R/KW)	Fuel Cost(R/MWH)	Fixed O&M (R/KWmonth)	Variable O&M(R/MWH)
A	150	300	20.409	1	1
B	250	350	14	3	3
C	100	250	25.953	2.5	2.5

Peak Load

	Year 0	Year 1	Year 2	Year 3	Year 4
Peak Load (MW)	500	600	700	800	900

Including the reserve

	Year 0	Year 1	Year 2	Year 3	Year 4
Peak Load (MW)	600	700	800	900	1000

Formulation

Objective Function:

$$\underbrace{Minimize}_{X_{i,t}\,,\;Z_{i,t}} \;\; C_{total} = C_{inv} + C_{fuel} + C_{O\&M} - C_{\text{salv}}$$

Where:

$$C_{inv} = \sum_{t=0}^{4} (1.1)^{-t'} \sum_{i=1}^{3} Cost\_Inv_{i,t} * PG_i * Z_{i,t}$$

$$Z_{i,t} = X_{i,t} - X_{i,t-1}$$

$$C\_fuel_{e,t} = \sum_{t=0}^{t=4} (1.1)^{-(t'+0.5)} \sum_{k=1}^{8760} P_{e,t}^{k} * Cost\_Fuel_{e,t}$$

$$C\_fuel_{i,t} = \sum_{t=0}^{t=4} (1.1)^{-(t'+0.5)} \sum_{k=1}^{8760} P_{i,t}^{k} * Cost\_Fuel_{i,t}$$

$$C_{fuel} = \sum_{t=0}^{4} (\sum C\_fuel_{e,t} + \sum C\_fuel_{i,t})$$

$$C_{O\&M} = \sum_{t=0}^{4} (1.1)^{-(t'+0.5)} (\sum_{i=1}^{3} Cost\_FOM_{i,t} * PG_i * X_{i,t} + \sum_{i=1}^{3} 1 \sum_{k=0}^{8760} Cost\_VOM_{i,t} * PG_{i,t})$$

$$C_{salv} = \sum_{t=1}^{5} (1.1)^{-T'} \sum_{i=1}^{3} Cost\_Salv_{i,t} * PG_i * Z_{i,t}$$

Subject to:

$$\sum_{i=1}^{3} P_{i,t}^{k} + \sum_{e} P_{e,t}^{k} = Load_t^k$$

$$0 \leq P_{i,t}^{k} \leq PG_i * X_{i,t}$$

$$\sum_{i=0}^{3} PG_i * X_{i.t} + \sum_{e} PG_{e,t} \geq Max(Load_t) * 1.2$$

Simulation Result

After running the simulation using PuLP in Python, the optimal solution for the problem is summarized in the table below. The table presents the newly installed units during the project lifetime.

Unit Type	Year 0	Year 1	Year 2	Year 3	Year 4
A	4	1	1	1	1
B	0	0	0	0	0
C	0	0	0	0	0

With this combination, the cost is minimized to:

C_{total} = C_{inv} + C_{fuel} + $C_{O\&M}$ - C_{salv}

= ₨5,918,125,596,004.134

The code for this problem can be seen in the attachment.