Xichen Jiang
ECE 476
Hw 9

12.19

$$\text{Min} \quad C_1(P_1) + C_2(P_2)$$

subject to $P_1 + P_2 = 1000\ \text{MW}$

$$\begin{cases} \dfrac{\partial C_1}{\partial P_1} = 15 + 0.1 P_1 = \lambda \\ \dfrac{\partial C_2}{\partial P_2} = 20 + 0.08 P_2 = \lambda \\ P_1 + P_2 = 1000 \end{cases}$$

$$\begin{bmatrix} 0.1 & 0 & -1 \\ 0 & 0.08 & -1 \\ 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ \lambda \end{bmatrix} = \begin{bmatrix} -15 \\ -20 \\ 1000 \end{bmatrix}$$

$P_1 = 472\ \text{MW}$
$P_2 = 527\ \text{MW}$
$\lambda = 62\ \$/\text{MWh}$

$$\therefore \quad \frac{\partial C_1}{\partial P_1} = \frac{\partial C_2}{\partial P_2} = \boxed{62\ \$/\text{MW}}$$

$C_1 + C_2 = \boxed{\$41230}\ /\text{hr}$

12.20

From 12.19, we know $P_2^* > P_{2\,max} = 500$

$\therefore$ set $\boxed{P_2 = 500 \text{ mw}}$

Since $P_1 + P_2 = 1000$ mw

$\therefore \boxed{P_1 = 500 \text{ mw}}$

$\lambda = 15 + 0.05 \cdot 2 \cdot 500 = \boxed{\$65/\text{mwh}}$

$C_{total} = C_1 + C_2 = \boxed{\$41300/\text{hr}}$

12.21

$$\frac{dC_1}{dP_1} = \lambda(1) \Rightarrow 15 + 0.1P_1 = \lambda$$

$$\frac{dC_2}{dP_2} = \lambda(0.95)^{-1} \Rightarrow 20 + 0.08P_2 = \frac{1}{0.95}\lambda$$

$P_1 + P_2 = 1000$

↑ Loss already included in this 1000

$P_1 = 454$ mw
$P_2 = 545$ mw
$\lambda = 60.5$ \$/mwh
$C_{total} = \$41259/\text{hr}$

12.24

$P_L = 282\ MW$

$$\frac{\partial C_1}{\partial P_1} = 0.02 P_1 + 2$$

$$\frac{\partial C_2}{\partial P_2} = 0.008 P_2 + 2.6$$

$$\therefore \begin{cases} 0.02 P_1 + 2 = \lambda \\ 0.008 P_2 + 2.6 = \lambda \\ P_1 + P_2 = 282 \end{cases}$$

$P_1 = 162$

$P_2 = 180$

$\lambda = 4.04$