$$\underset{x_m^n, p_m^n}{\text{Maximize}}\ EE = \frac{\sum_{n=1}^{N}\sum_{m=1}^{N} c_m^n \cdot x_m^n}{\varepsilon_0 \cdot \sum_{n=1}^{N}\sum_{m=1}^{N} p_m^n \cdot x_m^n + P_0} \tag{1}$$

$$\underset{x_m^n, p_m^n}{\text{Maximize}}\ EE = \sum_{n=1}^{N}\sum_{m=1}^{M} c_m^n x_m^n - q(\varepsilon_0 \sum_{n=1}^{N}\sum_{m=1}^{N} p_m^n x_m^n + P_0) \tag{2}$$

$$\begin{aligned}
\mathcal{L}(\mathbf{X}, \mathbf{P}, \lambda, \mu) &= \sum_{n=1}^{N}\sum_{m=1}^{M} c_m^n \cdot x_m^n \\
&\quad -q\left(\varepsilon_0 \sum_{n=1}^{N}\sum_{m=1}^{N} p_m^n x_m^n + P_0\right) \\
&\quad + \sum_{m=1}^{M} \lambda_m \left(\sum_{n=1}^{N}\sum_{m=1}^{M} c_m^n x_m^n - \overline{c}_m\right) \\
&\quad +\mu\left(P_T - \sum_{n=1}^{N}\sum_{m=1}^{M} p_m^n \cdot x_m^n\right) \\
&= \sum_{n=1}^{N}\left[\sum_{m=1}^{M}(1+\lambda_m)c_m^n \cdot x_m^n - \sum_{m=1}^{M}(q\varepsilon_0 + \mu)p_m^n \cdot x_m^n\right] \\
&\quad +\mu P_T - \sum_{m=1}^{M} \lambda_m * \overline{c}_m - qP_0
\end{aligned} \tag{3}$$

$$\begin{aligned}
\underset{x_m^n, p_m^n}{\text{Maximize}}\ \mathcal{L}(\mathbf{X_n}, \mathbf{P_n}) &= \sum_{m=1}^{M}(1+\lambda_m)c_m^n \cdot x_m^n \\
&\quad - \sum_{m=1}^{M}(q\varepsilon_0 + \mu)p_m^n \cdot x_m^n \\
&\quad +\mu P_T - \sum_{m=1}^{M} \lambda_m * \overline{c}_m - qP_0
\end{aligned} \tag{4}$$

$$\begin{aligned}
\frac{d\mathcal{L}}{dp_{m^*}^n} &= \frac{B(1+\lambda_m^*)}{Ln(2)} \times \left(\frac{H_{m^*}^n}{1 + p_{m^*}^n \cdot H_{m^*}^n}\right) \\
&\quad -(q\varepsilon_0 + \mu)
\end{aligned} \tag{5}$$