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

  2 */ vytvoreni promenne t
  3 Set t 'hours' / t1*t24 /;
  4 */ vytvoreni tabulky data s promennou t
  5
  6 Table data(t,*)
  7 */ vstup hodnot do tabulky data
  8   Dh   De   Dg   PV   Lambda_e
  9 t1   415.77 77.22 19.74 0.00   2.502
 10 t2 415.77   70.20 19.74 0.00   2.502
 11 t3 415.77   66.69 19.74 0.00   2.502
 12 t4 415.77   66.69 19.74 0.00   2.502
 13 t5 415.77   66.69 19.74 0.00   2.502
 14 t6 415.77   84.24 19.74 0.00   2.502
 15 t7 415.77   108.81 19.74 0.56   2.502
 16 t8 415.77   115.83 19.74 3.93   2.502
 17 t9 415.77   115.83 19.74 27.53 2.502
 18 t10 415.77   129.87 19.74 47.05 2.502
 19 t11 415.77   143.91 19.74 62.05 2.502
 20 t12 415.77   147.42 19.74 71.8   3.099
 21 t13 415.77   143.91 19.74 66.56 3.099
 22 t14 415.77   147.42 19.74 51.54 3.099
 23 t15 415.77   143.91 19.74 31.51 2.502
 24 t16 415.77   143.91 19.74 0.32   2.502
 25 t17 415.77   164.97 19.74 0.00   2.502
 26 t18 415.77   196.56 19.74 0.00   2.502
 27 t19 415.77   203.58 19.74 0.00   3.099
 28 t20 415.77   189.54 19.74 0.00   3.099
 29 t21 415.77   175.50 19.74 0.00   3.099
 30 t22 415.77   150.93 19.74 0.00   3.099
 31 t23 415.77   126.36 19.74 0.00   3.099
 32 t24 415.77   98.28 19.74 0.00   2.502;
 33
 34 */ zavedeni promenne cost - provozni naklady
 35 Variable cost;
 36
 37 */ zavedeni kladnych promennych
 38 Positive Variables E(t), E1(t), E2(t), G(t), G1(t), G2(t), G3(t),
 39 H1(t), H_ehp(t);
 40
 41 */ zavedeni binarnich promennych
 42 binary variables Ih(t);
 43
 45 */ zavedeni promennych s danymi hodnotami
 46 scalar eta_ee / 0.96 / ,!! účinnost transformatoru
 47 eta_ge / 0.392 / ,   !! účinnost kogenerační jednotky vyroba elektro
 48 eta_gh / 0.518 / ,   !! účinnost kogenerační jednotky vyroba teplo
 49 COP / 3.8 / ,   !! topný faktor tepelného čerpadla
 50 H_ehpMax / 260 / ,   !! výkon tepelného čerpadla max
 51 H_ehpMin / 0.5 / ,   !! výkon tepelného čerpadla min
 52 Chpmax / 465 / ,   !! max výkon kogenerační jednotky

```
53  Fmax / 576 / ,        !! výkon plynový kotel
54  eta_ghf / 0.915 / ,    !! účinnost spalování plynu plynovým kotlem
55  lambda_g / 1.737 / ;   !! cena plyn
56
57  */ dodatecne upresneni hodnot promennych
58  H_ehp.up(t) = H_ehpMax ; !! MAX výkon tepelného čerpadla
59  G1.up(t)=Chpmax ;        !! MAX výkon KVET
60  G2.up(t)=Fmax ;          !! MAX výkon plynový kotel
61
62  */ zavedeni potrebneho poctu rovnic s oznacenim
63  Equation eq1, eq2, eq3, eq4, eq5, eq6, eq7, eq8, eq9, eq10, eq11 ;
64
65  */ rovnice matematického modelu EnergyHub:
66
67  */ objektivni hodnotici funkce - soucet nakladu na energie
68  eq1..    cost =e= sum(t, data(t,'lambda_e')*E(t)+lambda_g*G(t));
69  */ tok elektricke energie z EnergyHubu
70  eq2(t).. E1(t)+eta_ge*G1(t) =e= data(t, 'De')+E2(t) ;
71  */ tok elektricke energie do EnergyHubu
72  eq3(t).. eta_ee*E(t) =e= E1(t) ;
73  */ tok plynu do EnergyHubu
74  eq4(t).. G(t) =e= G1(t)+G2(t)+G3(t) ;
75  */ tok plynu z EnergyHubu
76  eq5(t).. G3(t) =e= data(t, 'Dg') ;
77  */ tok tepla z EnergyHubu
78  eq6(t).. eta_gh*G1(t)+H1(t)+H_ehp(t) =e= data(t, 'Dh') ;
79  */ fungovani plynoveho kotle
80  eq7(t).. eta_ghf*G2(t) =e= H1(t) ;
81  */ vykon tepelneho cerpadla
82  eq8(t).. H_ehp(t) =e= E2(t)*COP ;
83  */ omezeni maximalniho tepelneho vykonu tepelneho cerpadla
84  eq9(t).. H_ehp(t) =l= H_ehpMax*Ih(t) ;
85  */ omezeni minimalniho tepelneho vykonu tepelneho cerpadla
86  eq10(t).. H_ehp(t) =g= H_ehpMax*Ih(t)*H_ehpMin ;
87  */ provozni rezim tepelneho cerpadla (chlazeni/topeni)
88  eq11(t).. Ih(t) =l= 1 ;
89
90  */ vytvoreni matematickeho modelu ze zadanych dat
91  Model Hub / all /;
92
93  */ prikaz pro reseni daneho modelu pomoci MIP resitele s minimalizaci promenne cost
94  solve hub us mip min cost;
95
96  Parameter report(t,*);
97  report(t, 'E(t)') = E.l(t);
98  report(t, 'KVET - el') = eta_ge*G1.l(t);
99  report(t, 'E1(t)') = E1.l(t);
100  report(t, 'De(t)') = data(t, 'De');
101  report(t, 'Dh(t)') = data(t, 'Dh');
102  report(t, 'G(t)') = G.l(t);
103  report(t, 'G1(t)') = G1.l(t);
104  report(t, 'G2(t)') = G2.l(t);
105  report(t, 'G3(t)') = G3.l(t);
106  report(t, 'Kotel - teplo') = H1.l(t);
107  report(t, 'KVET - teplo') = eta_gh*G1.l(t);
```

```
108  report(t, 'TC - teplo') = H_ehp.l(t);
109  display report;
```

COMPILATION TIME   =   0.000 SECONDS   3 MB 38.1.0 a1a3b545 WEX-WEI
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Optimal operation of energy hub
Equation Listing   SOLVE Hub Using MIP From line 94

---- eq1 =E=

eq1.. cost - 2.502*E(t1) - 2.502*E(t2) - 2.502*E(t3) - 2.502*E(t4) - 2.502*E(t5) - 2.502*E(t6) - 2.502*E(t7) - 2.502
*E(t8) - 2.502*E(t9) - 2.502*E(t10) - 2.502*E(t11) - 3.099*E(t12) - 3.099*E(t13) - 3.099*E(t14) - 2.502*E(t15) - 2.
502*E(t16) - 2.502*E(t17) - 2.502*E(t18) - 3.099*E(t19) - 3.099*E(t20) - 3.099*E(t21) - 3.099*E(t22) - 3.099*E(t2
3) - 2.502*E(t24) - 1.737*G(t1) - 1.737*G(t2) - 1.737*G(t3) - 1.737*G(t4) - 1.737*G(t5) - 1.737*G(t6) - 1.737*G(t
7) - 1.737*G(t8) - 1.737*G(t9) - 1.737*G(t10) - 1.737*G(t11) - 1.737*G(t12) - 1.737*G(t13) - 1.737*G(t14) - 1.737
*G(t15) - 1.737*G(t16) - 1.737*G(t17) - 1.737*G(t18) - 1.737*G(t19) - 1.737*G(t20) - 1.737*G(t21) - 1.737*G(t22
) - 1.737*G(t23) - 1.737*G(t24) =E= 0 ; (LHS = 0)

---- eq2 =E=

eq2(t1).. E1(t1) - E2(t1) + 0.392*G1(t1) =E= 77.22 ; (LHS = 0, INFES = 77.22 ****)

eq2(t2).. E1(t2) - E2(t2) + 0.392*G1(t2) =E= 70.2 ; (LHS = 0, INFES = 70.2 ****)

eq2(t3).. E1(t3) - E2(t3) + 0.392*G1(t3) =E= 66.69 ; (LHS = 0, INFES = 66.69 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq3 =E=

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

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

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

REMAINING 21 ENTRIES SKIPPED

---- eq4 =E=

eq4(t1).. G(t1) - G1(t1) - G2(t1) - G3(t1) =E= 0 ; (LHS = 0)

eq4(t2).. G(t2) - G1(t2) - G2(t2) - G3(t2) =E= 0 ; (LHS = 0)

eq4(t3).. G(t3) - G1(t3) - G2(t3) - G3(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq5 =E=
```

eq5(t1)..  G3(t1) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq5(t2)..  G3(t2) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq5(t3)..  G3(t3) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

REMAINING 21 ENTRIES SKIPPED


---- eq6  =E=

eq6(t1)..  0.518*G1(t1) + H1(t1) + H_ehp(t1) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq6(t2)..  0.518*G1(t2) + H1(t2) + H_ehp(t2) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq6(t3)..  0.518*G1(t3) + H1(t3) + H_ehp(t3) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

REMAINING 21 ENTRIES SKIPPED


---- eq7  =E=

eq7(t1)..  0.915*G2(t1) - H1(t1) =E= 0 ; (LHS = 0)

eq7(t2)..  0.915*G2(t2) - H1(t2) =E= 0 ; (LHS = 0)

eq7(t3)..  0.915*G2(t3) - H1(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED


---- eq8  =E=

eq8(t1)..  - 3.8*E2(t1) + H_ehp(t1) =E= 0 ; (LHS = 0)

eq8(t2)..  - 3.8*E2(t2) + H_ehp(t2) =E= 0 ; (LHS = 0)

eq8(t3)..  - 3.8*E2(t3) + H_ehp(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED


---- eq9  =L=

eq9(t1)..  H_ehp(t1) - 260*Ih(t1) =L= 0 ; (LHS = 0)

eq9(t2)..  H_ehp(t2) - 260*Ih(t2) =L= 0 ; (LHS = 0)

eq9(t3)..  H_ehp(t3) - 260*Ih(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED


---- eq10  =G=

eq10(t1).. H_ehp(t1) - 130*Ih(t1) =G= 0 ; (LHS = 0)

eq10(t2).. H_ehp(t2) - 130*Ih(t2) =G= 0 ; (LHS = 0)

eq10(t3).. H_ehp(t3) - 130*Ih(t3) =G= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED


---- eq11  =L=

eq11(t1).. Ih(t1) =L= 1 ; (LHS = 0)

eq11(t2).. Ih(t2) =L= 1 ; (LHS = 0)

eq11(t3).. Ih(t3) =L= 1 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

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Optimal operation of energy hub
Column Listing     SOLVE Hub Using MIP From line 94

---- cost

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


---- E

E(t1)
          (.LO, .L, .UP, .M = 0, 0, +INF, 0)
    -2.502   eq1
     0.96    eq3(t1)

E(t2)
          (.LO, .L, .UP, .M = 0, 0, +INF, 0)
    -2.502   eq1
     0.96    eq3(t2)

E(t3)
          (.LO, .L, .UP, .M = 0, 0, +INF, 0)
    -2.502   eq1
     0.96    eq3(t3)

REMAINING 21 ENTRIES SKIPPED

---- E1

E1(t1)
          (.LO, .L, .UP, .M = 0, 0, +INF, 0)

1      eq2(t1)
      -1      eq3(t1)


E1(t2)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
       1       eq2(t2)
      -1       eq3(t2)


E1(t3)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
       1       eq2(t3)
      -1       eq3(t3)

REMAINING 21 ENTRIES SKIPPED


---- E2


E2(t1)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq2(t1)
      -3.8     eq8(t1)


E2(t2)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq2(t2)
      -3.8     eq8(t2)


E2(t3)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
      -1       eq2(t3)
      -3.8     eq8(t3)

REMAINING 21 ENTRIES SKIPPED


---- G


G(t1)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
     -1.737   eq1
       1       eq4(t1)


G(t2)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
     -1.737   eq1
       1       eq4(t2)


G(t3)
              (.LO, .L, .UP, .M = 0, 0, +INF, 0)
     -1.737   eq1
       1       eq4(t3)

REMAINING 21 ENTRIES SKIPPED


---- G1

G1(t1)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
   0.392   eq2(t1)
  -1      eq4(t1)
  0.518   eq6(t1)

G1(t2)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
   0.392   eq2(t2)
  -1      eq4(t2)
  0.518   eq6(t2)

G1(t3)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
   0.392   eq2(t3)
  -1      eq4(t3)
  0.518   eq6(t3)

REMAINING 21 ENTRIES SKIPPED

---- G2

G2(t1)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
  -1      eq4(t1)
  0.915   eq7(t1)

G2(t2)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
  -1      eq4(t2)
  0.915   eq7(t2)

G2(t3)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
  -1      eq4(t3)
  0.915   eq7(t3)

REMAINING 21 ENTRIES SKIPPED

---- G3

G3(t1)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
  -1      eq4(t1)
  1      eq5(t1)

G3(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
  -1      eq4(t2)
  1      eq5(t2)

G3(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
  -1      eq4(t3)
  1      eq5(t3)

REMAINING 21 ENTRIES SKIPPED

---- H1

H1(t1)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   1    eq6(t1)
  -1    eq7(t1)

H1(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   1    eq6(t2)
  -1    eq7(t2)

H1(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   1    eq6(t3)
  -1    eq7(t3)

REMAINING 21 ENTRIES SKIPPED

---- H_ehp

H_ehp(t1)
        (.LO, .L, .UP, .M = 0, 0, 260, 0)
   1    eq6(t1)
   1    eq8(t1)
   1    eq9(t1)
   1    eq10(t1)

H_ehp(t2)
        (.LO, .L, .UP, .M = 0, 0, 260, 0)
   1    eq6(t2)
   1    eq8(t2)
   1    eq9(t2)
   1    eq10(t2)

H_ehp(t3)
        (.LO, .L, .UP, .M = 0, 0, 260, 0)
   1    eq6(t3)
   1    eq8(t3)
   1    eq9(t3)
   1    eq10(t3)

REMAINING 21 ENTRIES SKIPPED

---- Ih

Ih(t1)
        (.LO, .L, .UP, .M = 0, 0, 1, 0)
 -260    eq9(t1)
 -130    eq10(t1)
   1    eq11(t1)

Ih(t2)

        (.LO, .L, .UP, .M = 0, 0, 1, 0)
-260     eq9(t2)
-130     eq10(t2)
  1      eq11(t2)


Ih(t3)

        (.LO, .L, .UP, .M = 0, 0, 1, 0)
-260     eq9(t3)
-130     eq10(t3)
  1      eq11(t3)


REMAINING 21 ENTRIES SKIPPED

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Optimal operation of energy hub
Model Statistics   SOLVE Hub Using MIP From line 94


MODEL STATISTICS

BLOCKS OF EQUATIONS     11   SINGLE EQUATIONS     241
BLOCKS OF VARIABLES     11   SINGLE VARIABLES     241
NON ZERO ELEMENTS     577   DISCRETE VARIABLES   24


GENERATION TIME   =    0.672 SECONDS    4 MB 38.1.0 a1a3b545 WEX-WEI

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Optimal operation of energy hub
Solution Report   SOLVE Hub Using MIP From line 94


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

   MODEL  Hub          OBJECTIVE  cost
   TYPE   MIP         DIRECTION  MINIMIZE
   SOLVER  CPLEX        FROM LINE  94

**** SOLVER STATUS    1 Normal Completion
**** MODEL STATUS     1 Optimal
**** OBJECTIVE VALUE      18841.0220

 RESOURCE USAGE, LIMIT      0.985 10000000000.000
 ITERATION COUNT, LIMIT     2   2147483647
--- *** This solver runs with a demo license. No commercial use.
--- GMO setup time: 0.00s
--- GMO memory 0.56 Mb (peak 0.56 Mb)
--- Dictionary memory 0.00 Mb
--- Cplex 20.1.0.1 link memory 0.01 Mb (peak 0.03 Mb)
--- Starting Cplex


--- MIP status (101): integer optimal solution.
--- Cplex Time: 0.02sec (det. 23.72 ticks)

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

--- Fixed MIP status (1): optimal.
--- Cplex Time: 0.00sec (det. 0.35 ticks)


Proven optimal solution
MIP Solution:        18841.021967    (2 iterations, 0 nodes)
Final Solve:         18841.021967    (26 iterations)

Best possible:       18841.021967
Absolute gap:          0.000000
Relative gap:          0.000000


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

---- EQU eq2

|  | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|
| t1 | 77.2200 | 77.2200 | 77.2200 | 2.6063 |
| t2 | 70.2000 | 70.2000 | 70.2000 | 2.6063 |
| t3 | 66.6900 | 66.6900 | 66.6900 | 2.6063 |
| t4 | 66.6900 | 66.6900 | 66.6900 | 2.6063 |
| t5 | 66.6900 | 66.6900 | 66.6900 | 2.6063 |
| t6 | 84.2400 | 84.2400 | 84.2400 | 2.6063 |
| t7 | 108.8100 | 108.8100 | 108.8100 | 2.6063 |
| t8 | 115.8300 | 115.8300 | 115.8300 | 2.6063 |
| t9 | 115.8300 | 115.8300 | 115.8300 | 2.6063 |
| t10 | 129.8700 | 129.8700 | 129.8700 | 2.6063 |
| t11 | 143.9100 | 143.9100 | 143.9100 | 2.6063 |
| t12 | 147.4200 | 147.4200 | 147.4200 | 3.2281 |
| t13 | 143.9100 | 143.9100 | 143.9100 | 3.2281 |
| t14 | 147.4200 | 147.4200 | 147.4200 | 3.2281 |
| t15 | 143.9100 | 143.9100 | 143.9100 | 2.6063 |
| t16 | 143.9100 | 143.9100 | 143.9100 | 2.6063 |
| t17 | 164.9700 | 164.9700 | 164.9700 | 2.6063 |
| t18 | 196.5600 | 196.5600 | 196.5600 | 2.6063 |
| t19 | 203.5800 | 203.5800 | 203.5800 | 3.2281 |
| t20 | 189.5400 | 189.5400 | 189.5400 | 3.2281 |
| t21 | 175.5000 | 175.5000 | 175.5000 | 3.2281 |
| t22 | 150.9300 | 150.9300 | 150.9300 | 3.2281 |
| t23 | 126.3600 | 126.3600 | 126.3600 | 3.2281 |
| t24 | 98.2800 | 98.2800 | 98.2800 | 2.6063 |

---- EQU eq3

|  | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|
| t1 | . | . | . | 2.6063 |
| t2 | . | . | . | 2.6063 |
| t3 | . | . | . | 2.6063 |

| | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|
| t4 | . | . | . | 2.6063 |
| t5 | . | . | . | 2.6063 |
| t6 | . | . | . | 2.6063 |
| t7 | . | . | . | 2.6063 |
| t8 | . | . | . | 2.6063 |
| t9 | . | . | . | 2.6063 |
| t10 | . | . | . | 2.6063 |
| t11 | . | . | . | 2.6063 |
| t12 | . | . | . | 3.2281 |
| t13 | . | . | . | 3.2281 |
| t14 | . | . | . | 3.2281 |
| t15 | . | . | . | 2.6063 |
| t16 | . | . | . | 2.6063 |
| t17 | . | . | . | 2.6063 |
| t18 | . | . | . | 2.6063 |
| t19 | . | . | . | 3.2281 |
| t20 | . | . | . | 3.2281 |
| t21 | . | . | . | 3.2281 |
| t22 | . | . | . | 3.2281 |
| t23 | . | . | . | 3.2281 |
| t24 | . | . | . | 2.6063 |

---- EQU eq4

| | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|
| t1 | . | . | . | 1.7370 |
| t2 | . | . | . | 1.7370 |
| t3 | . | . | . | 1.7370 |
| t4 | . | . | . | 1.7370 |
| t5 | . | . | . | 1.7370 |
| t6 | . | . | . | 1.7370 |
| t7 | . | . | . | 1.7370 |
| t8 | . | . | . | 1.7370 |
| t9 | . | . | . | 1.7370 |
| t10 | . | . | . | 1.7370 |
| t11 | . | . | . | 1.7370 |
| t12 | . | . | . | 1.7370 |
| t13 | . | . | . | 1.7370 |
| t14 | . | . | . | 1.7370 |
| t15 | . | . | . | 1.7370 |
| t16 | . | . | . | 1.7370 |
| t17 | . | . | . | 1.7370 |
| t18 | . | . | . | 1.7370 |
| t19 | . | . | . | 1.7370 |
| t20 | . | . | . | 1.7370 |
| t21 | . | . | . | 1.7370 |
| t22 | . | . | . | 1.7370 |
| t23 | . | . | . | 1.7370 |
| t24 | . | . | . | 1.7370 |

---- EQU eq5

| | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|

| | LOWER | LEVEL | UPPER | MARGINAL |
|-----|---------|---------|---------|---------|
| t1 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t2 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t3 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t4 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t5 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t6 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t7 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t8 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t9 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t10 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t11 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t12 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t13 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t14 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t15 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t16 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t17 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t18 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t19 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t20 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t21 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t22 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t23 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |
| t24 | 19.7400 | 19.7400 | 19.7400 | 1.7370 |

---- EQU eq6

| | LOWER | LEVEL | UPPER | MARGINAL |
|-----|----------|----------|----------|---------|
| t1 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t2 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t3 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t4 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t5 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t6 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t7 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t8 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t9 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t10 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t11 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t12 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t13 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t14 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t15 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t16 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t17 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t18 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |
| t19 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t20 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t21 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t22 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t23 | 415.7700 | 415.7700 | 415.7700 | 0.9104 |
| t24 | 415.7700 | 415.7700 | 415.7700 | 1.3810 |

---- EQU eq7

|       | LOWER | LEVEL | UPPER | MARGINAL |
|-------|-------|-------|-------|----------|
| t1    | .     | .     | .     | 1.8984   |
| t2    | .     | .     | .     | 1.8984   |
| t3    | .     | .     | .     | 1.8984   |
| t4    | .     | .     | .     | 1.8984   |
| t5    | .     | .     | .     | 1.8984   |
| t6    | .     | .     | .     | 1.8984   |
| t7    | .     | .     | .     | 1.8984   |
| t8    | .     | .     | .     | 1.8984   |
| t9    | .     | .     | .     | 1.8984   |
| t10   | .     | .     | .     | 1.8984   |
| t11   | .     | .     | .     | 1.8984   |
| t12   | .     | .     | .     | 1.8984   |
| t13   | .     | .     | .     | 1.8984   |
| t14   | .     | .     | .     | 1.8984   |
| t15   | .     | .     | .     | 1.8984   |
| t16   | .     | .     | .     | 1.8984   |
| t17   | .     | .     | .     | 1.8984   |
| t18   | .     | .     | .     | 1.8984   |
| t19   | .     | .     | .     | 1.8984   |
| t20   | .     | .     | .     | 1.8984   |
| t21   | .     | .     | .     | 1.8984   |
| t22   | .     | .     | .     | 1.8984   |
| t23   | .     | .     | .     | 1.8984   |
| t24   | .     | .     | .     | 1.8984   |

---- EQU eq8

|       | LOWER | LEVEL | UPPER | MARGINAL |
|-------|-------|-------|-------|----------|
| t1    | .     | .     | .     | -0.6859  |
| t2    | .     | .     | .     | -0.6859  |
| t3    | .     | .     | .     | -0.6859  |
| t4    | .     | .     | .     | -0.6859  |
| t5    | .     | .     | .     | -0.6859  |
| t6    | .     | .     | .     | -0.6859  |
| t7    | .     | .     | .     | -0.6859  |
| t8    | .     | .     | .     | -0.6859  |
| t9    | .     | .     | .     | -0.6859  |
| t10   | .     | .     | .     | -0.6859  |
| t11   | .     | .     | .     | -0.6859  |
| t12   | .     | .     | .     | -0.8495  |
| t13   | .     | .     | .     | -0.8495  |
| t14   | .     | .     | .     | -0.8495  |
| t15   | .     | .     | .     | -0.6859  |
| t16   | .     | .     | .     | -0.6859  |
| t17   | .     | .     | .     | -0.6859  |
| t18   | .     | .     | .     | -0.6859  |
| t19   | .     | .     | .     | -0.8495  |
| t20   | .     | .     | .     | -0.8495  |
| t21   | .     | .     | .     | -0.8495  |
| t22   | .     | .     | .     | -0.8495  |
| t23   | .     | .     | .     | -0.8495  |

| | | | |
|---|---|---|---|
| t24 | . | . | . | -0.6859 |

---- EQU eq9

| | 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 eq10

| | LOWER | LEVEL | UPPER | MARGINAL |
|---|---|---|---|---|
| t1 | . | 130.0000 | +INF | . |
| t2 | . | 130.0000 | +INF | . |
| t3 | . | 130.0000 | +INF | . |
| t4 | . | 130.0000 | +INF | . |
| t5 | . | 130.0000 | +INF | . |
| t6 | . | 130.0000 | +INF | . |
| t7 | . | 130.0000 | +INF | . |
| t8 | . | 130.0000 | +INF | . |
| t9 | . | 130.0000 | +INF | . |
| t10 | . | 130.0000 | +INF | . |
| t11 | . | 130.0000 | +INF | . |
| t12 | . | 130.0000 | +INF | . |
| t13 | . | 130.0000 | +INF | . |
| t14 | . | 130.0000 | +INF | . |
| t15 | . | 130.0000 | +INF | . |
| t16 | . | 130.0000 | +INF | . |
| t17 | . | 130.0000 | +INF | . |
| t18 | . | 130.0000 | +INF | . |
| t19 | . | 130.0000 | +INF | . |
| t20 | . | 130.0000 | +INF | . |

```
t21        .        130.0000      +INF           .
t22        .        130.0000      +INF           .
t23        .        130.0000      +INF           .
t24        .        130.0000      +INF           .
```

---- EQU eq11

	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	18841.0220	+INF	.

---- VAR E

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	28.9178	+INF	.
t2	.	21.6053	+INF	.
t3	.	17.9490	+INF	.
t4	.	17.9490	+INF	.
t5	.	17.9490	+INF	.
t6	.	36.2303	+INF	.
t7	.	61.8240	+INF	.
t8	.	69.1365	+INF	.
t9	.	69.1365	+INF	.
t10	.	83.7615	+INF	.
t11	.	98.3865	+INF	.
t12	.	102.0428	+INF	.
t13	.	98.3865	+INF	.

	LOWER	LEVEL	UPPER	MARGINAL
t14	.	102.0428	+INF	.
t15	.	98.3865	+INF	.
t16	.	98.3865	+INF	.
t17	.	120.3240	+INF	.
t18	.	153.2303	+INF	.
t19	.	160.5428	+INF	.
t20	.	145.9178	+INF	.
t21	.	131.2928	+INF	.
t22	.	105.6990	+INF	.
t23	.	80.1053	+INF	.
t24	.	50.8553	+INF	.

---- VAR E1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	27.7611	+INF	.
t2	.	20.7411	+INF	.
t3	.	17.2311	+INF	.
t4	.	17.2311	+INF	.
t5	.	17.2311	+INF	.
t6	.	34.7811	+INF	.
t7	.	59.3511	+INF	.
t8	.	66.3711	+INF	.
t9	.	66.3711	+INF	.
t10	.	80.4111	+INF	.
t11	.	94.4511	+INF	.
t12	.	97.9611	+INF	.
t13	.	94.4511	+INF	.
t14	.	97.9611	+INF	.
t15	.	94.4511	+INF	.
t16	.	94.4511	+INF	.
t17	.	115.5111	+INF	.
t18	.	147.1011	+INF	.
t19	.	154.1211	+INF	.
t20	.	140.0811	+INF	.
t21	.	126.0411	+INF	.
t22	.	101.4711	+INF	.
t23	.	76.9011	+INF	.
t24	.	48.8211	+INF	.

---- VAR E2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	68.4211	+INF	.
t2	.	68.4211	+INF	.
t3	.	68.4211	+INF	.
t4	.	68.4211	+INF	.
t5	.	68.4211	+INF	.
t6	.	68.4211	+INF	.
t7	.	68.4211	+INF	.
t8	.	68.4211	+INF	.
t9	.	68.4211	+INF	.
t10	.	68.4211	+INF	.

	LOWER	LEVEL	UPPER	MARGINAL
t11	.	68.4211	+INF	.
t12	.	68.4211	+INF	.
t13	.	68.4211	+INF	.
t14	.	68.4211	+INF	.
t15	.	68.4211	+INF	.
t16	.	68.4211	+INF	.
t17	.	68.4211	+INF	.
t18	.	68.4211	+INF	.
t19	.	68.4211	+INF	.
t20	.	68.4211	+INF	.
t21	.	68.4211	+INF	.
t22	.	68.4211	+INF	.
t23	.	68.4211	+INF	.
t24	.	68.4211	+INF	.

---- VAR G

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	320.4543	+INF	.
t2	.	320.4543	+INF	.
t3	.	320.4543	+INF	.
t4	.	320.4543	+INF	.
t5	.	320.4543	+INF	.
t6	.	320.4543	+INF	.
t7	.	320.4543	+INF	.
t8	.	320.4543	+INF	.
t9	.	320.4543	+INF	.
t10	.	320.4543	+INF	.
t11	.	320.4543	+INF	.
t12	.	320.4543	+INF	.
t13	.	320.4543	+INF	.
t14	.	320.4543	+INF	.
t15	.	320.4543	+INF	.
t16	.	320.4543	+INF	.
t17	.	320.4543	+INF	.
t18	.	320.4543	+INF	.
t19	.	320.4543	+INF	.
t20	.	320.4543	+INF	.
t21	.	320.4543	+INF	.
t22	.	320.4543	+INF	.
t23	.	320.4543	+INF	.
t24	.	320.4543	+INF	.

---- VAR G1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	300.7143	465.0000	.
t2	.	300.7143	465.0000	.
t3	.	300.7143	465.0000	.
t4	.	300.7143	465.0000	.
t5	.	300.7143	465.0000	.
t6	.	300.7143	465.0000	.
t7	.	300.7143	465.0000	.

	LOWER	LEVEL	UPPER	MARGINAL
t8	.	300.7143	465.0000	.
t9	.	300.7143	465.0000	.
t10	.	300.7143	465.0000	.
t11	.	300.7143	465.0000	.
t12	.	300.7143	465.0000	.
t13	.	300.7143	465.0000	.
t14	.	300.7143	465.0000	.
t15	.	300.7143	465.0000	.
t16	.	300.7143	465.0000	.
t17	.	300.7143	465.0000	.
t18	.	300.7143	465.0000	.
t19	.	300.7143	465.0000	.
t20	.	300.7143	465.0000	.
t21	.	300.7143	465.0000	.
t22	.	300.7143	465.0000	.
t23	.	300.7143	465.0000	.
t24	.	300.7143	465.0000	.

---- VAR G2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	576.0000	.
t2	.	.	576.0000	.
t3	.	.	576.0000	.
t4	.	.	576.0000	.
t5	.	.	576.0000	.
t6	.	.	576.0000	.
t7	.	.	576.0000	.
t8	.	.	576.0000	.
t9	.	.	576.0000	.
t10	.	.	576.0000	.
t11	.	.	576.0000	.
t12	.	.	576.0000	.
t13	.	.	576.0000	.
t14	.	.	576.0000	.
t15	.	.	576.0000	.
t16	.	.	576.0000	.
t17	.	.	576.0000	.
t18	.	.	576.0000	.
t19	.	.	576.0000	.
t20	.	.	576.0000	.
t21	.	.	576.0000	.
t22	.	.	576.0000	.
t23	.	.	576.0000	.
t24	.	.	576.0000	.

---- VAR G3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	19.7400	+INF	.
t2	.	19.7400	+INF	.
t3	.	19.7400	+INF	.
t4	.	19.7400	+INF	.

```
t5      .      19.7400      +INF       .
t6      .      19.7400      +INF       .
t7      .      19.7400      +INF       .
t8      .      19.7400      +INF       .
t9      .      19.7400      +INF       .
t10     .      19.7400      +INF       .
t11     .      19.7400      +INF       .
t12     .      19.7400      +INF       .
t13     .      19.7400      +INF       .
t14     .      19.7400      +INF       .
t15     .      19.7400      +INF       .
t16     .      19.7400      +INF       .
t17     .      19.7400      +INF       .
t18     .      19.7400      +INF       .
t19     .      19.7400      +INF       .
t20     .      19.7400      +INF       .
t21     .      19.7400      +INF       .
t22     .      19.7400      +INF       .
t23     .      19.7400      +INF       .
t24     .      19.7400      +INF       .
```

---- VAR H1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	+INF	0.5174
t2	.	.	+INF	0.5174
t3	.	.	+INF	0.5174
t4	.	.	+INF	0.5174
t5	.	.	+INF	0.5174
t6	.	.	+INF	0.5174
t7	.	.	+INF	0.5174
t8	.	.	+INF	0.5174
t9	.	.	+INF	0.5174
t10	.	.	+INF	0.5174
t11	.	.	+INF	0.5174
t12	.	.	+INF	0.9880
t13	.	.	+INF	0.9880
t14	.	.	+INF	0.9880
t15	.	.	+INF	0.5174
t16	.	.	+INF	0.5174
t17	.	.	+INF	0.5174
t18	.	.	+INF	0.5174
t19	.	.	+INF	0.9880
t20	.	.	+INF	0.9880
t21	.	.	+INF	0.9880
t22	.	.	+INF	0.9880
t23	.	.	+INF	0.9880
t24	.	.	+INF	0.5174

---- VAR H_ehp

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	260.0000	260.0000	-0.6951

```
t2      .      260.0000    260.0000    -0.6951
t3      .      260.0000    260.0000    -0.6951
t4      .      260.0000    260.0000    -0.6951
t5      .      260.0000    260.0000    -0.6951
t6      .      260.0000    260.0000    -0.6951
t7      .      260.0000    260.0000    -0.6951
t8      .      260.0000    260.0000    -0.6951
t9      .      260.0000    260.0000    -0.6951
t10     .      260.0000    260.0000    -0.6951
t11     .      260.0000    260.0000    -0.6951
t12     .      260.0000    260.0000    -0.0609
t13     .      260.0000    260.0000    -0.0609
t14     .      260.0000    260.0000    -0.0609
t15     .      260.0000    260.0000    -0.6951
t16     .      260.0000    260.0000    -0.6951
t17     .      260.0000    260.0000    -0.6951
t18     .      260.0000    260.0000    -0.6951
t19     .      260.0000    260.0000    -0.0609
t20     .      260.0000    260.0000    -0.0609
t21     .      260.0000    260.0000    -0.0609
t22     .      260.0000    260.0000    -0.0609
t23     .      260.0000    260.0000    -0.0609
t24     .      260.0000    260.0000    -0.6951
```

---- 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

**** REPORT SUMMARY :   0   NONOPT

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Optimal operation of energy hub
E x e c u t i o n

----   109 PARAMETER report

	E(t)	KVET - el	E1(t)	De(t)	Dh(t)	G(t)	G1(t)	G3(t)	KVET - te~	TC - teplo
t1	28.918	117.880	27.761	77.220	415.770	320.454	300.714	19.740	155.770	260.000
t2	21.605	117.880	20.741	70.200	415.770	320.454	300.714	19.740	155.770	260.000
t3	17.949	117.880	17.231	66.690	415.770	320.454	300.714	19.740	155.770	260.000
t4	17.949	117.880	17.231	66.690	415.770	320.454	300.714	19.740	155.770	260.000
t5	17.949	117.880	17.231	66.690	415.770	320.454	300.714	19.740	155.770	260.000
t6	36.230	117.880	34.781	84.240	415.770	320.454	300.714	19.740	155.770	260.000
t7	61.824	117.880	59.351	108.810	415.770	320.454	300.714	19.740	155.770	260.000
t8	69.137	117.880	66.371	115.830	415.770	320.454	300.714	19.740	155.770	260.000
t9	69.137	117.880	66.371	115.830	415.770	320.454	300.714	19.740	155.770	260.000
t10	83.762	117.880	80.411	129.870	415.770	320.454	300.714	19.740	155.770	260.000
t11	98.387	117.880	94.451	143.910	415.770	320.454	300.714	19.740	155.770	260.000
t12	102.043	117.880	97.961	147.420	415.770	320.454	300.714	19.740	155.770	260.000
t13	98.387	117.880	94.451	143.910	415.770	320.454	300.714	19.740	155.770	260.000
t14	102.043	117.880	97.961	147.420	415.770	320.454	300.714	19.740	155.770	260.000
t15	98.387	117.880	94.451	143.910	415.770	320.454	300.714	19.740	155.770	260.000
t16	98.387	117.880	94.451	143.910	415.770	320.454	300.714	19.740	155.770	260.000
t17	120.324	117.880	115.511	164.970	415.770	320.454	300.714	19.740	155.770	260.000
t18	153.230	117.880	147.101	196.560	415.770	320.454	300.714	19.740	155.770	260.000
t19	160.543	117.880	154.121	203.580	415.770	320.454	300.714	19.740	155.770	260.000
t20	145.918	117.880	140.081	189.540	415.770	320.454	300.714	19.740	155.770	260.000
t21	131.293	117.880	126.041	175.500	415.770	320.454	300.714	19.740	155.770	260.000
t22	105.699	117.880	101.471	150.930	415.770	320.454	300.714	19.740	155.770	260.000
t23	80.105	117.880	76.901	126.360	415.770	320.454	300.714	19.740	155.770	260.000
t24	50.855	117.880	48.821	98.280	415.770	320.454	300.714	19.740	155.770	260.000

EXECUTION TIME   =   2.360 SECONDS   4 MB 38.1.0 a1a3b545 WEX-WEI

**** FILE SUMMARY

Input   E:\DP\GAMS\Varianta_1.gms
Output   E:\DP\GAMS\Varianta_1.lst

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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    415.77  77.22  19.74  0.00   2.502
 12  t2  415.77   70.20  19.74  0.00   2.502
 13  t3  415.77   66.69  19.74  0.00   2.502
 14  t4  415.77   66.69  19.74  0.00   2.502
 15  t5  415.77   66.69  19.74  0.00   2.502
 16  t6  415.77   84.24  19.74  0.00   2.502
 17  t7  415.77   108.81  19.74  0.56   2.502
 18  t8  415.77   115.83  19.74  3.93   2.502
 19  t9  415.77   115.83  19.74  27.53  2.502
 20  t10 415.77   129.87  19.74  47.05  2.502
 21  t11 415.77   143.91  19.74  62.05  2.502
 22  t12 415.77   147.42  19.74  71.8   3.099
 23  t13 415.77   143.91  19.74  66.56  3.099
 24  t14 415.77   147.42  19.74  51.54  3.099
 25  t15 415.77   143.91  19.74  31.51  2.502
 26  t16 415.77   143.91  19.74  0.32   2.502
 27  t17 415.77   164.97  19.74  0.00   2.502
 28  t18 415.77   196.56  19.74  0.00   2.502
 29  t19 415.77   203.58  19.74  0.00   3.099
 30  t20 415.77   189.54  19.74  0.00   3.099
 31  t21 415.77   175.50  19.74  0.00   3.099
 32  t22 415.77   150.93  19.74  0.00   3.099
 33  t23 415.77   126.36  19.74  0.00   3.099
 34  t24 415.77   98.28  19.74  0.00    2.502;
 35
 36  */ zavedeni promenne cost - provozni naklady
 37  Variable cost;
 38
 39  */ zavedeni kladnych promennych
 40  Positive Variables E(t), E1(t), E2(t), G(t), G1(t), G2(t), G3(t),
 41  H1(t), H_ehp(t);
 42
 43  */ zavedeni binarnich promennych
 44  binary variables Ih(t);
 45
 47  */ zavedeni promennych s danymi hodnotami
 48  scalar eta_ee / 0.96 / , !! účinnost transformatoru
 49  eta_ge / 0.392 / ,      !! účinnost kogenerační jednotky vyroba elektro
 50  eta_gh / 0.518 / ,      !! účinnost kogenerační jednotky vyroba teplo
 51  COP / 3.8 / ,          !! topný faktor tepelného čerpadla
 52  H_ehpMax / 260 / ,     !! výkon tepelného čerpadla max
```

```
53  H_ehpMin / 0.5 / ,      !! výkon tepelného čerpadla min
54  Chpmax / 465 / ,        !! max výkon kogenerační jednotky
55  Fmax / 576 / ,          !! výkon plynový kotel
56  eta_ghf / 0.915 / ,     !! účinnost spalování plynu plynovým kotlem
57  lambda_g / 1.737 / ;    !! cena plyn
58
59  */ dodatecne upresneni hodnot promennych
60  H_ehp.up(t) = H_ehpMax ; !! MAX výkon tepelného čerpadla
61  G1.up(t)=Chpmax ;        !! MAX výkon KVET
62  G2.up(t)=Fmax ;          !! MAX výkon plynový kotel
63
64  */ zavedeni potrebneho poctu rovnic s oznacenim
65  Equation eq1, eq2, eq3, eq4, eq5, eq6, eq7, eq8, eq9, eq10, eq11 ;
66
67  */ rovnice matematického modelu EnergyHub:
68
69  */ objektivni hodnotici funkce - soucet nakladu na energie
70  eq1..   cost =e= sum(t, data(t,'lambda_e')*E(t)+lambda_g*G(t));
71  */ tok elektricke energie z EnergyHubu
72  eq2(t).. E1(t)+eta_ge*G1(t) =e= data(t, 'De')+E2(t) ;
73  */ tok elektricke energie do EnergyHubu
74  eq3(t).. eta_ee*E(t) + data(t, 'PV') =e= E1(t) ;
75  */ tok plynu do EnergyHubu
76  eq4(t).. G(t) =e= G1(t)+G2(t)+G3(t) ;
77  */ tok plynu z EnergyHubu
78  eq5(t).. G3(t) =e= data(t, 'Dg') ;
79  */ tok tepla z EnergyHubu
80  eq6(t).. eta_gh*G1(t)+H1(t)+H_ehp(t) =e= data(t, 'Dh') ;
81  */ tok tepla z EnergyHubu
82  eq7(t).. eta_ghf*G2(t) =e= H1(t) ;
83  */ vykon tepelneho cerpadla
84  eq8(t).. H_ehp(t) =e= E2(t)*COP ;
85  */ omezeni maximalniho tepelneho vykonu tepelneho cerpadla
86  eq9(t).. H_ehp(t) =l= H_ehpMax*Ih(t) ;
87  */ omezeni minimalniho tepelneho vykonu tepelneho cerpadla
88  eq10(t).. H_ehp(t) =g= H_ehpMax*Ih(t)*H_ehpMin ;
89  */ provozni rezim tepelneho cerpadla (chlazeni/topeni)
90  eq11(t).. Ih(t) =l= 1 ;
91
92  */ vytvoreni matematickeho modelu ze zadanych dat
93  Model Hub / all /;
94
95  */ prikaz pro reseni daneho modelu pomoci MIP resitele s minimalizaci promenne cost
96  solve hub us mip min cost;
97
98  Parameter report(t,*);
99  report(t, 'E(t)') = E.l(t);
100  report(t, 'KVET - el') = eta_ge*G1.l(t);
101  report(t, 'PV(t)') = data(t, 'PV');
102  report(t, 'E1(t)') = E1.l(t);
103  report(t, 'De(t)') = data(t, 'De');
104  report(t, 'G(t)') = G.l(t);
105  report(t, 'G1(t)') = G1.l(t);
106  report(t, 'G2(t)') = G2.l(t);
107  report(t, 'G3(t)') = G3.l(t);
```

```
108  report(t, 'Kotel - teplo') = H1.l(t);
109  report(t, 'KVET - teplo') = eta_gh*G1.l(t);
110  report(t, 'TC - teplo') = H_ehp.l(t);
111  display report;
```

COMPILATION TIME   =   0.000 SECONDS   3 MB 38.1.0 a1a3b545 WEX-WEI
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Optimal operation of energy hub
Equation Listing   SOLVE Hub Using MIP From line 96

---- eq1 =E=

eq1.. cost - 2.502*E(t1) - 2.502*E(t2) - 2.502*E(t3) - 2.502*E(t4) - 2.502*E(t5) - 2.502*E(t6) - 2.502*E(t7) - 2.502
*E(t8) - 2.502*E(t9) - 2.502*E(t10) - 2.502*E(t11) - 3.099*E(t12) - 3.099*E(t13) - 3.099*E(t14) - 2.502*E(t15) - 2.
502*E(t16) - 2.502*E(t17) - 2.502*E(t18) - 3.099*E(t19) - 3.099*E(t20) - 3.099*E(t21) - 3.099*E(t22) - 3.099*E(t2
3) - 2.502*E(t24) - 1.737*G(t1) - 1.737*G(t2) - 1.737*G(t3) - 1.737*G(t4) - 1.737*G(t5) - 1.737*G(t6) - 1.737*G(t
7) - 1.737*G(t8) - 1.737*G(t9) - 1.737*G(t10) - 1.737*G(t11) - 1.737*G(t12) - 1.737*G(t13) - 1.737*G(t14) - 1.737
*G(t15) - 1.737*G(t16) - 1.737*G(t17) - 1.737*G(t18) - 1.737*G(t19) - 1.737*G(t20) - 1.737*G(t21) - 1.737*G(t22
) - 1.737*G(t23) - 1.737*G(t24) =E= 0 ; (LHS = 0)

---- eq2 =E=

eq2(t1).. E1(t1) - E2(t1) + 0.392*G1(t1) =E= 77.22 ; (LHS = 0, INFES = 77.22 ****)

eq2(t2).. E1(t2) - E2(t2) + 0.392*G1(t2) =E= 70.2 ; (LHS = 0, INFES = 70.2 ****)

eq2(t3).. E1(t3) - E2(t3) + 0.392*G1(t3) =E= 66.69 ; (LHS = 0, INFES = 66.69 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq3 =E=

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

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

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

REMAINING 21 ENTRIES SKIPPED

---- eq4 =E=

eq4(t1).. G(t1) - G1(t1) - G2(t1) - G3(t1) =E= 0 ; (LHS = 0)

eq4(t2).. G(t2) - G1(t2) - G2(t2) - G3(t2) =E= 0 ; (LHS = 0)

eq4(t3).. G(t3) - G1(t3) - G2(t3) - G3(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq5 =E=

eq5(t1).. G3(t1) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq5(t2).. G3(t2) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq5(t3).. G3(t3) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq6 =E=

eq6(t1).. 0.518*G1(t1) + H1(t1) + H_ehp(t1) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq6(t2).. 0.518*G1(t2) + H1(t2) + H_ehp(t2) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq6(t3).. 0.518*G1(t3) + H1(t3) + H_ehp(t3) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq7 =E=

eq7(t1).. 0.915*G2(t1) - H1(t1) =E= 0 ; (LHS = 0)

eq7(t2).. 0.915*G2(t2) - H1(t2) =E= 0 ; (LHS = 0)

eq7(t3).. 0.915*G2(t3) - H1(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq8 =E=

eq8(t1).. - 3.8*E2(t1) + H_ehp(t1) =E= 0 ; (LHS = 0)

eq8(t2).. - 3.8*E2(t2) + H_ehp(t2) =E= 0 ; (LHS = 0)

eq8(t3).. - 3.8*E2(t3) + H_ehp(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq9 =L=

eq9(t1).. H_ehp(t1) - 260*Ih(t1) =L= 0 ; (LHS = 0)

eq9(t2).. H_ehp(t2) - 260*Ih(t2) =L= 0 ; (LHS = 0)

eq9(t3).. H_ehp(t3) - 260*Ih(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq10 =G=

eq10(t1).. H_ehp(t1) - 130*Ih(t1) =G= 0 ; (LHS = 0)

eq10(t2).. H_ehp(t2) - 130*Ih(t2) =G= 0 ; (LHS = 0)

eq10(t3).. H_ehp(t3) - 130*Ih(t3) =G= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq11 =L=

eq11(t1).. Ih(t1) =L= 1 ; (LHS = 0)

eq11(t2).. Ih(t2) =L= 1 ; (LHS = 0)

eq11(t3).. Ih(t3) =L= 1 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

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Optimal operation of energy hub
Column Listing   SOLVE Hub Using MIP From line 96

---- cost

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

---- E

E(t1)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   -2.502   eq1
    0.96   eq3(t1)

E(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   -2.502   eq1
    0.96   eq3(t2)

E(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
   -2.502   eq1
    0.96   eq3(t3)

REMAINING 21 ENTRIES SKIPPED

---- E1

E1(t1)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　1　　eq2(t1)
　　-1　　eq3(t1)

E1(t2)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　1　　eq2(t2)
　　-1　　eq3(t2)

E1(t3)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　1　　eq2(t3)
　　-1　　eq3(t3)

REMAINING 21 ENTRIES SKIPPED

---- E2

E2(t1)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1　　eq2(t1)
　　-3.8　eq8(t1)

E2(t2)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1　　eq2(t2)
　　-3.8　eq8(t2)

E2(t3)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1　　eq2(t3)
　　-3.8　eq8(t3)

REMAINING 21 ENTRIES SKIPPED

---- G

G(t1)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1.737　eq1
　　1　　eq4(t1)

G(t2)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1.737　eq1
　　1　　eq4(t2)

G(t3)
　　　　(.LO, .L, .UP, .M = 0, 0, +INF, 0)
　　-1.737　eq1
　　1　　eq4(t3)

REMAINING 21 ENTRIES SKIPPED

---- G1

G1(t1)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
    0.392   eq2(t1)
    -1   eq4(t1)
    0.518   eq6(t1)

G1(t2)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
    0.392   eq2(t2)
    -1   eq4(t2)
    0.518   eq6(t2)

G1(t3)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
    0.392   eq2(t3)
    -1   eq4(t3)
    0.518   eq6(t3)

REMAINING 21 ENTRIES SKIPPED

---- G2

G2(t1)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
    -1   eq4(t1)
    0.915   eq7(t1)

G2(t2)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
    -1   eq4(t2)
    0.915   eq7(t2)

G2(t3)
        (.LO, .L, .UP, .M = 0, 0, 576, 0)
    -1   eq4(t3)
    0.915   eq7(t3)

REMAINING 21 ENTRIES SKIPPED

---- G3

G3(t1)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
    -1   eq4(t1)
    1   eq5(t1)

G3(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
    -1   eq4(t2)
    1   eq5(t2)

G3(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)

```
       -1      eq4(t3)
        1      eq5(t3)
```

REMAINING 21 ENTRIES SKIPPED

---- H1

H1(t1)
```
               (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eq6(t1)
       -1       eq7(t1)
```

H1(t2)
```
               (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eq6(t2)
       -1       eq7(t2)
```

H1(t3)
```
               (.LO, .L, .UP, .M = 0, 0, +INF, 0)
        1       eq6(t3)
       -1       eq7(t3)
```

REMAINING 21 ENTRIES SKIPPED

---- H_ehp

H_ehp(t1)
```
               (.LO, .L, .UP, .M = 0, 0, 260, 0)
        1       eq6(t1)
        1       eq8(t1)
        1       eq9(t1)
        1       eq10(t1)
```

H_ehp(t2)
```
               (.LO, .L, .UP, .M = 0, 0, 260, 0)
        1       eq6(t2)
        1       eq8(t2)
        1       eq9(t2)
        1       eq10(t2)
```

H_ehp(t3)
```
               (.LO, .L, .UP, .M = 0, 0, 260, 0)
        1       eq6(t3)
        1       eq8(t3)
        1       eq9(t3)
        1       eq10(t3)
```

REMAINING 21 ENTRIES SKIPPED

---- Ih

Ih(t1)
```
               (.LO, .L, .UP, .M = 0, 0, 1, 0)
     -260       eq9(t1)
     -130       eq10(t1)
```

1   eq11(t1)

Ih(t2)

         (.LO, .L, .UP, .M = 0, 0, 1, 0)
   -260   eq9(t2)
   -130   eq10(t2)
     1   eq11(t2)

Ih(t3)

         (.LO, .L, .UP, .M = 0, 0, 1, 0)
   -260   eq9(t3)
   -130   eq10(t3)
     1   eq11(t3)

REMAINING 21 ENTRIES SKIPPED

Optimal operation of energy hub
Model Statistics   SOLVE Hub Using MIP From line 96

MODEL STATISTICS

BLOCKS OF EQUATIONS   11   SINGLE EQUATIONS   241
BLOCKS OF VARIABLES   11   SINGLE VARIABLES   241
NON ZERO ELEMENTS   577   DISCRETE VARIABLES   24

GENERATION TIME   =   0.140 SECONDS   4 MB 38.1.0 a1a3b545 WEX-WEI
Optimal operation of energy hub
Solution Report   SOLVE Hub Using MIP From line 96

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

   MODEL   Hub   OBJECTIVE cost
   TYPE   MIP   DIRECTION MINIMIZE
   SOLVER CPLEX   FROM LINE 96

**** SOLVER STATUS   1 Normal Completion
**** MODEL STATUS   1 Optimal
**** OBJECTIVE VALUE   17777.2501

 RESOURCE USAGE, LIMIT   0.062 10000000000.000
 ITERATION COUNT, LIMIT   2   2147483647
--- *** This solver runs with a demo license. No commercial use.
--- GMO setup time: 0.00s
--- GMO memory 0.56 Mb (peak 0.56 Mb)
--- Dictionary memory 0.00 Mb
--- Cplex 20.1.0.1 link memory 0.01 Mb (peak 0.03 Mb)
--- Starting Cplex

--- MIP status (101): integer optimal solution.
--- Cplex Time: 0.03sec (det. 23.72 ticks)

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

--- Fixed MIP status (1): optimal.
--- Cplex Time: 0.03sec (det. 0.33 ticks)

Proven optimal solution
MIP Solution: 17777.250092   (2 iterations, 0 nodes)
Final Solve: 17777.250092   (42 iterations)

Best possible: 17777.250092
Absolute gap: 0.000000
Relative gap: 0.000000

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

---- EQU eq2

	LOWER	LEVEL	UPPER	MARGINAL
t1	77.2200	77.2200	77.2200	2.6063
t2	70.2000	70.2000	70.2000	2.6063
t3	66.6900	66.6900	66.6900	2.6063
t4	66.6900	66.6900	66.6900	2.6063
t5	66.6900	66.6900	66.6900	2.6063
t6	84.2400	84.2400	84.2400	2.6063
t7	108.8100	108.8100	108.8100	2.6063
t8	115.8300	115.8300	115.8300	2.6063
t9	115.8300	115.8300	115.8300	2.6063
t10	129.8700	129.8700	129.8700	2.6063
t11	143.9100	143.9100	143.9100	2.6063
t12	147.4200	147.4200	147.4200	3.2281
t13	143.9100	143.9100	143.9100	3.2281
t14	147.4200	147.4200	147.4200	3.2281
t15	143.9100	143.9100	143.9100	2.6063
t16	143.9100	143.9100	143.9100	2.6063
t17	164.9700	164.9700	164.9700	2.6063
t18	196.5600	196.5600	196.5600	2.6063
t19	203.5800	203.5800	203.5800	3.2281
t20	189.5400	189.5400	189.5400	3.2281
t21	175.5000	175.5000	175.5000	3.2281
t22	150.9300	150.9300	150.9300	3.2281
t23	126.3600	126.3600	126.3600	3.2281
t24	98.2800	98.2800	98.2800	2.6063

---- EQU eq3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	2.6063

	LOWER	LEVEL	UPPER	MARGINAL
t2	.	.	.	2.6063
t3	.	.	.	2.6063
t4	.	.	.	2.6063
t5	.	.	.	2.6063
t6	.	.	.	2.6063
t7	-0.5600	-0.5600	-0.5600	2.6063
t8	-3.9300	-3.9300	-3.9300	2.6063
t9	-27.5300	-27.5300	-27.5300	2.6063
t10	-47.0500	-47.0500	-47.0500	2.6063
t11	-62.0500	-62.0500	-62.0500	2.6063
t12	-71.8000	-71.8000	-71.8000	3.2281
t13	-66.5600	-66.5600	-66.5600	3.2281
t14	-51.5400	-51.5400	-51.5400	3.2281
t15	-31.5100	-31.5100	-31.5100	2.6063
t16	-0.3200	-0.3200	-0.3200	2.6063
t17	.	.	.	2.6063
t18	.	.	.	2.6063
t19	.	.	.	3.2281
t20	.	.	.	3.2281
t21	.	.	.	3.2281
t22	.	.	.	3.2281
t23	.	.	.	3.2281
t24	.	.	.	2.6063

---- EQU eq4

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	1.7370
t2	.	.	.	1.7370
t3	.	.	.	1.7370
t4	.	.	.	1.7370
t5	.	.	.	1.7370
t6	.	.	.	1.7370
t7	.	.	.	1.7370
t8	.	.	.	1.7370
t9	.	.	.	1.7370
t10	.	.	.	1.7370
t11	.	.	.	1.7370
t12	.	.	.	1.7370
t13	.	.	.	1.7370
t14	.	.	.	1.7370
t15	.	.	.	1.7370
t16	.	.	.	1.7370
t17	.	.	.	1.7370
t18	.	.	.	1.7370
t19	.	.	.	1.7370
t20	.	.	.	1.7370
t21	.	.	.	1.7370
t22	.	.	.	1.7370
t23	.	.	.	1.7370
t24	.	.	.	1.7370

---- EQU eq5

	LOWER	LEVEL	UPPER	MARGINAL
t1	19.7400	19.7400	19.7400	1.7370
t2	19.7400	19.7400	19.7400	1.7370
t3	19.7400	19.7400	19.7400	1.7370
t4	19.7400	19.7400	19.7400	1.7370
t5	19.7400	19.7400	19.7400	1.7370
t6	19.7400	19.7400	19.7400	1.7370
t7	19.7400	19.7400	19.7400	1.7370
t8	19.7400	19.7400	19.7400	1.7370
t9	19.7400	19.7400	19.7400	1.7370
t10	19.7400	19.7400	19.7400	1.7370
t11	19.7400	19.7400	19.7400	1.7370
t12	19.7400	19.7400	19.7400	1.7370
t13	19.7400	19.7400	19.7400	1.7370
t14	19.7400	19.7400	19.7400	1.7370
t15	19.7400	19.7400	19.7400	1.7370
t16	19.7400	19.7400	19.7400	1.7370
t17	19.7400	19.7400	19.7400	1.7370
t18	19.7400	19.7400	19.7400	1.7370
t19	19.7400	19.7400	19.7400	1.7370
t20	19.7400	19.7400	19.7400	1.7370
t21	19.7400	19.7400	19.7400	1.7370
t22	19.7400	19.7400	19.7400	1.7370
t23	19.7400	19.7400	19.7400	1.7370
t24	19.7400	19.7400	19.7400	1.7370

---- EQU eq6

	LOWER	LEVEL	UPPER	MARGINAL
t1	415.7700	415.7700	415.7700	1.3810
t2	415.7700	415.7700	415.7700	1.3810
t3	415.7700	415.7700	415.7700	1.3810
t4	415.7700	415.7700	415.7700	1.3810
t5	415.7700	415.7700	415.7700	1.3810
t6	415.7700	415.7700	415.7700	1.3810
t7	415.7700	415.7700	415.7700	1.3810
t8	415.7700	415.7700	415.7700	1.3810
t9	415.7700	415.7700	415.7700	1.3810
t10	415.7700	415.7700	415.7700	1.3810
t11	415.7700	415.7700	415.7700	1.3810
t12	415.7700	415.7700	415.7700	0.9104
t13	415.7700	415.7700	415.7700	0.9104
t14	415.7700	415.7700	415.7700	0.9104
t15	415.7700	415.7700	415.7700	1.3810
t16	415.7700	415.7700	415.7700	1.3810
t17	415.7700	415.7700	415.7700	1.3810
t18	415.7700	415.7700	415.7700	1.3810
t19	415.7700	415.7700	415.7700	0.9104
t20	415.7700	415.7700	415.7700	0.9104
t21	415.7700	415.7700	415.7700	0.9104
t22	415.7700	415.7700	415.7700	0.9104
t23	415.7700	415.7700	415.7700	0.9104
t24	415.7700	415.7700	415.7700	1.3810

---- EQU eq7

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	1.8984
t2	.	.	.	1.8984
t3	.	.	.	1.8984
t4	.	.	.	1.8984
t5	.	.	.	1.8984
t6	.	.	.	1.8984
t7	.	.	.	1.8984
t8	.	.	.	1.8984
t9	.	.	.	1.8984
t10	.	.	.	1.8984
t11	.	.	.	1.8984
t12	.	.	.	1.8984
t13	.	.	.	1.8984
t14	.	.	.	1.8984
t15	.	.	.	1.8984
t16	.	.	.	1.8984
t17	.	.	.	1.8984
t18	.	.	.	1.8984
t19	.	.	.	1.8984
t20	.	.	.	1.8984
t21	.	.	.	1.8984
t22	.	.	.	1.8984
t23	.	.	.	1.8984
t24	.	.	.	1.8984

---- EQU eq8

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	-0.6859
t2	.	.	.	-0.6859
t3	.	.	.	-0.6859
t4	.	.	.	-0.6859
t5	.	.	.	-0.6859
t6	.	.	.	-0.6859
t7	.	.	.	-0.6859
t8	.	.	.	-0.6859
t9	.	.	.	-0.6859
t10	.	.	.	-0.6859
t11	.	.	.	-0.6859
t12	.	.	.	-0.8495
t13	.	.	.	-0.8495
t14	.	.	.	-0.8495
t15	.	.	.	-0.6859
t16	.	.	.	-0.6859
t17	.	.	.	-0.6859
t18	.	.	.	-0.6859
t19	.	.	.	-0.8495
t20	.	.	.	-0.8495
t21	.	.	.	-0.8495

t22	.	.	.	-0.8495
t23	.	.	.	-0.8495
t24	.	.	.	-0.6859

---- EQU eq9

	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 eq10

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	130.0000	+INF	.
t2	.	130.0000	+INF	.
t3	.	130.0000	+INF	.
t4	.	130.0000	+INF	.
t5	.	130.0000	+INF	.
t6	.	130.0000	+INF	.
t7	.	130.0000	+INF	.
t8	.	130.0000	+INF	.
t9	.	130.0000	+INF	.
t10	.	130.0000	+INF	.
t11	.	130.0000	+INF	.
t12	.	130.0000	+INF	.
t13	.	130.0000	+INF	.
t14	.	130.0000	+INF	.
t15	.	130.0000	+INF	.
t16	.	130.0000	+INF	.
t17	.	130.0000	+INF	.
t18	.	130.0000	+INF	.

t19	.	130.0000	+INF	.
t20	.	130.0000	+INF	.
t21	.	130.0000	+INF	.
t22	.	130.0000	+INF	.
t23	.	130.0000	+INF	.
t24	.	130.0000	+INF	.

---- EQU eq11

	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   17777.2501   +INF   .

---- VAR E

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	28.9178	+INF	.
t2	.	21.6053	+INF	.
t3	.	17.9490	+INF	.
t4	.	17.9490	+INF	.
t5	.	17.9490	+INF	.
t6	.	36.2303	+INF	.
t7	.	61.2407	+INF	.
t8	.	65.0428	+INF	.
t9	.	40.4594	+INF	.
t10	.	34.7511	+INF	.
t11	.	33.7511	+INF	.

	LOWER	LEVEL	UPPER	MARGINAL
t12	.	27.2511	+INF	.
t13	.	29.0532	+INF	.
t14	.	48.3553	+INF	.
t15	.	65.5636	+INF	.
t16	.	98.0532	+INF	.
t17	.	120.3240	+INF	.
t18	.	153.2303	+INF	.
t19	.	160.5428	+INF	.
t20	.	145.9178	+INF	.
t21	.	131.2928	+INF	.
t22	.	105.6990	+INF	.
t23	.	80.1053	+INF	.
t24	.	50.8553	+INF	.

---- VAR E1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	27.7611	+INF	.
t2	.	20.7411	+INF	.
t3	.	17.2311	+INF	.
t4	.	17.2311	+INF	.
t5	.	17.2311	+INF	.
t6	.	34.7811	+INF	.
t7	.	59.3511	+INF	.
t8	.	66.3711	+INF	.
t9	.	66.3711	+INF	.
t10	.	80.4111	+INF	.
t11	.	94.4511	+INF	.
t12	.	97.9611	+INF	.
t13	.	94.4511	+INF	.
t14	.	97.9611	+INF	.
t15	.	94.4511	+INF	.
t16	.	94.4511	+INF	.
t17	.	115.5111	+INF	.
t18	.	147.1011	+INF	.
t19	.	154.1211	+INF	.
t20	.	140.0811	+INF	.
t21	.	126.0411	+INF	.
t22	.	101.4711	+INF	.
t23	.	76.9011	+INF	.
t24	.	48.8211	+INF	.

---- VAR E2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	68.4211	+INF	.
t2	.	68.4211	+INF	.
t3	.	68.4211	+INF	.
t4	.	68.4211	+INF	.
t5	.	68.4211	+INF	.
t6	.	68.4211	+INF	.
t7	.	68.4211	+INF	.
t8	.	68.4211	+INF	.

```
t9        .      68.4211     +INF        .
t10       .      68.4211     +INF        .
t11       .      68.4211     +INF        .
t12       .      68.4211     +INF        .
t13       .      68.4211     +INF        .
t14       .      68.4211     +INF        .
t15       .      68.4211     +INF        .
t16       .      68.4211     +INF        .
t17       .      68.4211     +INF        .
t18       .      68.4211     +INF        .
t19       .      68.4211     +INF        .
t20       .      68.4211     +INF        .
t21       .      68.4211     +INF        .
t22       .      68.4211     +INF        .
t23       .      68.4211     +INF        .
t24       .      68.4211     +INF        .
```

---- VAR G

```
          LOWER      LEVEL       UPPER       MARGINAL

t1        .      320.4543     +INF        .
t2        .      320.4543     +INF        .
t3        .      320.4543     +INF        .
t4        .      320.4543     +INF        .
t5        .      320.4543     +INF        .
t6        .      320.4543     +INF        .
t7        .      320.4543     +INF        .
t8        .      320.4543     +INF        .
t9        .      320.4543     +INF        .
t10       .      320.4543     +INF        .
t11       .      320.4543     +INF        .
t12       .      320.4543     +INF        .
t13       .      320.4543     +INF        .
t14       .      320.4543     +INF        .
t15       .      320.4543     +INF        .
t16       .      320.4543     +INF        .
t17       .      320.4543     +INF        .
t18       .      320.4543     +INF        .
t19       .      320.4543     +INF        .
t20       .      320.4543     +INF        .
t21       .      320.4543     +INF        .
t22       .      320.4543     +INF        .
t23       .      320.4543     +INF        .
t24       .      320.4543     +INF        .
```

---- VAR G1

```
          LOWER      LEVEL       UPPER       MARGINAL

t1        .      300.7143    465.0000      .
t2        .      300.7143    465.0000      .
t3        .      300.7143    465.0000      .
t4        .      300.7143    465.0000      .
t5        .      300.7143    465.0000      .
```

```
t6      .       300.7143    465.0000       .
t7      .       300.7143    465.0000       .
t8      .       300.7143    465.0000       .
t9      .       300.7143    465.0000       .
t10     .       300.7143    465.0000       .
t11     .       300.7143    465.0000       .
t12     .       300.7143    465.0000       .
t13     .       300.7143    465.0000       .
t14     .       300.7143    465.0000       .
t15     .       300.7143    465.0000       .
t16     .       300.7143    465.0000       .
t17     .       300.7143    465.0000       .
t18     .       300.7143    465.0000       .
t19     .       300.7143    465.0000       .
t20     .       300.7143    465.0000       .
t21     .       300.7143    465.0000       .
t22     .       300.7143    465.0000       .
t23     .       300.7143    465.0000       .
t24     .       300.7143    465.0000       .
```

---- VAR G2

```
        LOWER       LEVEL       UPPER       MARGINAL

t1      .       .       576.0000       .
t2      .       .       576.0000       .
t3      .       .       576.0000       .
t4      .       .       576.0000       .
t5      .       .       576.0000       .
t6      .       .       576.0000       .
t7      .       .       576.0000       .
t8      .       .       576.0000       .
t9      .       .       576.0000       .
t10     .       .       576.0000       .
t11     .       .       576.0000       .
t12     .       .       576.0000       .
t13     .       .       576.0000       .
t14     .       .       576.0000       .
t15     .       .       576.0000       .
t16     .       .       576.0000       .
t17     .       .       576.0000       .
t18     .       .       576.0000       .
t19     .       .       576.0000       .
t20     .       .       576.0000       .
t21     .       .       576.0000       .
t22     .       .       576.0000       .
t23     .       .       576.0000       .
t24     .       .       576.0000       .
```

---- VAR G3

```
        LOWER       LEVEL       UPPER       MARGINAL

t1      .       19.7400     +INF        .
t2      .       19.7400     +INF        .
```

	LOWER	LEVEL	UPPER	MARGINAL
t3	.	19.7400	+INF	.
t4	.	19.7400	+INF	.
t5	.	19.7400	+INF	.
t6	.	19.7400	+INF	.
t7	.	19.7400	+INF	.
t8	.	19.7400	+INF	.
t9	.	19.7400	+INF	.
t10	.	19.7400	+INF	.
t11	.	19.7400	+INF	.
t12	.	19.7400	+INF	.
t13	.	19.7400	+INF	.
t14	.	19.7400	+INF	.
t15	.	19.7400	+INF	.
t16	.	19.7400	+INF	.
t17	.	19.7400	+INF	.
t18	.	19.7400	+INF	.
t19	.	19.7400	+INF	.
t20	.	19.7400	+INF	.
t21	.	19.7400	+INF	.
t22	.	19.7400	+INF	.
t23	.	19.7400	+INF	.
t24	.	19.7400	+INF	.

---- VAR H1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	+INF	0.5174
t2	.	.	+INF	0.5174
t3	.	.	+INF	0.5174
t4	.	.	+INF	0.5174
t5	.	.	+INF	0.5174
t6	.	.	+INF	0.5174
t7	.	.	+INF	0.5174
t8	.	.	+INF	0.5174
t9	.	.	+INF	0.5174
t10	.	.	+INF	0.5174
t11	.	.	+INF	0.5174
t12	.	.	+INF	0.9880
t13	.	.	+INF	0.9880
t14	.	.	+INF	0.9880
t15	.	.	+INF	0.5174
t16	.	.	+INF	0.5174
t17	.	.	+INF	0.5174
t18	.	.	+INF	0.5174
t19	.	.	+INF	0.9880
t20	.	.	+INF	0.9880
t21	.	.	+INF	0.9880
t22	.	.	+INF	0.9880
t23	.	.	+INF	0.9880
t24	.	.	+INF	0.5174

---- VAR H_ehp

	LOWER	LEVEL	UPPER	MARGINAL

t1	.	260.0000	260.0000	-0.6951
t2	.	260.0000	260.0000	-0.6951
t3	.	260.0000	260.0000	-0.6951
t4	.	260.0000	260.0000	-0.6951
t5	.	260.0000	260.0000	-0.6951
t6	.	260.0000	260.0000	-0.6951
t7	.	260.0000	260.0000	-0.6951
t8	.	260.0000	260.0000	-0.6951
t9	.	260.0000	260.0000	-0.6951
t10	.	260.0000	260.0000	-0.6951
t11	.	260.0000	260.0000	-0.6951
t12	.	260.0000	260.0000	-0.0609
t13	.	260.0000	260.0000	-0.0609
t14	.	260.0000	260.0000	-0.0609
t15	.	260.0000	260.0000	-0.6951
t16	.	260.0000	260.0000	-0.6951
t17	.	260.0000	260.0000	-0.6951
t18	.	260.0000	260.0000	-0.6951
t19	.	260.0000	260.0000	-0.0609
t20	.	260.0000	260.0000	-0.0609
t21	.	260.0000	260.0000	-0.0609
t22	.	260.0000	260.0000	-0.0609
t23	.	260.0000	260.0000	-0.0609
t24	.	260.0000	260.0000	-0.6951

---- 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

**** REPORT SUMMARY :   0   NONOPT
                 0 INFEASIBLE
                 0 UNBOUNDED

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Optimal operation of energy hub
E x e c u t i o n

----   111 PARAMETER report

	E(t)	KVET - el	PV(t)	E1(t)	De(t)	G(t)	G1(t)	G3(t)	KVET - te~	TC - teplo
t1	28.918	117.880		27.761	77.220	320.454	300.714	19.740	155.770	260.000
t2	21.605	117.880		20.741	70.200	320.454	300.714	19.740	155.770	260.000
t3	17.949	117.880		17.231	66.690	320.454	300.714	19.740	155.770	260.000
t4	17.949	117.880		17.231	66.690	320.454	300.714	19.740	155.770	260.000
t5	17.949	117.880		17.231	66.690	320.454	300.714	19.740	155.770	260.000
t6	36.230	117.880		34.781	84.240	320.454	300.714	19.740	155.770	260.000
t7	61.241	117.880	0.560	59.351	108.810	320.454	300.714	19.740	155.770	260.000
t8	65.043	117.880	3.930	66.371	115.830	320.454	300.714	19.740	155.770	260.000
t9	40.459	117.880	27.530	66.371	115.830	320.454	300.714	19.740	155.770	260.000
t10	34.751	117.880	47.050	80.411	129.870	320.454	300.714	19.740	155.770	260.000
t11	33.751	117.880	62.050	94.451	143.910	320.454	300.714	19.740	155.770	260.000
t12	27.251	117.880	71.800	97.961	147.420	320.454	300.714	19.740	155.770	260.000
t13	29.053	117.880	66.560	94.451	143.910	320.454	300.714	19.740	155.770	260.000
t14	48.355	117.880	51.540	97.961	147.420	320.454	300.714	19.740	155.770	260.000
t15	65.564	117.880	31.510	94.451	143.910	320.454	300.714	19.740	155.770	260.000
t16	98.053	117.880	0.320	94.451	143.910	320.454	300.714	19.740	155.770	260.000
t17	120.324	117.880		115.511	164.970	320.454	300.714	19.740	155.770	260.000
t18	153.230	117.880		147.101	196.560	320.454	300.714	19.740	155.770	260.000
t19	160.543	117.880		154.121	203.580	320.454	300.714	19.740	155.770	260.000
t20	145.918	117.880		140.081	189.540	320.454	300.714	19.740	155.770	260.000
t21	131.293	117.880		126.041	175.500	320.454	300.714	19.740	155.770	260.000
t22	105.699	117.880		101.471	150.930	320.454	300.714	19.740	155.770	260.000
t23	80.105	117.880		76.901	126.360	320.454	300.714	19.740	155.770	260.000
t24	50.855	117.880		48.821	98.280	320.454	300.714	19.740	155.770	260.000

EXECUTION TIME   =   0.390 SECONDS   4 MB 38.1.0 a1a3b545 WEX-WEI

**** FILE SUMMARY

Input   E:\DP\GAMS\Varianta_2.gms
Output   E:\DP\GAMS\Varianta_2.lst

GAMS 38.1.0 Alena Bazaluk Jan 31, 2022   WEX-WEI x86 64bit/MS Windows - 05/13/22 20:37:15 Page 1
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     415.77  77.22   19.74  0.00   2.502
 12  t2  415.77    70.20   19.74  0.00   2.502
 13  t3  415.77    66.69   19.74  0.00   2.502
 14  t4  415.77    66.69   19.74  0.00   2.502
 15  t5  415.77    66.69   19.74  0.00   2.502
 16  t6  415.77    84.24   19.74  0.00   2.502
 17  t7  415.77   108.81   19.74  0.56   2.502
 18  t8  415.77   115.83   19.74  3.93   2.502
 19  t9  415.77   115.83   19.74  27.53  2.502
 20  t10 415.77   129.87   19.74  47.05  2.502
 21  t11 415.77   143.91   19.74  62.05  2.502
 22  t12 415.77   147.42   19.74  71.8   3.099
 23  t13 415.77   143.91   19.74  66.56  3.099
 24  t14 415.77   147.42   19.74  51.54  3.099
 25  t15 415.77   143.91   19.74  31.51  2.502
 26  t16 415.77   143.91   19.74  0.32   2.502
 27  t17 415.77   164.97   19.74  0.00   2.502
 28  t18 415.77   196.56   19.74  0.00   2.502
 29  t19 415.77   203.58   19.74  0.00   3.099
 30  t20 415.77   189.54   19.74  0.00   3.099
 31  t21 415.77   175.50   19.74  0.00   3.099
 32  t22 415.77   150.93   19.74  0.00   3.099
 33  t23 415.77   126.36   19.74  0.00   3.099
 34  t24 415.77    98.28   19.74  0.00   2.502;
 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 / 0.392 / ,     !! účinnost kogenerační jednotky vyroba elektro
 50  eta_gh / 0.518 / ,     !! 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 / 3.8 / ,          !! topný faktor tepelného čerpadla
54  H_ehpMax / 260 / ,      !! výkon tepelného čerpadla max
55  H_ehpMin / 0.5 / ,      !! výkon tepelného čerpadla min
56  Chpmax / 465 / ,        !! max výkon kogenerační jednotky
57  Fmax / 576 / ,          !! výkon plynový kotel
58  eta_ghf / 0.915 / ,     !! účinnost spalování plynu plynovým kotlem
59  lambda_g / 1.737 / ,    !! cena plyn
60  SOCmax / 232 / ,        !! 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 baterioveho uloziste
89  eq4(t).. E1(t) =e= Ec(t) ;
90  */ zmena stavu urovne nabiti baterioveho 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 = 0.016 SECONDS 3 MB 38.1.0 a1a3b545 WEX-WEI
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Optimal operation of energy hub
Equation Listing SOLVE Hub Using MIP From line 119

---- eq1 =E=

eq1.. cost - 2.502*E(t1) - 2.502*E(t2) - 2.502*E(t3) - 2.502*E(t4) - 2.502*E(t5) - 2.502*E(t6) - 2.502*E(t7) - 2.502
*E(t8) - 2.502*E(t9) - 2.502*E(t10) - 2.502*E(t11) - 3.099*E(t12) - 3.099*E(t13) - 3.099*E(t14) - 2.502*E(t15) - 2.
502*E(t16) - 2.502*E(t17) - 2.502*E(t18) - 3.099*E(t19) - 3.099*E(t20) - 3.099*E(t21) - 3.099*E(t22) - 3.099*E(t2
3) - 2.502*E(t24) - 1.737*G(t1) - 1.737*G(t2) - 1.737*G(t3) - 1.737*G(t4) - 1.737*G(t5) - 1.737*G(t6) - 1.737*G(t
7) - 1.737*G(t8) - 1.737*G(t9) - 1.737*G(t10) - 1.737*G(t11) - 1.737*G(t12) - 1.737*G(t13) - 1.737*G(t14) - 1.737
*G(t15) - 1.737*G(t16) - 1.737*G(t17) - 1.737*G(t18) - 1.737*G(t19) - 1.737*G(t20) - 1.737*G(t21) - 1.737*G(t22
) - 1.737*G(t23) - 1.737*G(t24) =E= 0 ; (LHS = 0)

---- eq2 =E=

eq2(t1).. E2(t1) - E3(t1) + 0.392*G1(t1) + Ed(t1) =E= 77.22 ; (LHS = 0, INFES = 77.22 ****)

eq2(t2).. E2(t2) - E3(t2) + 0.392*G1(t2) + Ed(t2) =E= 70.2 ; (LHS = 0, INFES = 70.2 ****)

eq2(t3).. E2(t3) - E3(t3) + 0.392*G1(t3) + Ed(t3) =E= 66.69 ; (LHS = 0, INFES = 66.69 ****)

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= 46.4 ; (LHS = 46.4)

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) - 46.4*Idch(t1) =L= 0 ; (LHS = 0)

eq6(t2).. Ed(t2) - 46.4*Idch(t2) =L= 0 ; (LHS = 0)

eq6(t3).. Ed(t3) - 46.4*Idch(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq7 =L=

eq7(t1).. Ec(t1) - 46.4*Idch(t1) =L= 0 ; (LHS = 0)

eq7(t2).. Ec(t2) - 46.4*Idch(t2) =L= 0 ; (LHS = 0)

eq7(t3).. Ec(t3) - 46.4*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= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq10(t2).. G3(t2) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

eq10(t3).. G3(t3) =E= 19.74 ; (LHS = 0, INFES = 19.74 ****)

REMAINING 21 ENTRIES SKIPPED

---- eq11 =E=

eq11(t1).. 0.518*G1(t1) + H1(t1) + H_ehp(t1) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq11(t2).. 0.518*G1(t2) + H1(t2) + H_ehp(t2) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

eq11(t3).. 0.518*G1(t3) + H1(t3) + H_ehp(t3) =E= 415.77 ; (LHS = 0, INFES = 415.77 ****)

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

eq13(t2).. - 3.8*E3(t2) + H_ehp(t2) =E= 0 ; (LHS = 0)

eq13(t3).. - 3.8*E3(t3) + H_ehp(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq14 =L=

eq14(t1).. H_ehp(t1) - 260*Ih(t1) =L= 0 ; (LHS = 0)

eq14(t2).. H_ehp(t2) - 260*Ih(t2) =L= 0 ; (LHS = 0)

eq14(t3).. H_ehp(t3) - 260*Ih(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq15 =G=

eq15(t1).. H_ehp(t1) - 130*Ih(t1) =G= 0 ; (LHS = 0)

eq15(t2).. H_ehp(t2) - 130*Ih(t2) =G= 0 ; (LHS = 0)

eq15(t3).. H_ehp(t3) - 130*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

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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)

   -2.502 eq1

   0.96   eq3(t1)

E(t2)

        (.LO, .L, .UP, .M = 0, 0, +INF, 0)

   -2.502 eq1

   0.96   eq3(t2)

E(t3)

        (.LO, .L, .UP, .M = 0, 0, +INF, 0)

   -2.502 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)
 -3.8   eq13(t1)

E3(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
  -1   eq2(t2)
 -3.8   eq13(t2)

E3(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
  -1   eq2(t3)
 -3.8   eq13(t3)

REMAINING 21 ENTRIES SKIPPED

---- G

G(t1)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
 -1.737   eq1
  1   eq9(t1)

G(t2)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
 -1.737   eq1
  1   eq9(t2)

G(t3)
        (.LO, .L, .UP, .M = 0, 0, +INF, 0)
 -1.737   eq1
  1   eq9(t3)

REMAINING 21 ENTRIES SKIPPED

---- G1

G1(t1)
        (.LO, .L, .UP, .M = 0, 0, 465, 0)
 0.392   eq2(t1)
  -1   eq9(t1)
 0.518   eq11(t1)

G1(t2)

(.LO, .L, .UP, .M = 0, 0, 465, 0)
    0.392   eq2(t2)
    -1   eq9(t2)
    0.518   eq11(t2)

G1(t3)
           (.LO, .L, .UP, .M = 0, 0, 465, 0)
    0.392   eq2(t3)
    -1   eq9(t3)
    0.518   eq11(t3)

REMAINING 21 ENTRIES SKIPPED

---- G2

G2(t1)
           (.LO, .L, .UP, .M = 0, 0, 576, 0)
    -1   eq9(t1)
    0.915   eq12(t1)

G2(t2)
           (.LO, .L, .UP, .M = 0, 0, 576, 0)
    -1   eq9(t2)
    0.915   eq12(t2)

G2(t3)
           (.LO, .L, .UP, .M = 0, 0, 576, 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, 46.4, 0)

```
        1      eq2(t1)
     1.1111  eq5(t1)
        1      eq6(t1)


Ed(t2)
            (.LO, .L, .UP, .M = 0, 0, 46.4, 0)
        1      eq2(t2)
     1.1111  eq5(t2)
        1      eq6(t2)


Ed(t3)
            (.LO, .L, .UP, .M = 0, 0, 46.4, 0)
        1      eq2(t3)
     1.1111  eq5(t3)
        1      eq6(t3)
```

REMAINING 21 ENTRIES SKIPPED

---- Ec

```
Ec(t1)
            (.LO, .L, .UP, .M = 0, 0, 46.4, 0)
       -1      eq4(t1)
      -0.9    eq5(t1)
        1      eq7(t1)


Ec(t2)
            (.LO, .L, .UP, .M = 0, 0, 46.4, 0)
       -1      eq4(t2)
      -0.9    eq5(t2)
        1      eq7(t2)


Ec(t3)
            (.LO, .L, .UP, .M = 0, 0, 46.4, 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, 260, 0)
    1   eq11(t1)
    1   eq13(t1)
    1   eq14(t1)
    1   eq15(t1)

H_ehp(t2)
        (.LO, .L, .UP, .M = 0, 0, 260, 0)
    1   eq11(t2)
    1   eq13(t2)
    1   eq14(t2)
    1   eq15(t2)

H_ehp(t3)
        (.LO, .L, .UP, .M = 0, 0, 260, 0)
    1   eq11(t3)
    1   eq13(t3)
    1   eq14(t3)
    1   eq15(t3)

REMAINING 21 ENTRIES SKIPPED

---- SOC

SOC(t1)
        (.LO, .L, .UP, .M = 46.4, 46.4, 232, 0)
    1   eq5(t1)
   -1   eq5(t2)
    0   (OLD LEVEL ****)

SOC(t2)
        (.LO, .L, .UP, .M = 46.4, 46.4, 232, 0)
    1   eq5(t2)
   -1   eq5(t3)
    0   (OLD LEVEL ****)

SOC(t3)
        (.LO, .L, .UP, .M = 46.4, 46.4, 232, 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)

```
       -260      eq14(t1)
       -130      eq15(t1)
          1      eq16(t1)


Ih(t2)
                 (.LO, .L, .UP, .M = 0, 0, 1, 0)
       -260      eq14(t2)
       -130      eq15(t2)
          1      eq16(t2)


Ih(t3)
                 (.LO, .L, .UP, .M = 0, 0, 1, 0)
       -260      eq14(t3)
       -130      eq15(t3)
          1      eq16(t3)


REMAINING 21 ENTRIES SKIPPED


---- Idch


Idch(t1)
                 (.LO, .L, .UP, .M = 0, 0, 1, 0)
      -46.4      eq6(t1)
      -46.4      eq7(t1)
          1      eq8(t1)


Idch(t2)
                 (.LO, .L, .UP, .M = 0, 0, 1, 0)
      -46.4      eq6(t2)
      -46.4      eq7(t2)
          1      eq8(t2)


Idch(t3)
                 (.LO, .L, .UP, .M = 0, 0, 1, 0)
      -46.4      eq6(t3)
      -46.4      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
```

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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   =   0.140 SECONDS   4 MB 38.1.0 a1a3b545 WEX-WEI

GAMS 38.1.0 a1a3b545 Jan 31, 2022   WEX-WEI x86 64bit/MS Windows - 05/13/22 20:37:15 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   17774.4328

 RESOURCE USAGE, LIMIT   0.078 10000000000.000
 ITERATION COUNT, LIMIT   62   2147483647
--- *** This solver runs with a demo license. No commercial use.
--- GMO setup time: 0.00s
--- 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 20.1.0.1 link memory 0.01 Mb (peak 0.04 Mb)
--- Starting Cplex

--- MIP status (101): integer optimal solution.
--- Cplex Time: 0.08sec (det. 1.50 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: 17774.432756   (62 iterations, 0 nodes)
Final Solve: 17774.432756   (57 iterations)

Best possible: 17774.432756

```
Absolute gap:        0.000000
Relative gap:        0.000000


                LOWER        LEVEL       UPPER       MARGINAL

---- EQU eq1            .         .         .          1.0000

---- EQU eq2

            LOWER        LEVEL       UPPER       MARGINAL

t1      77.2200      77.2200      77.2200       2.6063
t2      70.2000      70.2000      70.2000       2.6063
t3      66.6900      66.6900      66.6900       2.6063
t4      66.6900      66.6900      66.6900       2.6063
t5      66.6900      66.6900      66.6900       2.6063
t6      84.2400      84.2400      84.2400       2.6063
t7     108.8100     108.8100     108.8100       2.6063
t8     115.8300     115.8300     115.8300       2.6063
t9     115.8300     115.8300     115.8300       2.6063
t10    129.8700     129.8700     129.8700       2.6063
t11    143.9100     143.9100     143.9100       2.6063
t12    147.4200     147.4200     147.4200       3.2176
t13    143.9100     143.9100     143.9100       3.2176
t14    147.4200     147.4200     147.4200       3.2281
t15    143.9100     143.9100     143.9100       2.6063
t16    143.9100     143.9100     143.9100       2.6063
t17    164.9700     164.9700     164.9700       2.6063
t18    196.5600     196.5600     196.5600       2.6063
t19    203.5800     203.5800     203.5800       3.2281
t20    189.5400     189.5400     189.5400       3.2281
t21    175.5000     175.5000     175.5000       3.2281
t22    150.9300     150.9300     150.9300       3.2281
t23    126.3600     126.3600     126.3600       3.2281
t24     98.2800      98.2800      98.2800       2.6063

---- EQU eq3

            LOWER        LEVEL       UPPER       MARGINAL

t1       .         .         .           2.6063
t2       .         .         .           2.6063
t3       .         .         .           2.6063
t4       .         .         .           2.6063
t5       .         .         .           2.6063
t6       .         .         .           2.6063
t7      -0.5600      -0.5600      -0.5600      2.6063
t8      -3.9300      -3.9300      -3.9300      2.6063
t9     -27.5300     -27.5300     -27.5300       2.6063
t10    -47.0500     -47.0500     -47.0500       2.6063
t11    -62.0500     -62.0500     -62.0500       2.6063
t12    -71.8000     -71.8000     -71.8000       3.2176
t13    -66.5600     -66.5600     -66.5600       3.2176
t14    -51.5400     -51.5400     -51.5400       3.2281
```

	LOWER	LEVEL	UPPER	MARGINAL
t15	-31.5100	-31.5100	-31.5100	2.6063
t16	-0.3200	-0.3200	-0.3200	2.6063
t17	.	.	.	2.6063
t18	.	.	.	2.6063
t19	.	.	.	3.2281
t20	.	.	.	3.2281
t21	.	.	.	3.2281
t22	.	.	.	3.2281
t23	.	.	.	3.2281
t24	.	.	.	2.6063

---- EQU eq4

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	2.6063
t2	.	.	.	2.6063
t3	.	.	.	2.6063
t4	.	.	.	2.6063
t5	.	.	.	2.6063
t6	.	.	.	2.6063
t7	.	.	.	2.6063
t8	.	.	.	2.6063
t9	.	.	.	2.6063
t10	.	.	.	2.6063
t11	.	.	.	2.6063
t12	.	.	.	3.2176
t13	.	.	.	3.2176
t14	.	.	.	3.2281
t15	.	.	.	2.6063
t16	.	.	.	2.6063
t17	.	.	.	2.6063
t18	.	.	.	2.6063
t19	.	.	.	3.2281
t20	.	.	.	3.2281
t21	.	.	.	3.2281
t22	.	.	.	3.2281
t23	.	.	.	3.2281
t24	.	.	.	2.6063

---- EQU eq5

	LOWER	LEVEL	UPPER	MARGINAL
t1	46.4000	46.4000	46.4000	-2.8958
t2	.	.	.	-2.8958
t3	.	.	.	-2.8958
t4	.	.	.	-2.8958
t5	.	.	.	-2.8958
t6	.	.	.	-2.8958
t7	.	.	.	-2.8958
t8	.	.	.	-2.8958
t9	.	.	.	-2.8958
t10	.	.	.	-2.8958
t11	.	.	.	-2.8958

```
t12      .       .       .       -2.8958
t13      .       .       .       -2.8958
t14      .       .       .       -2.8958
t15      .       .       .       -2.8958
t16      .       .       .       -2.8958
t17      .       .       .       -2.8958
t18      .       .       .       -2.8958
t19      .       .       .       -2.9053
t20      .       .       .       -2.9053
t21      .       .       .       -2.9053
t22      .       .       .       -2.9053
t23      .       .       .       -2.9053
t24      .       .       .       -2.8958
```

---- EQU eq6

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	-46.4000	.	.
t2	-INF	-46.4000	.	.
t3	-INF	-46.4000	.	.
t4	-INF	-46.4000	.	.
t5	-INF	-46.4000	.	.
t6	-INF	-46.4000	.	.
t7	-INF	-46.4000	.	.
t8	-INF	-46.4000	.	.
t9	-INF	-46.4000	.	.
t10	-INF	-46.4000	.	.
t11	-INF	-46.4000	.	.
t12	-INF	-20.2389	.	.
t13	-INF	-18.5089	.	.
t14	-INF	.	.	.
t15	-INF	-46.4000	.	.
t16	-INF	-46.4000	.	.
t17	-INF	-46.4000	.	.
t18	-INF	-46.4000	.	.
t19	-INF	-18.5600	.	.
t20	-INF	.	.	.
t21	-INF	.	.	.
t22	-INF	-46.4000	.	.
t23	-INF	.	.	.
t24	-INF	-46.4000	.	.

---- EQU eq7

	LOWER	LEVEL	UPPER	MARGINAL
t1	-INF	.	.	.
t2	-INF	.	.	.
t3	-INF	-46.4000	.	.
t4	-INF	-46.4000	.	.
t5	-INF	-25.7778	.	.
t6	-INF	.	.	.
t7	-INF	-46.4000	.	.
t8	-INF	-46.4000	.	.

	LOWER	LEVEL	UPPER	MARGINAL
t9	-INF	-46.4000	.	.
t10	-INF	-46.4000	.	.
t11	-INF	.	.	.
t12	-INF	-46.4000	.	.
t13	-INF	-46.4000	.	.
t14	-INF	-46.4000	.	.
t15	-INF	-46.4000	.	.
t16	-INF	-15.1851	.	.
t17	-INF	.	.	.
t18	-INF	.	.	.
t19	-INF	-46.4000	.	.
t20	-INF	-46.4000	.	.
t21	-INF	-46.4000	.	.
t22	-INF	-46.4000	.	.
t23	-INF	-46.4000	.	.
t24	-INF	-46.4000	.	.

---- 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	.	.	.	1.7370
t2	.	.	.	1.7370
t3	.	.	.	1.7370
t4	.	.	.	1.7370
t5	.	.	.	1.7370

				1.7370
t6	.	.	.	1.7370
t7	.	.	.	1.7370
t8	.	.	.	1.7370
t9	.	.	.	1.7370
t10	.	.	.	1.7370
t11	.	.	.	1.7370
t12	.	.	.	1.7370
t13	.	.	.	1.7370
t14	.	.	.	1.7370
t15	.	.	.	1.7370
t16	.	.	.	1.7370
t17	.	.	.	1.7370
t18	.	.	.	1.7370
t19	.	.	.	1.7370
t20	.	.	.	1.7370
t21	.	.	.	1.7370
t22	.	.	.	1.7370
t23	.	.	.	1.7370
t24	.	.	.	1.7370

---- EQU eq10

	LOWER	LEVEL	UPPER	MARGINAL
t1	19.7400	19.7400	19.7400	1.7370
t2	19.7400	19.7400	19.7400	1.7370
t3	19.7400	19.7400	19.7400	1.7370
t4	19.7400	19.7400	19.7400	1.7370
t5	19.7400	19.7400	19.7400	1.7370
t6	19.7400	19.7400	19.7400	1.7370
t7	19.7400	19.7400	19.7400	1.7370
t8	19.7400	19.7400	19.7400	1.7370
t9	19.7400	19.7400	19.7400	1.7370
t10	19.7400	19.7400	19.7400	1.7370
t11	19.7400	19.7400	19.7400	1.7370
t12	19.7400	19.7400	19.7400	1.7370
t13	19.7400	19.7400	19.7400	1.7370
t14	19.7400	19.7400	19.7400	1.7370
t15	19.7400	19.7400	19.7400	1.7370
t16	19.7400	19.7400	19.7400	1.7370
t17	19.7400	19.7400	19.7400	1.7370
t18	19.7400	19.7400	19.7400	1.7370
t19	19.7400	19.7400	19.7400	1.7370
t20	19.7400	19.7400	19.7400	1.7370
t21	19.7400	19.7400	19.7400	1.7370
t22	19.7400	19.7400	19.7400	1.7370
t23	19.7400	19.7400	19.7400	1.7370
t24	19.7400	19.7400	19.7400	1.7370

---- EQU eq11

	LOWER	LEVEL	UPPER	MARGINAL
t1	415.7700	415.7700	415.7700	1.3810
t2	415.7700	415.7700	415.7700	1.3810

t3	415.7700	415.7700	415.7700	1.3810
t4	415.7700	415.7700	415.7700	1.3810
t5	415.7700	415.7700	415.7700	1.3810
t6	415.7700	415.7700	415.7700	1.3810
t7	415.7700	415.7700	415.7700	1.3810
t8	415.7700	415.7700	415.7700	1.3810
t9	415.7700	415.7700	415.7700	1.3810
t10	415.7700	415.7700	415.7700	1.3810
t11	415.7700	415.7700	415.7700	1.3810
t12	415.7700	415.7700	415.7700	0.9183
t13	415.7700	415.7700	415.7700	0.9183
t14	415.7700	415.7700	415.7700	0.9104
t15	415.7700	415.7700	415.7700	1.3810
t16	415.7700	415.7700	415.7700	1.3810
t17	415.7700	415.7700	415.7700	1.3810
t18	415.7700	415.7700	415.7700	1.3810
t19	415.7700	415.7700	415.7700	0.9104
t20	415.7700	415.7700	415.7700	0.9104
t21	415.7700	415.7700	415.7700	0.9104
t22	415.7700	415.7700	415.7700	0.9104
t23	415.7700	415.7700	415.7700	0.9104
t24	415.7700	415.7700	415.7700	1.3810

---- EQU eq12

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	.	1.8984
t2	.	.	.	1.8984
t3	.	.	.	1.8984
t4	.	.	.	1.8984
t5	.	.	.	1.8984
t6	.	.	.	1.8984
t7	.	.	.	1.8984
t8	.	.	.	1.8984
t9	.	.	.	1.8984
t10	.	.	.	1.8984
t11	.	.	.	1.8984
t12	.	.	.	1.8984
t13	.	.	.	1.8984
t14	.	.	.	1.8984
t15	.	.	.	1.8984
t16	.	.	.	1.8984
t17	.	.	.	1.8984
t18	.	.	.	1.8984
t19	.	.	.	1.8984
t20	.	.	.	1.8984
t21	.	.	.	1.8984
t22	.	.	.	1.8984
t23	.	.	.	1.8984
t24	.	.	.	1.8984

---- EQU eq13

	LOWER	LEVEL	UPPER	MARGINAL

t1	.	.	.	-0.6859
t2	.	.	.	-0.6859
t3	.	.	.	-0.6859
t4	.	.	.	-0.6859
t5	.	.	.	-0.6859
t6	.	.	.	-0.6859
t7	.	.	.	-0.6859
t8	.	.	.	-0.6859
t9	.	.	.	-0.6859
t10	.	.	.	-0.6859
t11	.	.	.	-0.6859
t12	.	.	.	-0.8467
t13	.	.	.	-0.8467
t14	.	.	.	-0.8495
t15	.	.	.	-0.6859
t16	.	.	.	-0.6859
t17	.	.	.	-0.6859
t18	.	.	.	-0.6859
t19	.	.	.	-0.8495
t20	.	.	.	-0.8495
t21	.	.	.	-0.8495
t22	.	.	.	-0.8495
t23	.	.	.	-0.8495
t24	.	.	.	-0.6859

---- 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	.	130.0000	+INF	.
t2	.	130.0000	+INF	.
t3	.	130.0000	+INF	.
t4	.	130.0000	+INF	.
t5	.	130.0000	+INF	.
t6	.	130.0000	+INF	.
t7	.	130.0000	+INF	.
t8	.	130.0000	+INF	.
t9	.	130.0000	+INF	.
t10	.	130.0000	+INF	.
t11	.	130.0000	+INF	.
t12	.	130.0000	+INF	.
t13	.	130.0000	+INF	.
t14	.	130.0000	+INF	.
t15	.	130.0000	+INF	.
t16	.	130.0000	+INF	.
t17	.	130.0000	+INF	.
t18	.	130.0000	+INF	.
t19	.	130.0000	+INF	.
t20	.	130.0000	+INF	.
t21	.	130.0000	+INF	.
t22	.	130.0000	+INF	.
t23	.	130.0000	+INF	.
t24	.	130.0000	+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     17774.4328     +INF         .

---- VAR E

         LOWER       LEVEL       UPPER      MARGINAL

t1      .       77.2511      +INF         .
t2      .       69.9386      +INF         .
t3      .       17.9490      +INF         .
t4      .       17.9490      +INF         .
t5      .       39.4305      +INF         .
t6      .       84.5636      +INF         .
t7      .       61.2407      +INF         .
t8      .       65.0428      +INF         .
t9      .       40.4594      +INF         .
t10     .       34.7511      +INF         .
t11     .       82.0844      +INF         .
t12     .         .         +INF      0.0101
t13     .         .         +INF      0.0101
t14     .       0.0219      +INF         .
t15     .       65.5636      +INF         .
t16     .      130.5687      +INF         .
t17     .      168.6573      +INF         .
t18     .      201.5636      +INF         .
t19     .      131.5428      +INF         .
t20     .       97.5844      +INF         .
t21     .       82.9594      +INF         .
t22     .      105.6990      +INF         .
t23     .       31.7719      +INF         .
t24     .       50.8553      +INF         .

---- VAR E1

         LOWER       LEVEL       UPPER      MARGINAL

t1      .       46.4000      +INF         .
t2      .       46.4000      +INF         .
t3      .         .         +INF         .
t4      .         .         +INF         .
t5      .       20.6222      +INF         .
t6      .       46.4000      +INF         .
t7      .         .         +INF         .
t8      .         .         +INF         .
t9      .         .         +INF         .
t10     .         .         +INF         .
t11     .       46.4000      +INF         .
t12     .         .         +INF         .
t13     .         .         +INF         .
t14     .         .         +INF         .
t15     .         .         +INF         .
```

	LOWER	LEVEL	UPPER	MARGINAL
t16	.	31.2149	+INF	.
t17	.	46.4000	+INF	.
t18	.	46.4000	+INF	.
t19	.	.	+INF	.
t20	.	.	+INF	.
t21	.	.	+INF	.
t22	.	.	+INF	.
t23	.	.	+INF	.
t24	.	.	+INF	.

---- VAR E2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	27.7611	+INF	.
t2	.	20.7411	+INF	.
t3	.	17.2311	+INF	.
t4	.	17.2311	+INF	.
t5	.	17.2311	+INF	.
t6	.	34.7811	+INF	.
t7	.	59.3511	+INF	.
t8	.	66.3711	+INF	.
t9	.	66.3711	+INF	.
t10	.	80.4111	+INF	.
t11	.	94.4511	+INF	.
t12	.	71.8000	+INF	.
t13	.	66.5600	+INF	.
t14	.	51.5611	+INF	.
t15	.	94.4511	+INF	.
t16	.	94.4511	+INF	.
t17	.	115.5111	+INF	.
t18	.	147.1011	+INF	.
t19	.	126.2811	+INF	.
t20	.	93.6811	+INF	.
t21	.	79.6411	+INF	.
t22	.	101.4711	+INF	.
t23	.	30.5011	+INF	.
t24	.	48.8211	+INF	.

---- VAR E3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	68.4211	+INF	.
t2	.	68.4211	+INF	.
t3	.	68.4211	+INF	.
t4	.	68.4211	+INF	.
t5	.	68.4211	+INF	.
t6	.	68.4211	+INF	.
t7	.	68.4211	+INF	.
t8	.	68.4211	+INF	.
t9	.	68.4211	+INF	.
t10	.	68.4211	+INF	.
t11	.	68.4211	+INF	.
t12	.	68.4211	+INF	.

	LOWER	LEVEL	UPPER	MARGINAL
t13	.	68.4211	+INF	.
t14	.	68.4211	+INF	.
t15	.	68.4211	+INF	.
t16	.	68.4211	+INF	.
t17	.	68.4211	+INF	.
t18	.	68.4211	+INF	.
t19	.	68.4211	+INF	.
t20	.	68.4211	+INF	.
t21	.	68.4211	+INF	.
t22	.	68.4211	+INF	.
t23	.	68.4211	+INF	.
t24	.	68.4211	+INF	.

---- VAR G

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	320.4543	+INF	.
t2	.	320.4543	+INF	.
t3	.	320.4543	+INF	.
t4	.	320.4543	+INF	.
t5	.	320.4543	+INF	.
t6	.	320.4543	+INF	.
t7	.	320.4543	+INF	.
t8	.	320.4543	+INF	.
t9	.	320.4543	+INF	.
t10	.	320.4543	+INF	.
t11	.	320.4543	+INF	.
t12	.	320.4543	+INF	.
t13	.	320.4543	+INF	.
t14	.	320.4543	+INF	.
t15	.	320.4543	+INF	.
t16	.	320.4543	+INF	.
t17	.	320.4543	+INF	.
t18	.	320.4543	+INF	.
t19	.	320.4543	+INF	.
t20	.	320.4543	+INF	.
t21	.	320.4543	+INF	.
t22	.	320.4543	+INF	.
t23	.	320.4543	+INF	.
t24	.	320.4543	+INF	.

---- VAR G1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	300.7143	465.0000	.
t2	.	300.7143	465.0000	.
t3	.	300.7143	465.0000	.
t4	.	300.7143	465.0000	.
t5	.	300.7143	465.0000	.
t6	.	300.7143	465.0000	.
t7	.	300.7143	465.0000	.
t8	.	300.7143	465.0000	.
t9	.	300.7143	465.0000	.

	LOWER	LEVEL	UPPER	MARGINAL
t10	.	300.7143	465.0000	.
t11	.	300.7143	465.0000	.
t12	.	300.7143	465.0000	.
t13	.	300.7143	465.0000	.
t14	.	300.7143	465.0000	.
t15	.	300.7143	465.0000	.
t16	.	300.7143	465.0000	.
t17	.	300.7143	465.0000	.
t18	.	300.7143	465.0000	.
t19	.	300.7143	465.0000	.
t20	.	300.7143	465.0000	.
t21	.	300.7143	465.0000	.
t22	.	300.7143	465.0000	.
t23	.	300.7143	465.0000	.
t24	.	300.7143	465.0000	.

---- VAR G2

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	576.0000	.
t2	.	.	576.0000	.
t3	.	.	576.0000	.
t4	.	.	576.0000	.
t5	.	.	576.0000	.
t6	.	.	576.0000	.
t7	.	.	576.0000	.
t8	.	.	576.0000	.
t9	.	.	576.0000	.
t10	.	.	576.0000	.
t11	.	.	576.0000	.
t12	.	.	576.0000	.
t13	.	.	576.0000	.
t14	.	.	576.0000	.
t15	.	.	576.0000	.
t16	.	.	576.0000	.
t17	.	.	576.0000	.
t18	.	.	576.0000	.
t19	.	.	576.0000	.
t20	.	.	576.0000	.
t21	.	.	576.0000	.
t22	.	.	576.0000	.
t23	.	.	576.0000	.
t24	.	.	576.0000	.

---- VAR G3

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	19.7400	+INF	.
t2	.	19.7400	+INF	.
t3	.	19.7400	+INF	.
t4	.	19.7400	+INF	.
t5	.	19.7400	+INF	.
t6	.	19.7400	+INF	.

```
t7        .        19.7400     +INF        .
t8        .        19.7400     +INF        .
t9        .        19.7400     +INF        .
t10       .        19.7400     +INF        .
t11       .        19.7400     +INF        .
t12       .        19.7400     +INF        .
t13       .        19.7400     +INF        .
t14       .        19.7400     +INF        .
t15       .        19.7400     +INF        .
t16       .        19.7400     +INF        .
t17       .        19.7400     +INF        .
t18       .        19.7400     +INF        .
t19       .        19.7400     +INF        .
t20       .        19.7400     +INF        .
t21       .        19.7400     +INF        .
t22       .        19.7400     +INF        .
t23       .        19.7400     +INF        .
t24       .        19.7400     +INF        .
```

---- VAR Ed

```
          LOWER        LEVEL        UPPER      MARGINAL

t1        .        .        46.4000      0.6113
t2        .        .        46.4000      0.6113
t3        .        .        46.4000      0.6113
t4        .        .        46.4000      0.6113
t5        .        .        46.4000      0.6113
t6        .        .        46.4000      0.6113
t7        .        .        46.4000      0.6113
t8        .        .        46.4000      0.6113
t9        .        .        46.4000      0.6113
t10       .        .        46.4000      0.6113
t11       .        .        46.4000      0.6113
t12       .      26.1611    46.4000        .
t13       .      27.8911    46.4000        .
t14       .      46.4000    46.4000      -0.0105
t15       .        .        46.4000      0.6113
t16       .        .        46.4000      0.6113
t17       .        .        46.4000      0.6113
t18       .        .        46.4000      0.6113
t19       .      27.8400    46.4000        .
t20       .      46.4000    46.4000   -4.44089E-16
t21       .      46.4000    46.4000   -4.44089E-16
t22       .        .        46.4000   -4.44089E-16
t23       .      46.4000    46.4000   -4.44089E-16
t24       .        .        46.4000      0.6113
```

---- VAR Ec

```
          LOWER        LEVEL        UPPER      MARGINAL

t1        .      46.4000    46.4000      EPS
t2        .      46.4000    46.4000      EPS
t3        .        .        46.4000      EPS
```

	LOWER	LEVEL	UPPER	MARGINAL
t4	.	.	46.4000	EPS
t5	.	20.6222	46.4000	.
t6	.	46.4000	46.4000	EPS
t7	.	.	46.4000	EPS
t8	.	.	46.4000	EPS
t9	.	.	46.4000	EPS
t10	.	.	46.4000	EPS
t11	.	46.4000	46.4000	EPS
t12	.	.	46.4000	0.6113
t13	.	.	46.4000	0.6113
t14	.	.	46.4000	0.6219
t15	.	.	46.4000	EPS
t16	.	31.2149	46.4000	.
t17	.	46.4000	46.4000	EPS
t18	.	46.4000	46.4000	EPS
t19	.	.	46.4000	0.6133
t20	.	.	46.4000	0.6133
t21	.	.	46.4000	0.6133
t22	.	.	46.4000	0.6133
t23	.	.	46.4000	0.6133
t24	.	.	46.4000	.

---- VAR H1

	LOWER	LEVEL	UPPER	MARGINAL
t1	.	.	+INF	0.5174
t2	.	.	+INF	0.5174
t3	.	.	+INF	0.5174
t4	.	.	+INF	0.5174
t5	.	.	+INF	0.5174
t6	.	.	+INF	0.5174
t7	.	.	+INF	0.5174
t8	.	.	+INF	0.5174
t9	.	.	+INF	0.5174
t10	.	.	+INF	0.5174
t11	.	.	+INF	0.5174
t12	.	.	+INF	0.9800
t13	.	.	+INF	0.9800
t14	.	.	+INF	0.9880
t15	.	.	+INF	0.5174
t16	.	.	+INF	0.5174
t17	.	.	+INF	0.5174
t18	.	.	+INF	0.5174
t19	.	.	+INF	0.9880
t20	.	.	+INF	0.9880
t21	.	.	+INF	0.9880
t22	.	.	+INF	0.9880
t23	.	.	+INF	0.9880
t24	.	.	+INF	0.5174

---- VAR H_ehp

	LOWER	LEVEL	UPPER	MARGINAL

t1	.	260.0000	260.0000	-0.6951
t2	.	260.0000	260.0000	-0.6951
t3	.	260.0000	260.0000	-0.6951
t4	.	260.0000	260.0000	-0.6951
t5	.	260.0000	260.0000	-0.6951
t6	.	260.0000	260.0000	-0.6951
t7	.	260.0000	260.0000	-0.6951
t8	.	260.0000	260.0000	-0.6951
t9	.	260.0000	260.0000	-0.6951
t10	.	260.0000	260.0000	-0.6951
t11	.	260.0000	260.0000	-0.6951
t12	.	260.0000	260.0000	-0.0716
t13	.	260.0000	260.0000	-0.0716
t14	.	260.0000	260.0000	-0.0609
t15	.	260.0000	260.0000	-0.6951
t16	.	260.0000	260.0000	-0.6951
t17	.	260.0000	260.0000	-0.6951
t18	.	260.0000	260.0000	-0.6951
t19	.	260.0000	260.0000	-0.0609
t20	.	260.0000	260.0000	-0.0609
t21	.	260.0000	260.0000	-0.0609
t22	.	260.0000	260.0000	-0.0609
t23	.	260.0000	260.0000	-0.0609
t24	.	260.0000	260.0000	-0.6951

---- VAR SOC

	LOWER	LEVEL	UPPER	MARGINAL
t1	46.4000	88.1600	232.0000	.
t2	46.4000	129.9200	232.0000	.
t3	46.4000	129.9200	232.0000	.
t4	46.4000	129.9200	232.0000	.
t5	46.4000	148.4800	232.0000	.
t6	46.4000	190.2400	232.0000	.
t7	46.4000	190.2400	232.0000	.
t8	46.4000	190.2400	232.0000	.
t9	46.4000	190.2400	232.0000	.
t10	46.4000	190.2400	232.0000	.
t11	46.4000	232.0000	232.0000	EPS
t12	46.4000	202.9322	232.0000	.
t13	46.4000	171.9421	232.0000	.
t14	46.4000	120.3865	232.0000	.
t15	46.4000	120.3865	232.0000	.
t16	46.4000	148.4800	232.0000	.
t17	46.4000	190.2400	232.0000	.
t18	46.4000	232.0000	232.0000	-0.0095
t19	46.4000	201.0667	232.0000	.
t20	46.4000	149.5111	232.0000	.
t21	46.4000	97.9556	232.0000	.
t22	46.4000	97.9556	232.0000	.
t23	46.4000	46.4000	232.0000	0.0095
t24	46.4000	46.4000	46.4000	2.8958

---- 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 38.1.0 a1a3b545 Jan 31, 2022   WEX-WEI x86 64bit/MS Windows - 05/13/22 20:37:15 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)	G3(t)	KVET - te~	TC - teplo	Ec(t)	Ed(t)	SOC(t)
t1	77.251	117.880		46.400	77.220	320.454	300.714	19.740	155.770	260.000	46.400		88.160
t2	69.939	117.880		46.400	70.200	320.454	300.714	19.740	155.770	260.000	46.400		129.920
t3	17.949	117.880			66.690	320.454	300.714	19.740	155.770	260.000			129.920
t4	17.949	117.880			66.690	320.454	300.714	19.740	155.770	260.000			129.920
t5	39.430	117.880		20.622	66.690	320.454	300.714	19.740	155.770	260.000	20.622		148.480

t6	84.564	117.880		46.400	84.240	320.454	300.714	19.740	155.770	260.000	46.400	190.240
t7	61.241	117.880	0.560		108.810	320.454	300.714	19.740	155.770	260.000		190.240
t8	65.043	117.880	3.930		115.830	320.454	300.714	19.740	155.770	260.000		190.240
t9	40.459	117.880	27.530		115.830	320.454	300.714	19.740	155.770	260.000		190.240
t10	34.751	117.880	47.050		129.870	320.454	300.714	19.740	155.770	260.000		190.240
t11	82.084	117.880	62.050	46.400	143.910	320.454	300.714	19.740	155.770	260.000	46.400	232.000
t12		117.880	71.800		147.420	320.454	300.714	19.740	155.770	260.000	26.161	202.932
t13		117.880	66.560		143.910	320.454	300.714	19.740	155.770	260.000	27.891	171.942
t14	0.022	117.880	51.540		147.420	320.454	300.714	19.740	155.770	260.000	46.400	120.387
t15	65.564	117.880	31.510		143.910	320.454	300.714	19.740	155.770	260.000		120.387
t16	130.569	117.880	0.320	31.215	143.910	320.454	300.714	19.740	155.770	260.000	31.215	148.480
t17	168.657	117.880		46.400	164.970	320.454	300.714	19.740	155.770	260.000	46.400	190.240
t18	201.564	117.880		46.400	196.560	320.454	300.714	19.740	155.770	260.000	46.400	232.000
t19	131.543	117.880			203.580	320.454	300.714	19.740	155.770	260.000	27.840	201.067
t20	97.584	117.880			189.540	320.454	300.714	19.740	155.770	260.000	46.400	149.511
t21	82.959	117.880			175.500	320.454	300.714	19.740	155.770	260.000	46.400	97.956
t22	105.699	117.880			150.930	320.454	300.714	19.740	155.770	260.000		97.956
t23	31.772	117.880			126.360	320.454	300.714	19.740	155.770	260.000	46.400	46.400
t24	50.855	117.880			98.280	320.454	300.714	19.740	155.770	260.000		46.400

EXECUTION TIME   =   0.453 SECONDS   4 MB 38.1.0 a1a3b545 WEX-WEI

**** FILE SUMMARY

Input   E:\DP\GAMS\Varianta_3.gms
Output   E:\DP\GAMS\Varianta_3.lst