Optimal operation of energy hub
C o m p i l a t i o n

```
 2
 3  */ vytvoreni promenne t
 4  Set t 'hours' / t1*t24 /;
 5
 6  */ vytvoreni tabulky data s promennou t
 7  Table data(t,*)
 8
 9  */ vstup hodnot do tabulky data
10         Dh         De     Dg     PV    Lambda_e
11  t1     7844.38 112.50  45.00   0.00    2.13
12  t2     7844.38 97.50   45.00   0.00    2.13
13  t3     7844.38 90.00   45.00   0.00    2.13
14  t4     7844.38 90.00   45.00   0.00    2.13
15  t5     7844.38 97.50   45.00   0.00    2.13
16  t6     7844.38 112.50  45.00   0.00    2.13
17  t7     7844.38 142.50  45.00   0.00    2.13
18  t8     7844.38 172.50  45.00   0.00    2.13
19  t9     7844.38 187.50  45.00   212.89  2.13
20  t10    7844.38 187.50  45.00   456.28  2.13
21  t11    7844.38 195.00  45.00   608.17  2.55
22  t12    7844.38 210.00  45.00   626.22  2.55
23  t13    7844.38 202.50  45.00   412.39  2.55
24  t14    7844.38 180.00  45.00   181.79  2.13
25  t15    7844.38 195.00  45.00   7.24    2.13
26  t16    7844.38 210.00  45.00   0.00    2.13
27  t17    7844.38 255.00  45.00   0.00    2.13
28  t18    7844.38 307.50  45.00   0.00    2.13
29  t19    7844.38 315.00  45.00   0.00    2.13
30  t20    7844.38 307.50  45.00   0.00    2.13
31  t21    7844.38 285.00  45.00   0.00    2.55
32  t22    7844.38 247.50  45.00   0.00    2.55
33  t23    7844.38 195.00  45.00   0.00    2.55
34  t24    7844.38 150.00  45.00   0.00    2.13;
35
36  */ zavedeni promenne cost - provozni naklady
37  Variable cost;
38
39  */ zavedeni kladnych promennych
40  Positive Variables E(t), E1(t), E2(t), E3(t), G(t), G1(t), G2(t), G3(t), Ed(t), Ec(t),
41  H1(t), H_ehp(t), SOC(t) ;
42
```

```
43  */ zavedeni binarnich promennych
44  binary variables Ih(t), Idch(t), Ich(t) ;
45
47  */ zavedeni promennych s danymi hodnotami
48  scalar eta_ee / 0.96 / ,!! účinnost transformatoru
49  eta_ge / 0.429 / ,     !! účinnost kogenerační jednotky vyroba elektro
50  eta_gh / 0.456 / ,     !! účinnost kogenerační jednotky vyroba teplo
51  eta_c / 0.9 / ,        !! účinnost nabíjení bateriového úložiště
52  eta_d / 0.9 / ,        !! účinnost vybíjení bateriového úložiště
53  COP / 4.1 / ,          !! topný faktor tepelného čerpadla
54  H_ehpMax / 2000 / ,    !! výkon tepelného čerpadla max
55  H_ehpMin / 0.5 / ,     !! výkon tepelného čerpadla min
56  Chpmax / 1400 / ,      !! max výkon kogenerační jednotky
57  Fmax / 6500 / ,        !! výkon plynový kotel
58  eta_ghf / 0.915 / ,    !! účinnost spalování plynu plynovým kotlem
59  lambda_g / 1.231 / ,   !! cena plyn
60  SOCmax / 464 / ,       !! max stav nabití bateriového úložiště
61  SOC0 / 0 / ;           !! min stav nabití bateriového úložiště
62
63  */ dodatecne upresneni hodnot promennych
64  H_ehp.up(t) = H_ehpMax ;!! max výkon tepelného čerpadla
65  G1.up(t)=Chpmax ;      !! max výkon KVET
66  G2.up(t)=Fmax ;        !! max výkon plynový kotel
67  SOC0=0.2*SOCmax ;      !! počáteční stav bat. úložiště
68  SOC.up(t)=SOCmax ;     !! maximální kapacita bat. úložiště
69  SOC.lo(t)=0.2*SOCmax ; !! minimální kapacita bat. úložiště
70  SOC.fx('t24')=SOC0 ;   !! cyklus bat. úložiště
71  EC.up(t)=0.2*SOCmax ;  !! maximum nabíjení
72  EC.lo(t)=0 ;           !! minimum nabíjení
73  Ed.up(t)=0.2*SOCmax ;  !! maximum vybíjení
74  Ed.lo(t)=0 ;           !! minimum vybíjení
75
76  */ zavedeni potrebneho poctu rovnic s oznacenim
77  Equation eq1, eq2, eq3, eq4, eq5, eq6, eq7, eq8, eq9, eq10, eq11,
78  eq12, eq13, eq14, eq15, eq16 ;
79
80  */ rovnice definujici matematicky model EnergyHub:
81
82  */ objektivni hodnotici funkce - soucet nakladu na energie
83  eq1..    cost =e= sum(t, data(t,'lambda_e')*E(t)+lambda_g*G(t));
84  */ tok elektricke energie z EnergyHubu
85  eq2(t).. E2(t)+eta_ge*G1(t)+Ed(t) =e= data(t, 'De')+E3(t) ;
86  */ tok elektricke energie do EnergyHubu
87  eq3(t).. eta_ee*E(t) + data(t, 'PV') =e= E1(t) + E2(t) ;
88  */ definovani vstupu elektricke energie do bateriove uloziste
89  eq4(t).. E1(t) =e= Ec(t) ;
90  */ zmena stavu urovne nabiti bateriove uloziste
```

```
 91  eq5(t).. SOC(t) =e= SOC0$(ord(t)=1)+SOC(t-1)$(ord(t)>1)+Ec(t)*eta_c-Ed(t)/eta_d ;
 92  */ omezeni vybijeni baterioveho uloziste
 93  eq6(t).. Ed(t) =l= 0.2*SOCmax*Idch(t) ;
 94  */ omezeni nabijeni baterioveho uloziste
 95  eq7(t).. Ec(t) =l= 0.2*SOCmax*Idch(t) ;
 96  */ provozni rezim baterioveho uloziste (nabijeni/vybijeni)
 97  eq8(t).. Idch(t)+Ich(t) =l= 1 ;
 98  */ tok plynu do EnergyHubu
 99  eq9(t).. G(t) =e= G1(t)+G2(t)+G3(t) ;
100  */ tok plynu z EnergyHubu
101  eq10(t).. G3(t) =e= data(t, 'Dg') ;
102  */ tok tepla z EnergyHubu
103  eq11(t).. eta_gh*G1(t)+H1(t)+H_ehp(t) =e= data(t, 'Dh') ;
104  */ fungovani plynoveho kotle
105  eq12(t).. eta_ghf*G2(t) =e= H1(t) ;
106  */ vykon tepelneho cerpadla
107  eq13(t).. H_ehp(t) =e= E3(t)*COP ;
108  */ omezeni maximalniho tepelneho vykonu tepelneho cerpadl
109  eq14(t).. H_ehp(t) =l= H_ehpMax*Ih(t) ;
110  */ omezeni minimalniho tepelneho vykonu tepelneho cerpadla
111  eq15(t).. H_ehp(t) =g= H_ehpMax*Ih(t)*H_ehpMin ;
112  */ provozni rezim tepelneho cerpadla (chlazeni/topeni)
113  eq16(t).. Ih(t) =l= 1 ;
114
115  */ vytvoreni matematickeho modelu ze zadanych dat
116  Model Hub / all /;
117
118  */ prikaz pro reseni daneho modelu pomoci MIP resitele s minimalizaci promenne cost
119  solve hub us mip min cost ;
120
121  Parameter report(t,*);
122  report(t, 'E(t)') = E.l(t);
123  report(t, 'KVET - el') = eta_ge*G1.l(t);
124  report(t, 'PV(t)') = data(t, 'PV');
125  report(t, 'E1(t)') = E1.l(t);
126  report(t, 'De(t)') = data(t, 'De');
127  report(t, 'G(t)') = G.l(t);
128  report(t, 'G1(t)') = G1.l(t);
129  report(t, 'G2(t)') = G2.l(t);
130  report(t, 'G3(t)') = G3.l(t);
131  report(t, 'Kotel - teplo') = H1.l(t);
132  report(t, 'KVET - teplo') = eta_gh*G1.l(t);
133  report(t, 'TC - teplo') = H_ehp.l(t);
134  report(t, 'Ec(t)') = Ec.l(t);
135  report(t, 'Ed(t)') = Ed.l(t);
136  report(t, 'SOC(t)') = SOC.l(t);
137
```

```
 138  display report;


COMPILATION TIME     =        0.002 SECONDS      3 MB  34.2.0 r6925a71 DEX-DEG
GAMS 34.2.0  r6925a71 Released Feb  5, 2021 DEX-DEG x86 64bit/Mac OS X - 05/14/21
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Optimal operation of energy hub
Equation Listing    SOLVE Hub Using MIP From line 119


---- eq1  =E=

eq1..  cost - 2.13*E(t1) - 2.13*E(t2) - 2.13*E(t3) - 2.13*E(t4) - 2.13*E(t5) - 2.13*E(t6) -
2.13*E(t7) - 2.13*E(t8) - 2.13*E(t9) - 2.13*E(t10) - 2.55*E(t11) - 2.55*E(t12) - 2.55*E(t13) -
2.13*E(t14) - 2.13*E(t15) - 2.13*E(t16) - 2.13*E(t17) - 2.13*E(t18) - 2.13*E(t19) - 2.13*E(t20)
- 2.55*E(t21) - 2.55*E(t22) - 2.55*E(t23) - 2.13*E(t24) - 1.231*G(t1) - 1.231*G(t2) -
1.231*G(t3) - 1.231*G(t4) - 1.231*G(t5) - 1.231*G(t6) - 1.231*G(t7) - 1.231*G(t8) -
1.231*G(t9) - 1.231*G(t10) - 1.231*G(t11) - 1.231*G(t12) - 1.231*G(t13) - 1.231*G(t14) -
1.231*G(t15) - 1.231*G(t16) - 1.231*G(t17) - 1.231*G(t18) - 1.231*G(t19) - 1.231*G(t20) -
1.231*G(t21) - 1.231*G(t22) - 1.231*G(t23) - 1.231*G(t24) =E= 0 ; (LHS = 0)


---- eq2  =E=

eq2(t1)..  E2(t1) - E3(t1) + 0.429*G1(t1) + Ed(t1) =E= 112.5 ; (LHS = 0, INFES = 112.5 ****)

eq2(t2)..  E2(t2) - E3(t2) + 0.429*G1(t2) + Ed(t2) =E= 97.5 ; (LHS = 0, INFES = 97.5 ****)

eq2(t3)..  E2(t3) - E3(t3) + 0.429*G1(t3) + Ed(t3) =E= 90 ; (LHS = 0, INFES = 90 ****)

REMAINING 21 ENTRIES SKIPPED


---- eq3  =E=

eq3(t1)..  0.96*E(t1) - E1(t1) - E2(t1) =E= 0 ; (LHS = 0)

eq3(t2)..  0.96*E(t2) - E1(t2) - E2(t2) =E= 0 ; (LHS = 0)

eq3(t3)..  0.96*E(t3) - E1(t3) - E2(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED


---- eq4  =E=

eq4(t1)..  E1(t1) - Ec(t1) =E= 0 ; (LHS = 0)
```

eq4(t2).. E1(t2) - Ec(t2) =E= 0 ; (LHS = 0)

eq4(t3).. E1(t3) - Ec(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq5 =E=

eq5(t1).. 1.11111111111111*Ed(t1) - 0.9*Ec(t1) + SOC(t1) =E= 92.8 ; (LHS = 92.8)

eq5(t2).. 1.11111111111111*Ed(t2) - 0.9*Ec(t2) - SOC(t1) + SOC(t2) =E= 0 ; (LHS = 0)

eq5(t3).. 1.11111111111111*Ed(t3) - 0.9*Ec(t3) - SOC(t2) + SOC(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq6 =L=

eq6(t1).. Ed(t1) - 92.8*Idch(t1) =L= 0 ; (LHS = 0)

eq6(t2).. Ed(t2) - 92.8*Idch(t2) =L= 0 ; (LHS = 0)

eq6(t3).. Ed(t3) - 92.8*Idch(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq7 =L=

eq7(t1).. Ec(t1) - 92.8*Idch(t1) =L= 0 ; (LHS = 0)

eq7(t2).. Ec(t2) - 92.8*Idch(t2) =L= 0 ; (LHS = 0)

eq7(t3).. Ec(t3) - 92.8*Idch(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq8 =L=

eq8(t1).. Idch(t1) + Ich(t1) =L= 1 ; (LHS = 0)

eq8(t2).. Idch(t2) + Ich(t2) =L= 1 ; (LHS = 0)

eq8(t3).. Idch(t3) + Ich(t3) =L= 1 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq9 =E=

eq9(t1).. G(t1) - G1(t1) - G2(t1) - G3(t1) =E= 0 ; (LHS = 0)

eq9(t2).. G(t2) - G1(t2) - G2(t2) - G3(t2) =E= 0 ; (LHS = 0)

eq9(t3).. G(t3) - G1(t3) - G2(t3) - G3(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq10 =E=

eq10(t1).. G3(t1) =E= 45 ; (LHS = 0, INFES = 45 ****)

eq10(t2).. G3(t2) =E= 45 ; (LHS = 0, INFES = 45 ****)

eq10(t3).. G3(t3) =E= 45 ; (LHS = 0, INFES = 45 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq11 =E=

eq11(t1).. 0.456*G1(t1) + H1(t1) + H_ehp(t1) =E= 7844.38 ; (LHS = 0, INFES = 7844.38 ****)

eq11(t2).. 0.456*G1(t2) + H1(t2) + H_ehp(t2) =E= 7844.38 ; (LHS = 0, INFES = 7844.38 ****)

eq11(t3).. 0.456*G1(t3) + H1(t3) + H_ehp(t3) =E= 7844.38 ; (LHS = 0, INFES = 7844.38 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq12 =E=

eq12(t1).. 0.915*G2(t1) - H1(t1) =E= 0 ; (LHS = 0)

eq12(t2).. 0.915*G2(t2) - H1(t2) =E= 0 ; (LHS = 0)

eq12(t3).. 0.915*G2(t3) - H1(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq13 =E=

eq13(t1).. - 4.1*E3(t1) + H_ehp(t1) =E= 0 ; (LHS = 0)

eq13(t2).. - 4.1*E3(t2) + H_ehp(t2) =E= 0 ; (LHS = 0)

eq13(t3).. - 4.1*E3(t3) + H_ehp(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq14 =L=

eq14(t1).. H_ehp(t1) - 2000*Ih(t1) =L= 0 ; (LHS = 0)

eq14(t2).. H_ehp(t2) - 2000*Ih(t2) =L= 0 ; (LHS = 0)

eq14(t3).. H_ehp(t3) - 2000*Ih(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq15 =G=

eq15(t1).. H_ehp(t1) - 1000*Ih(t1) =G= 0 ; (LHS = 0)

eq15(t2).. H_ehp(t2) - 1000*Ih(t2) =G= 0 ; (LHS = 0)

eq15(t3).. H_ehp(t3) - 1000*Ih(t3) =G= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq16 =L=

eq16(t1).. Ih(t1) =L= 1 ; (LHS = 0)

eq16(t2).. Ih(t2) =L= 1 ; (LHS = 0)

eq16(t3).. Ih(t3) =L= 1 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

Optimal operation of energy hub
Column Listing SOLVE Hub Using MIP From line 119

---- cost

cost
(.LO, .L, .UP, .M = -INF, 0, +INF, 0)
1 eq1

---- E

E(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-2.13 eq1
0.96 eq3(t1)

E(t2)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-2.13 eq1
0.96 eq3(t2)

E(t3)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-2.13 eq1
0.96 eq3(t3)

REMAINING 21 ENTRIES SKIPPED

---- E1

E1(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq3(t1)
1 eq4(t1)

E1(t2)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq3(t2)
1 eq4(t2)

E1(t3)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq3(t3)
1 eq4(t3)

REMAINING 21 ENTRIES SKIPPED

---- E2

E2(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq2(t1)
-1 eq3(t1)

E2(t2)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq2(t2)
-1 eq3(t2)

E2(t3)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq2(t3)
-1 eq3(t3)

REMAINING 21 ENTRIES SKIPPED

---- E3

E3(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq2(t1)
-4.1 eq13(t1)

E3(t2)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq2(t2)
-4.1 eq13(t2)

E3(t3)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1 eq2(t3)
-4.1 eq13(t3)

REMAINING 21 ENTRIES SKIPPED

---- G

G(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
-1.231 eq1
1 eq9(t1)

```
G(t2)
            (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1.231   eq1
       1       eq9(t2)

G(t3)
            (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1.231   eq1
       1       eq9(t3)

REMAINING 21 ENTRIES SKIPPED

---- G1

G1(t1)
            (.LO, .L, .UP, .M = 0, 0, 1400, 0)
       0.429   eq2(t1)
      -1       eq9(t1)
       0.456   eq11(t1)

G1(t2)
            (.LO, .L, .UP, .M = 0, 0, 1400, 0)
       0.429   eq2(t2)
      -1       eq9(t2)
       0.456   eq11(t2)

G1(t3)
            (.LO, .L, .UP, .M = 0, 0, 1400, 0)
       0.429   eq2(t3)
      -1       eq9(t3)
       0.456   eq11(t3)

REMAINING 21 ENTRIES SKIPPED

---- G2

G2(t1)
            (.LO, .L, .UP, .M = 0, 0, 6500, 0)
      -1       eq9(t1)
       0.915   eq12(t1)

G2(t2)
            (.LO, .L, .UP, .M = 0, 0, 6500, 0)
      -1       eq9(t2)
       0.915   eq12(t2)

G2(t3)
```

```
            (.LO, .L, .UP, .M = 0, 0, 6500, 0)
      -1       eq9(t3)
       0.915   eq12(t3)

REMAINING 21 ENTRIES SKIPPED

---- G3

G3(t1)
            (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq9(t1)
       1       eq10(t1)

G3(t2)
            (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq9(t2)
       1       eq10(t2)

G3(t3)
            (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq9(t3)
       1       eq10(t3)

REMAINING 21 ENTRIES SKIPPED

---- Ed

Ed(t1)
            (.LO, .L, .UP, .M = 0, 0, 92.8, 0)
       1       eq2(t1)
       1.1111  eq5(t1)
       1       eq6(t1)

Ed(t2)
            (.LO, .L, .UP, .M = 0, 0, 92.8, 0)
       1       eq2(t2)
       1.1111  eq5(t2)
       1       eq6(t2)

Ed(t3)
            (.LO, .L, .UP, .M = 0, 0, 92.8, 0)
       1       eq2(t3)
       1.1111  eq5(t3)
       1       eq6(t3)

REMAINING 21 ENTRIES SKIPPED
```

---- Ec

Ec(t1)
(.LO, .L, .UP, .M = 0, 0, 92.8, 0)
-1 eq4(t1)
-0.9 eq5(t1)
1 eq7(t1)

Ec(t2)
(.LO, .L, .UP, .M = 0, 0, 92.8, 0)
-1 eq4(t2)
-0.9 eq5(t2)
1 eq7(t2)

Ec(t3)
(.LO, .L, .UP, .M = 0, 0, 92.8, 0)
-1 eq4(t3)
-0.9 eq5(t3)
1 eq7(t3)

REMAINING 21 ENTRIES SKIPPED

---- H1

H1(t1)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq11(t1)
-1 eq12(t1)

H1(t2)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq11(t2)
-1 eq12(t2)

H1(t3)
(.LO, .L, .UP, .M = 0, 0, +INF, 0)
1 eq11(t3)
-1 eq12(t3)

REMAINING 21 ENTRIES SKIPPED

---- H_ehp

H_ehp(t1)
(.LO, .L, .UP, .M = 0, 0, 2000, 0)
1 eq11(t1)
1 eq13(t1)

```
      1      eq14(t1)
      1      eq15(t1)

H_ehp(t2)
            (.LO, .L, .UP, .M = 0, 0, 2000, 0)
      1      eq11(t2)
      1      eq13(t2)
      1      eq14(t2)
      1      eq15(t2)

H_ehp(t3)
            (.LO, .L, .UP, .M = 0, 0, 2000, 0)
      1      eq11(t3)
      1      eq13(t3)
      1      eq14(t3)
      1      eq15(t3)

REMAINING 21 ENTRIES SKIPPED

---- SOC

SOC(t1)
            (.LO, .L, .UP, .M = 92.8, 92.8, 464, 0)
      1      eq5(t1)
     -1      eq5(t2)
      0      (OLD LEVEL ****)

SOC(t2)
            (.LO, .L, .UP, .M = 92.8, 92.8, 464, 0)
      1      eq5(t2)
     -1      eq5(t3)
      0      (OLD LEVEL ****)

SOC(t3)
            (.LO, .L, .UP, .M = 92.8, 92.8, 464, 0)
      1      eq5(t3)
     -1      eq5(t4)
      0      (OLD LEVEL ****)

REMAINING 21 ENTRIES SKIPPED

---- Ih

Ih(t1)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
  -2000      eq14(t1)
  -1000      eq15(t1)
```

```
      1      eq16(t1)

Ih(t2)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
   -2000      eq14(t2)
   -1000      eq15(t2)
      1      eq16(t2)

Ih(t3)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
   -2000      eq14(t3)
   -1000      eq15(t3)
      1      eq16(t3)

REMAINING 21 ENTRIES SKIPPED

---- Idch

Idch(t1)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
    -92.8    eq6(t1)
    -92.8    eq7(t1)
      1      eq8(t1)

Idch(t2)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
    -92.8    eq6(t2)
    -92.8    eq7(t2)
      1      eq8(t2)

Idch(t3)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
    -92.8    eq6(t3)
    -92.8    eq7(t3)
      1      eq8(t3)

REMAINING 21 ENTRIES SKIPPED

---- Ich

Ich(t1)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
      1      eq8(t1)

Ich(t2)
            (.LO, .L, .UP, .M = 0, 0, 1, 0)
      1      eq8(t2)
```

Ich(t3)
(.LO, .L, .UP, .M = 0, 0, 1, 0)
1 eq8(t3)

REMAINING 21 ENTRIES SKIPPED
GAMS 34.2.0 r6925a71 Released Feb 5, 2021 DEX-DEG x86 64bit/Mac OS X - 05/14/21 00:53:52 Page 4
Optimal operation of energy hub
Model Statistics SOLVE Hub Using MIP From line 119

MODEL STATISTICS

BLOCKS OF EQUATIONS 16 SINGLE EQUATIONS 361
BLOCKS OF VARIABLES 17 SINGLE VARIABLES 385 23 projected
NON ZERO ELEMENTS 912 DISCRETE VARIABLES 72

GENERATION TIME = 0.011 SECONDS 4 MB 34.2.0 r6925a71 DEX-DEG
GAMS 34.2.0 r6925a71 Released Feb 5, 2021 DEX-DEG x86 64bit/Mac OS X - 05/14/21 00:53:52 Page 5
Optimal operation of energy hub
Solution Report SOLVE Hub Using MIP From line 119

S O L V E S U M M A R Y

MODEL Hub OBJECTIVE cost
TYPE MIP DIRECTION MINIMIZE
SOLVER CPLEX FROM LINE 119

**** SOLVER STATUS 1 Normal Completion
**** MODEL STATUS 1 Optimal
**** OBJECTIVE VALUE 210837.7845

RESOURCE USAGE, LIMIT 0.027 10000000000.000
ITERATION COUNT, LIMIT 55 2147483647
--- *** This solver runs with a demo license. No commercial use.
--- Space for names approximately 0.01 Mb
--- Use option 'names no' to turn use of names off
--- GMO memory 0.59 Mb (peak 0.59 Mb)
--- Dictionary memory 0.00 Mb
--- Cplex 20.1.0.0 link memory 0.01 Mb (peak 0.04 Mb)
--- Starting Cplex

--- MIP status (101): integer optimal solution.
--- Cplex Time: 0.01sec (det. 0.91 ticks)

--- Fixing integer variables and solving final LP...

--- Fixed MIP status (1): optimal.
--- Cplex Time: 0.00sec (det. 0.59 ticks)

Proven optimal solution
MIP Solution: 210837.784458 (55 iterations, 0 nodes)
Final Solve: 210837.784458 (69 iterations)

Best possible: 210837.784458
Absolute gap: 0.000000
Relative gap: 0.000000

	LOWER	LEVEL	UPPER	MARGINAL
---- EQU eq1	.	.	.	1.0000

---- EQU eq2

	LOWER	LEVEL	UPPER	MARGINAL
t1	112.5000	112.5000	112.5000	1.4394
t2	97.5000	97.5000	97.5000	1.4394
t3	90.0000	90.0000	90.0000	1.4394
t4	90.0000	90.0000	90.0000	1.4394
t5	97.5000	97.5000	97.5000	1.4394
t6	112.5000	112.5000	112.5000	1.4394
t7	142.5000	142.5000	142.5000	2.2187
t8	172.5000	172.5000	172.5000	2.2187
t9	187.5000	187.5000	187.5000	1.4394
t10	187.5000	187.5000	187.5000	1.4394
t11	195.0000	195.0000	195.0000	1.4394
t12	210.0000	210.0000	210.0000	1.4394
t13	202.5000	202.5000	202.5000	1.4394
t14	180.0000	180.0000	180.0000	1.4394
t15	195.0000	195.0000	195.0000	2.2187
t16	210.0000	210.0000	210.0000	2.2187
t17	255.0000	255.0000	255.0000	2.2187
t18	307.5000	307.5000	307.5000	2.2187
t19	315.0000	315.0000	315.0000	2.2187
t20	307.5000	307.5000	307.5000	2.2187

t21	285.0000	285.0000	285.0000	2.6562
t22	247.5000	247.5000	247.5000	2.6562
t23	195.0000	195.0000	195.0000	2.2187
t24	150.0000	150.0000	150.0000	2.2187

---- EQU eq3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	2.2187
t2	.	.	.	2.2187
t3	.	.	.	2.2187
t4	.	.	.	2.2187
t5	.	.	.	2.2187
t6	.	.	.	2.2187
t7	.	.	.	2.2187
t8	.	.	.	2.2187
t9	-212.8900	-212.8900	-212.8900	1.4394
t10	-456.2800	-456.2800	-456.2800	1.4394
t11	-608.1700	-608.1700	-608.1700	1.4394
t12	-626.2200	-626.2200	-626.2200	1.4394
t13	-412.3900	-412.3900	-412.3900	1.4394
t14	-181.7900	-181.7900	-181.7900	1.4394
t15	-7.2400	-7.2400	-7.2400	2.2187
t16	.	.	.	2.2187
t17	.	.	.	2.2187
t18	.	.	.	2.2187
t19	.	.	.	2.2187
t20	.	.	.	2.2187
t21	.	.	.	2.6562
t22	.	.	.	2.6562
t23	.	.	.	2.6562
t24	.	.	.	2.2187

---- EQU eq4

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	2.2187
t2	.	.	.	2.2187
t3	.	.	.	2.2187
t4	.	.	.	2.2187
t5	.	.	.	2.2187
t6	.	.	.	2.2187
t7	.	.	.	2.2187
t8	.	.	.	2.2187
t9	.	.	.	1.4394

t10	.	.	.	1.4394
t11	.	.	.	1.4394
t12	.	.	.	1.4394
t13	.	.	.	1.4394
t14	.	.	.	1.4394
t15	.	.	.	2.2187
t16	.	.	.	2.2187
t17	.	.	.	2.2187
t18	.	.	.	2.2187
t19	.	.	.	2.2187
t20	.	.	.	2.2187
t21	.	.	.	2.6562
t22	.	.	.	2.6562
t23	.	.	.	2.6562
t24	.	.	.	2.2187

---- EQU eq5

	LOWER	LEVEL	UPPER	MARGINAL
t1	92.8000	92.8000	92.8000	-1.9969
t2	.	.	.	-1.9969
t3	.	.	.	-1.9969
t4	.	.	.	-1.9969
t5	.	.	.	-1.9969
t6	.	.	.	-1.9969
t7	.	.	.	-1.9969
t8	.	.	.	-1.9969
t9	.	.	.	-1.5994
t10	.	.	.	-1.5994
t11	.	.	.	-1.5994
t12	.	.	.	-1.5994
t13	.	.	.	-1.5994
t14	.	.	.	-1.5994
t15	.	.	.	-1.9969
t16	.	.	.	-1.9969
t17	.	.	.	-1.9969
t18	.	.	.	-1.9969
t19	.	.	.	-1.9969
t20	.	.	.	-1.9969
t21	.	.	.	-1.9969
t22	.	.	.	-1.9969
t23	.	.	.	-1.9969
t24	.	.	.	-1.9969

---- EQU eq6

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	-92.8000	.	.
t2	-INF	-92.8000	.	.
t3	-INF	-92.8000	.	.
t4	-INF	-92.8000	.	.
t5	-INF	-92.8000	.	.
t6	-INF	-92.8000	.	.
t7	-INF	-92.8000	.	.
t8	-INF	-92.8000	.	.
t9	-INF	-92.8000	.	.
t10	-INF	-92.8000	.	.
t11	-INF	-92.8000	.	.
t12	-INF	-92.8000	.	.
t13	-INF	-92.8000	.	.
t14	-INF	-92.8000	.	.
t15	-INF	-92.8000	.	.
t16	-INF	-92.8000	.	.
t17	-INF	-92.8000	.	.
t18	-INF	-92.8000	.	.
t19	-INF	-92.8000	.	.
t20	-INF	-26.5249	.	.
t21	-INF	.	.	.
t22	-INF	.	.	.
t23	-INF	-10.5951	.	.
t24	-INF	-92.8000	.	.

---- EQU eq7

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	-92.8000	.	.
t2	-INF	-92.8000	.	.
t3	-INF	-92.8000	.	.
t4	-INF	-92.8000	.	.
t5	-INF	-92.8000	.	.
t6	-INF	-92.8000	.	.
t7	-INF	-92.8000	.	.
t8	-INF	-92.8000	.	.
t9	-INF	.	.	.
t10	-INF	-51.5556	.	.
t11	-INF	-92.8000	.	.
t12	-INF	.	.	.
t13	-INF	.	.	.
t14	-INF	.	.	.
t15	-INF	-92.8000	.	.
t16	-INF	-92.8000	.	.

t17	-INF	-92.8000	.	.
t18	-INF	-92.8000	.	.
t19	-INF	-92.8000	.	.
t20	-INF	-92.8000	.	.
t21	-INF	-92.8000	.	.
t22	-INF	-92.8000	.	.
t23	-INF	-92.8000	.	.
t24	-INF	-92.8000	.	.

---- EQU eq8

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	1.0000	1.0000	.
t2	-INF	1.0000	1.0000	.
t3	-INF	1.0000	1.0000	.
t4	-INF	1.0000	1.0000	.
t5	-INF	1.0000	1.0000	.
t6	-INF	1.0000	1.0000	.
t7	-INF	1.0000	1.0000	.
t8	-INF	1.0000	1.0000	.
t9	-INF	1.0000	1.0000	.
t10	-INF	1.0000	1.0000	.
t11	-INF	1.0000	1.0000	.
t12	-INF	1.0000	1.0000	.
t13	-INF	1.0000	1.0000	.
t14	-INF	1.0000	1.0000	.
t15	-INF	1.0000	1.0000	.
t16	-INF	1.0000	1.0000	.
t17	-INF	1.0000	1.0000	.
t18	-INF	1.0000	1.0000	.
t19	-INF	1.0000	1.0000	.
t20	-INF	1.0000	1.0000	.
t21	-INF	1.0000	1.0000	.
t22	-INF	1.0000	1.0000	.
t23	-INF	1.0000	1.0000	.
t24	-INF	1.0000	1.0000	.

---- EQU eq9

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	1.2310	
t2	.	.	1.2310	
t3	.	.	1.2310	
t4	.	.	1.2310	
t5	.	.	1.2310	

t6	.	.	.	1.2310
t7	.	.	.	1.2310
t8	.	.	.	1.2310
t9	.	.	.	1.2310
t10	.	.	.	1.2310
t11	.	.	.	1.2310
t12	.	.	.	1.2310
t13	.	.	.	1.2310
t14	.	.	.	1.2310
t15	.	.	.	1.2310
t16	.	.	.	1.2310
t17	.	.	.	1.2310
t18	.	.	.	1.2310
t19	.	.	.	1.2310
t20	.	.	.	1.2310
t21	.	.	.	1.2310
t22	.	.	.	1.2310
t23	.	.	.	1.2310
t24	.	.	.	1.2310

---- EQU eq10

	LOWER	LEVEL	UPPER	MARGINAL
t1	45.0000	45.0000	45.0000	1.2310
t2	45.0000	45.0000	45.0000	1.2310
t3	45.0000	45.0000	45.0000	1.2310
t4	45.0000	45.0000	45.0000	1.2310
t5	45.0000	45.0000	45.0000	1.2310
t6	45.0000	45.0000	45.0000	1.2310
t7	45.0000	45.0000	45.0000	1.2310
t8	45.0000	45.0000	45.0000	1.2310
t9	45.0000	45.0000	45.0000	1.2310
t10	45.0000	45.0000	45.0000	1.2310
t11	45.0000	45.0000	45.0000	1.2310
t12	45.0000	45.0000	45.0000	1.2310
t13	45.0000	45.0000	45.0000	1.2310
t14	45.0000	45.0000	45.0000	1.2310
t15	45.0000	45.0000	45.0000	1.2310
t16	45.0000	45.0000	45.0000	1.2310
t17	45.0000	45.0000	45.0000	1.2310
t18	45.0000	45.0000	45.0000	1.2310
t19	45.0000	45.0000	45.0000	1.2310
t20	45.0000	45.0000	45.0000	1.2310
t21	45.0000	45.0000	45.0000	1.2310
t22	45.0000	45.0000	45.0000	1.2310
t23	45.0000	45.0000	45.0000	1.2310

t24 45.0000 45.0000 45.0000 1.2310

---- EQU eq11

	LOWER	LEVEL	UPPER	MARGINAL
t1	7844.3800	7844.3800	7844.3800	1.3454
t2	7844.3800	7844.3800	7844.3800	1.3454
t3	7844.3800	7844.3800	7844.3800	1.3454
t4	7844.3800	7844.3800	7844.3800	1.3454
t5	7844.3800	7844.3800	7844.3800	1.3454
t6	7844.3800	7844.3800	7844.3800	1.3454
t7	7844.3800	7844.3800	7844.3800	1.3454
t8	7844.3800	7844.3800	7844.3800	1.3454
t9	7844.3800	7844.3800	7844.3800	1.3454
t10	7844.3800	7844.3800	7844.3800	1.3454
t11	7844.3800	7844.3800	7844.3800	1.3454
t12	7844.3800	7844.3800	7844.3800	1.3454
t13	7844.3800	7844.3800	7844.3800	1.3454
t14	7844.3800	7844.3800	7844.3800	1.3454
t15	7844.3800	7844.3800	7844.3800	1.3454
t16	7844.3800	7844.3800	7844.3800	1.3454
t17	7844.3800	7844.3800	7844.3800	1.3454
t18	7844.3800	7844.3800	7844.3800	1.3454
t19	7844.3800	7844.3800	7844.3800	1.3454
t20	7844.3800	7844.3800	7844.3800	1.3454
t21	7844.3800	7844.3800	7844.3800	1.3454
t22	7844.3800	7844.3800	7844.3800	1.3454
t23	7844.3800	7844.3800	7844.3800	1.3454
t24	7844.3800	7844.3800	7844.3800	1.3454

---- EQU eq12

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	1.3454
t2	.	.	.	1.3454
t3	.	.	.	1.3454
t4	.	.	.	1.3454
t5	.	.	.	1.3454
t6	.	.	.	1.3454
t7	.	.	.	1.3454
t8	.	.	.	1.3454
t9	.	.	.	1.3454
t10	.	.	.	1.3454
t11	.	.	.	1.3454
t12	.	.	.	1.3454

t13	.	.	.	1.3454
t14	.	.	.	1.3454
t15	.	.	.	1.3454
t16	.	.	.	1.3454
t17	.	.	.	1.3454
t18	.	.	.	1.3454
t19	.	.	.	1.3454
t20	.	.	.	1.3454
t21	.	.	.	1.3454
t22	.	.	.	1.3454
t23	.	.	.	1.3454
t24	.	.	.	1.3454

---- EQU eq13

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	-0.3511
t2	.	.	.	-0.3511
t3	.	.	.	-0.3511
t4	.	.	.	-0.3511
t5	.	.	.	-0.3511
t6	.	.	.	-0.3511
t7	.	.	.	-0.5412
t8	.	.	.	-0.5412
t9	.	.	.	-0.3511
t10	.	.	.	-0.3511
t11	.	.	.	-0.3511
t12	.	.	.	-0.3511
t13	.	.	.	-0.3511
t14	.	.	.	-0.3511
t15	.	.	.	-0.5412
t16	.	.	.	-0.5412
t17	.	.	.	-0.5412
t18	.	.	.	-0.5412
t19	.	.	.	-0.5412
t20	.	.	.	-0.5412
t21	.	.	.	-0.6479
t22	.	.	.	-0.6479
t23	.	.	.	-0.5412
t24	.	.	.	-0.5412

---- EQU eq14

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	.	.	.

t2	-INF	.	.	.
t3	-INF	.	.	.
t4	-INF	.	.	.
t5	-INF	.	.	.
t6	-INF	.	.	.
t7	-INF	.	.	.
t8	-INF	.	.	.
t9	-INF	.	.	.
t10	-INF	.	.	.
t11	-INF	.	.	.
t12	-INF	.	.	.
t13	-INF	.	.	.
t14	-INF	.	.	.
t15	-INF	.	.	.
t16	-INF	.	.	.
t17	-INF	.	.	.
t18	-INF	.	.	.
t19	-INF	.	.	.
t20	-INF	.	.	.
t21	-INF	.	.	.
t22	-INF	.	.	.
t23	-INF	.	.	.
t24	-INF	.	.	.

---- EQU eq15

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	1000.0000	+INF	.
t2	.	1000.0000	+INF	.
t3	.	1000.0000	+INF	.
t4	.	1000.0000	+INF	.
t5	.	1000.0000	+INF	.
t6	.	1000.0000	+INF	.
t7	.	1000.0000	+INF	.
t8	.	1000.0000	+INF	.
t9	.	1000.0000	+INF	.
t10	.	1000.0000	+INF	.
t11	.	1000.0000	+INF	.
t12	.	1000.0000	+INF	.
t13	.	1000.0000	+INF	.
t14	.	1000.0000	+INF	.
t15	.	1000.0000	+INF	.
t16	.	1000.0000	+INF	.
t17	.	1000.0000	+INF	.
t18	.	1000.0000	+INF	.
t19	.	1000.0000	+INF	.

t20 . 1000.0000 +INF .
t21 . 1000.0000 +INF .
t22 . 1000.0000 +INF .
t23 . 1000.0000 +INF .
t24 . 1000.0000 +INF .

---- EQU eq16

LOWER LEVEL UPPER MARGINAL

t1 -INF 1.0000 1.0000 .
t2 -INF 1.0000 1.0000 .
t3 -INF 1.0000 1.0000 .
t4 -INF 1.0000 1.0000 .
t5 -INF 1.0000 1.0000 .
t6 -INF 1.0000 1.0000 .
t7 -INF 1.0000 1.0000 .
t8 -INF 1.0000 1.0000 .
t9 -INF 1.0000 1.0000 .
t10 -INF 1.0000 1.0000 .
t11 -INF 1.0000 1.0000 .
t12 -INF 1.0000 1.0000 .
t13 -INF 1.0000 1.0000 .
t14 -INF 1.0000 1.0000 .
t15 -INF 1.0000 1.0000 .
t16 -INF 1.0000 1.0000 .
t17 -INF 1.0000 1.0000 .
t18 -INF 1.0000 1.0000 .
t19 -INF 1.0000 1.0000 .
t20 -INF 1.0000 1.0000 .
t21 -INF 1.0000 1.0000 .
t22 -INF 1.0000 1.0000 .
t23 -INF 1.0000 1.0000 .
t24 -INF 1.0000 1.0000 .

LOWER LEVEL UPPER MARGINAL

---- VAR cost -INF 210837.7845 +INF .

---- VAR E

LOWER LEVEL UPPER MARGINAL

t1 . . +INF .
t2 . . +INF .
t3 . . +INF .
t4 . . +INF .

t5	.	.	+INF	.
t6	.	.	+INF	.
t7	.	30.9426	+INF	.
t8	.	62.1926	+INF	.
t9	.	.	+INF	0.7481
t10	.	.	+INF	0.7481
t11	.	.	+INF	1.1681
t12	.	.	+INF	1.1681
t13	.	.	+INF	1.1681
t14	.	.	+INF	0.7481
t15	.	78.0884	+INF	.
t16	.	101.2551	+INF	.
t17	.	148.1301	+INF	.
t18	.	202.8176	+INF	.
t19	.	210.6301	+INF	.
t20	.	133.7810	+INF	.
t21	.	82.7134	+INF	.
t22	.	43.6509	+INF	.
t23	.	.	+INF	.
t24	.	38.7551	+INF	.

---- VAR E1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	+INF	.
t2	.	.	+INF	.
t3	.	.	+INF	.
t4	.	.	+INF	.
t5	.	.	+INF	.
t6	.	.	+INF	.
t7	.	.	+INF	.
t8	.	.	+INF	.
t9	.	92.8000	+INF	.
t10	.	41.2444	+INF	.
t11	.	.	+INF	.
t12	.	92.8000	+INF	.
t13	.	92.8000	+INF	.
t14	.	92.8000	+INF	.
t15	.	.	+INF	.
t16	.	.	+INF	.
t17	.	.	+INF	.
t18	.	.	+INF	.
t19	.	.	+INF	.
t20	.	.	+INF	.
t21	.	.	+INF	.
t22	.	.	+INF	.

t23	.	.	+INF	.
t24	.	.	+INF	.

---- VAR E2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	+INF	0.7793
t2	.	.	+INF	0.7793
t3	.	.	+INF	0.7793
t4	.	.	+INF	0.7793
t5	.	.	+INF	0.7793
t6	.	.	+INF	0.7793
t7	.	29.7049	+INF	.
t8	.	59.7049	+INF	.
t9	.	120.0900	+INF	.
t10	.	415.0356	+INF	.
t11	.	608.1700	+INF	.
t12	.	533.4200	+INF	.
t13	.	319.5900	+INF	.
t14	.	88.9900	+INF	.
t15	.	82.2049	+INF	.
t16	.	97.2049	+INF	.
t17	.	142.2049	+INF	.
t18	.	194.7049	+INF	.
t19	.	202.2049	+INF	.
t20	.	128.4298	+INF	.
t21	.	79.4049	+INF	.
t22	.	41.9049	+INF	.
t23	.	.	+INF	0.4375
t24	.	37.2049	+INF	.

---- VAR E3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	487.8049	+INF	.
t2	.	487.8049	+INF	.
t3	.	487.8049	+INF	.
t4	.	487.8049	+INF	.
t5	.	487.8049	+INF	.
t6	.	487.8049	+INF	.
t7	.	487.8049	+INF	.
t8	.	487.8049	+INF	.
t9	.	487.8049	+INF	.
t10	.	487.8049	+INF	.
t11	.	487.8049	+INF	.

t12	.	487.8049	+INF	.
t13	.	487.8049	+INF	.
t14	.	487.8049	+INF	.
t15	.	487.8049	+INF	.
t16	.	487.8049	+INF	.
t17	.	487.8049	+INF	.
t18	.	487.8049	+INF	.
t19	.	487.8049	+INF	.
t20	.	487.8049	+INF	.
t21	.	487.8049	+INF	.
t22	.	487.8049	+INF	.
t23	.	487.8049	+INF	.
t24	.	487.8049	+INF	.

---- VAR G

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	7134.2505	+INF	.
t2	.	7116.7107	+INF	.
t3	.	7107.9408	+INF	.
t4	.	7107.9408	+INF	.
t5	.	7116.7107	+INF	.
t6	.	7134.2505	+INF	.
t7	.	7134.5956	+INF	.
t8	.	7134.5956	+INF	.
t9	.	7081.5258	+INF	.
t10	.	6736.6393	+INF	.
t11	.	6519.5728	+INF	.
t12	.	6624.5195	+INF	.
t13	.	6865.7858	+INF	.
t14	.	7109.1218	+INF	.
t15	.	7134.5956	+INF	.
t16	.	7134.5956	+INF	.
t17	.	7134.5956	+INF	.
t18	.	7134.5956	+INF	.
t19	.	7134.5956	+INF	.
t20	.	7134.5956	+INF	.
t21	.	7134.5956	+INF	.
t22	.	7134.5956	+INF	.
t23	.	7134.5956	+INF	.
t24	.	7134.5956	+INF	.

---- VAR G1

	LOWER	LEVEL	UPPER	MARGINAL

t1	.	1399.3121	1400.0000	.
t2	.	1364.3470	1400.0000	.
t3	.	1346.8645	1400.0000	.
t4	.	1346.8645	1400.0000	.
t5	.	1364.3470	1400.0000	.
t6	.	1399.3121	1400.0000	.
t7	.	1400.0000	1400.0000	-0.3343
t8	.	1400.0000	1400.0000	-0.3343
t9	.	1294.2072	1400.0000	.
t10	.	606.6884	1400.0000	.
t11	.	173.9741	1400.0000	.
t12	.	383.1815	1400.0000	.
t13	.	864.1372	1400.0000	.
t14	.	1349.2188	1400.0000	.
t15	.	1400.0000	1400.0000	-0.3343
t16	.	1400.0000	1400.0000	-0.3343
t17	.	1400.0000	1400.0000	-0.3343
t18	.	1400.0000	1400.0000	-0.3343
t19	.	1400.0000	1400.0000	-0.3343
t20	.	1400.0000	1400.0000	-0.3343
t21	.	1400.0000	1400.0000	-0.5220
t22	.	1400.0000	1400.0000	-0.5220
t23	.	1400.0000	1400.0000	-0.3343
t24	.	1400.0000	1400.0000	-0.3343

---- VAR G2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	5689.9385	6500.0000	.
t2	.	5707.3637	6500.0000	.
t3	.	5716.0763	6500.0000	.
t4	.	5716.0763	6500.0000	.
t5	.	5707.3637	6500.0000	.
t6	.	5689.9385	6500.0000	.
t7	.	5689.5956	6500.0000	.
t8	.	5689.5956	6500.0000	.
t9	.	5742.3186	6500.0000	.
t10	.	6084.9509	6500.0000	.
t11	.	6300.5987	6500.0000	.
t12	.	6196.3379	6500.0000	.
t13	.	5956.6485	6500.0000	.
t14	.	5714.9030	6500.0000	.
t15	.	5689.5956	6500.0000	.
t16	.	5689.5956	6500.0000	.
t17	.	5689.5956	6500.0000	.
t18	.	5689.5956	6500.0000	.

t19	.	5689.5956	6500.0000	.
t20	.	5689.5956	6500.0000	.
t21	.	5689.5956	6500.0000	.
t22	.	5689.5956	6500.0000	.
t23	.	5689.5956	6500.0000	.
t24	.	5689.5956	6500.0000	.

---- VAR G3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	45.0000	+INF	.
t2	.	45.0000	+INF	.
t3	.	45.0000	+INF	.
t4	.	45.0000	+INF	.
t5	.	45.0000	+INF	.
t6	.	45.0000	+INF	.
t7	.	45.0000	+INF	.
t8	.	45.0000	+INF	.
t9	.	45.0000	+INF	.
t10	.	45.0000	+INF	.
t11	.	45.0000	+INF	.
t12	.	45.0000	+INF	.
t13	.	45.0000	+INF	.
t14	.	45.0000	+INF	.
t15	.	45.0000	+INF	.
t16	.	45.0000	+INF	.
t17	.	45.0000	+INF	.
t18	.	45.0000	+INF	.
t19	.	45.0000	+INF	.
t20	.	45.0000	+INF	.
t21	.	45.0000	+INF	.
t22	.	45.0000	+INF	.
t23	.	45.0000	+INF	.
t24	.	45.0000	+INF	.

---- VAR Ed

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	92.8000	0.7793
t2	.	.	92.8000	0.7793
t3	.	.	92.8000	0.7793
t4	.	.	92.8000	0.7793
t5	.	.	92.8000	0.7793
t6	.	.	92.8000	0.7793
t7	.	.	92.8000	EPS

t8	.	.	92.8000	.
t9	.	.	92.8000	0.3376
t10	.	.	92.8000	0.3376
t11	.	.	92.8000	0.3376
t12	.	.	92.8000	0.3376
t13	.	.	92.8000	0.3376
t14	.	.	92.8000	0.3376
t15	.	.	92.8000	.
t16	.	.	92.8000	EPS
t17	.	.	92.8000	EPS
t18	.	.	92.8000	EPS
t19	.	.	92.8000	EPS
t20	.	66.2751	92.8000	.
t21	.	92.8000	92.8000	-0.4375
t22	.	92.8000	92.8000	-0.4375
t23	.	82.2049	92.8000	.
t24	.	.	92.8000	.

---- VAR Ec

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	92.8000	0.4216
t2	.	.	92.8000	0.4216
t3	.	.	92.8000	0.4216
t4	.	.	92.8000	0.4216
t5	.	.	92.8000	0.4216
t6	.	.	92.8000	0.4216
t7	.	.	92.8000	0.4216
t8	.	.	92.8000	0.4216
t9	.	92.8000	92.8000	EPS
t10	.	41.2444	92.8000	.
t11	.	.	92.8000	EPS
t12	.	92.8000	92.8000	EPS
t13	.	92.8000	92.8000	EPS
t14	.	92.8000	92.8000	EPS
t15	.	.	92.8000	0.4216
t16	.	.	92.8000	0.4216
t17	.	.	92.8000	0.4216
t18	.	.	92.8000	0.4216
t19	.	.	92.8000	0.4216
t20	.	.	92.8000	0.4216
t21	.	.	92.8000	0.8591
t22	.	.	92.8000	0.8591
t23	.	.	92.8000	0.8591
t24	.	.	92.8000	0.4216

---- VAR H1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	5206.2937	+INF	.
t2	.	5222.2378	+INF	.
t3	.	5230.2098	+INF	.
t4	.	5230.2098	+INF	.
t5	.	5222.2378	+INF	.
t6	.	5206.2937	+INF	.
t7	.	5205.9800	+INF	.
t8	.	5205.9800	+INF	.
t9	.	5254.2215	+INF	.
t10	.	5567.7301	+INF	.
t11	.	5765.0478	+INF	.
t12	.	5669.6492	+INF	.
t13	.	5450.3334	+INF	.
t14	.	5229.1362	+INF	.
t15	.	5205.9800	+INF	.
t16	.	5205.9800	+INF	.
t17	.	5205.9800	+INF	.
t18	.	5205.9800	+INF	.
t19	.	5205.9800	+INF	.
t20	.	5205.9800	+INF	.
t21	.	5205.9800	+INF	.
t22	.	5205.9800	+INF	.
t23	.	5205.9800	+INF	.
t24	.	5205.9800	+INF	.

---- VAR H_ehp

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	2000.0000	2000.0000	-0.9943
t2	.	2000.0000	2000.0000	-0.9943
t3	.	2000.0000	2000.0000	-0.9943
t4	.	2000.0000	2000.0000	-0.9943
t5	.	2000.0000	2000.0000	-0.9943
t6	.	2000.0000	2000.0000	-0.9943
t7	.	2000.0000	2000.0000	-0.8042
t8	.	2000.0000	2000.0000	-0.8042
t9	.	2000.0000	2000.0000	-0.9943
t10	.	2000.0000	2000.0000	-0.9943
t11	.	2000.0000	2000.0000	-0.9943
t12	.	2000.0000	2000.0000	-0.9943
t13	.	2000.0000	2000.0000	-0.9943
t14	.	2000.0000	2000.0000	-0.9943

t15	.	2000.0000	2000.0000	-0.8042
t16	.	2000.0000	2000.0000	-0.8042
t17	.	2000.0000	2000.0000	-0.8042
t18	.	2000.0000	2000.0000	-0.8042
t19	.	2000.0000	2000.0000	-0.8042
t20	.	2000.0000	2000.0000	-0.8042
t21	.	2000.0000	2000.0000	-0.6975
t22	.	2000.0000	2000.0000	-0.6975
t23	.	2000.0000	2000.0000	-0.8042
t24	.	2000.0000	2000.0000	-0.8042

---- VAR SOC

	LOWER	LEVEL	UPPER	MARGINAL
t1	92.8000	92.8000	464.0000	.
t2	92.8000	92.8000	464.0000	.
t3	92.8000	92.8000	464.0000	.
t4	92.8000	92.8000	464.0000	.
t5	92.8000	92.8000	464.0000	.
t6	92.8000	92.8000	464.0000	.
t7	92.8000	92.8000	464.0000	.
t8	92.8000	92.8000	464.0000	0.3975
t9	92.8000	176.3200	464.0000	.
t10	92.8000	213.4400	464.0000	.
t11	92.8000	213.4400	464.0000	.
t12	92.8000	296.9600	464.0000	.
t13	92.8000	380.4800	464.0000	.
t14	92.8000	464.0000	464.0000	-0.3975
t15	92.8000	464.0000	464.0000	EPS
t16	92.8000	464.0000	464.0000	.
t17	92.8000	464.0000	464.0000	.
t18	92.8000	464.0000	464.0000	.
t19	92.8000	464.0000	464.0000	.
t20	92.8000	390.3610	464.0000	.
t21	92.8000	287.2499	464.0000	.
t22	92.8000	184.1388	464.0000	.
t23	92.8000	92.8000	464.0000	EPS
t24	92.8000	92.8000	92.8000	1.9969

---- VAR Ih

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	1.0000	1.0000	EPS
t2	.	1.0000	1.0000	EPS
t3	.	1.0000	1.0000	EPS

t4	.	1.0000	1.0000	EPS
t5	.	1.0000	1.0000	EPS
t6	.	1.0000	1.0000	EPS
t7	.	1.0000	1.0000	EPS
t8	.	1.0000	1.0000	EPS
t9	.	1.0000	1.0000	EPS
t10	.	1.0000	1.0000	EPS
t11	.	1.0000	1.0000	EPS
t12	.	1.0000	1.0000	EPS
t13	.	1.0000	1.0000	EPS
t14	.	1.0000	1.0000	EPS
t15	.	1.0000	1.0000	EPS
t16	.	1.0000	1.0000	EPS
t17	.	1.0000	1.0000	EPS
t18	.	1.0000	1.0000	EPS
t19	.	1.0000	1.0000	EPS
t20	.	1.0000	1.0000	EPS
t21	.	1.0000	1.0000	EPS
t22	.	1.0000	1.0000	EPS
t23	.	1.0000	1.0000	EPS
t24	.	1.0000	1.0000	EPS

---- VAR Idch

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	1.0000	1.0000	EPS
t2	.	1.0000	1.0000	EPS
t3	.	1.0000	1.0000	EPS
t4	.	1.0000	1.0000	EPS
t5	.	1.0000	1.0000	EPS
t6	.	1.0000	1.0000	EPS
t7	.	1.0000	1.0000	EPS
t8	.	1.0000	1.0000	EPS
t9	.	1.0000	1.0000	EPS
t10	.	1.0000	1.0000	EPS
t11	.	1.0000	1.0000	EPS
t12	.	1.0000	1.0000	EPS
t13	.	1.0000	1.0000	EPS
t14	.	1.0000	1.0000	EPS
t15	.	1.0000	1.0000	EPS
t16	.	1.0000	1.0000	EPS
t17	.	1.0000	1.0000	EPS
t18	.	1.0000	1.0000	EPS
t19	.	1.0000	1.0000	EPS
t20	.	1.0000	1.0000	EPS
t21	.	1.0000	1.0000	EPS

t22 . 1.0000 1.0000 EPS
t23 . 1.0000 1.0000 EPS
t24 . 1.0000 1.0000 EPS

---- VAR Ich

LOWER LEVEL UPPER MARGINAL

t1 . . 1.0000 EPS
t2 . . 1.0000 EPS
t3 . . 1.0000 EPS
t4 . . 1.0000 EPS
t5 . . 1.0000 EPS
t6 . . 1.0000 EPS
t7 . . 1.0000 EPS
t8 . . 1.0000 EPS
t9 . . 1.0000 EPS
t10 . . 1.0000 EPS
t11 . . 1.0000 EPS
t12 . . 1.0000 EPS
t13 . . 1.0000 EPS
t14 . . 1.0000 EPS
t15 . . 1.0000 EPS
t16 . . 1.0000 EPS
t17 . . 1.0000 EPS
t18 . . 1.0000 EPS
t19 . . 1.0000 EPS
t20 . . 1.0000 EPS
t21 . . 1.0000 EPS
t22 . . 1.0000 EPS
t23 . . 1.0000 EPS
t24 . . 1.0000 EPS

**** REPORT SUMMARY : 0 NONOPT
0 INFEASIBLE
0 UNBOUNDED
GAMS 34.2.0 r6925a71 Released Feb 5, 2021 DEX-DEG x86 64bit/Mac OS X - 05/14/21 00:53:52 Page 6
Optimal operation of energy hub
E x e c u t i o n

---- 138 PARAMETER report

E(t) KVET - el PV(t) E1(t) De(t) G(t) G1(t) G2(t) G3(t) Kotel - t~ KVET - te~ TC - teplo Ec(t) Ed(t) SOC(t)

t1 600.305 112.500 7134.251 1399.312 5689.938 45.000
5206.294 638.086 2000.000 92.800
t2 585.305 97.500 7116.711 1364.347 5707.364 45.000
5222.238 622.142 2000.000 92.800
t3 577.805 90.000 7107.941 1346.865 5716.076 45.000
5230.210 614.170 2000.000 92.800
t4 577.805 90.000 7107.941 1346.865 5716.076 45.000
5230.210 614.170 2000.000 92.800
t5 585.305 97.500 7116.711 1364.347 5707.364 45.000
5222.238 622.142 2000.000 92.800
t6 600.305 112.500 7134.251 1399.312 5689.938 45.000
5206.294 638.086 2000.000 92.800
t7 30.943 600.600 142.500 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 92.800
t8 62.193 600.600 172.500 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 92.800
t9 555.215 212.890 92.800 187.500 7081.526 1294.207 5742.319
45.000 5254.222 590.158 2000.000 92.800 176.320
t10 260.269 456.280 41.244 187.500 6736.639 606.688 6084.951
45.000 5567.730 276.650 2000.000 41.244 213.440
t11 74.635 608.170 195.000 6519.573 173.974 6300.599
45.000 5765.048 79.332 2000.000 213.440
t12 164.385 626.220 92.800 210.000 6624.519 383.182 6196.338
45.000 5669.649 174.731 2000.000 92.800 296.960
t13 370.715 412.390 92.800 202.500 6865.786 864.137 5956.649
45.000 5450.333 394.047 2000.000 92.800 380.480
t14 578.815 181.790 92.800 180.000 7109.122 1349.219 5714.903
45.000 5229.136 615.244 2000.000 92.800 464.000
t15 78.088 600.600 7.240 195.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 464.000
t16 101.255 600.600 210.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 464.000
t17 148.130 600.600 255.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 464.000
t18 202.818 600.600 307.500 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 464.000
t19 210.630 600.600 315.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 464.000
t20 133.781 600.600 307.500 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 66.275 390.361
t21 82.713 600.600 285.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 92.800 287.250
t22 43.651 600.600 247.500 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 92.800 184.139
t23 600.600 195.000 7134.596 1400.000 5689.596 45.000
5205.980 638.400 2000.000 82.205 92.800

t24 38.755 600.600 150.000 7134.596 1400.000 5689.596
45.000 5205.980 638.400 2000.000 92.800

EXECUTION TIME = 0.073 SECONDS 4 MB 34.2.0 r6925a71 DEX-DEG

USER: GAMS Demo license for Olga Aralkina G210210|0002CO-GEN
Czech Technical University in Prague, Czech Republic DL031829

**** FILE SUMMARY

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Output /Users/olga/Documents/GAMS/Studio/workspace/Varianta2.lst