Original problem

$$\min \sum_{i\in I,t\in T}(l_{it}p_{it}+c_{it}s_{it})+\sum_{t\in T}c_{EIE}EIE_t+\sum_{t\in T}c_{ENP}ENP_t \tag{1}$$

$$\text{s.t. } p_{it}\le \bar{p}_i s_{it} \qquad \forall i\in I,t\in T \tag{2}$$

$$p_{it}\ge \underline{p}_i s_{it} \qquad \forall i\in I,t\in T \tag{3}$$

$$p_{it}\le p_{i(t-1)}+\delta_i^+ s_{i(t-1)}+\underline{p}_i(1-s_{i(t-1)}) \qquad \forall i\in I,t\in T \tag{4}$$

$$p_{i(t-1)}\ge p_{it}+\delta_i^- s_{it}+\bar{p}_i(1-s_{it}) \qquad \forall i\in I,t\in T \tag{5}$$

$$u_{it}^+\ge s_{it}-s_{i(t-1)} \qquad \forall i\in I,t\in T:t>0 \tag{6}$$

$$u_{it}^-\ge s_{i(t-1)}-s_{it} \qquad \forall i\in I,t\in T:t>0 \tag{7}$$

$$u_{it}^+\le s_{it} \qquad \forall i\in I,t\in T \tag{8}$$

$$u_{it}^-\le 1-s_{it} \qquad \forall i\in I,t\in T \tag{9}$$

$$s_{it}\ge \sum_{t'\in \max(0,t-\tau_i^+)\ldots t} u_{it'}^+ \qquad \forall i\in I,t\in T \tag{10}$$

$$s_{it}\le 1-\sum_{t'\in \max(0,t-\tau_i^-)\ldots t} u_{it'}^- \qquad \forall i\in I,t\in T \tag{11}$$

$$\sum_{i\in I}p_{it}+ENP_t=D_t+EIE_t \qquad \forall t\in T \tag{12}$$

$$s_{it},u_{it}^-,u_{it}^+\in\{0,1\} \qquad \forall i\in I,t\in T \tag{13}$$

Dualize Demand constraint

Due to constraint relaxation slack variables EIE and ENP are zero for every optimal solution and are thus omitted.

Objective function:

$$\min \sum_{i\in I,t\in T}(l_{it}p_{it}+c_{it}s_{it})+\sum_{t\in T}\lambda_t(\sum_{i\in I}D_t-p_{it})$$
$$=$$
$$\min \sum_{i\in I,t\in T}((l_{it}-\lambda_t)p_{it}+c_{it}s_{it})+\lambda_t D_t$$

$$\min \sum_{i\in I,t\in T}((l_{it}-\lambda_t)p_{it}+c_{it}s_{it})+\lambda_t D_t \text{s.t.} \qquad (2)-(11),(13) \tag{14}$$

Dualize Production/State constraint

Objective function:

$$\begin{aligned}
\min & \sum_{i\in I,t\in T}(l_{it}p_{it}+c_{it}s_{it})+\sum_{t\in T}c_{EIE}EIE_t+\sum_{t\in T}c_{ENP}ENP_t \\
& +\sum_{i\in I,t\in T}\lambda^+_{it}(p_{it}-\bar{p}_i s_{it})+\sum_{i\in I,t\in T}\lambda^-_{it}(\underline{p}_i s_{it}-p_{it}) \\
& +\sum_{i\in I,t\in T}\mu^+_{it}(p_{it}-p_{i(t-1)}-\delta^+_i s_{i(t-1)}-\underline{p}_i(1-s_{i(t-1)}))+ \\
& \sum_{i\in I,t\in T}\mu^-_{it}(p_{it}+\delta^-_i s_{it}+\bar{p}_i(1-s_{it})-p_{i(t-1)})\forall i\in I,t\in T \\
& = \\
& \sum_{i\in I,t\in T}(l_{it}+\lambda^+_{it}-\lambda^-_{it}+\mu^+_{it}+\mu^-_{it}-\mu^+_{i(t+1)}-\mu^-_{i(t+1)})p_{it} \\
& +(c_{it}-\lambda^+_{it}+\lambda^-_{it}-\mu^+_{it}+\mu^-_{it})s_{it} \\
& +\sum_{t\in T}c_{EIE}EIE_t+\sum_{t\in T}c_{ENP}ENP_t
\end{aligned}$$

$$\min\min \qquad \sum_{i\in I,t\in T}((l_{it}-\lambda_t)p_{it}+c_{it}s_{it})+\lambda_t D_t \text{s.t. } (2)-(11),(13) \tag{15}$$