Challenge EDF- 2010 EURO-ROADEF

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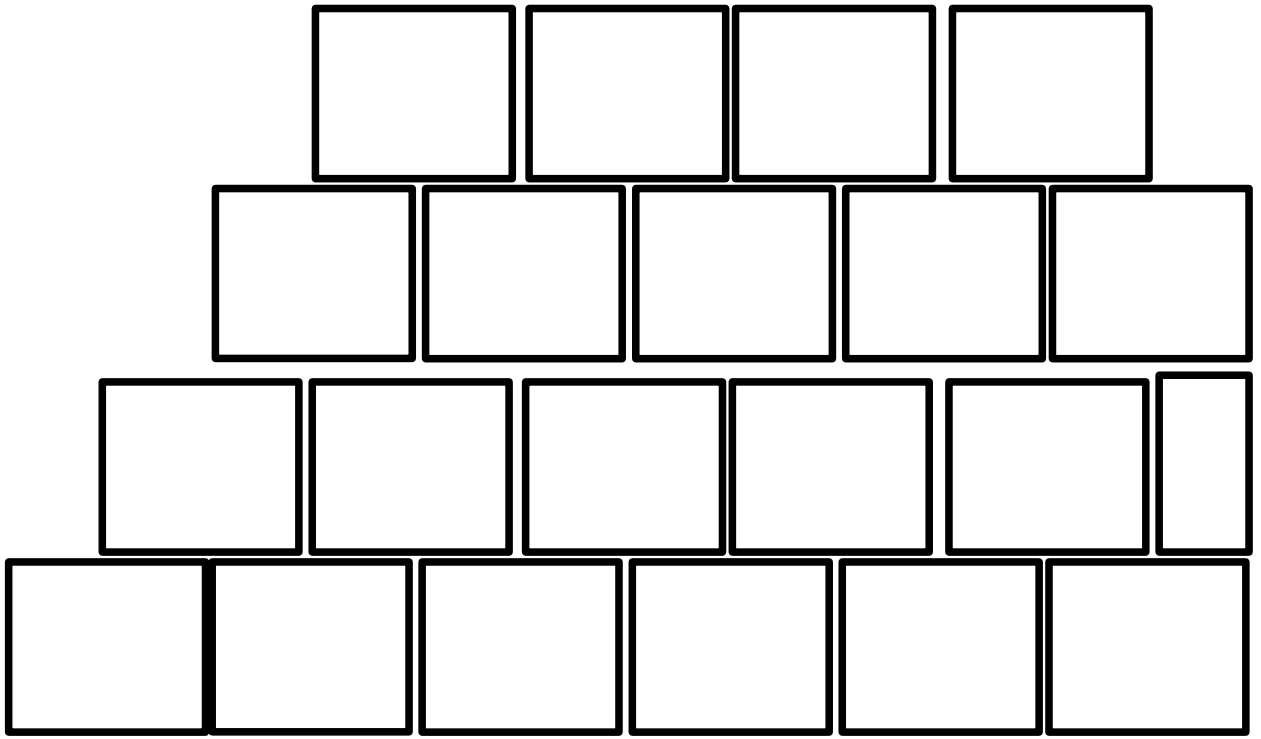
From the moon...

Scheduler : Dates of outages ha(i,k)

Refueler : Volumes fo refuels R(i,k)

Power assigner : on each plant for each (i,t,s)

Scheduler : The large stones first...



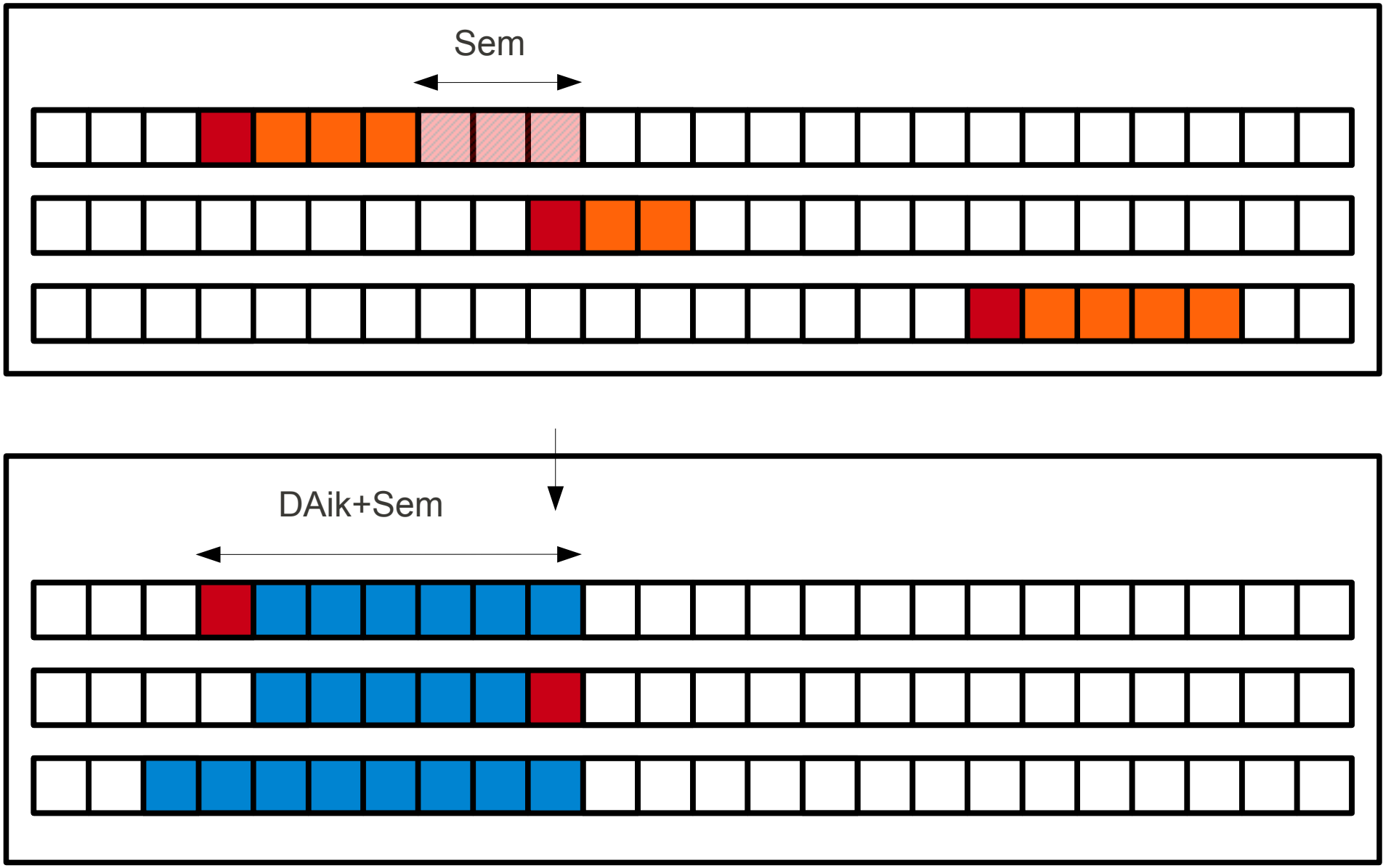
Scheduler

- Output : dates of outages
- ILP with binary variables X(i,k,h)
- Constraints CT[13-21] : exactly (packing)

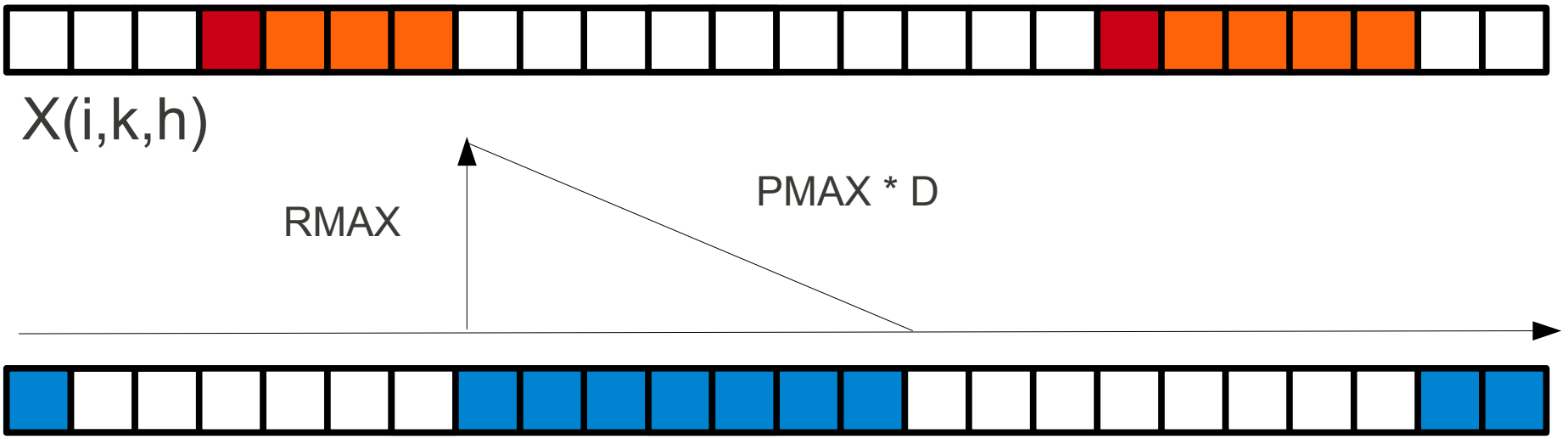
- Constraint CT11 : heuristically
  (on tuples (i,k1,h1,k2) only via minimal distances)

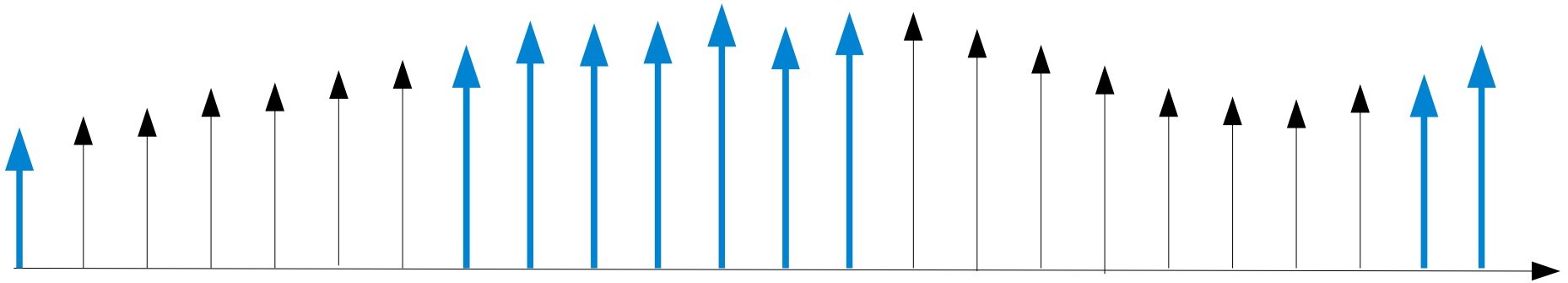
- Auxiliary variables P(i,h) for power
- Objective function : Σ dem(h) P(i,h)

Packing CT14



Variables P(i,h)

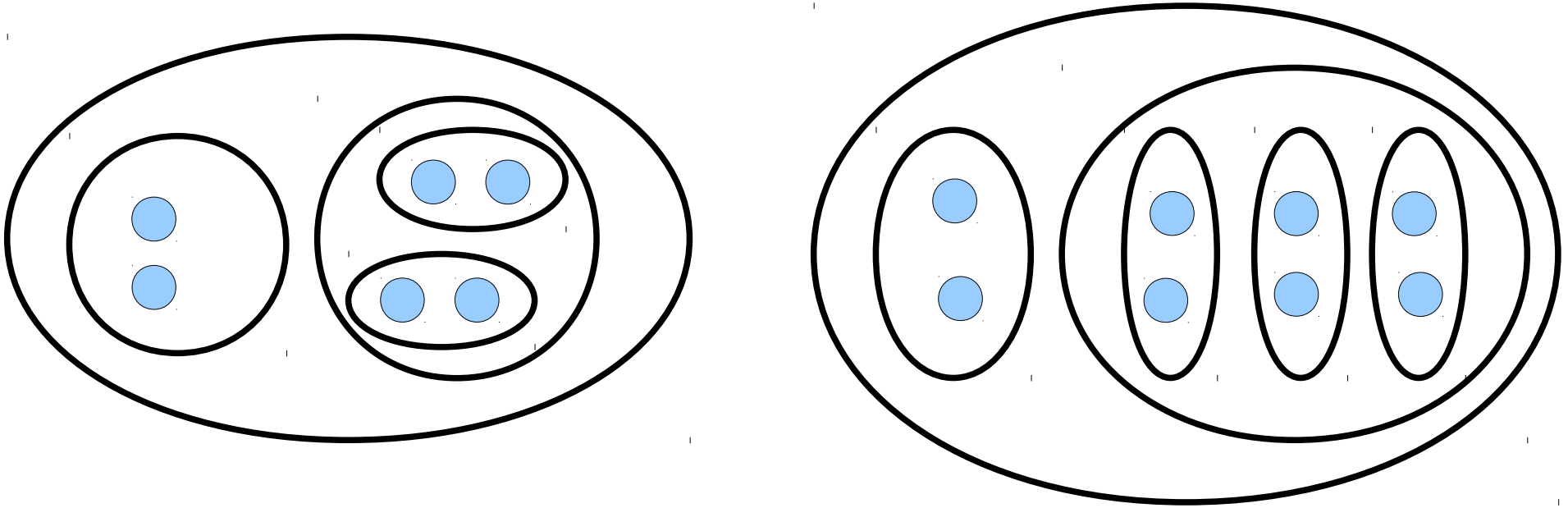




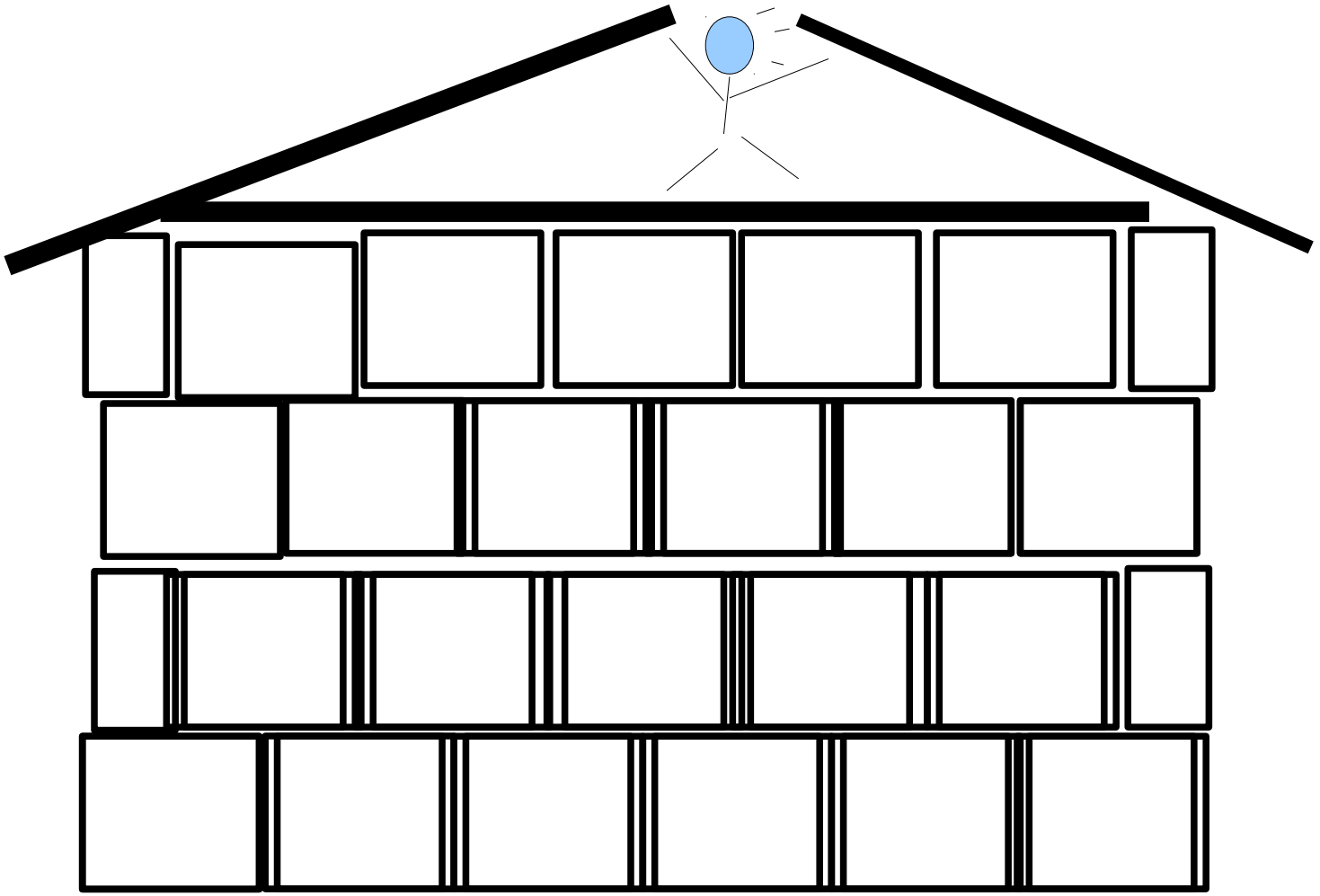
Rescheduler

- Given outages, supposing min refuels and no modulation, check CT11 (AMAX, SMAX).
- If no violation, ok.
- Otherwise, we use all violations to increase minimal distances between outages, and relaunch scheduler.

Using laminar structure of constraints to boost (re)schedule

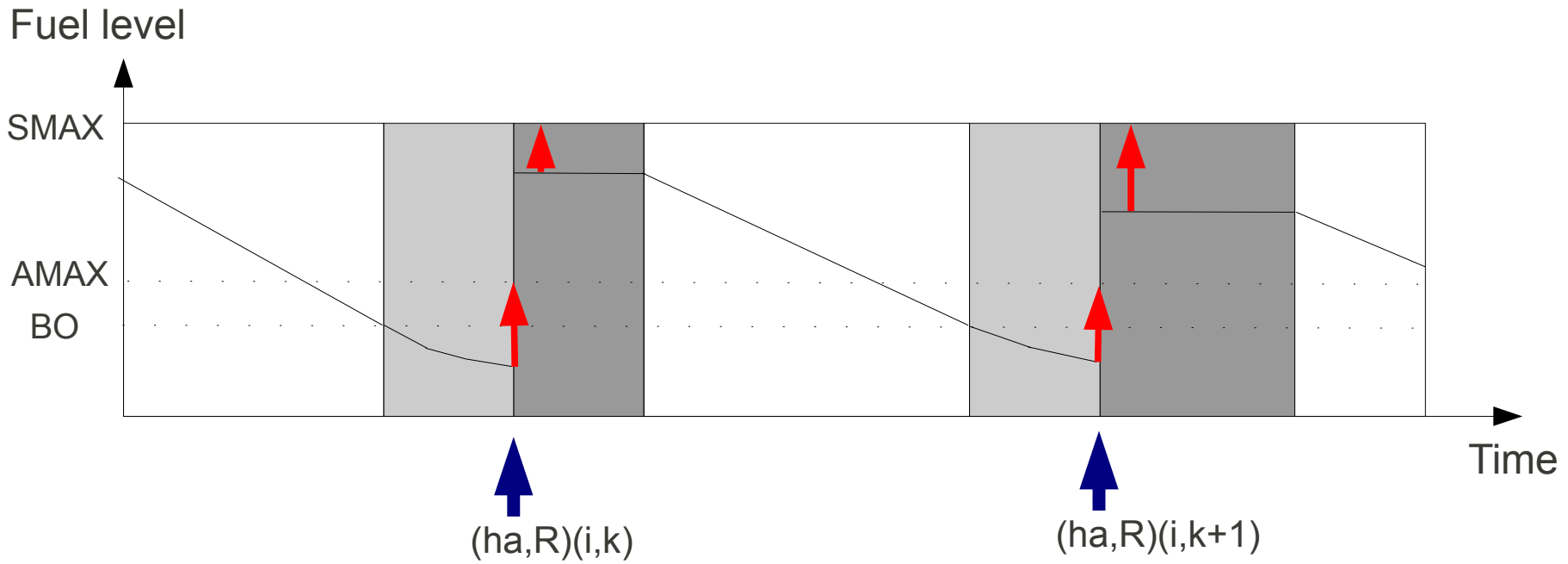


Power checker:
Getting secured fast...



Nuclear plant without demand

Input : Dates of outages ha(i,k) and volumes of refuel R(i,k)
Output : Gaps from fuel values to Amax and Smax



Type 2 => temporal greedy with forward security

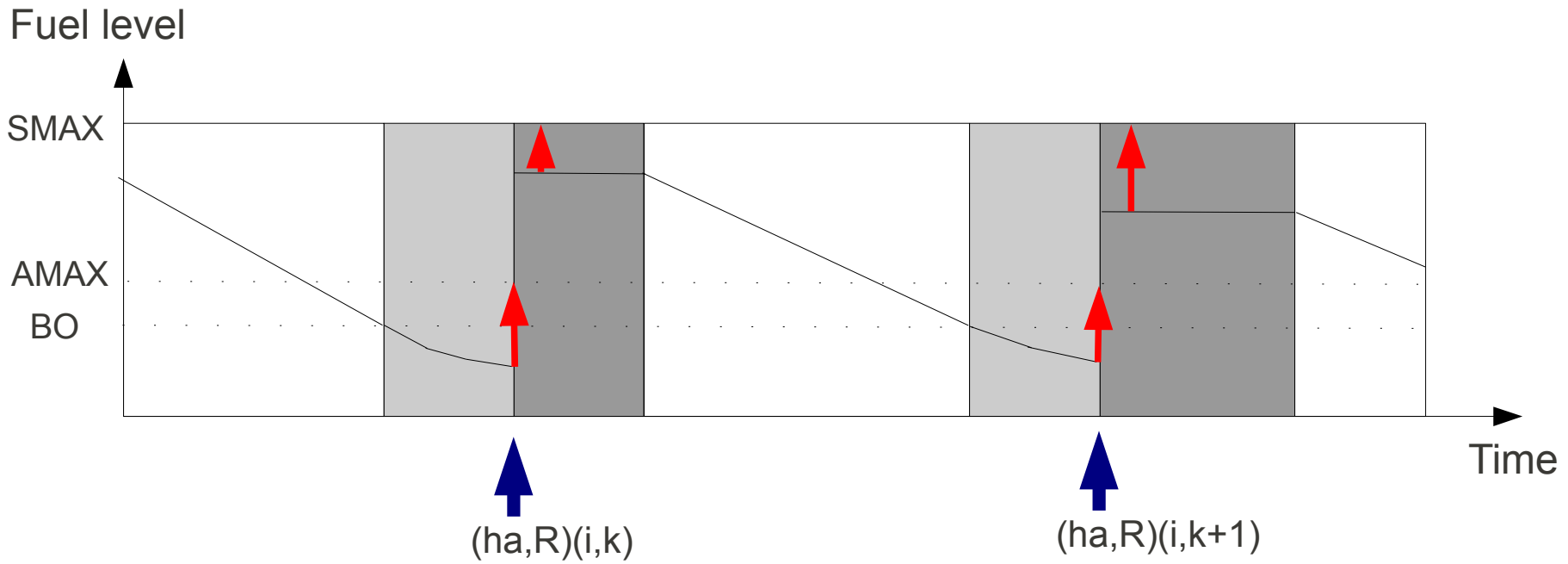
For each scenario,

For t from 0 to T

- If (Dem(t,s) >= Nuclear available)
  - Don't use modulation
- Else
  - Use modulation on plant with « largest gaps » first.

Plant modulation (with demand)

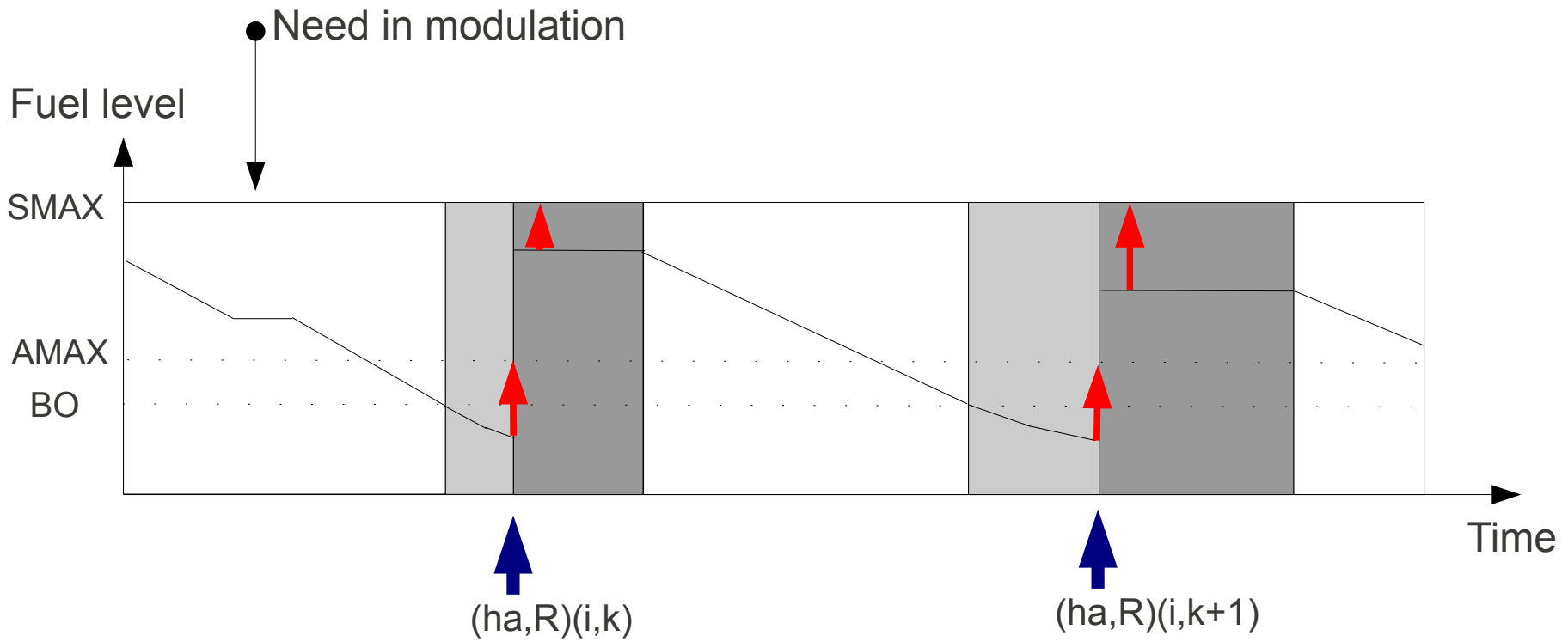
Input : Dates of outages ha(i,k) and volumes of refuel R(i,k)
In-Output : Gaps from fuel values to Amax and Smax



Real effect of modulation

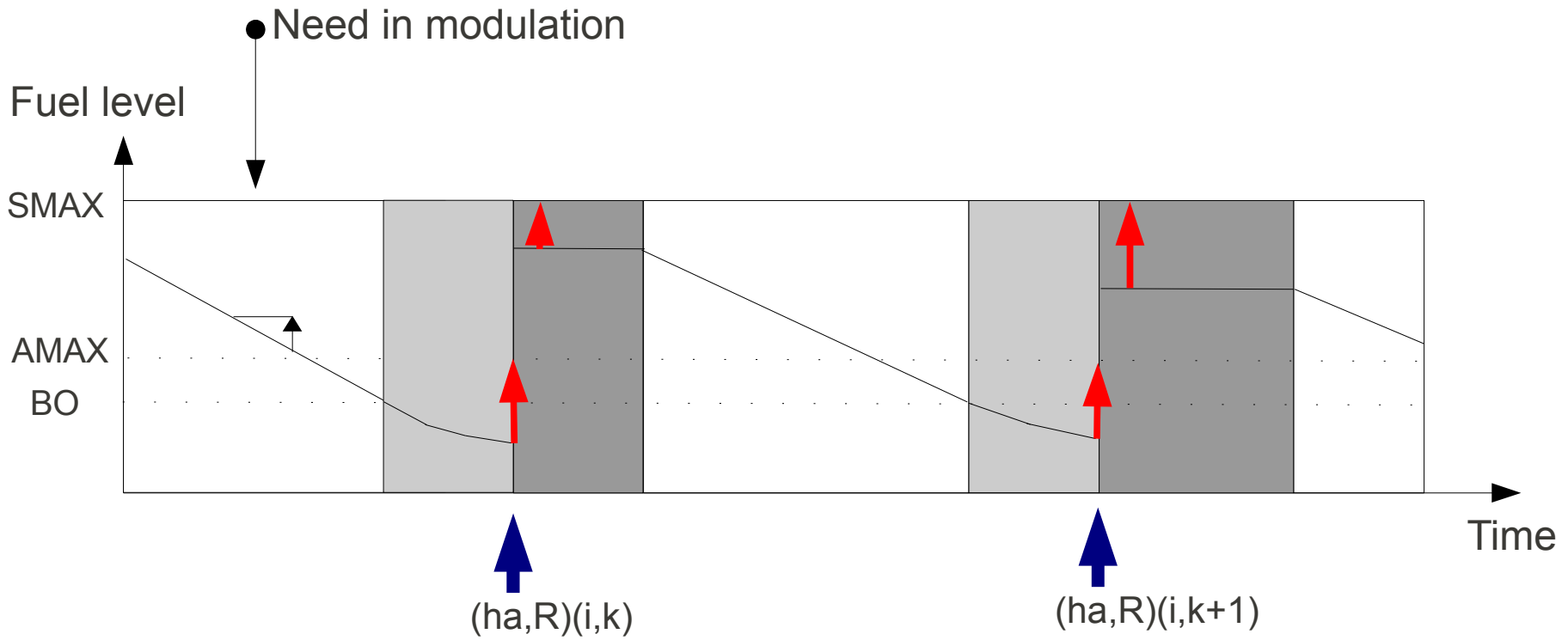
Input : Dates of outages ha(i,k) and volumes of refuel R(i,k)

In-Output : Gaps from fuel values to Amax and Smax



Fast over-approx of modulation

Input : Dates of outages ha(i,k) and volumes of refuel R(i,k)
In-Output : Gaps from fuel values to Amax and Smax



Fast over-approx of modulation

Input : Dates of outages ha(i,k) and volumes of refuel R(i,k)
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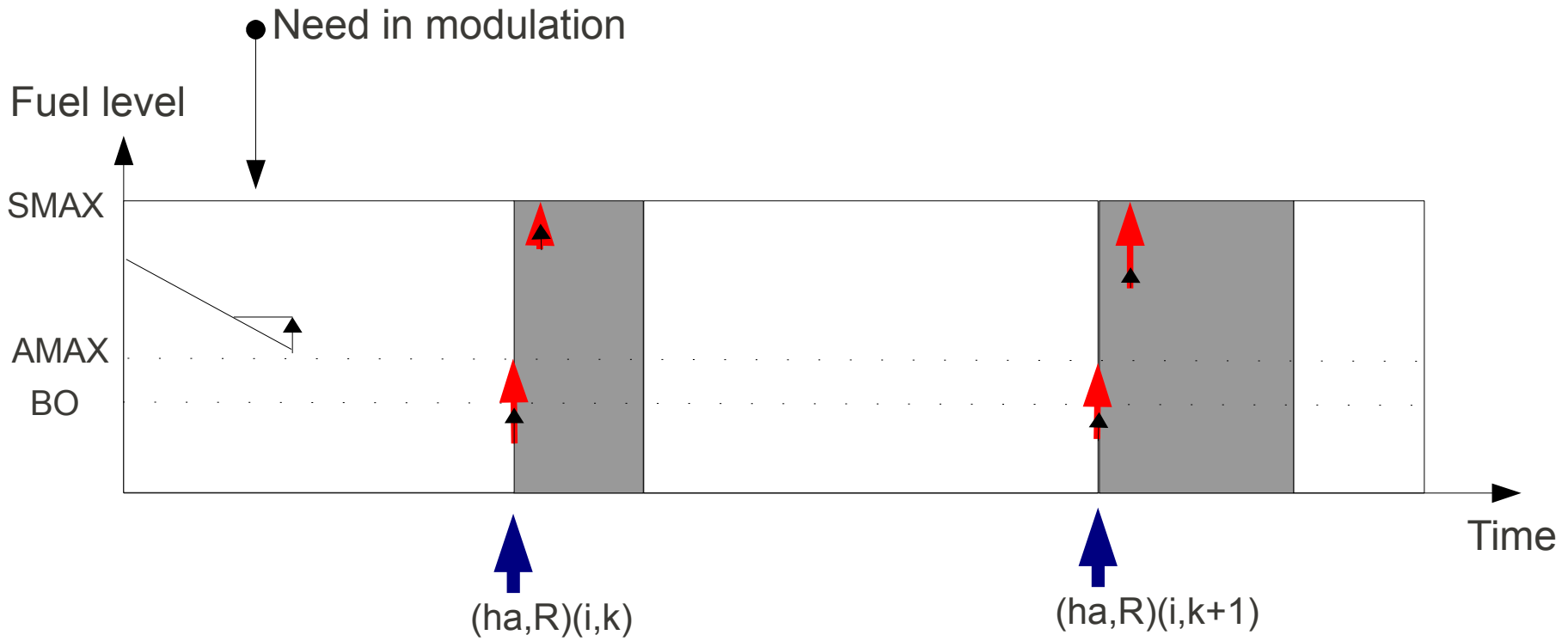

Fast over-approx of modulation

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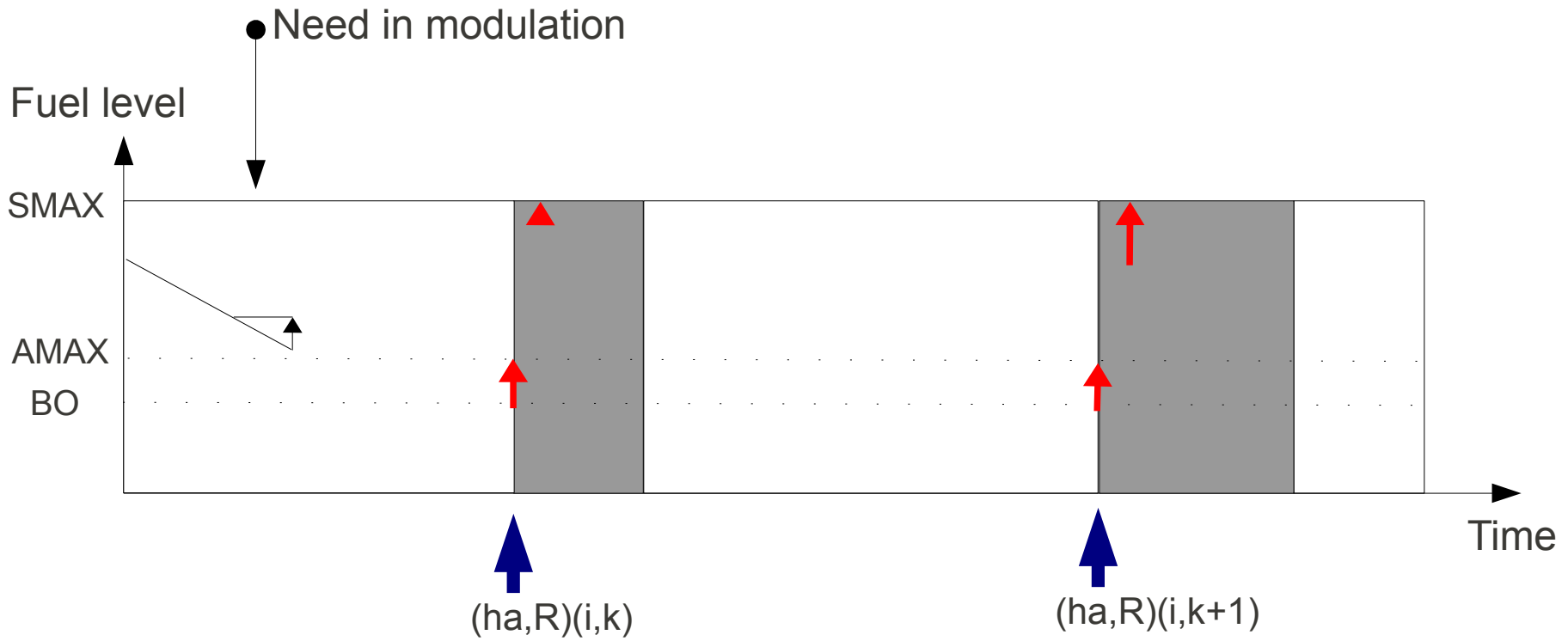
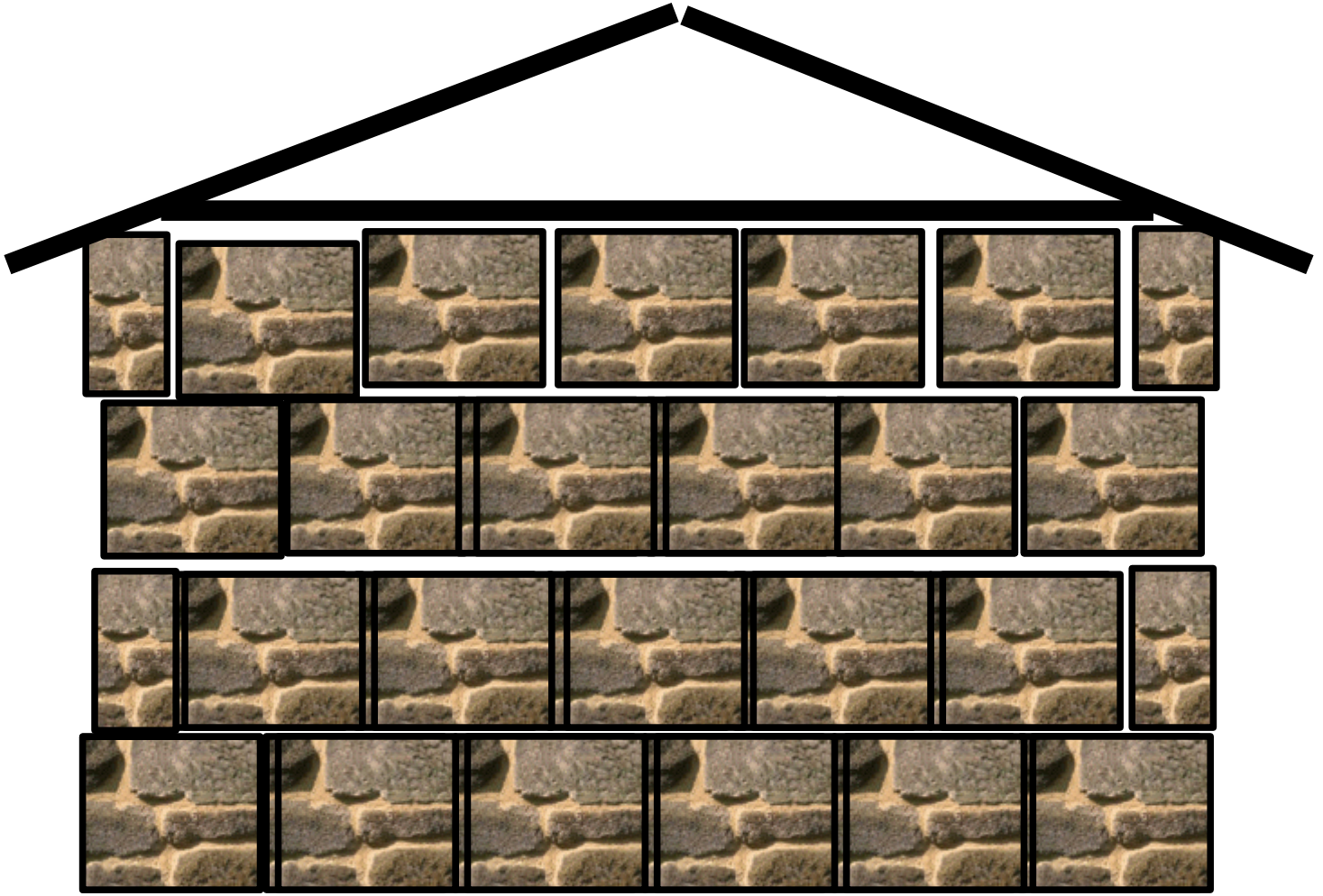
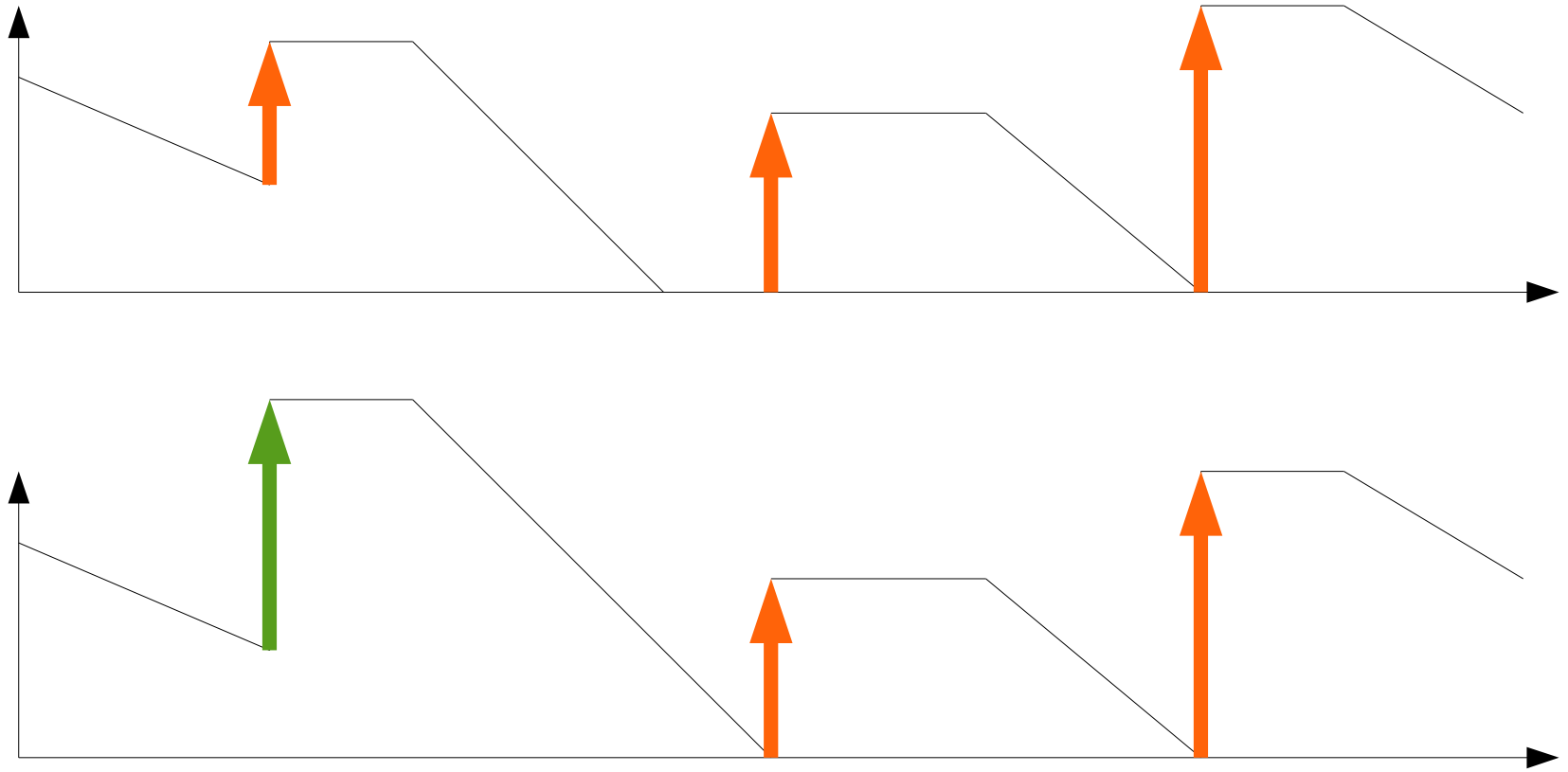


Refueler : Filling the picture fast...
...without overflowing



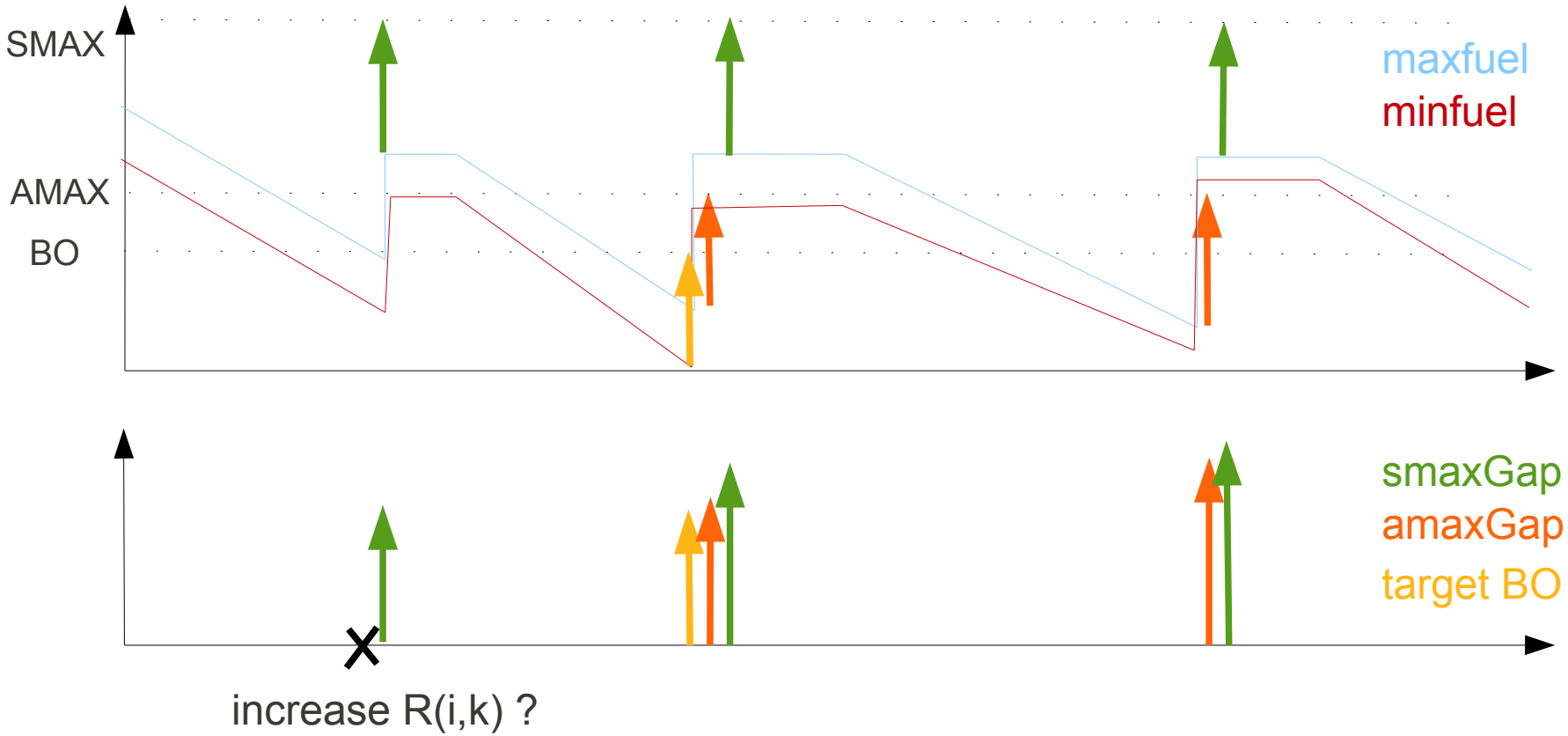
« Boucher les ptits trous »

Without demand

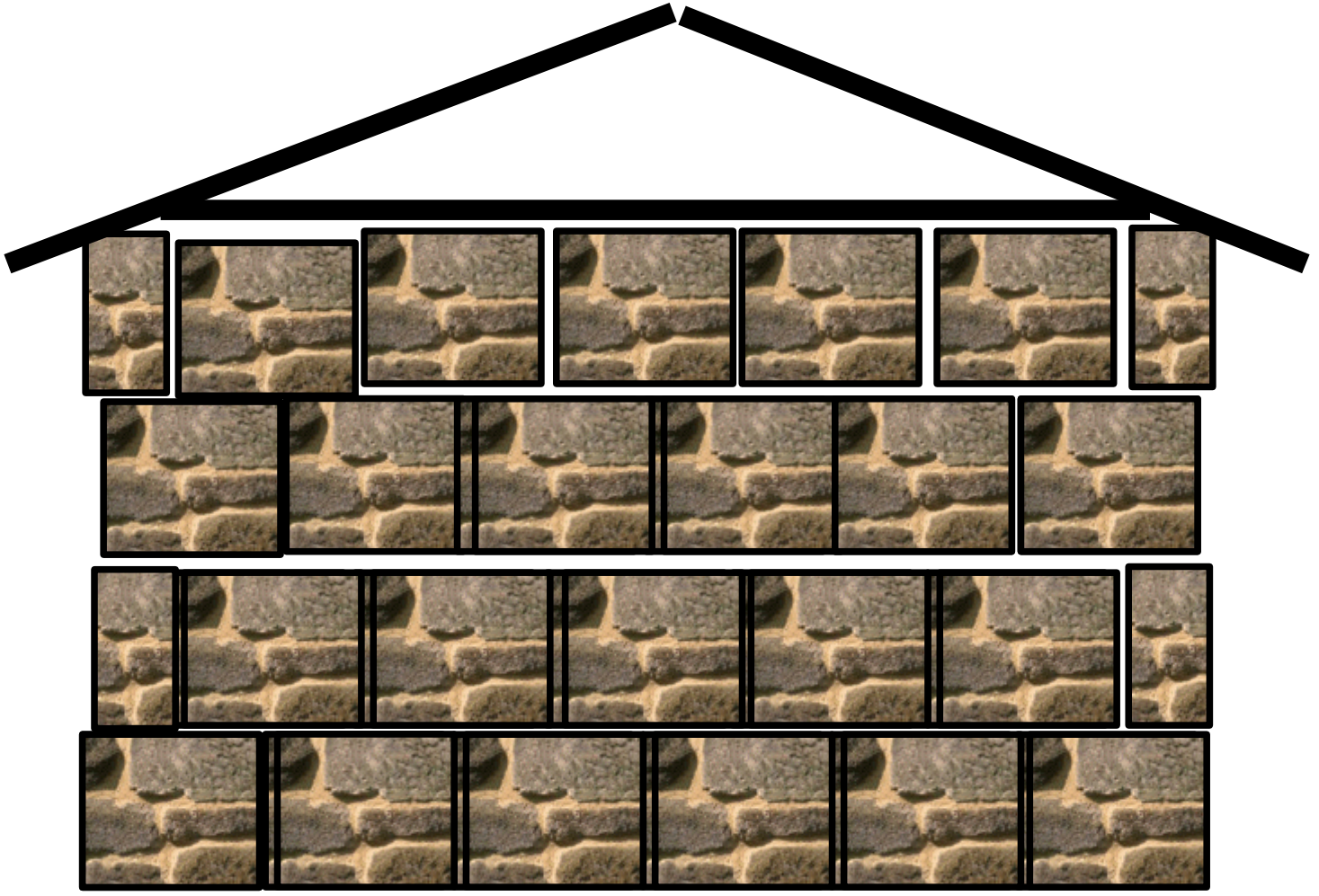


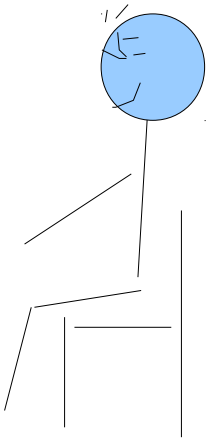
Increase Refuelings

- amax smax (with maxfuel)
- target BO (with minfuel)



Power assigner : enjoying the fruits





Type 1 => pre and post-treatment

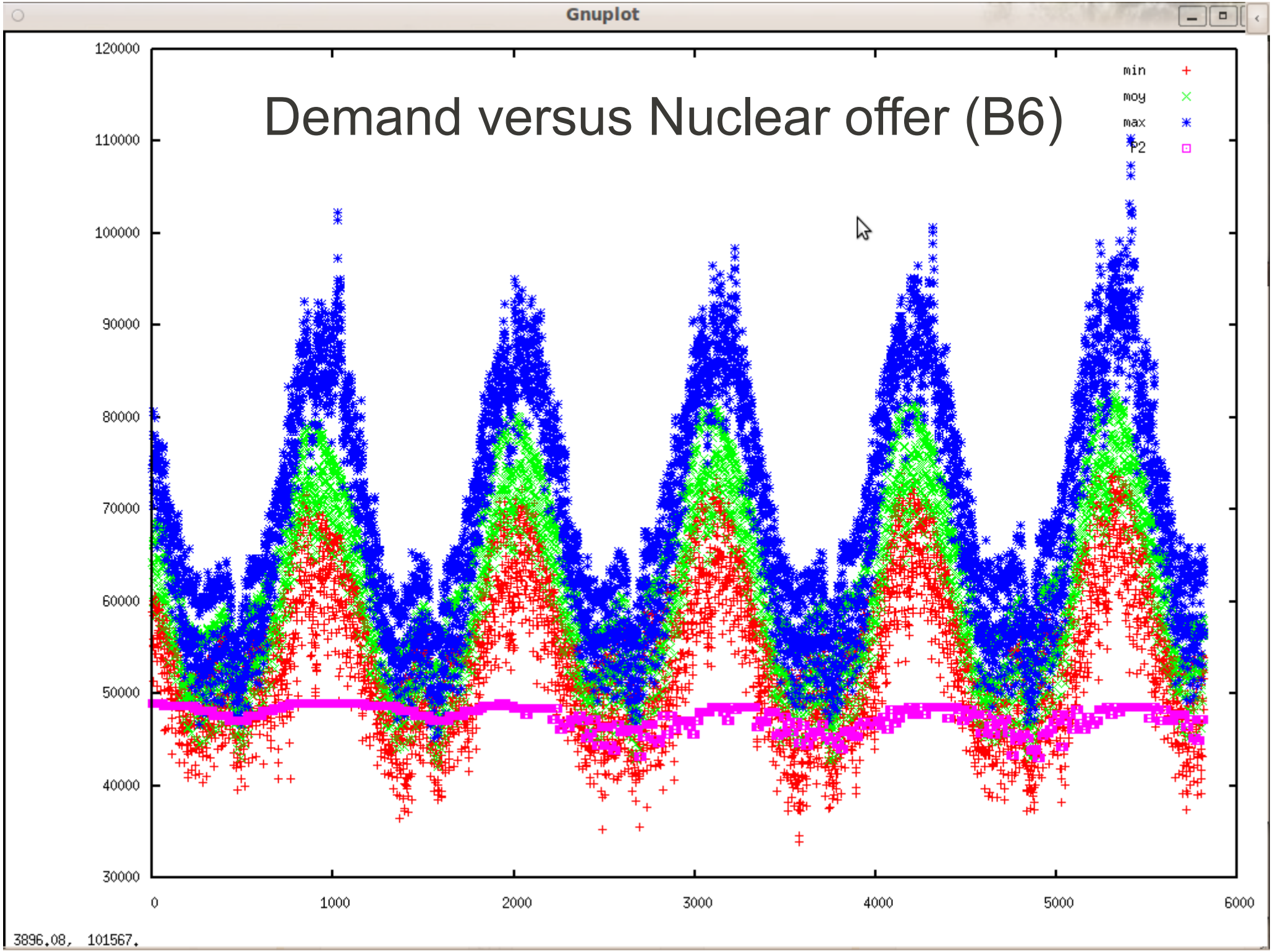
- Pmax, Dem, Pmin -= Pmin; // for all j,t,s.
- Sort plants by cost ; // for all t,s.

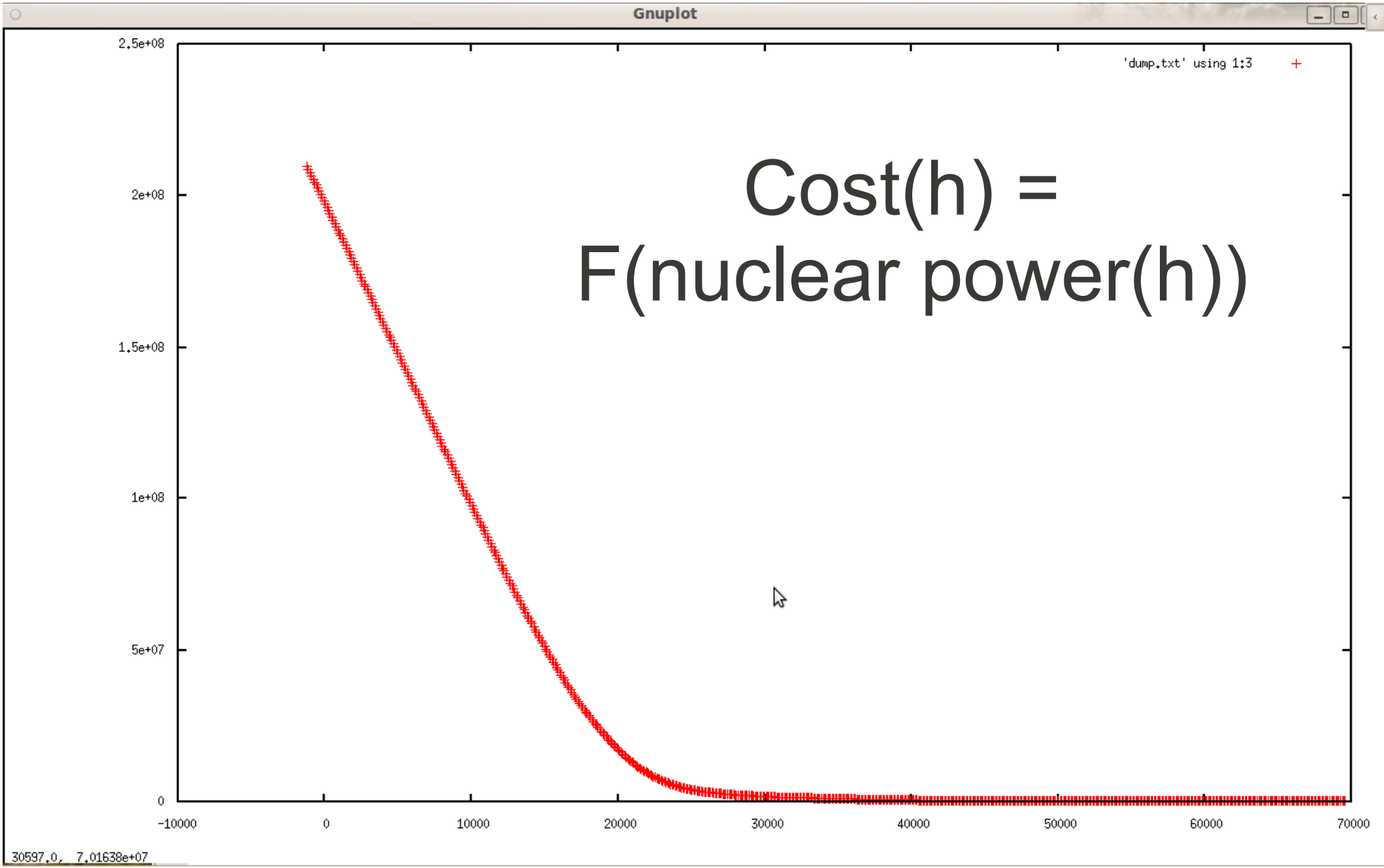
- When power of plants 2 has been assigned, complete demand greedily.

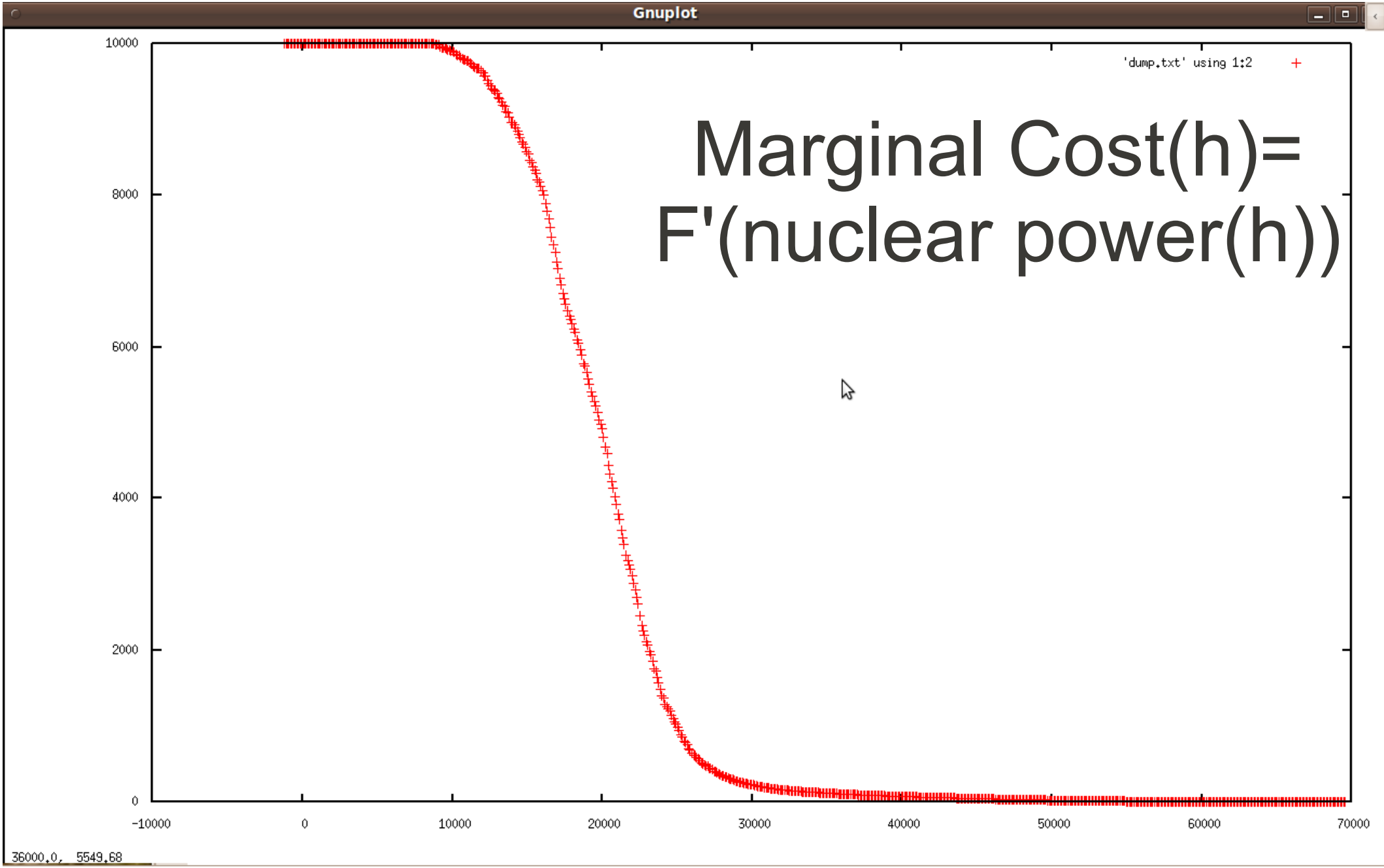
- Is optimal except when

  ((cost(j,t,s) ~< 20) AND (Dem(t,s) < Σ_i P(i,t)))

Analysis of demand and cost


Gnuplot
Demand versus Nuclear offer (B6)
min
moy
max
P2
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
0
1000
2000
3000
4000
5000
6000
3896.08, 101567.


Gnuplot
'dump.txt' using 1:3
2.5e+08
2e+08
1.5e+08
1e+08
5e+07
0
-10000
0
10000
20000
30000
40000
50000
60000
70000
30597.0, 7.01638e+07
Cost(h) =
F(nuclear power(h))


Gnuplot
'dump.txt' using 1:2
Marginal Cost(h)=
F'(nuclear power(h))
10000
8000
6000
4000
2000
0
-10000
0
10000
20000
30000
40000
50000
60000
70000
36000.0, 5549.68

Marginal cost = F'(h, nuclear power(h))