

Weather Forecasting for Combined Cycle Gas Turbine (CCGT) Power Stations

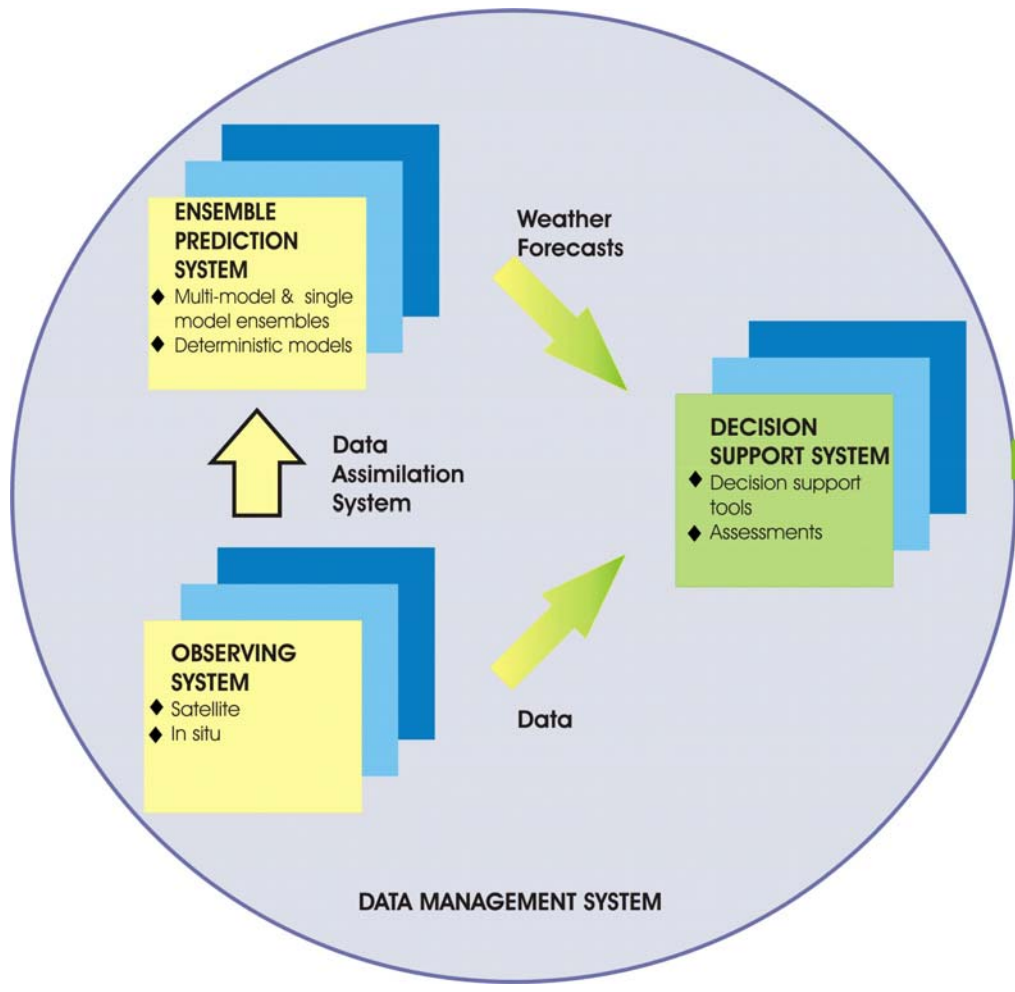
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Context



Identify Decisions That Users Can Make That Can Make a Difference



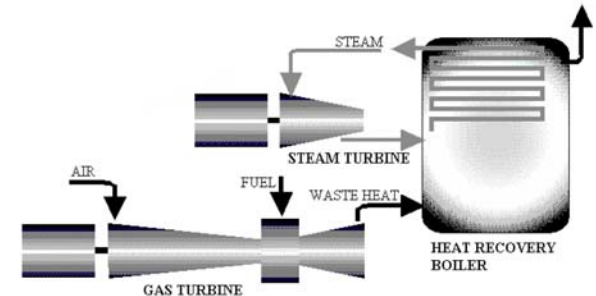
<http://www.wmo.int/thorpex/about.html>

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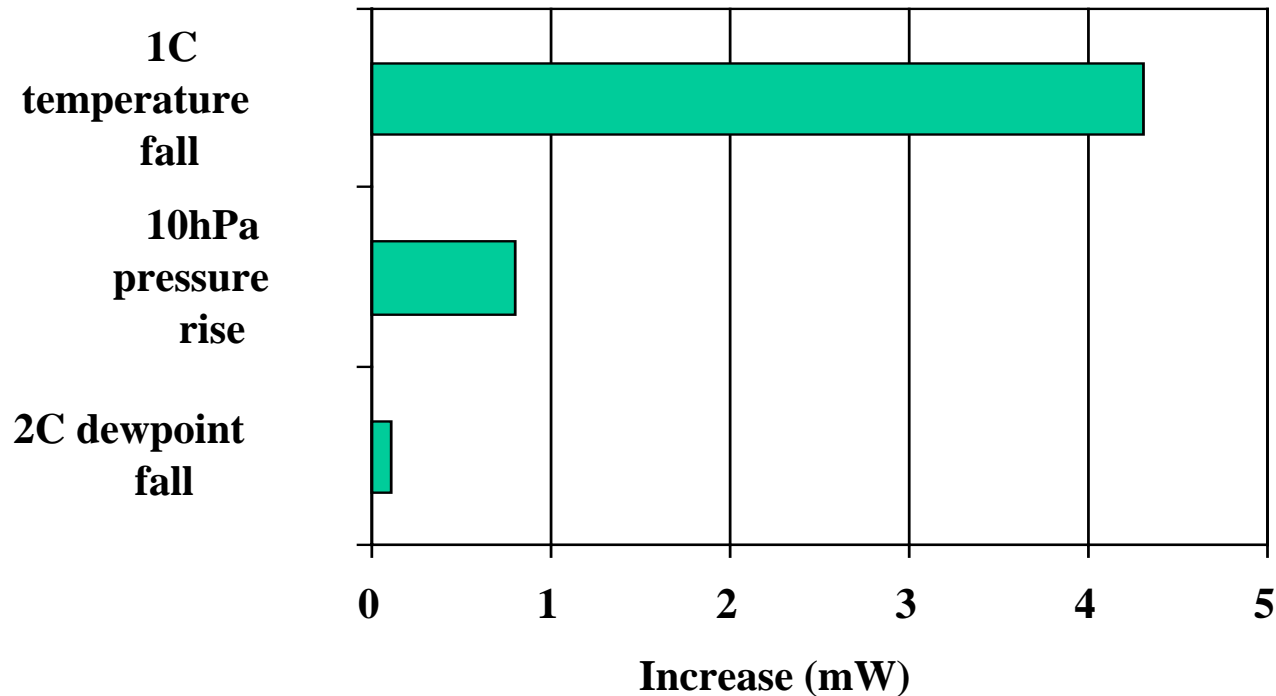
(4) Improve and demonstrate decision support tools, which utilise advanced forecasting products, in the most representative social and economic sectors.

CCGT Decision Making

- ◆ 300 gW of CCGT plants worldwide
- ◆ Burn natural gas to make electric power
- ◆ Maximum power output depends on temperature, pressure and humidity
- ◆ In deregulated market, operator can bid to sell an agreed amount of power “tomorrow”
- ◆ Decision - how many mW to offer?
 - If bid too little, lost opportunity
 - If bid too much, penalised by paying for shortfall at “spot” price

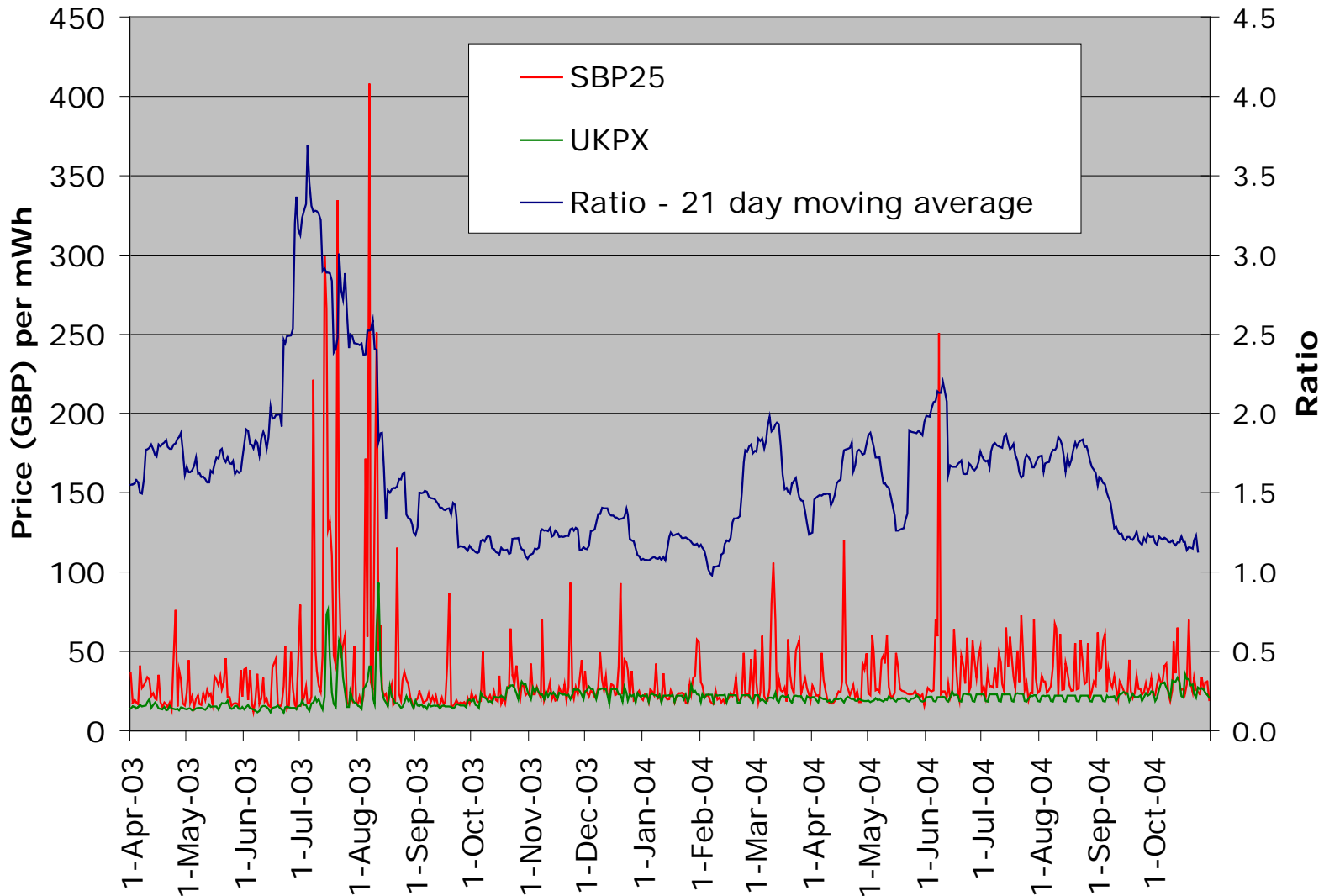


Summary of Weather Effect

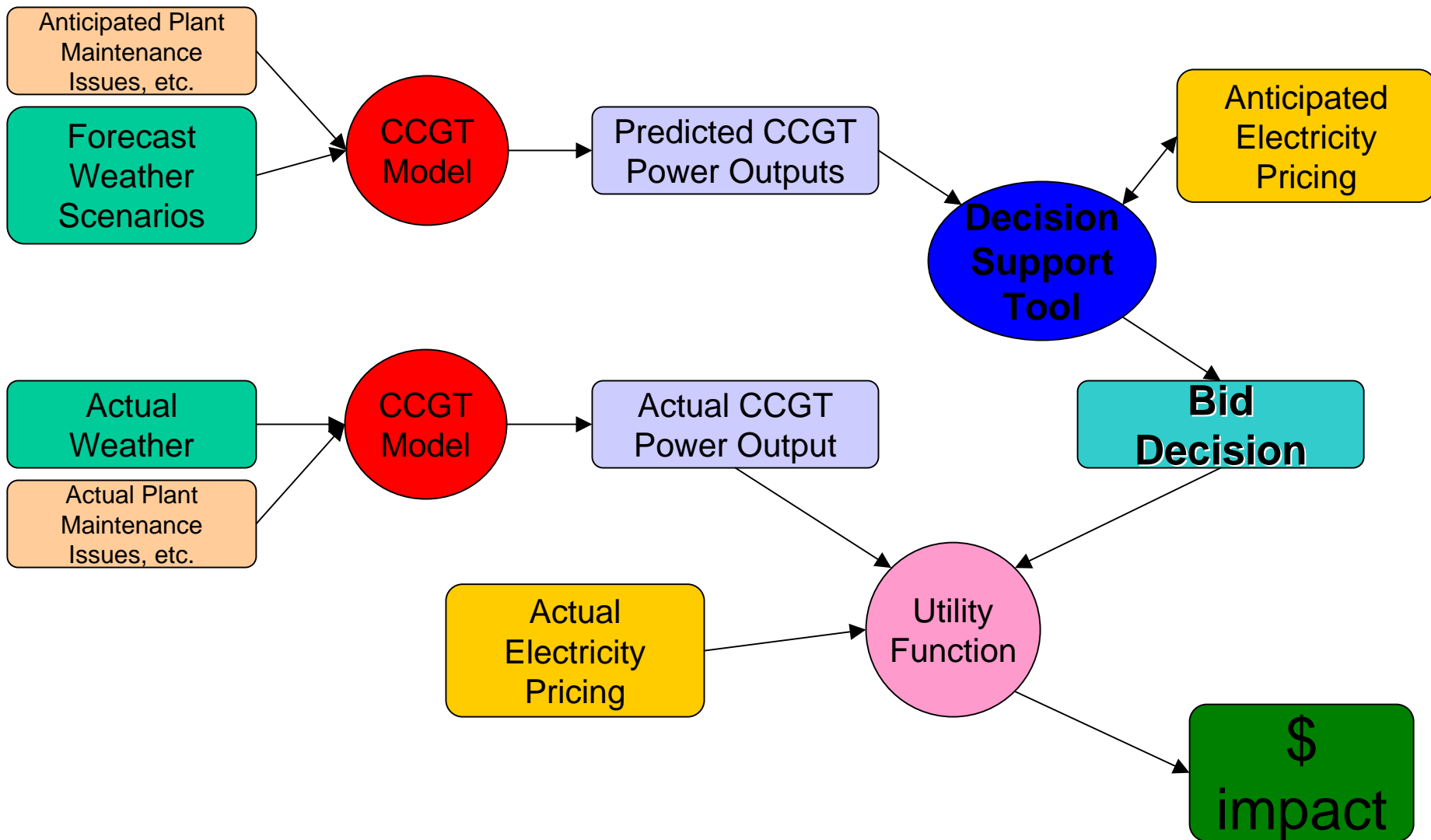


- ◆ Example is a CCGT model GE 209FA
- ◆ Rated output is 787 mW at:
 - 15°C, 1013.25 hPa, 60% RH

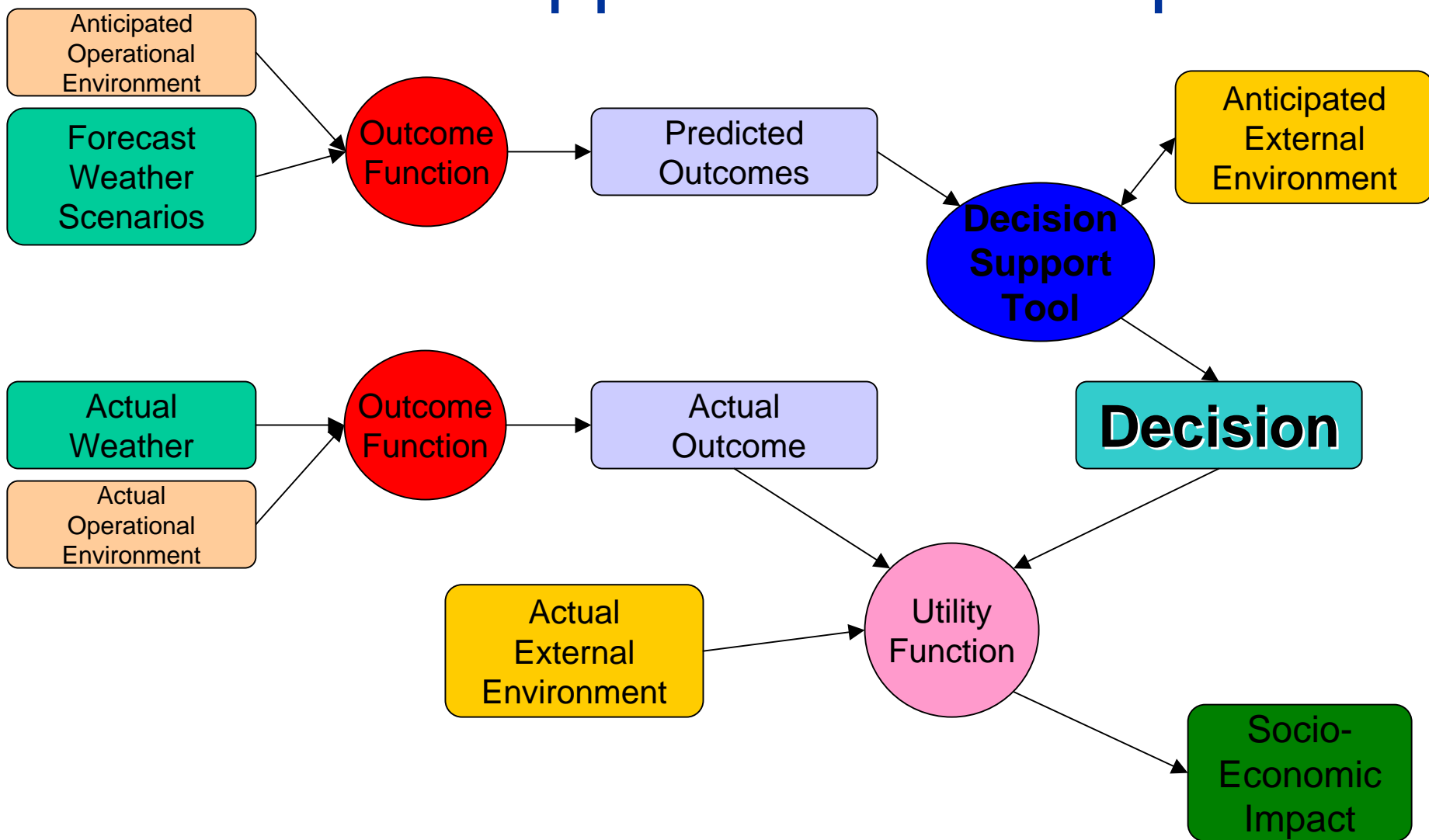
Price Environment



Decision Support Tool Application



Decision Support Tool Principles



Simple Example

- ◆ Day ahead forecasts (36h) valid at noon tomorrow
- ◆ Two models ... global and mesoscale
- ◆ Interpolated to Heathrow
 - not a real CCGT site
- ◆ Validation period May 2003 to Sep 2004
- ◆ Use actual electricity prices
 - but not known at time of bid
- ◆ Compare average revenue/h with that for perfect weather forecast
- ◆ Equivalent annual impact (£) for that one hour.

Three Strategies

1. Use single (global) model forecast output for bid
 - Annual loss is £54k compared to perfect weather
2. Choose “best” offset from global model forecast from recent sliding window
 - Using 20 day window, annual loss reduced by £4k to £50k
3. Ensemble of two models
 - Each dressed with errors from window, cross-validation for relative weights and best quantile choice
 - Using 45 day window, reduce annual loss by a further £4k to £46k
 - For 24h day, total annual benefit over simple single model would be £190k.

Concluding Points

- ◆ The key driver for THORPEX is to realise socio-economic (and environmental) benefits
- ◆ These will come from users making decisions that can make a difference
- ◆ Need to work with users to identify those decisions and their “outcome functions” and “utility functions”
- ◆ Need to provide decision support tools that take forecast weather scenarios into account
- ◆ This simple example of a CCGT shows that potential economic benefits are large.

