Modelling of planned and forced outages in TIMES

Outline of presentation

• Introduction/objective
  – Why and when is capacity de-ration 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-ration 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 AVAILABILITY 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)

Case Study - Assumptions

• 3 power plants with similar characteristics
Results for 3-12 plants

![Graphs showing results for 3-12 plants with different plant capacities and time periods.]

Ratio of capacity

![Graph showing the ratio of capacity with and without unserved energy for different numbers of plants.]

[Image of a graph showing the ratio of capacity with and without unserved energy for different numbers of plants.]
Conclusion

- The de-ration 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.