

# Modelling of planned and forced outages in TIMES

## Outline of presentation

- Introduction/objective
  - Why and when is capacity de-rating for power generation expansion planning not always adequate?
- Methodology:
  - How forced and planned outages are simulated
- Results
  - Comparisons of expansion plans using simulation and capacity de-rating approximation
- Conclusions

# Introduction

Common approaches for accounting for outages in the TIMES/MARKAL framework:

- Planned outage: Capacity de-ration using availability parameter
- Forced outage: Capacity de-ration or reserve margin

Assumes:

- a) A high number of power plants
- b) Unlimited power transfer

Objective:

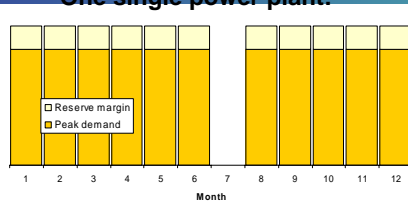
- Show that this approach is not suitable in all cases
- Attempt to quantify the error
- Provide a possible solution applicable to TIMES/MARKAL

# Principle:

Capacity de-ration:

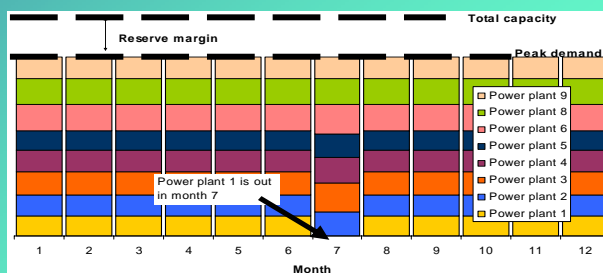
If plant is out for maintenance for 1 out of 12 time periods, set AVAILABILTY parameter to 11/12

**One single power plant:**



In the case of one power plant: however high the reserve margin, demand will not be met when plant is out.

**8 power plants:**



With more power plants to supply the demand, the outage of one power plant is no problem

# Our attempt to simulate forced and planned outages

26 time slices ~ two 2-week long outages:

- One planned (in the same time slice each year)
- One forced (in a different time slice randomly selected)

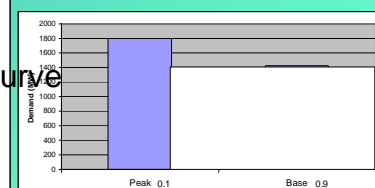
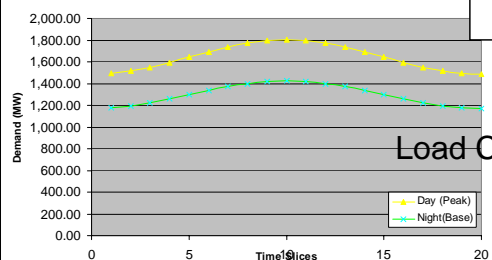
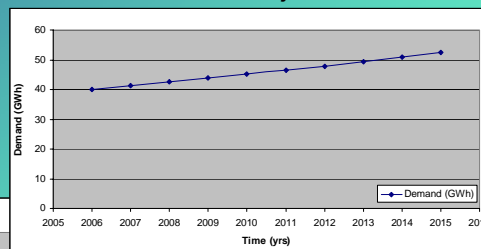
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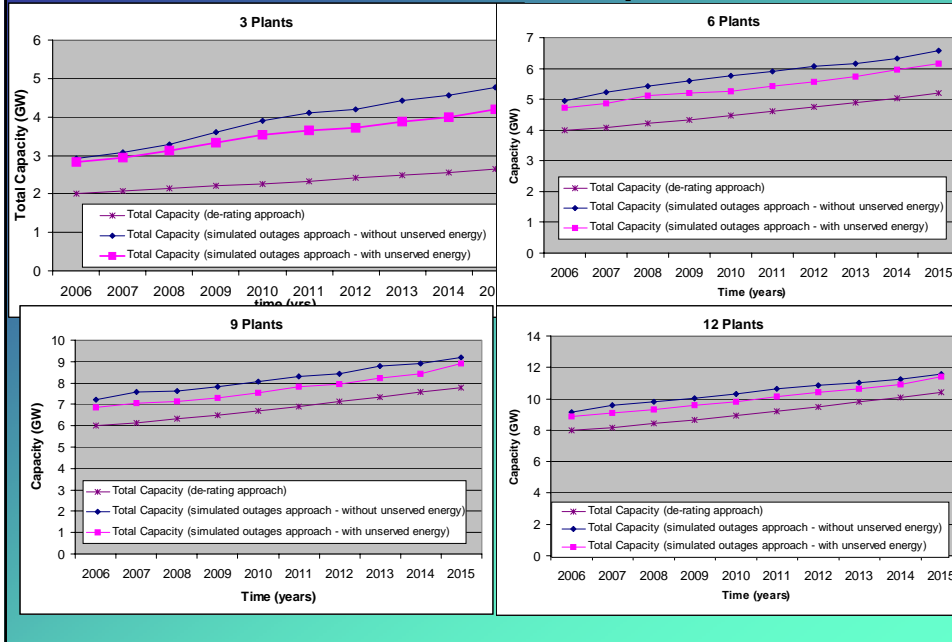
# Case Study - Assumptions

- 3 power plants with similar characteristics

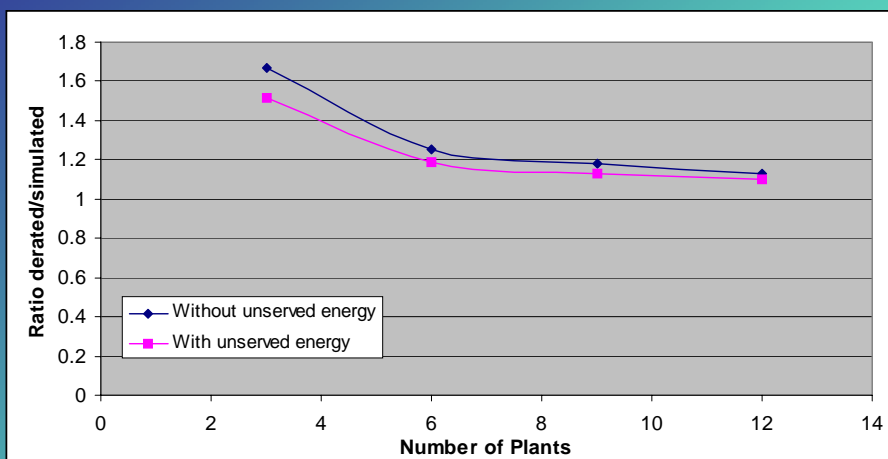
Demand Projection



# Results for 3-12 plants



# Ratio of capacity



## Conclusion

- The de-rating approach was identified as a poor approximation in power systems with few generating units
- An alternative method to approximate the loss of capacity due to outages was presented
- Further experimentation is required to assess this approach, including for e.g. transmission between nodes