基于 CCG 算法的 TS-FCUC 重构模型

目标函数：

$$
\begin{aligned}
&\sum_{t\in\mathcal{T}}\{\sum_{d\in\mathcal{D}}[(\widehat{P}_{d,t}^{\mathcal{D}}\cdot\lambda_t^{SD}+P_{d,t}^{\mathcal{D}+}\cdot\vartheta_{d,t}^{SD})-(\widehat{P}_{d,t}^{\mathcal{D}}\cdot\beta_{d,t}^{MAX}\\
&\quad+P_{d,t}^{\mathcal{D}+}\cdot\vartheta_{d,t}^{MAX})]+\sum_{g\in\mathcal{G}}(x_{g,t}\cdot P_g^{\mathcal{G},Min}\cdot\alpha_{g,t}^{MIN}\\
&\quad-x_{g,t}\cdot P_g^{\mathcal{G},Max}\cdot\alpha_{g,t}^{MAX}-PFR_g^{\mathcal{G},Max}\cdot u_{g,t}^{\mathcal{G}}\cdot\delta_{g,t}^{PMAX}\\
&\quad-SFR_g^{\mathcal{G},Max}\cdot v_{g,t}^{\mathcal{G}}\cdot\delta_{g,t}^{SMAX}-M\cdot(1-x_{g,t}^{\mathcal{G}})\cdot\rho_{g,t}^{MIN-}\\
&\quad-M\cdot x_{g,t}^{\mathcal{G}}\cdot\rho_{g,t}^{MAX+})+\sum_{w\in\mathcal{W}}[\widehat{P}_{w,t}^{\mathcal{W}}\cdot\beta_{w,t}^{SD}-P_{w,t}^{\mathcal{W}-}\\
&\quad\cdot\vartheta_{w,t}^{SD}-(\widehat{P}_{w,t}^{\mathcal{W}}\cdot\beta_{w,t}^{MAX}-P_{w,t}^{\mathcal{W}-}\cdot\vartheta_{w,t}^{MAX})-PFR_w^{\mathcal{W},Max}\\
&\quad\cdot u_{w,t}^{\mathcal{W}}\cdot\delta_{w,t}^{PMAX}-SFR_w^{\mathcal{W},Max}\cdot v_{w,t}^{\mathcal{W}}\cdot\delta_{w,t}^{SMAX}\\
&\quad-M\cdot(1-o_{w,t}^{\mathcal{W}})\cdot\rho_{w,t}^{MIN-}-M\cdot o_{w,t}^{\mathcal{W}}\cdot\rho_{w,t}^{MAX+}]\\
&\quad+\sum_{c\in\mathcal{CSP}}[\widehat{Q}_{c,t}^{\mathcal{SF}}\cdot\theta_{c,t}^{SD}-Q_{c,t}^{\mathcal{SF}-}\cdot\vartheta_{c,t}^{SD}+P_c^{\mathcal{PB},Min}\\
&\quad\cdot x_{c,t}^{\mathcal{PB}}\cdot\theta_{c,t}^{MIN}-P_c^{\mathcal{PB},Max}\cdot x_{c,t}^{\mathcal{PB}}\cdot\theta_{c,t}^{MAX}+[r_c^{\mathcal{TES},lim}\\
&\quad\cdot E_c^{\mathcal{TES},Max}-(1-\iota)^t\cdot E_c^{\mathcal{TES},in}]\cdot\theta_{c,t}^{TMIN}-[E_c^{\mathcal{TES},Max}\\
&\quad-(1-\iota)^t\cdot E_c^{\mathcal{TES},in}]\cdot\theta_{c,t}^{TMAX}-Q_{c,t}^{\mathcal{HT},Max}\cdot\theta_{c,t}^{IMAX}\\
&\quad\cdot\varsigma_{c,t}^{\mathcal{HT}}-Q_{c,t}^{\mathcal{TH},Max}\cdot\theta_{c,t}^{OMAX}\cdot(1-\varsigma_{c,t}^{\mathcal{HT}})\\
&\quad-PFR_{c,t}^{\mathcal{PB},Max}\cdot u_{c,t}^{\mathcal{PB}}\cdot\delta_{c,t}^{PMAX}-SFR_{c,t}^{\mathcal{PB},Max}\cdot v_{c,t}^{\mathcal{PB}}\\
&\quad\cdot\delta_{c,t}^{SMAX}-M\cdot(1-x_{c,t}^{\mathcal{PB}})\cdot\rho_{c,t}^{MIN-}-M\cdot x_{c,t}^{\mathcal{PB}}\\
&\quad\cdot\rho_{c,t}^{MAX+}]-\sum_{l\in\mathcal{L}}(F_l^{Max}\cdot\varepsilon_{l,t}^{MIN}+F_l^{Max}\cdot\varepsilon_{l,t}^{MAX})\\
&\quad-(D'\cdot\Delta f_{Max}^{QSS}-\Delta P_{t,Max}^{\mathcal{D}})\cdot\pi_t^{QSS}+\Delta f_{Max}^{QSS}\cdot D\cdot\\
&\quad\sum_{d\in\mathcal{D}}P_{d,t}^{\mathcal{D}+}\cdot\vartheta_{d,t}^{QSS}+\kappa'\cdot f_0\cdot\rho_t\\
&\quad+(SFR^{Min}-\Delta P_{Max}^{\mathcal{L}}\cdot\frac{t_{SFR}-t_{QSS}-2\zeta_1}{20\zeta_2})\cdot\nu_t^{MIN}\\
&\quad-(SFR^{Max}-\Delta P_{Max}^{\mathcal{L}}\cdot\frac{t_{SFR}-t_{QSS}-2\zeta_1}{20\zeta_2})\cdot\nu_t^{MAX}\\
&\quad+\Delta P_{t,Max}^{\mathcal{D}}\cdot\nu_t^{FRS}\}-\sum_{t\in\mathcal{T}\setminus\{1\}}\{\sum_{g\in\mathcal{G}}\{[P_g^{\mathcal{G},Max}\\
&\quad-x_{g,t-1}^{\mathcal{G}}\cdot(P_g^{\mathcal{G},Min}-\Delta P_g^{\mathcal{G},Up})-x_{g,t}^{\mathcal{G}}\cdot(P_g^{\mathcal{G},Max}\\
&\quad-P_g^{\mathcal{G},Min})]\cdot\alpha_{g,t}^{UP}+[P_g^{\mathcal{G},Max}-x_{g,t}^{\mathcal{G}}\cdot(P_g^{\mathcal{G},Min}\\
&\quad-\Delta P_g^{\mathcal{G},Dn})-x_{g,t-1}^{\mathcal{G}}\cdot(P_g^{\mathcal{G},Max}-P_g^{\mathcal{G},Min})]\cdot\alpha_{g,t}^{DN}\}\\
&\quad+\sum_{c\in\mathcal{CSP}}\{[P_c^{\mathcal{PB},Max}-x_{c,t-1}^{\mathcal{PB}}\cdot(P_c^{\mathcal{PB},Max}-R_c^{\mathcal{PB},Up})\\
&\quad-x_{c,t}^{\mathcal{PB}}\cdot(P_c^{\mathcal{PB},Max}-R_c^{\mathcal{PB},Min})]\cdot\theta_{c,t}^{UP}+[P_c^{\mathcal{PB},Max}\\
&\quad-x_{c,t}^{\mathcal{PB}}\cdot(P_c^{\mathcal{PB},Min}-R_c^{\mathcal{PB},Dn})-x_{c,t-1}^{\mathcal{PB}}\cdot(P_c^{\mathcal{PB},Max}\\
&\quad-R_c^{\mathcal{PB},Min})]\cdot\theta_{c,t}^{DN}\}\}
\end{aligned}
\tag{1}
$$

其中：

$$
\begin{aligned}
&\vartheta_{d,t}^{SD}=o_{d,t}^{\mathcal{D}}\cdot\lambda_t^{SD};\vartheta_{d,t}^{MAX}=o_{d,t}^{\mathcal{D}}\cdot\beta_{d,t}^{MAX};\\
&\vartheta_{d,t}^{QSS}=o_{d,t}^{\mathcal{D}}\cdot\pi_t^{QSS};d\in\mathcal{D},t\in\mathcal{T}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
&\vartheta_{w,t}^{SD}=o_{w,t}^{\mathcal{W}}\cdot\beta_{w,t}^{SD};\vartheta_{w,t}^{MAX}=o_{w,t}^{\mathcal{W}}\cdot\beta_{w,t}^{MAX}\\
&w\in\mathcal{W},t\in\mathcal{T}
\end{aligned}
\tag{3}
$$

$$
\vartheta_{c,t}^{SD}=o_{c,t}^{\mathcal{SF}}\cdot\theta_{c,t}^{SD};\quad c\in\mathcal{CSP},t\in\mathcal{T}
\tag{4}
$$

约束：

$$
\begin{aligned}
&-M\cdot(1-o_{d,t}^{\mathcal{D}})\le\vartheta_{d,t}^{SD}-\lambda_t^{SD}\le0;0\le\vartheta_{d,t}^{SD}\le M\cdot o_{d,t}^{\mathcal{D}};\\
&-M\cdot(1-o_{d,t}^{\mathcal{D}})\le\vartheta_{d,t}^{MAX}-\beta_{d,t}^{MAX}\le0;\\
&0\le\vartheta_{d,t}^{SD}\le M\cdot o_{d,t}^{\mathcal{D}};\\
&-M\cdot(1-o_{d,t}^{\mathcal{D}})\le\vartheta_{d,t}^{QSS}-\pi_t^{QSS}\le0;0\le\vartheta_{d,t}^{QSS}\le M\cdot o_{d,t}^{\mathcal{D}};\\
&d\in\mathcal{D},t\in\mathcal{T}
\end{aligned}
\tag{5}
$$

$$
\begin{aligned}
&-M\cdot(1-o_{w,t}^{\mathcal{W}})\le\vartheta_{w,t}^{SD}-\beta_{w,t}^{SD}\le0;0\le\vartheta_{w,t}^{SD}\le M\cdot o_{w,t}^{\mathcal{W}};\\
&-M\cdot(1-o_{w,t}^{\mathcal{W}})\le\vartheta_{w,t}^{MAX}-\beta_{w,t}^{MAX}\le0;\\
&0\le\vartheta_{w,t}^{MAX}\le M\cdot o_{w,t}^{\mathcal{W}};w\in\mathcal{W},t\in\mathcal{T}
\end{aligned}
\tag{6}
$$

$$
\begin{aligned}
&-M\cdot(1-o_{c,t}^{\mathcal{SF}})\le\vartheta_{c,t}^{SD}-\theta_{c,t}^{SD}\le0;\\
&0\le\vartheta_{c,t}^{SD}\le M\cdot o_{c,t}^{\mathcal{SF}};c\in\mathcal{CSP},t\in\mathcal{T}
\end{aligned}
\tag{7}
$$

$$
\begin{aligned}
&\alpha_{g,t}^{MIN}-\alpha_{g,t}^{MAX}+\lambda_t^{SD}-\alpha_{g,t}^{UP}+\alpha_{g,t+1}^{UP}+\alpha_{g,t}^{DN}-\alpha_{g,t+1}^{DN}\\
&+\sum_{l\in\mathcal{L}}(\varGamma_{l,g}^{\mathcal{G}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,g}^{\mathcal{G}}\cdot\varepsilon_{l,t}^{MAX})=VC_g^{\mathcal{G}}:(P_{g,t}^{\mathcal{G}})\\
&g\in\mathcal{G},t\in\mathcal{T}\setminus\{1,N^{\mathcal{T}}\}
\end{aligned}
\tag{8}
$$

$$
\begin{aligned}
&\alpha_{g,t}^{MIN}-\alpha_{g,t}^{MAX}+\lambda_t^{SD}-\alpha_{g,t}^{UP}+\alpha_{g,t}^{DN}+\sum_{l\in\mathcal{L}}(\varGamma_{l,g}^{\mathcal{G}}\cdot\varepsilon_{l,t}^{MIN}\\
&-\varGamma_{l,g}^{\mathcal{G}}\cdot\varepsilon_{l,t}^{MAX})=VC_g^{\mathcal{G}}:(P_{g,t}^{\mathcal{G}})\quad g\in\mathcal{G},t=N^{\mathcal{T}}
\end{aligned}
\tag{9}
$$

$$
\begin{aligned}
&\alpha_{g,t}^{MIN}-\alpha_{g,t}^{MAX}+\lambda_t^{SD}+\alpha_{g,t+1}^{UP}-\alpha_{g,t+1}^{DN}+\sum_{l\in\mathcal{L}}(\varGamma_{l,g}^{\mathcal{G}}\\
&\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,g}^{\mathcal{G}}\cdot\varepsilon_{l,t}^{MAX})=VC_g^{\mathcal{G}}:(P_{g,t}^{\mathcal{G}})\quad g\in\mathcal{G},t=1
\end{aligned}
\tag{10}
$$

$$
\begin{aligned}
&\lambda_t^{SD}+\beta_{w,t}^{SD}+\sum_{l\in\mathcal{L}}(\varGamma_{l,w}^{\mathcal{W}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,w}^{\mathcal{W}}\cdot\varepsilon_{l,t}^{MAX})=0\\
&:(P_{w,t}^{\mathcal{W}})\quad w\in\mathcal{W},t\in\mathcal{T}
\end{aligned}
\tag{11}
$$

$$
\beta_{w,t}^{SD.W}\le VoLL^{\mathcal{W}}:(P_{w,t}^{\mathcal{W},Cur})\quad w\in\mathcal{W},t\in\mathcal{T}
\tag{12}
$$

$$
\begin{aligned}
&-\lambda_t^{SD}+\beta_t^{SD.D}-\sum_{l\in\mathcal{L}}(\varGamma_{l,d}^{\mathcal{D}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,d}^{\mathcal{D}}\cdot\varepsilon_{l,t}^{MAX})=0\\
&:(P_{d,t}^{\mathcal{D}})\quad d\in\mathcal{D},t\in\mathcal{T}
\end{aligned}
\tag{13}
$$

$$
\lambda_t^{SD}+\beta_t^{SD.D}\le VoLL^{\mathcal{D}}:(P_{d,t}^{\mathcal{D},Cur})\quad d\in\mathcal{D},t\in\mathcal{T}
\tag{14}
$$

$$
\begin{aligned}
&\lambda_t^{SD}+\theta_{c,t}^{MIN}-\theta_{c,t}^{MAX}-\theta_{c,t}^{UP}+\theta_{c,t+1}^{UP}+\theta_{c,t}^{DN}-\theta_{c,t+1}^{DN}\\
&+\theta_{c,t}^{SD}/\eta_c^{PB}+\sum_{l\in\mathcal{L}}(\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MAX})\\
&=0:(Q_{c,t}^{\mathcal{PB}})\quad c\in\mathcal{CSP},t\in\mathcal{T}\setminus\{1,N^{\mathcal{T}}\}
\end{aligned}
\tag{15}
$$

$$
\begin{aligned}
&\lambda_t^{SD}+\theta_{c,t}^{MIN}-\theta_{c,t}^{MAX}+\theta_{c,t+1}^{UP}-\theta_{c,t+1}^{DN}+\theta_{c,t}^{SD}/\eta_c^{\mathcal{PB}}\\
&+\sum_{l\in\mathcal{L}}(\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MAX})=0:(Q_{c,t}^{\mathcal{PB}})\\
&c\in\mathcal{CSP},t=1
\end{aligned}
\tag{16}
$$

$$
\begin{aligned}
&\lambda_t^{SD}+\theta_{c,t}^{MIN}-\theta_{c,t}^{MAX}-\theta_{c,t}^{UP}+\theta_{c,t}^{DN}+\theta_{c,t}^{SD}/\eta_c^{\mathcal{PB}}\\
&+\sum_{l\in\mathcal{L}}(\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MIN}-\varGamma_{l,c}^{\mathcal{PB}}\cdot\varepsilon_{l,t}^{MAX})=0:(Q_{c,t}^{\mathcal{PB}})\\
&c\in\mathcal{CSP},t=N^{\mathcal{T}}
\end{aligned}
\tag{17}
$$

$$
\begin{aligned}
&-\eta_c^{dis}\cdot\theta_{c,t}^{SD}-\sum_{\tau\in t:N^{\mathcal{T}}}(1-\iota)^{\tau-t}\cdot(\theta_{c,\tau}^{TMIN}-\theta_{c,\tau}^{TMAX})\\
&+\theta_{c,t}^{OMIN}-\theta_{c,t}^{OMAX}=0:(Q_{c,t}^{\mathcal{TH}})\quad c\in\mathcal{CSP},t\in\mathcal{T}
\end{aligned}
\tag{18}
$$

$$\theta_{c,t}^{SD} / \eta_c^{cha} + \sum_{\tau \in t:N^{\mathcal{T}}} (1-\iota)^{\tau-t} \cdot (\theta_{c,\tau}^{TMIN} - \theta_{c,\tau}^{TMAX}) + \theta_{c,t}^{IMIN} - \theta_{c,t}^{IMAX} = 0 : (Q_{c,t}^{\mathcal{HT}}) \quad c \in \mathcal{CSP}, t \in \mathcal{T} \tag{19}$$

$$\omega_t - \sum_{g \in \mathcal{G}} (\rho_{g,t}^{MIN-} - \rho_{g,t}^{MAX-}) - \sum_{c \in \mathcal{CSP}} (\rho_{c,t}^{MIN-} - \rho_{c,t}^{MAX-}) - \sum_{w \in \mathcal{W}} (\rho_{w,t}^{MIN-} - \rho_{w,t}^{MAX-} - H_w^{\mathcal{W}} \cdot \hat{P}_{w,t}^{\mathcal{W}} \cdot \rho_t) - H_d^{\mathcal{D}} \cdot \Delta P_{t,Max}^{\mathcal{D}} / T_g \cdot \rho_t = 0 \tag{20}$$

$$\nu_t^{FRS} - \alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t}^{UP} - \alpha_{g,t+1}^{UP} - \alpha_{g,t}^{DN} - \alpha_{g,t+1}^{DN} - \delta_{g,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_g^{\mathcal{G}} : (PFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t \in \mathcal{T} \setminus \{1, N^{\mathcal{T}}\} \tag{21}$$

$$\nu_t^{FRS} - \alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t}^{UP} - \alpha_{g,t}^{DN} - \delta_{g,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_g^{\mathcal{G}} : (PFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t = N^{\mathcal{T}} \tag{22}$$

$$\nu_t^{FRS} - \alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t+1}^{UP} - \alpha_{g,t+1}^{DN} - \delta_{g,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_g^{\mathcal{G}} : (PFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t = 1 \tag{23}$$

$$\nu_t^{FRS} + \beta_{w,t}^{SD} + \delta_{w,t}^{PMIN} - \delta_{w,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_w^{\mathcal{W}} : (PFR_{w,t}^{\mathcal{W}}) \quad w \in \mathcal{W}, t \in \mathcal{T} \tag{24}$$

$$\nu_t^{FRS} - \theta_{c,t}^{MIN} - \theta_{c,t}^{MAX} - \theta_{c,t}^{UP} - \theta_{c,t+1}^{UP} - \theta_{c,t}^{DN} - \theta_{c,t+1}^{DN} - \delta_{c,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_c^{\mathcal{PB}} : (PFR_{c,t}^{\mathcal{CSP}}) \quad c \in \mathcal{CSP}, t \in \mathcal{T} \setminus \{1, N^{\mathcal{T}}\} \tag{25}$$

$$\nu_t^{FRS} - \theta_{c,t}^{MIN} - \theta_{c,t}^{MAX} - \theta_{c,t}^{UP} - \theta_{c,t}^{DN} - \delta_{c,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_c^{\mathcal{CSP}} : (PFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t = N^{\mathcal{T}} \tag{26}$$

$$\nu_t^{FRS} - \theta_{c,t}^{MIN} - \theta_{c,t}^{MAX} - \theta_{c,t+1}^{UP} - \theta_{c,t+1}^{DN} - \delta_{c,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_c^{\mathcal{CSP}} : (PFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t = 1 \tag{27}$$

$$\nu_t^{FRS} - \theta_{c,t}^{MIN} - \theta_{c,t}^{MAX} - \theta_{c,t+1}^{UP} - \theta_{c,t+1}^{DN} - \delta_{c,t}^{PMAX} + \pi_t^{QSS} - \omega_t / T_g - \frac{t_{SFR} - t_{QSS} - 2\zeta_1}{20\zeta_2} \cdot (\nu_t^{MIN} - \nu_t^{MAX}) \le PC_c^{\mathcal{CSP}} : (PFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t = 1 \tag{28}$$

$$-\alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t}^{UP} - \alpha_{g,t+1}^{UP} - \alpha_{g,t}^{DN} - \alpha_{g,t+1}^{DN} - \delta_{g,t}^{SMAX} + \nu_t^{FRS} \le SC_g^{\mathcal{G}} : (SFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t \in \mathcal{T} \setminus \{1, N^{\mathcal{T}}\} \tag{29}$$

$$-\alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t}^{UP} - \alpha_{g,t}^{DN} - \delta_{g,t}^{SMAX} + \nu_t^{FRS} \le SC_g^{\mathcal{G}} : (SFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t = N^{\mathcal{T}} \tag{30}$$

$$-\alpha_{g,t}^{MIN} - \alpha_{g,t}^{MAX} - \alpha_{g,t+1}^{UP} - \alpha_{g,t+1}^{DN} - \delta_{g,t}^{SMAX} + \nu_t^{FRS} \le SC_g^{\mathcal{G}} : (SFR_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t = 1 \tag{31}$$

$$\beta_t^{w,(SD)} - \delta_t^{w,(SMAX)} + \nu_t^{FRS} \le SC_w^{\mathcal{W}} : (SFR_{w,t}^{\mathcal{W}}) \quad w \in \mathcal{W}, t \in \mathcal{T} \tag{32}$$

$$-\theta_{c,t}^{MAX} - \theta_{c,t}^{MIN} - \theta_{c,t}^{UP} - \theta_{c,t+1}^{UP} - \theta_{c,t}^{DN} - \theta_{c,t+1}^{DN} + \delta_{c,t}^{SMIN} + \nu_t^{FRS} = SC_c^{\mathcal{PB}} : (SFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t \in \mathcal{T} \setminus \{1, N^{\mathcal{T}}\} \tag{33}$$

$$-\theta_{c,t}^{MAX} - \theta_{c,t}^{MIN} - \theta_{c,t}^{UP} - \theta_{c,t}^{DN} - \delta_{c,t}^{SMAX} + \nu_t^{FRS} \le SC_c^{\mathcal{PB}} : (SFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t = N^{\mathcal{T}} \tag{34}$$

$$-\theta_{c,t}^{MAX} - \theta_{c,t}^{MIN} - \theta_{c,t+1}^{UP} - \theta_{c,t+1}^{DN} - \delta_{c,t}^{SMAX} + \nu_t^{FRS} \le SC_c^{\mathcal{PB}} : (SFR_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t = 1 \tag{35}$$

$$H_g^{\mathcal{G}} \cdot P_g^{\mathcal{G},Max} \cdot \rho_t + \rho_{g,t}^{MIN-} - \rho_{g,t}^{MAX-} + \rho_{g,t}^{MIN+} - \rho_{g,t}^{MAX+} = 0 : (\varpi_{g,t}^{\mathcal{G}}) \quad g \in \mathcal{G}, t \in \mathcal{T} \tag{36}$$

$$H_c^{\mathcal{CSP}} \cdot P_c^{\mathcal{PB},Max} \cdot \rho_t + \rho_{c,t}^{MIN-} - \rho_{c,t}^{MAX-} + \rho_{c,t}^{MIN+} - \rho_{c,t}^{MAX+} = 0 : (\varpi_{c,t}^{\mathcal{PB}}) \quad c \in \mathcal{CSP}, t \in \mathcal{T} \tag{37}$$

$$-P_{w,t}^{\mathcal{W}-} \cdot \rho_t + \rho_{w,t}^{MIN-} - \rho_{w,t}^{MAX-} + \rho_{w,t}^{MIN+} - \rho_{w,t}^{MAX+} = 0 : (\varpi_{w,t}^{\mathcal{W}}) \quad c \in \mathcal{W}, t \in \mathcal{T} \tag{38}$$

$$\alpha, \beta, \lambda, \varepsilon, \delta, \nu, \theta, \rho, \pi \ge 0 \tag{39}$$