Table 1: Nomenclature

Notation	Definition
G	The graph or the network (All networks considered in this paper are directed)
W, P, G_s	Water, power, gas
$I^{A \to B}$	Interdependent network I of network B depending on network A (Resources flow from A to B)
$\mathcal{M}$	Set of networks
$\mathcal{N}^m$	Set of nodes in network m, $\mathcal{N}^m = N_d^m \cup N_t^m \cup N_s^m$
$\mathcal{N}_d^m, \mathcal{N}_t^m, \mathcal{N}_s^m$	Set of demand, transmission and supply nodes in network m
$\mathcal{E}^m$	Set of links in network m, link $e_{ij}^m, i, j \in \mathcal{N}^m$ points from node i to j
$N_+^m(i), N_-^m(i)$	Set of neighborhood nodes pointed out of/pointing into node i
$\xi^m(i)$	Set of closest edges relying on node i in network m
ρ	The density of the water
g	acceleration of gravity
n_d, n_t, n_s	The number of demand, transmission and supply nodes
α, β	The cooling ratio and the Hazen–Williams coefficient
l	The length of a link where $l_e^m(l_{ij}^m)$ is the length of the link $e_{ij} \in \mathcal{E}$ in network m
D_{ij}	The diameter of the edge or pipeline ij
c^m	The cost of transporting resources in network m
z	The demand value of certain type of resource
p^H, p^L	The power used to overcome the height difference or the friction loss
h	The elevation where h_i denotes the elevation of node i
Pr_s, T_s	Absolute pressure and temperature in standard conditions, 520 R, 14.73 psia
H	The heating value of natural gas
a_u, b_u, c_u	The fuel consumption coefficients of generating single unit of electricity per time
η_{ij}	The adiabatic efficiency of the compressor installed at link ij
H_{ij}^{AD}	The adiabatic head of link ij
Z	The compressibility factor
R	The gas constant
K	The adiabatic exponent, c_p/c_v
e	The efficiency factor of the gas pipelines
χ	The specific gravity of gas relative to the air
ϕ	The gas compressibility, different from the gas compressibility factor
δ_1	18.0625
δ_2	2.6667
δ_3	1.0
δ_4	1.0
δ_5	0.5
Decision variables	**Definition**
f_{ij}	The flow along link $ij \in \mathcal{E}^W \cup \mathcal{E}^{Gs} \cup \mathcal{E}^{I^{W \to P}} \cup \mathcal{E}^{I^{Gs \to P}}$
p_i	The power load of nodes in power network $i \in \mathcal{N}^P$
p_{ij}	The power load of links $ij \in \mathcal{E}^W \cup \mathcal{E}^{Gs} \cup \mathcal{E}^{I^{W \to P}} \cup \mathcal{E}^{I^{Gs \to P}}$
Pr_i	The pressure of node $i \in \mathcal{N}^{Gs} \cup \mathcal{N}_s^P$

$$\min c^W \sum_{(i,j)\in E^W} f_{ij} l_{ij} + c^{Gs} \sum_{(i,j)\in E^{Gs}} f_{ij} l_{ij} + c^P \sum_{i\in N_s^P} p_i \tag{1}$$

LINEAR CONSTRAINTS

$$\sum_{j\in N_-^W(i)} f_{ji} = \sum_{j\in N_+^W(i)} f_{ij}, \forall i \in \mathcal{N}_t^W \tag{2}$$

$$\sum_{j\in N_-^W(i)} f_{ji} = \sum_{j\in N_+^W(i)} f_{ij} + \sum_{j\in N_+^{I^{W\to P}}(i)} f_{ij} + z_i^W, \forall i \in \mathcal{N}_d^W \tag{3}$$

$$\sum_{j\in N_-^{Gs}(i)} f_{ji} = \sum_{j\in N_+^{Gs}(i)} f_{ij}, \forall i \in \mathcal{N}_t^{Gs} \tag{4}$$

$$\sum_{j\in N_-^{Gs}(i)} f_{ji} = \sum_{j\in N_+^{Gs}(i)} f_{ij} + \sum_{j\in N_+^{I^{Gs\to P}}(i)} f_{ij} + z_i^{Gs}, \forall i \in \mathcal{N}_d^{Gs} \tag{5}$$

$$p_i = \sum_{(j,k)\in \xi^W(i)} p_{jk} + \sum_{(j,k)\in \xi^{Gs}(i)} p_{jk} + \sum_{(j,k)\in \xi^{I^{P\to W}}(i)} p_{jk} + \sum_{(j,k)\in \xi^{I^{P\to Gs}}(i)} p_{jk} + z_i^P, \forall i \in \mathcal{N}_d^P \tag{6}$$

$$\bigcup_{i\in N_d^P} \xi^W(i) = \mathcal{E}^W \tag{7}$$

$$\bigcup_{i\in N_d^P} \xi^{Gs}(i) = \mathcal{E}^{Gs} \tag{8}$$

$$\bigcup_{i\in N_d^P} \xi^{I^{P\to W}}(i) = \mathcal{E}^{I^{P\to W}} \tag{9}$$

$$\bigcup_{i\in N_d^P} \xi^{I^{P\to Gs}}(i) = \mathcal{E}^{I^{P\to Gs}} \tag{10}$$

$$\sum_{i\in N_d^p} p_i = \sum_{i\in N_s^p} p_i \tag{11}$$

NONLINEAR CONSTRAINTS

$$\frac{a_u + b_u p_i + c_u p_i^2}{H} = \sum_{j\in N_-^{I^{Gs\to P}}(i)} f_{ji}, \forall i \in \mathcal{N}_s^P \tag{12}$$

$$H_{ij}^{AD} = \frac{ZRT_i}{(K-1)/K}((\frac{Pr_j}{Pr_i})^{(K-1)/K} - 1), \forall (i,j) \in (\mathcal{E}^{Gs} \cup \mathcal{E}^{Gs\to P}) \tag{13}$$

$$p_{ij} = \frac{f_{ij} H_{ij}^{AD}}{33000\eta_{ij}}, \forall (i,j) \in (\mathcal{E}^{Gs} \cup \mathcal{E}^{Gs\to P}) \tag{14}$$

$$p_{ij}^{H} = \rho g f_{ij}(h_j - h_i), \forall (i,j) \in (\mathcal{E}^{W} \cup \mathcal{E}^{I^{W\to P}}) \tag{15}$$

$$p_{ij}^{L} = K(f_{ij})^{1.852} = 10.654(\frac{f_{ij}}{\beta})^{1.852}\frac{l_{ij}}{D_{ij}}, \forall (i,j) \in (\mathcal{E}^{W} \cup \mathcal{E}^{I^{W\to P}}) \tag{16}$$

$$p_{ij} = p_{ij}^{H} + p_{ij}^{L}, \forall (i,j) \in (\mathcal{E}^{W} \cup \mathcal{E}^{I^{W\to P}}) \tag{17}$$

$$\sum_{i \in N_{-}^{I^{W\to P}}(j)} f_{ij} = \kappa p_j, \forall j \in \mathcal{N}_s^{P} \tag{18}$$

$$f_{ij} = \delta_1 e(D_{ij})^{\delta_2}(\frac{T_s}{Pr_s})^{\delta_3}(\frac{(Pr_i)^2 - (Pr_j)^2}{(\chi)^{\delta_4} l_{ij} T\phi})^{\delta_5}, \forall (i,j) \in (\mathcal{E}^{Gs} \cup \mathcal{E}^{I^{Gs\to P}}) \tag{19}$$