

Is nuclear power a threat to
security off supply?

Background

- Nuclear is the dominated contributor to base load generation and the share is increasing
 - 5th reactor in Finland, possibly more
 - Increased capacity in present Swedish reactors
 - Expected better performance of Swedish reactors
 - Discussions to build new capacity in Sweden
- Similar design implies that a security issue common for many plants can lead to major reduction of generation for a longer period

Case study

9 nuclear reactors stopped in Sweden and Finland

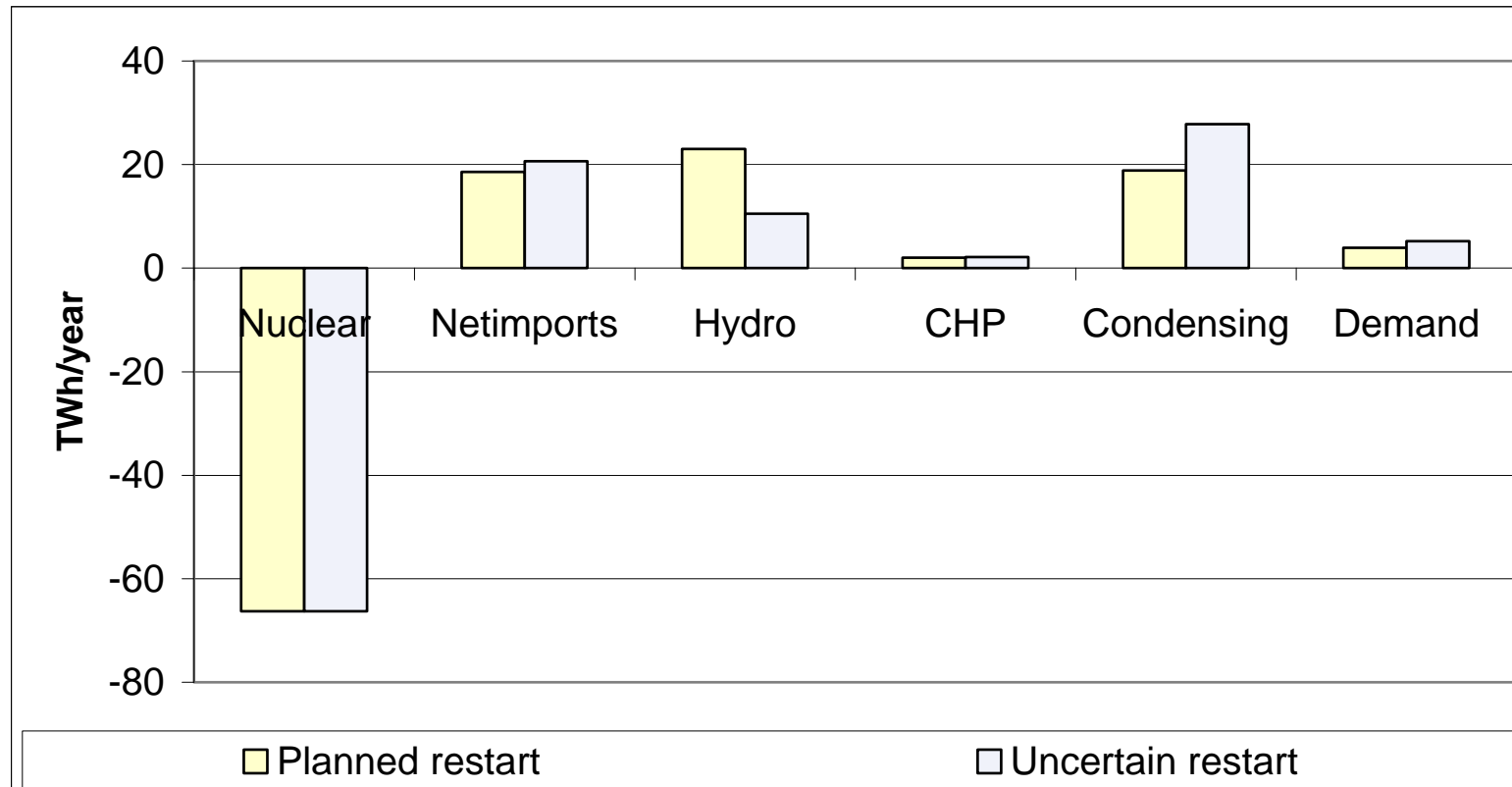
Reactors stopped for one year due to a common security problem

=> Nuclear production outage 66 TWh

(in comparison: dry year roughly
-30 TWh from normal year)

PoMo and EMM model simulations for 2010

PoMo results

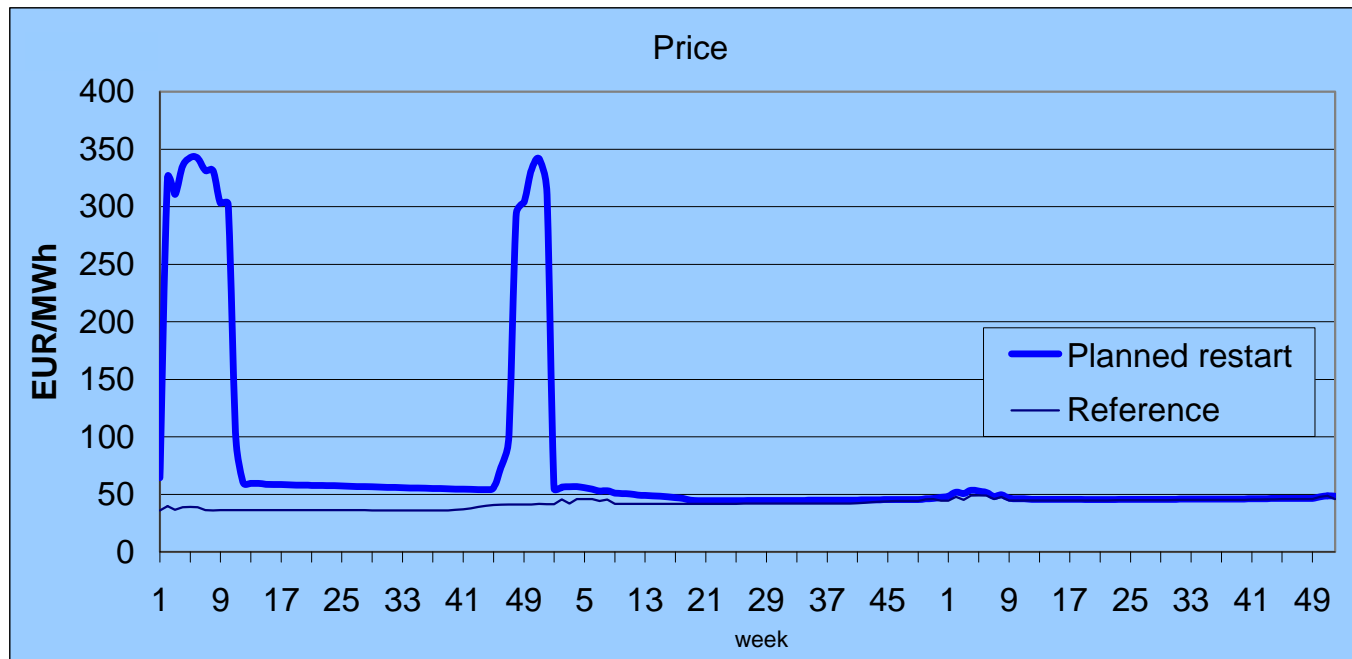


Planned restart:
The actors know the reactors will start after one year.

Uncertain start:
The actors don't know when the restart will be.

* DEMAND = The electricity intensive industry will reduce its consumption at high prices (4-5 TWh)

High prices during winter weeks



EMM: Production changes similar to PoMo

(here unplanned restart)

+ 39 TWh condensing power production

+ 26 TWh change in trade

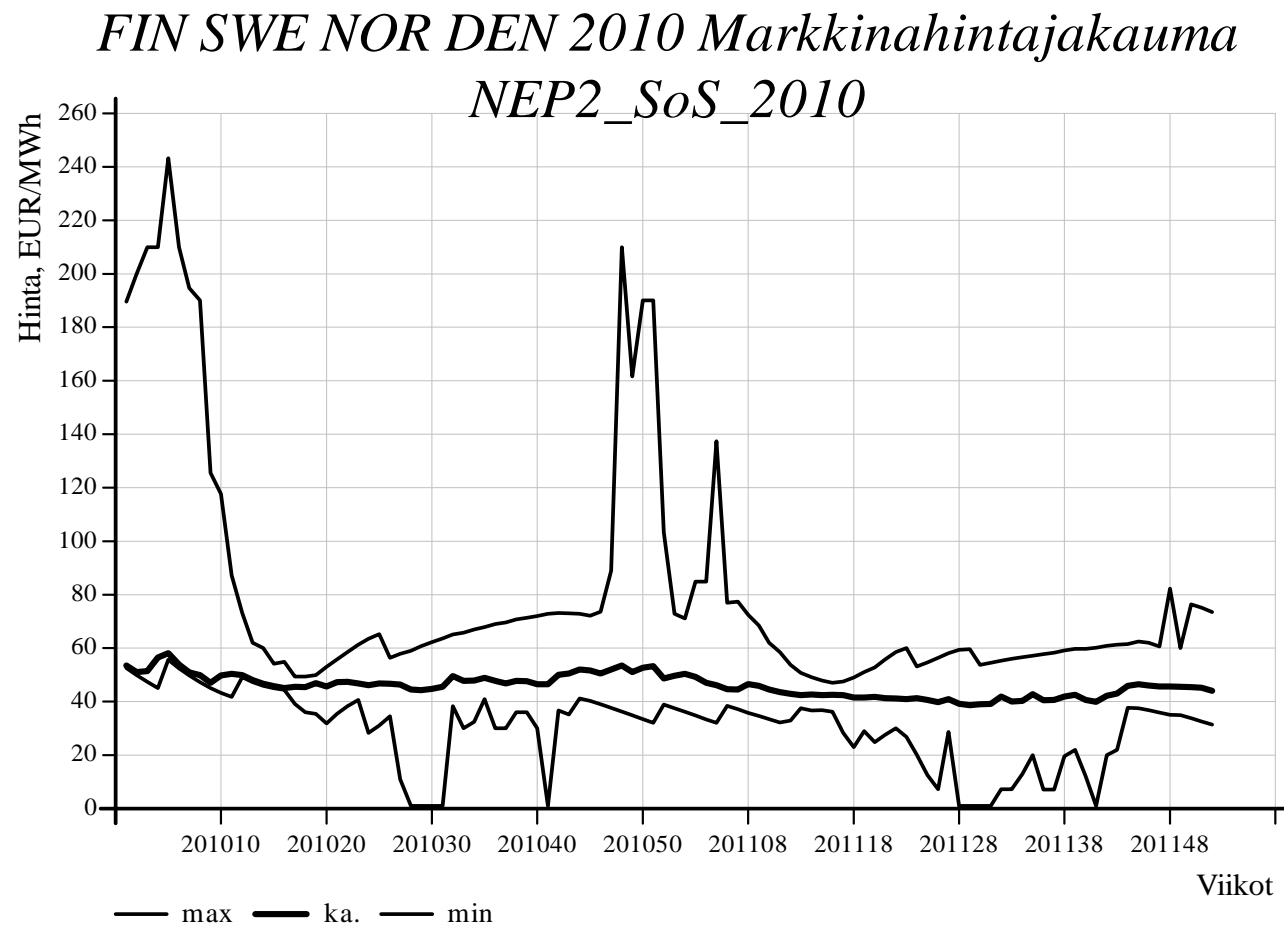
- 23 TWh net export in reference case
- 3 TWh net import in nuclear outage case
 - and there is room for more imports

But no change in demand with same price elasticity as
in PoMo!

(where 4-5 TWh dropped out)

System price for planned restart

(Weekly minimum, average and maximum prices)



- Price doesn't go anywhere near 290 €/MWh (start of demand flex)

- Average price shows only a "small" reaction:

- 40 €/MWh reference

- 49 €/MWh planned restart

- 55 €/MWh uncertain restart

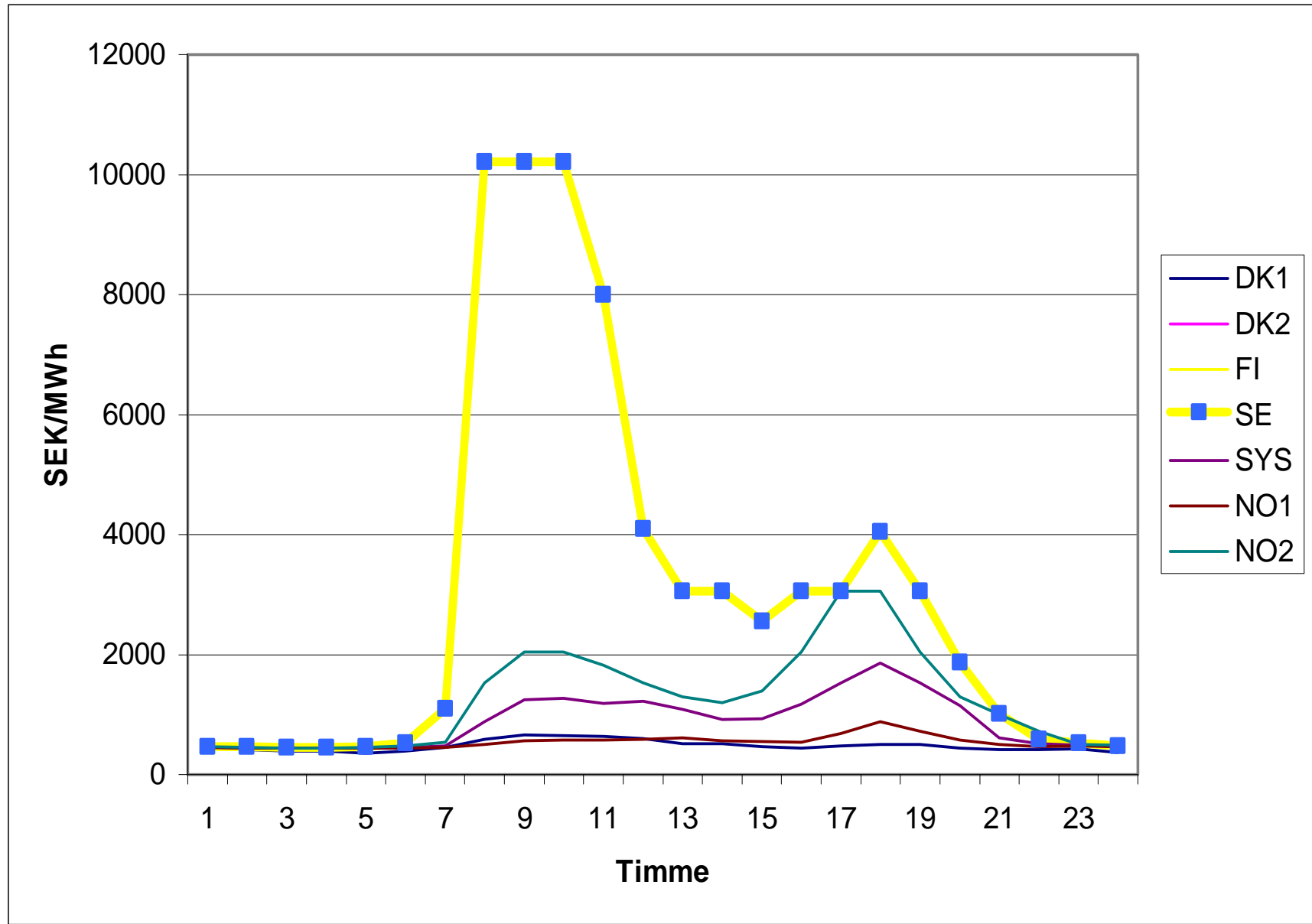
Interpretation of model results

PoMo and EMM are models for market price calculations and no grid models,

- transmission system congestions inside the market area are not taken into account at all
- grid operation and import/export possibilities will be very different in reality due to system operation issues etc.

Generation and import will probably be sufficient to meet the average weekly demand but will it be sufficient considering peak load and internal transmission constrains?

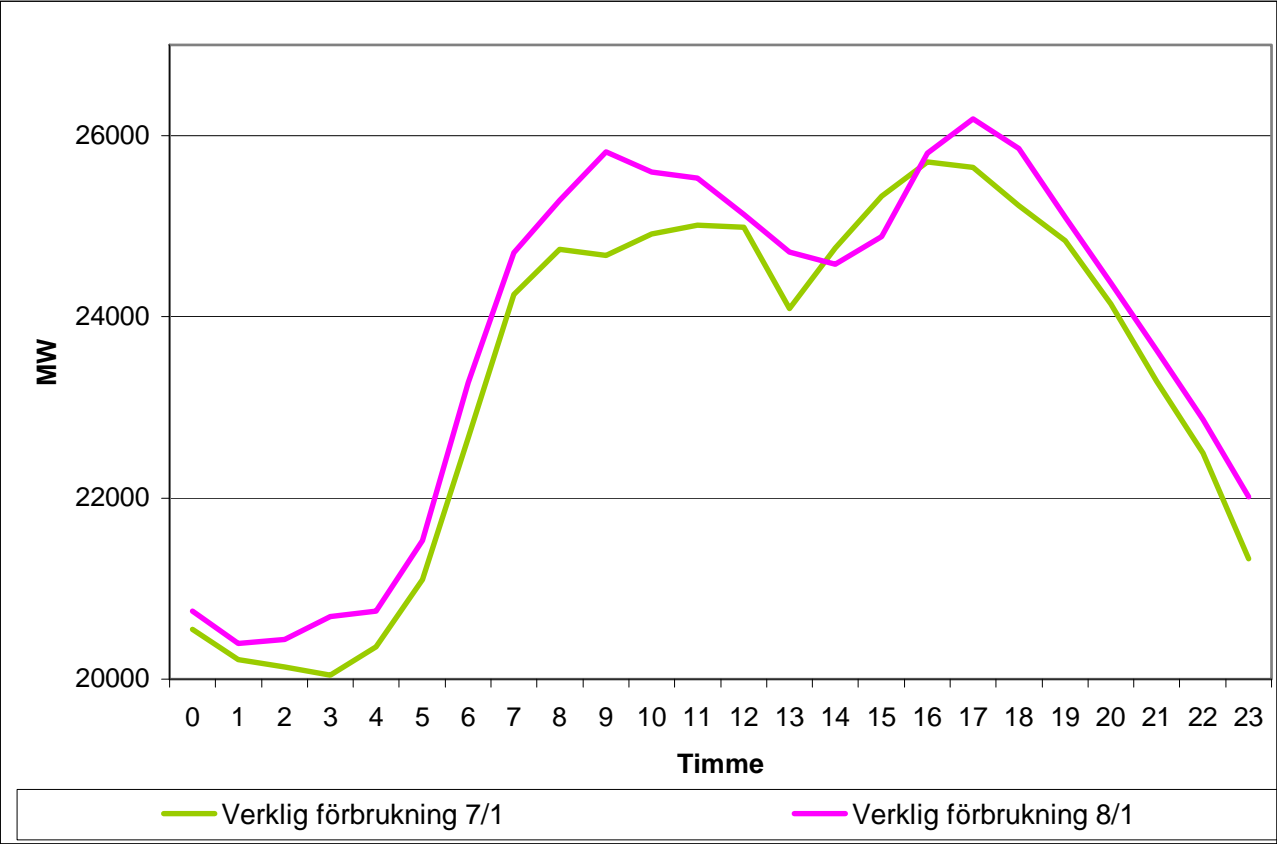
Example from January 8 2010 illustrates the difficulties.



What caused the price peaks?

- Nuclear production in Sweden was reduced with about 3400 MW
 - R1 and R2 was out du to delayed planned restart after large upgrading
 - O3 and F2 had test running with 24% resp 55% of the capacity
- Two main reasons for reduced capacity
 - Many reactors are undergoing programs to increase capacity, extend life time and increase security. These jobs has proven to be more complicated than predicted. Planned restarts has been delayed a number of times this winter
 - The safety authority has been very critical to some of the companies. Ringhals has been put under special surveillance. There is no room for more mistakes.

The temperatures in Sweden were at least 10 degrees lower than normal except in Lapland, but the demand was not extreme



Three hours price spike in Sweden, Finland and Sealand

- ❑ The commercial bids came from reduction in Finnish industry – 1000 EUR/MWh
- ❑ Resources from the special capacity reserve in Sweden and Finland was used in NordPool
 - 140 MW was accepted at Elspot
 - Mostly in Finland
 - It didn't effect the spot price

Svenska Kraftnät used the special capacity reserve to stabilize the grid

- Due to problems in the Swedish grid 1080 MW of generation from the reserve (1166 MW is contracted) was activated
 - The aim was to be able to allow for export from the northern part of Sweden to the south without violating the security limits
- This production increase implied down regulation during the price peak aprox. 1400 MW