Table 1. Zone 1 District heating subsystem pipe parameters

Pipe index	Length[m]	Diameter [m]	Heat transfer coefficient [MW/m/K]	Roughness [m]	From node	To node
1	70.6	0.125	0.321*(1e-6)	0.0004	1	2
2	95.2	0.032	0.189*(1e-6)	0.0004	2	3
3	105.1	0.032	0.189*(1e-6)	0.0004	2	4
4	61.8	0.04	0.21*(1e-6)	0.0004	2	5
5	136	0.032	0.189*(1e-6)	0.0004	5	6
6	123.3	0.032	0.189*(1e-6)	0.0004	5	7
7	52.1	0.065	0.236*(1e-6)	0.0004	5	8
8	161.1	0.032	0.189*(1e-6)	0.0004	8	9
9	134.2	0.032	0.189*(1e-6)	0.0004	8	10

Table 2. Zone 2 District heating subsystem pipe parameters

Pipe index	Length[m]	Diameter [m]	Heat transfer coefficient [MW/m/K]	Roughness [m]	From node	To node
1	257.6	0.125	0.321*(1e-6)	0.0004	1	2
2	136.4	0.032	0.189*(1e-6)	0.0004	2	3
3	134.1	0.032	0.189*(1e-6)	0.0004	2	4
4	44.9	0.08	0.278*(1e-6)	0.0004	2	5
5	136.4	0.032	0.189*(1e-6)	0.0004	5	6
6	136.2	0.032	0.189*(1e-6)	0.0004	5	7
7	41.8	0.05	0.219*(1e-6)	0.0004	5	8
8	116.8	0.032	0.189*(1e-6)	0.0004	8	9
9	136.4	0.032	0.189*(1e-6)	0.0004	8	10

Table 3. Zone 3 District heating subsystem pipe parameters

Pipe index	Length[m]	Diameter [m]	Heat transfer coefficient [MW/m/K]	Roughness [m]	From node	To node
1	201.3	0.125	0.321*(1e-6)	0.0004	1	2
2	186.1	0.04	0.210*(1e-6)	0.0004	2	3
3	129.1	0.04	0.210*(1e-6)	0.0004	2	4
4	160.8	0.04	0.210*(1e-6)	0.0004	3	5

Table 4 . Zone 1 District heating node parameters

Node index	Type (type1: load node; type2: source node; type3: slack node)	Power load [MW]
1	3	---
2	1	0
3	1	0.107
4	1	0.107

5	1	0.107

Table 5 . Zone 2 District heating node parameters

Node index	Type (type1: load node; type2: source node; type3: slack node)	Power supply/load [MW]
1	3	--
2	1	0
3	1	0.0805
4	1	0.0805
5	1	0
6	1	0.0805
7	1	0.0805
8	1	0
9	1	0.0805
10	1	0.0805

Table 6 . Zone 3 District heating node parameters

Node index	Type (type1: load node; type2: source node; type3: slack node)	Power supply/load [MW]
1	3	---
2	1	0
3	1	0.107
4	1	0.107
5	1	0.107

Table 7. PV output and electricity loads in test power system

Time	PV [normalized]	Electricity load [normalized]
0	0.00	0.86
1	0.00	0.82
2	0.00	0.74
3	0.00	0.71
4	0.00	0.68
5	0.00	0.68
6	0.00	0.71
7	0.00	0.77
8	0.03	0.82
9	0.31	0.84
10	0.68	0.80
11	0.92	0.76
12	1.00	0.74
13	0.90	0.75
14	0.80	0.75
15	0.61	0.77

16	0.27	0.80
17	0.02	0.87
18	0.00	0.95
19	0.00	1.00
20	0.00	0.98
21	0.00	0.94
22	0.00	0.88
23	0.00	0.82