

Data of Test Systems for “Strategic Bidding and Equilibria in Coupled Gas and Electricity Markets”

Case 1: 6 bus Power System + 7 bus Gas System

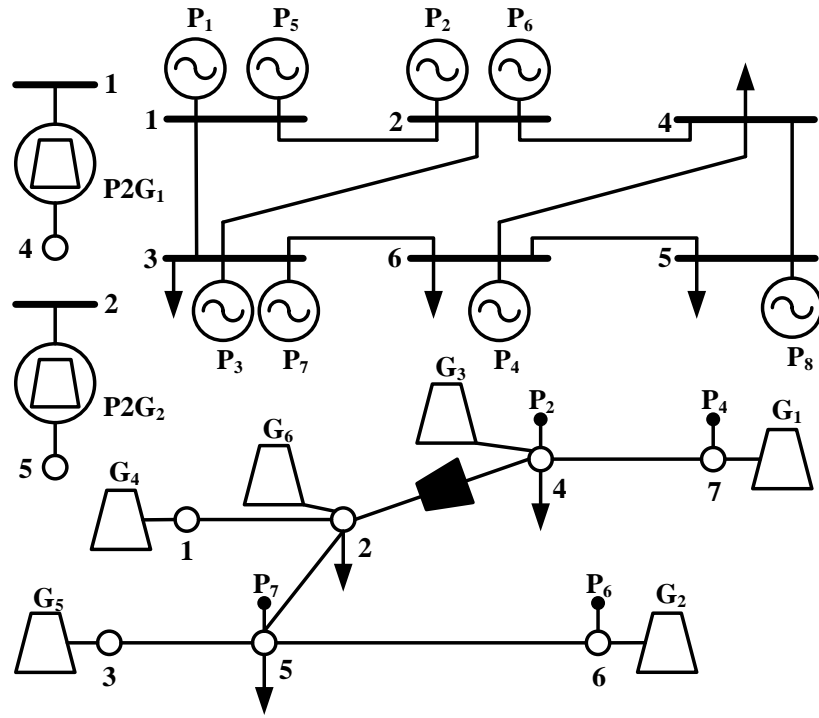


Fig. 1. Topology of the test system.

• Power System Parameters:

Table I. Parameters of Generators

No	Node	Ownership	Block 1 (MW)	Block 2 (MW)	Block 3 (MW)	Block 4 (MW)	Type
1	1	s1	54.25	38.75	31	31	coal
2	2	s2	25	25	20	20	gas
3	3	s3	54.25	38.75	31	31	coal
4	6	s4	68.95	49.25	39.4	39.4	gas
5	1	o	140	97.5	52.5	70	coal
6	2	o	68.95	49.25	39.4	39.4	gas
7	3	o	68.95	49.25	39.4	39.4	gas
8	5	o	54.25	38.75	31	31	coal

Table II. Generation cost of coal-fired generators

No.	Block 1 (\$/MWh)	Block 2 (\$/MWh)	Block 3 (\$/MWh)	Block 4 (\$/MWh)
1	9.92	10.25	10.68	11.26
3	9.92	10.25	10.68	11.26
5	19.2	20.32	21.22	22.13
8	9.92	10.25	10.68	11.26

Table III. Generation efficiency of gas-fired generators

No.	Block 1 (%)	Block 2 (%)	Block 3 (%)	Block 4 (%)	Gas Node
2	55	53	51	49	4
4	57	55	53	51	7
6	58	56	54	50	6
7	54	52	50	48	5

Table IV. Parameters of Power Lines

No.	From	To	B (b.u.)	Capacity (MW)
1	1	2	9.412	150
2	1	3	9.412	100
3	2	3	9.412	100
4	2	4	9.412	150
5	3	6	9.412	100
6	4	5	9.412	100
7	4	6	9.412	100
8	5	6	9.412	150

Table V. Load Portion

No	Node	Portion
1	3	0.19
2	4	0.27
3	5	0.27
4	6	0.27

Table VI. Parameters of P2G facilities

No	Power Node	Gas Node	Efficiency (%)
1	1	2	49
2	2	3	55

- Gas System Parameters:**

Table VII. Parameters of Gas Wells

No	Node	Ownership	Max (Sm ³ /h)	Min (Sm ³ /h)	Cost (\$/Sm ³)
1	7	v1	3300	0	0.6
2	6	v2	3000	0	0.5
3	4	v3	3000	0	0.7
4	1	w	3000	0	0.6
5	3	w	3000	0	0.8
6	2	w	3000	0	0.9

Table VIII. Parameters of Gas Passive Pipelines

No	From	To	Capacity (Sm ³)
1	1	2	3000
2	2	5	2000
3	5	6	3000
4	3	5	2000
5	4	7	2000

Table IX. Parameters of Compressor

No.	From	To	Capacity (Sm ³)
1	4	2	2000

Table X. Gas Load Portion

No	Node	Portion
1	2	1/2
2	4	1/6
3	5	1/3

Case 2: IEEE 118-bus System + 20-node Belgian High-calorific Gas System

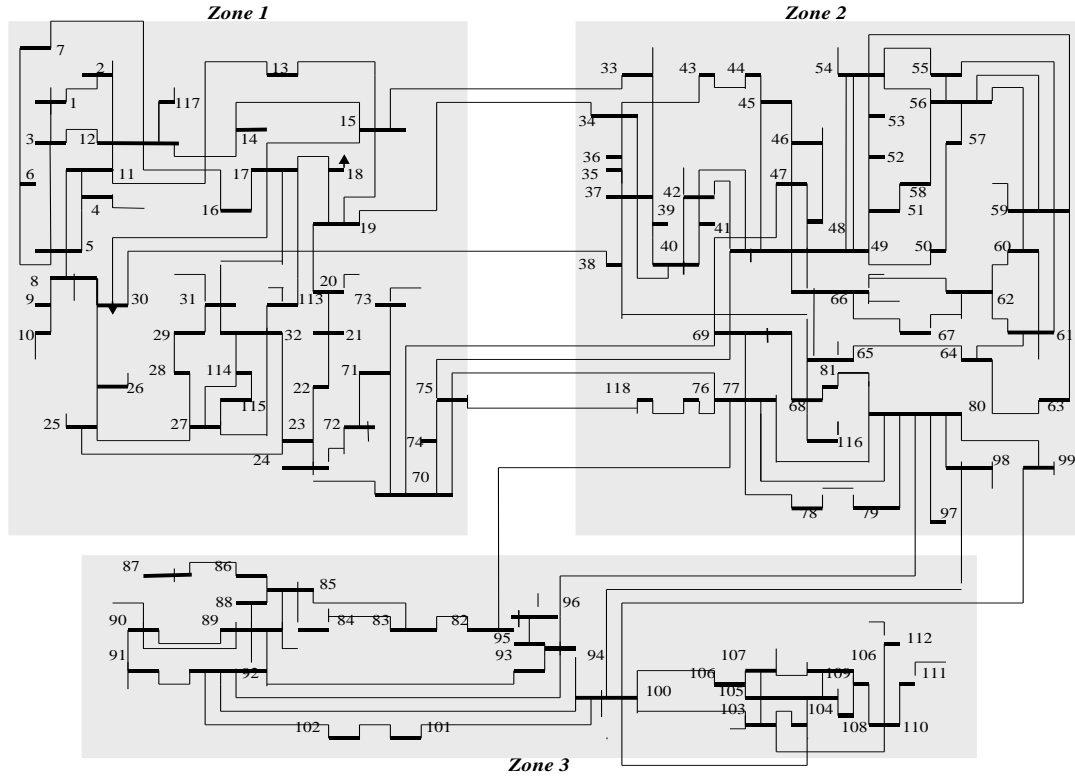


Fig. 2. Topology of the IEEE 118-bus system. (From http://motor.ece.iit.edu/data/IEAS_IEEE118.doc)

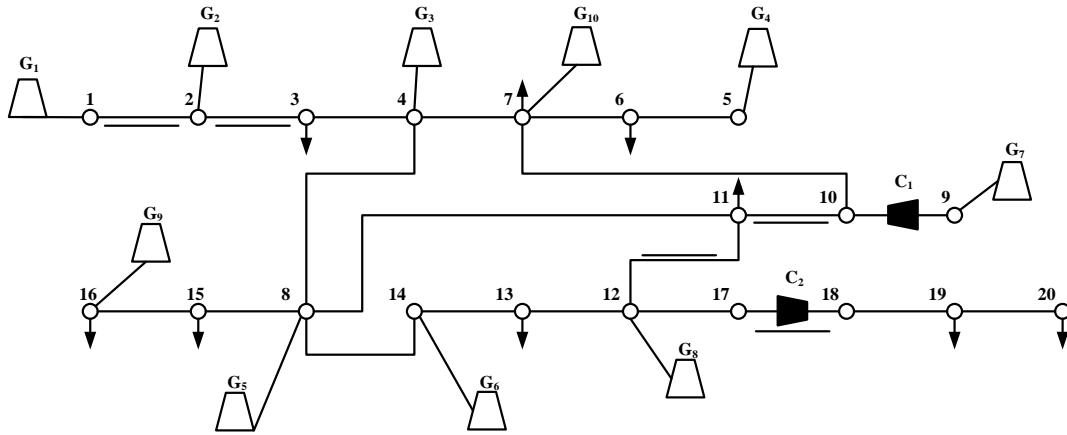


Fig. 3. Topology of the modified Belgian High-calorific Gas System.

- Power System Parameters:**

Table I. Parameters of Generators

No	Node	Block (MW)	No	Node	Block (MW)	No	Node	Block (MW)
1	4	30	19	46	100	37	82	100
2	6	30	20	49	250	38	85	30
3	8	30	21	54	250	39	87	300
4	10	300	22	55	100	40	89	200
5	12	300	23	56	100	41	90	20
6	15	30	24	59	200	42	91	50
7	18	100	25	61	200	43	92	300
8	19	30	26	62	100	44	99	300
9	24	30	27	65	420	45	100	300
10	25	300	28	66	420	46	103	20
11	26	350	29	69	300	47	104	100

12	27	30	30	70	80	48	105	100
13	31	30	31	72	30	49	107	20
14	32	100	32	73	30	50	110	50
15	34	30	33	74	20	51	111	100
16	36	100	34	76	100	52	112	100
17	40	30	35	77	100	53	113	100
18	42	30	36	80	300	54	116	50

Table II. Efficiency of Gas-fired Generators

No	Efficiency (%)	Gas Node	No	Efficiency (%)	Gas Node	No	Efficiency (%)	Gas Node
1	51	4	21	51	4	40	51	4
3	52	7	23	52	7	41	52	7
5	53	8	25	53	8	42	53	8
7	54	11	27	54	11	43	54	11
9	55	12	29	55	12	44	55	12
11	56	4	31	56	4	45	56	4
13	57	7	33	57	7	46	57	7
15	58	8	35	58	8	47	58	8
17	59	11	37	59	11	48	59	11
19	60	12	39	60	12	49	60	12

Table III. Generation Cost of Coal-fired Generators

No	Cost (\$/MWh)	No	Cost (\$/MWh)	No	Cost (\$/MWh)
2	20.03	18	18.6	34	20.03
4	10.66	20	10.08	36	10.66
6	10.66	22	10.08	38	10.66
8	10.25	24	9.92	50	18.6
10	21.67	26	22.72	51	9.92
12	11.09	28	11.72	52	10.08
14	11.09	30	11.72	53	19.2
16	10.68	32	11.26	54	10.08

Table IV. Parameters of Power Lines

No.	From	To	X (pu)	Capacity (MW)	No.	From	To	X (pu)	Capacity (MW)
1	1	2	0.0999	175	94	63	64	0.02	500
2	1	3	0.0424	175	95	64	61	0.0268	500
3	4	5	0.00798	500	96	38	65	0.0986	500
4	3	5	0.108	175	97	64	65	0.0302	500
5	5	6	0.054	175	98	49	66	0.0919	500
6	6	7	0.0208	175	99	49	66	0.0919	500
7	8	9	0.0305	500	100	62	66	0.218	175
8	8	5	0.0267	500	101	62	67	0.117	175
9	9	10	0.0322	500	102	65	66	0.037	500
10	4	11	0.0688	175	103	66	67	0.1015	175
11	5	11	0.0682	175	104	65	68	0.016	500
12	11	12	0.0196	175	105	47	69	0.2778	175
13	2	12	0.0616	175	106	49	69	0.324	175
14	3	12	0.16	175	107	68	69	0.037	500
15	7	12	0.034	175	108	69	70	0.127	500
16	11	13	0.0731	175	109	24	70	0.4115	175
17	12	14	0.0707	175	110	70	71	0.0355	175
18	13	15	0.2444	175	111	24	72	0.196	175
19	14	15	0.195	175	112	71	72	0.18	175
20	12	16	0.0834	175	113	71	73	0.0454	175
21	15	17	0.0437	500	114	70	74	0.1323	175
22	16	17	0.1801	175	115	70	75	0.141	175
23	17	18	0.0505	175	116	69	75	0.122	500
24	18	19	0.0493	175	117	74	75	0.0406	175
25	19	20	0.117	175	118	76	77	0.148	175
26	15	19	0.0394	175	119	69	77	0.101	175
27	20	21	0.0849	175	120	75	77	0.1999	175
28	21	22	0.097	175	121	77	78	0.0124	175
29	22	23	0.159	175	122	78	79	0.0244	175
30	23	24	0.0492	175	123	77	80	0.0485	500
31	23	25	0.08	500	124	77	80	0.105	500
32	26	25	0.0382	500	125	79	80	0.0704	175
33	25	27	0.163	500	126	68	81	0.0202	500
34	27	28	0.0855	175	127	81	80	0.037	500
35	28	29	0.0943	175	128	77	82	0.0853	200
36	30	17	0.0388	500	129	82	83	0.03665	200
37	8	30	0.0504	175	130	83	84	0.132	175
38	26	30	0.086	500	131	83	85	0.148	175

39	17	31	0.1563	175	132	84	85	0.0641	175
40	29	31	0.0331	175	133	85	86	0.123	500
41	23	32	0.1153	140	134	86	87	0.2074	500
42	31	32	0.0985	175	135	85	88	0.102	175
43	27	32	0.0755	175	136	85	89	0.173	175
44	15	33	0.1244	175	137	88	89	0.0712	500
45	19	34	0.247	175	138	89	90	0.188	500
46	35	36	0.0102	175	139	89	90	0.0997	500
47	35	37	0.0497	175	140	90	91	0.0836	175
48	33	37	0.142	175	141	89	92	0.0505	500
49	34	36	0.0268	175	142	89	92	0.1581	500
50	34	37	0.0094	500	143	91	92	0.1272	175
51	38	37	0.0375	500	144	92	93	0.0848	175
52	37	39	0.106	175	145	92	94	0.158	175
53	37	40	0.168	175	146	93	94	0.0732	175
54	30	38	0.054	175	147	94	95	0.0434	175
55	39	40	0.0605	175	148	80	96	0.182	175
56	40	41	0.0487	175	149	82	96	0.053	175
57	40	42	0.183	175	150	94	96	0.0869	175
58	41	42	0.135	175	151	80	97	0.0934	175
59	43	44	0.2454	175	152	80	98	0.108	175
60	34	43	0.1681	175	153	80	99	0.206	200
61	44	45	0.0901	175	154	92	100	0.295	175
62	45	46	0.1356	175	155	94	100	0.058	175
63	46	47	0.127	175	156	95	96	0.0547	175
64	46	48	0.189	175	157	96	97	0.0885	175
65	47	49	0.0625	175	158	98	100	0.179	175
66	42	49	0.323	175	159	99	100	0.0813	175
67	42	49	0.323	175	160	100	101	0.1262	175
68	45	49	0.186	175	161	92	102	0.0559	175
69	48	49	0.0505	175	162	101	102	0.112	175
70	49	50	0.0752	175	163	100	103	0.0525	500
71	49	51	0.137	175	164	100	104	0.204	175
72	51	52	0.0588	175	165	103	104	0.1584	175
73	52	53	0.1635	175	166	103	105	0.1625	175
74	53	54	0.122	175	167	100	106	0.229	175
75	49	54	0.289	175	168	104	105	0.0378	175
76	49	54	0.291	175	169	105	106	0.0547	175
77	54	55	0.0707	175	170	105	107	0.183	175
78	54	56	0.00955	175	171	105	108	0.0703	175
79	55	56	0.0151	175	172	106	107	0.183	175
80	56	57	0.0966	175	173	108	109	0.0288	175
81	50	57	0.134	175	174	103	110	0.1813	175
82	56	58	0.0966	175	175	109	110	0.0762	175
83	51	58	0.0719	175	176	110	111	0.0755	175
84	54	59	0.2293	175	177	110	112	0.064	175
85	56	59	0.251	175	178	17	113	0.0301	175
86	56	59	0.239	175	179	32	113	0.203	500
87	55	59	0.2158	175	180	32	114	0.0612	175
88	59	60	0.145	175	181	27	115	0.0741	175
89	59	61	0.15	175	182	114	115	0.0104	175
90	60	61	0.0135	500	183	68	116	0.00405	500
91	60	62	0.0561	175	184	12	117	0.14	175
92	61	62	0.0376	175	185	75	118	0.0481	175
93	63	59	0.0386	500	186	76	118	0.0544	175

Table V. Load Portion

No	Node	Portion (%)	No	Node	Portion (%)	No	Node	Portion (%)
1	1	1.450	31	41	0.990	61	80	3.480
2	2	0.560	32	42	0.990	62	82	1.440
3	3	1.100	33	43	0.480	63	83	0.530
4	4	0.850	34	44	0.420	64	84	0.290
5	6	1.470	35	45	1.410	65	85	0.640
6	7	0.540	36	46	0.750	66	86	0.560
7	11	1.990	37	47	0.910	67	88	1.280
8	12	1.330	38	48	0.530	68	90	2.080
9	13	0.960	39	49	2.330	69	92	1.740
10	14	0.390	40	50	0.450	70	93	0.320
11	15	2.550	41	51	0.450	71	94	0.800

12	16	0.710	42	52	0.480	72	95	1.120
13	17	0.310	43	53	0.610	73	96	1.010
14	18	1.700	44	54	3.020	74	97	0.400
15	19	1.270	45	55	1.680	75	98	0.910
16	20	0.510	46	56	2.250	76	100	0.990
17	21	0.390	47	57	0.320	77	101	0.580
18	22	0.280	48	58	0.320	78	102	0.130
19	23	0.190	49	59	7.420	79	103	0.610
20	27	1.760	50	60	2.080	80	104	1.010
21	28	0.480	51	62	2.060	81	105	0.830
22	29	0.680	52	66	1.040	82	106	1.150
23	31	1.220	53	67	0.750	83	107	0.750
24	32	1.670	54	70	1.760	84	108	0.050
25	33	0.650	55	74	1.820	85	109	0.210
26	34	1.670	56	75	1.250	86	110	1.040
27	35	0.930	57	76	1.820	87	112	0.660
28	36	0.880	58	77	1.630	88	114	0.220
29	39	0.720	59	78	1.900	89	115	0.620
30	40	0.530	60	79	1.040	90	117	0.560
91	118	0.880						

Table VI. Parameters of P2G facilities

No	Power Node	Gas Node	Efficiency (%)
1	20	3	49
2	38	13	55
3	93	11	60
4	15	7	58

- Gas System Parameters:**

Table VII. Parameters of Gas Well

No	Node	Max (Sm ³ /h)	Min (Sm ³ /h)	Cost (\$/Sm ³)
1	1	200000	0	0.6
2	2	300000	0	0.5
3	4	300000	0	0.7
4	5	200000	0	0.9
5	8	400000	0	0.8
6	14	400000	0	0.6
7	9	300000	0	0.5
8	12	200000	0	0.7
9	16	300000	0	0.9
10	7	200000	0	0.8

Table VIII. Parameters of Gas Passive Pipelines

No	From	To	Capacity (Sm ³)
1	1	2	200000
2	1	2	200000
3	2	3	200000
4	2	3	200000
5	3	4	200000
6	5	6	200000
7	6	7	200000
8	7	4	200000
9	4	8	200000
10	10	11	200000

11	10	11	200000
12	11	12	200000
13	11	12	200000
14	12	13	200000
15	13	14	200000
16	8	14	200000
17	8	15	200000
18	15	16	200000
19	12	17	200000
20	18	19	200000
21	19	20	200000

Table IX. Parameters of Compressor

No.	From	To	Capacity (Sm ³)
1	9	10	300000
2	9	10	300000
3	17	18	500000

Table X. Gas Load Portion

No	Node	Portion	Not-served Cost (\$/Sm ³)
1	3	0.085	3600
2	6	0.087	3800
3	7	0.113	4000
4	11	0.138	4200
5	13	0.046	4400
6	15	0.148	4600
7	16	0.337	4800
8	19	0.005	5000
9	20	0.041	5300

- Ownership of generators and gas wells:**

Table XI. Ownership of generators

Number of SEP	SEP	Non-SEP
3	1-12; 13-24; 25-32	33-54
4	1-8; 9-16; 17-24; 25-32	33-54
5	1-8; 9-14; 15-20; 21-26; 27-32	33-54

Table XII. Ownership of gas wells

Number of SGP	SGP	Non-SGP
3	1-2; 3-4; 5	6-10
4	1-2; 3; 4; 5	6-10
5	1; 2; 3; 4; 5	6-10