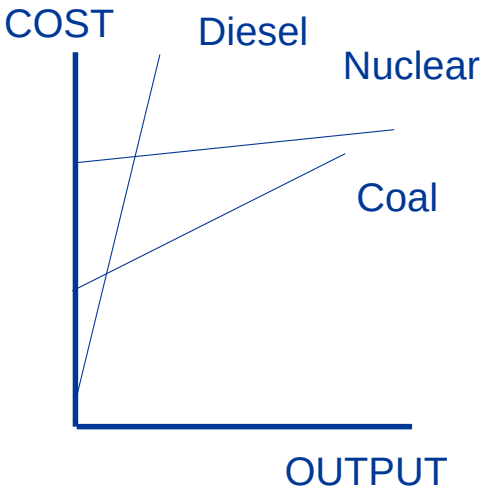
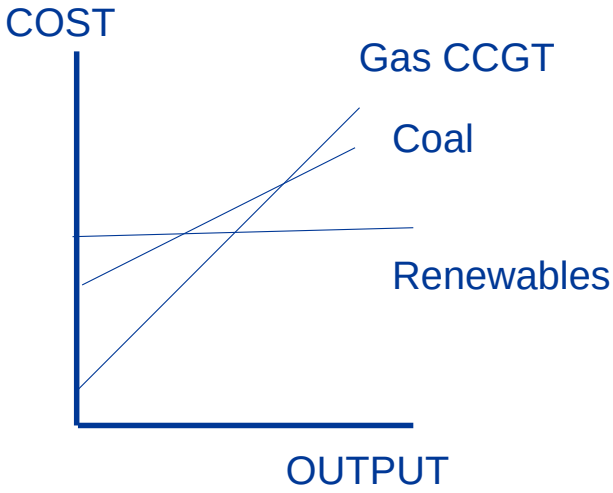
PCC Webinar – System Dynamics

September 2023

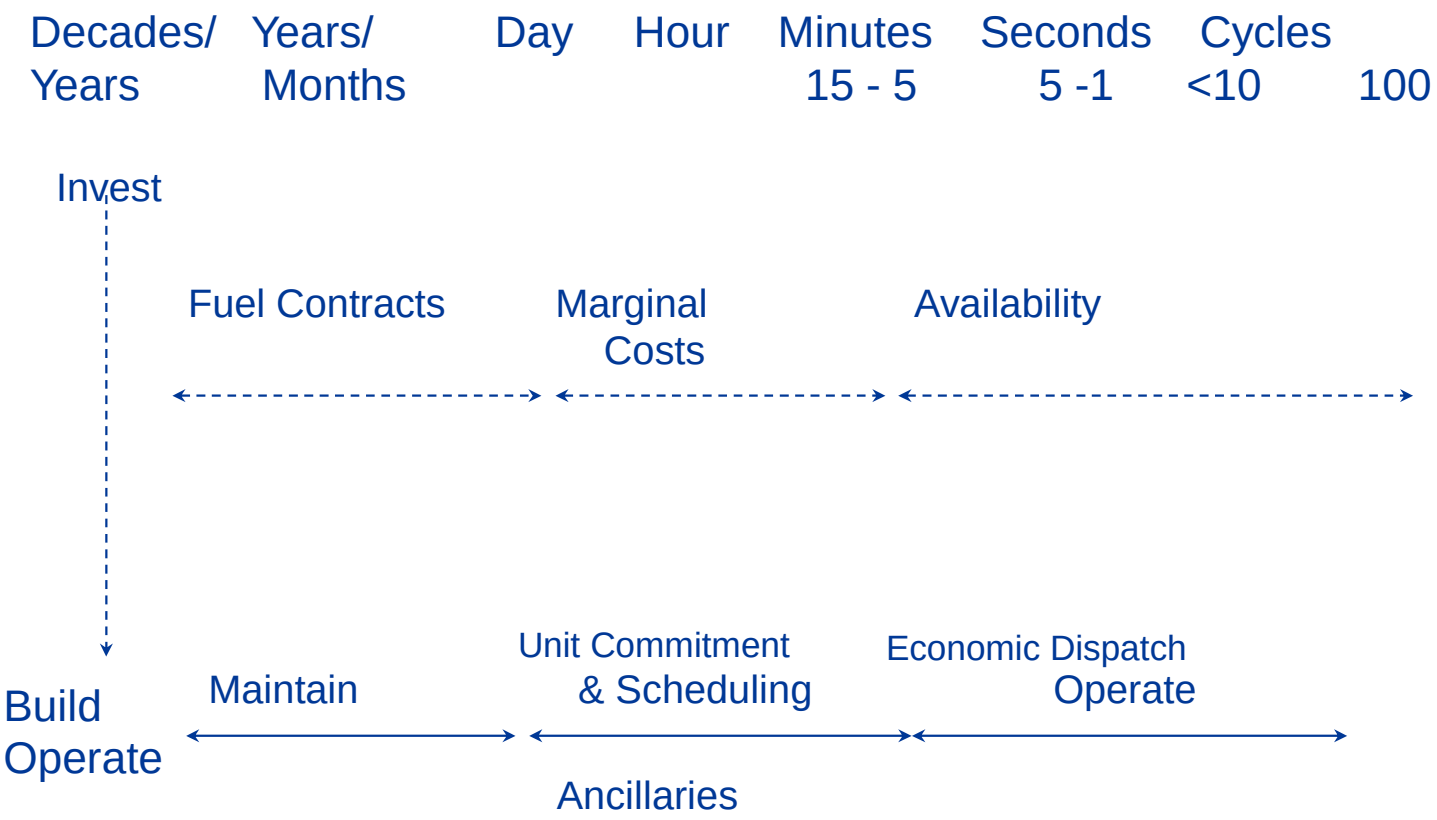
Costs of production



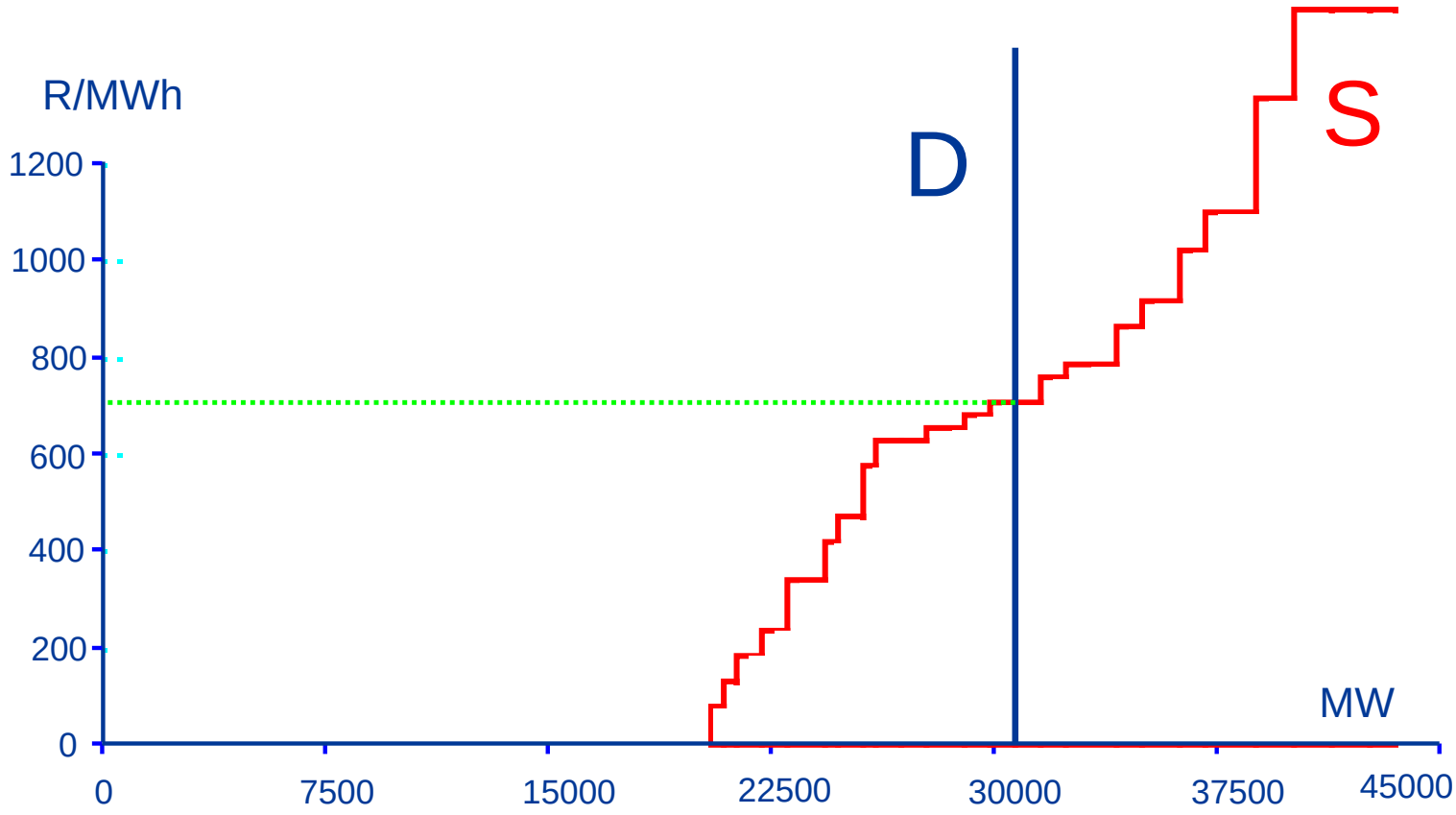


- All technologies have combination of fixed costs (costs that do not change with output) and variable costs (those directly related to output)
- Extremes:
  - Diesel – low fixed costs (cheap capacity) but exceptionally high variable (fuel) costs
  - Nuclear – low variable (fuel, O&M) costs but exceptionally high fixed costs
- Renewables, like nuclear, have high fixed costs with almost no variable costs (no fuel, only O&M) but are not dispatchable – dependent on external factors for production
- Gas CCGT vs Coal:
  - Gas has lower fixed costs (approx 30% of coal capacity costs) but generally higher fuel costs
  - At lower load factors Gas preferable but depends on international gas (and coal) prices

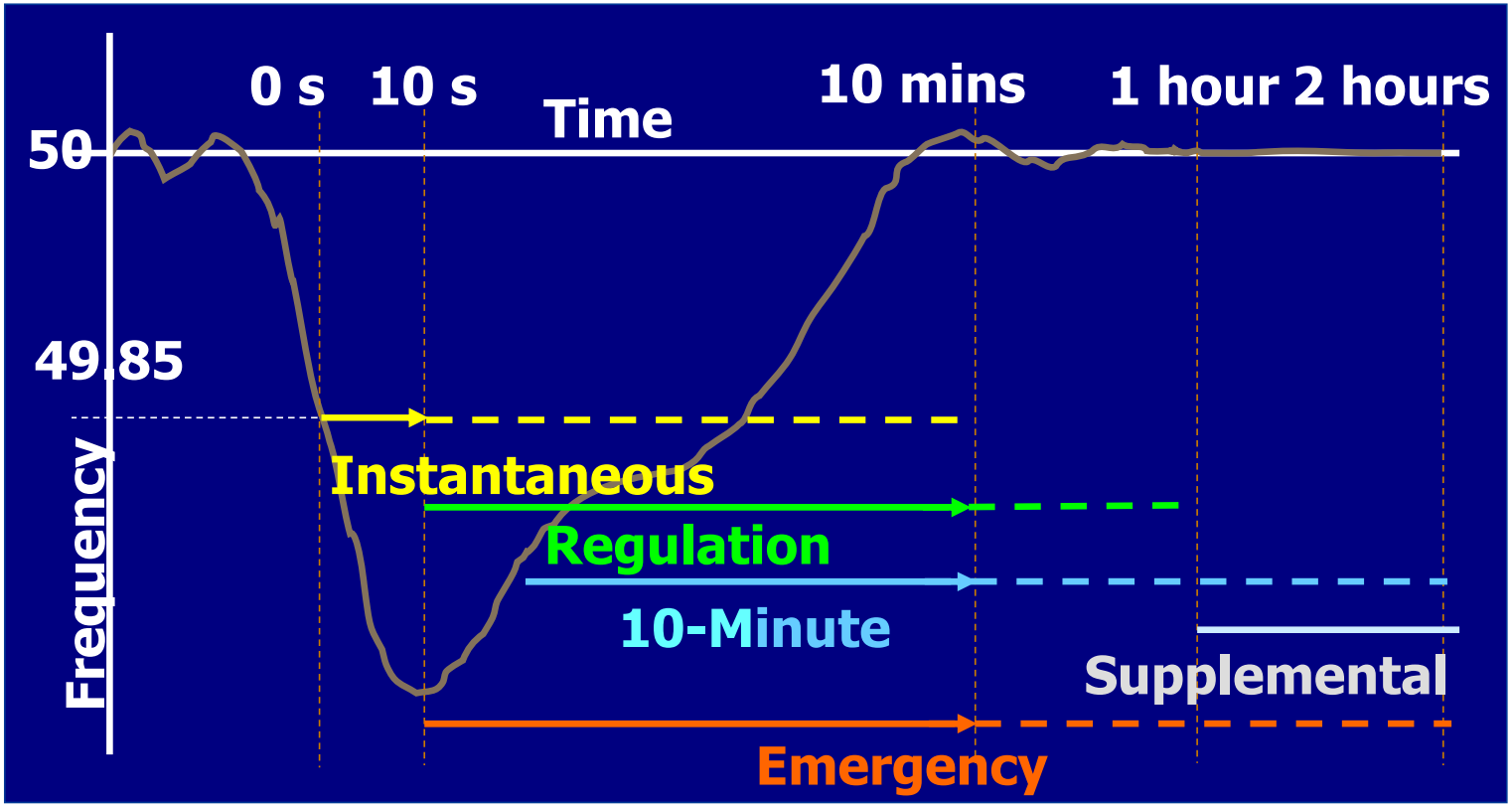
Decision-making timelines



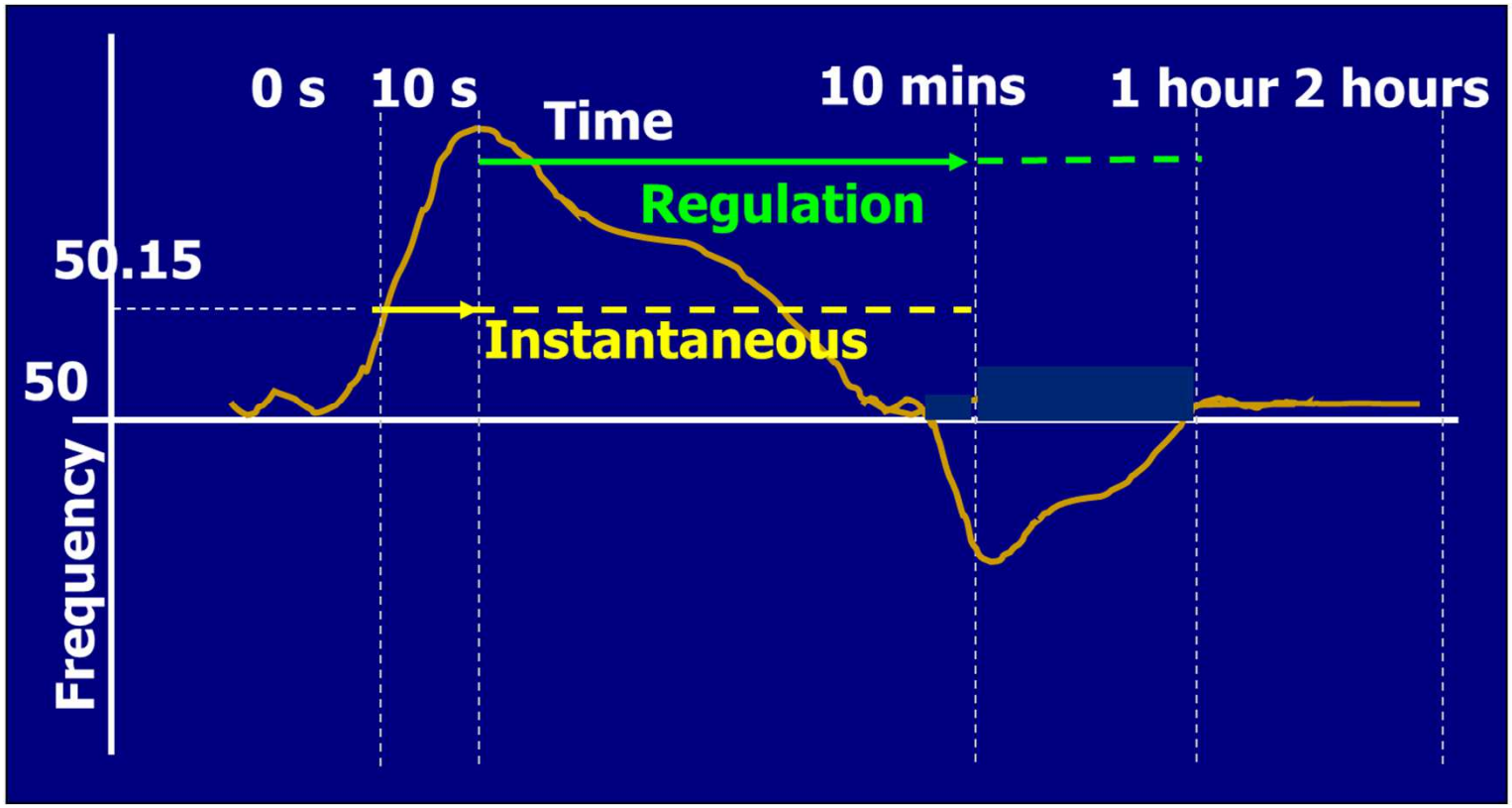
Dispatch in Short Term basis



Use of Reserves

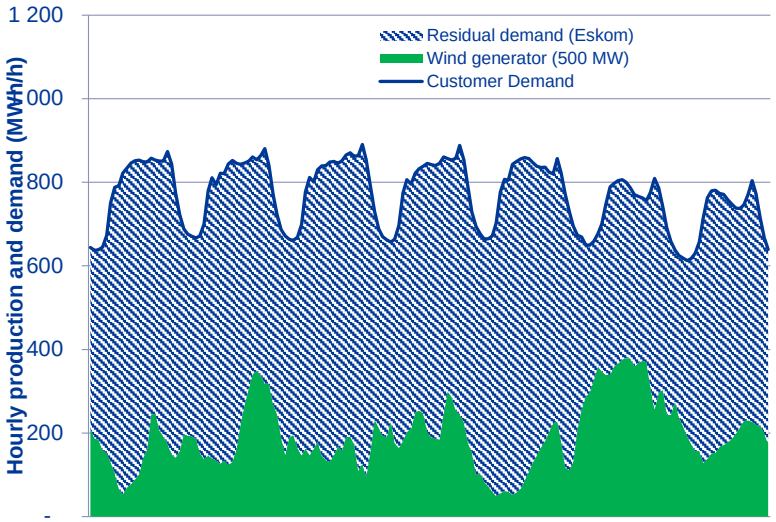


Ancillary Services – Fast Response (2)

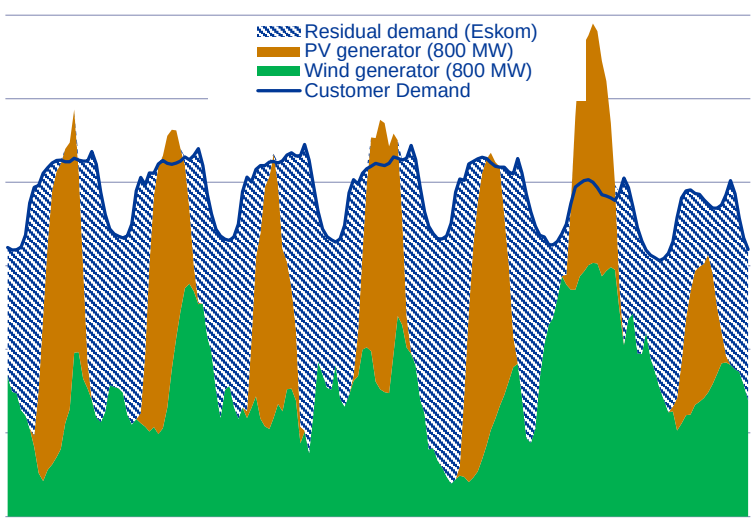


New focus on frequency movement in BOTH directions – probability of over-supply approaching that of under-supply. Reserves required to reduce output (which can be problematic with inflexible generators in certain hours).

Energy vs Capacity – who supplies residual load



Case 1: 1000 MW municipal customer procures 500 Wind generation

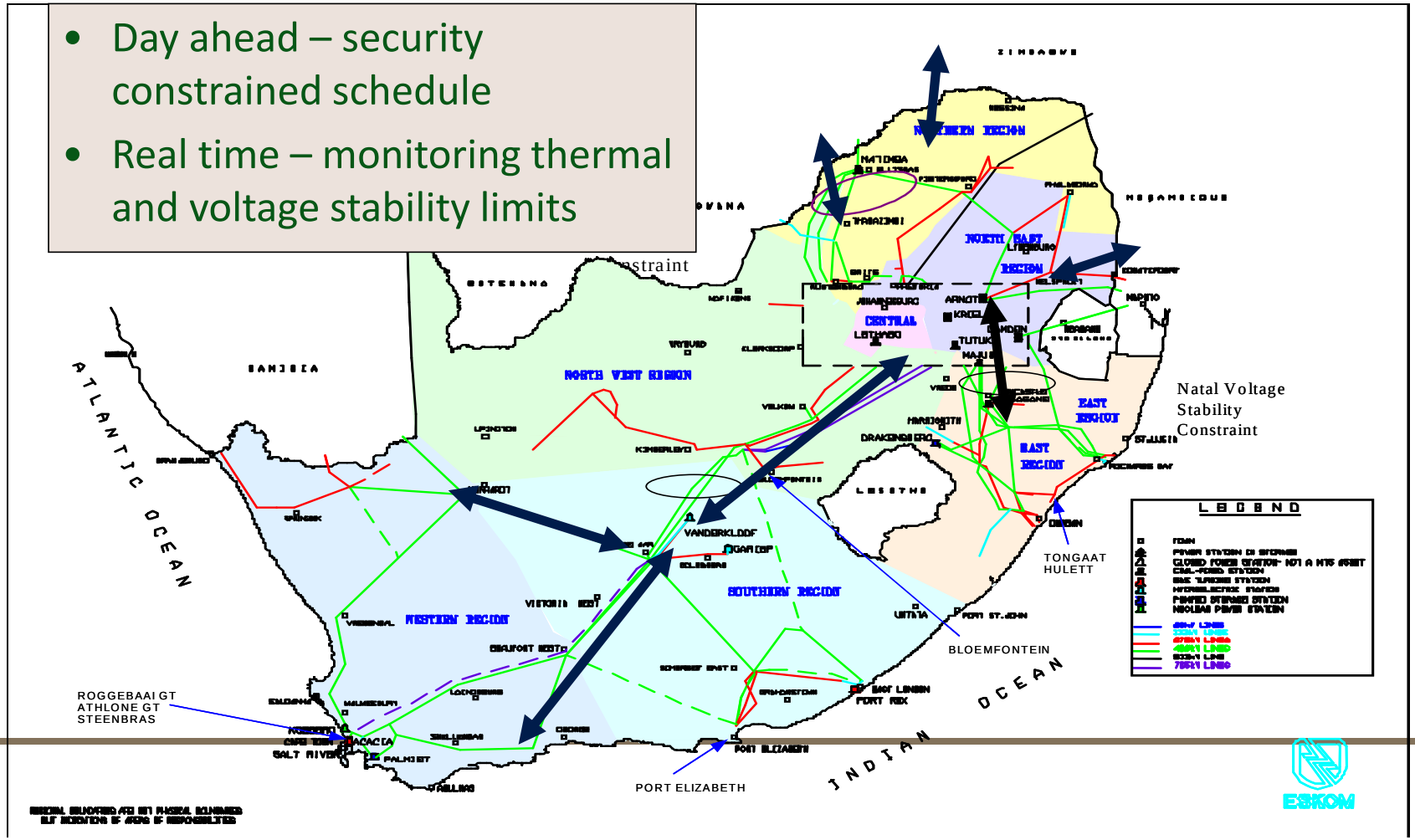


Case 2: 1000 MW municipal customer procures 800 Wind generation and 800 MW PV generation

- Cheapest potential energy source currently is renewable energy (either Wind or PV generation). An energy only market will tend to favour Wind and PV generation but the energy profile does not often match consumption patterns. Who supplies the residual demand?
- The IRP recommends a system balance of RE and back-up, currently recommending liquefied natural gas but potentially batteries. This capacity cannot be built to compete on ENERGY alone – needs a capacity market of some sort.

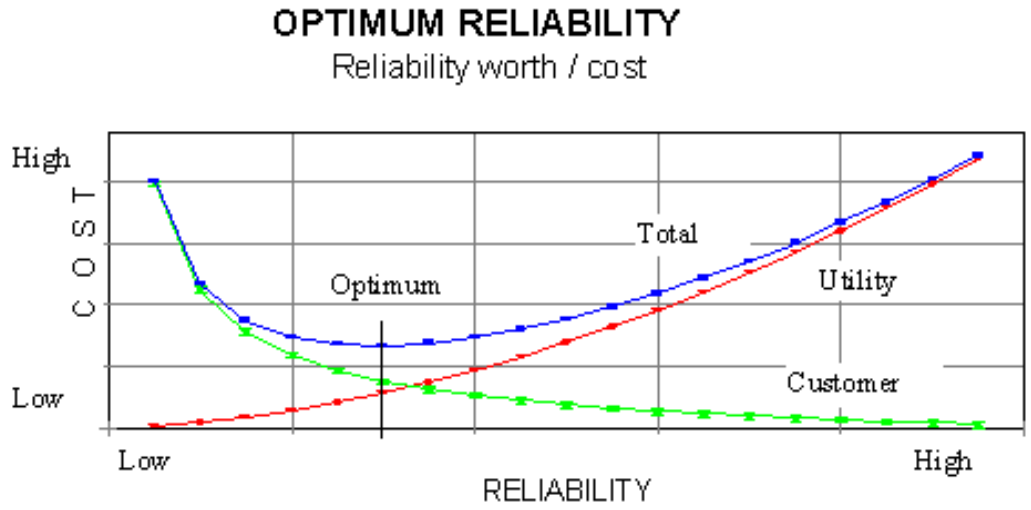
Congestion Management

- Day ahead – security constrained schedule
- Real time – monitoring thermal and voltage stability limits



Conclusion

Reliability cost vs. reliability worth



The balance between reliability and affordability of supply is difficult in a capital intensive long-lead time industry

Adequacy check

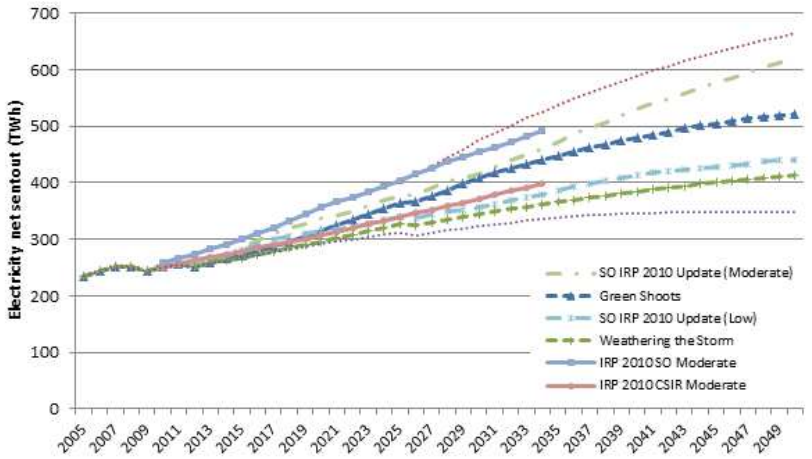
- Medium Term Outlook adequacy metrics

Adequacy Metric		Threshold	Detail
AM1: UE GWh	Unserved Energy (UE)	< 20 GWh per annum	The amount of energy in a year that could not be supplied due to system supply shortages.
AM2: GLF(OCGT)	OCGT Load Factor	< 6% per annum	The Gross Load Factor (GLF) of the combined OCGT plant in operation in a year.
AM3: EL1 GWh	Emergency Level 1 Energy	< 400 GWh per annum	The energy supplied in a year by generators operating above their continuous rating under instruction during supply emergencies. Interchangeable with OCGT generation.
AM4: GLF(EBLS)	Expensive Base Load Stations (EBLS) Load Factor	< 50% per annum	The Gross Load Factor (GLF) of the combined expensive Base-load Stations (typically Camden, Grootvlei and Komati) in a year.

- Applied to IRP portfolio planning production plans for 20 year window
  - Test on different demand trajectories

Scenario-wise decomposition

- Mechanism to incorporate uncertainty in planning
- Develop a probability distribution for key parameter and apply scenarios to these



- Rather than separate scenarios to evaluate – incorporates the probability into the plan.