Balancing of Grid with Large Scale Renewables

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Operational Issues With Large Scale Variable Generation

- The operational issues with Large Scale Variable Generation
  - Need for large balancing area
  - Reduced time for Scheduling/market
  - Incorporate RE forecast in Unit commitment and Grid operation
  - Increase in Flexibility of conventional power plants
  - Additional reserves
  - Mechanism for assimilating integration costs

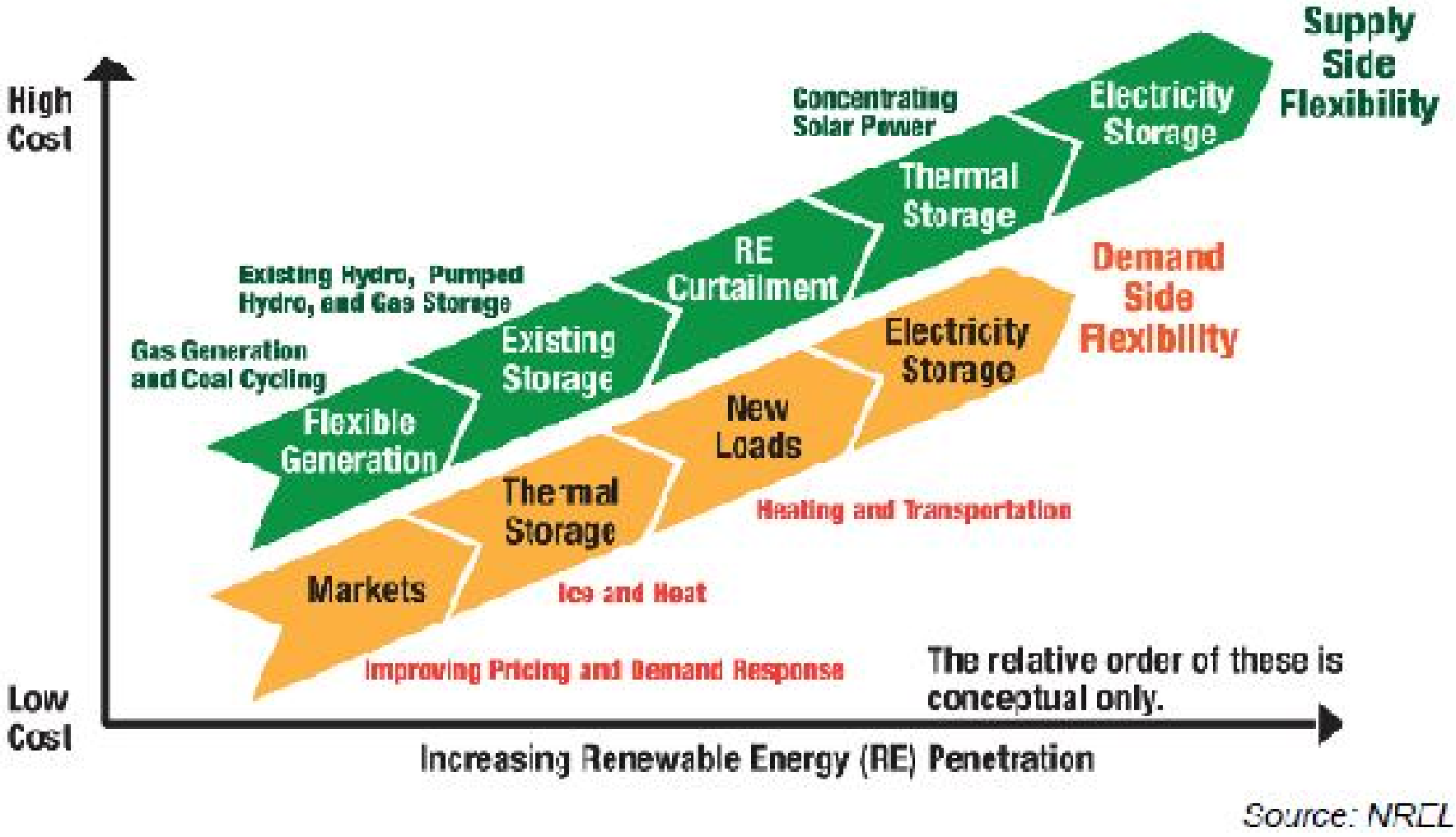
Balancing Area

- India-Bhutan along with interconnection with Bangladesh (asynchronous) forms large balance area for the grid for frequency stability
- 45GW of Hydro and 25GW of Gas generation is available for balancing but with associated cost
- In SR, 11GW of Hydro and 6GW of Gas is available for managing ~23GW of wind and solar

Balancing Services

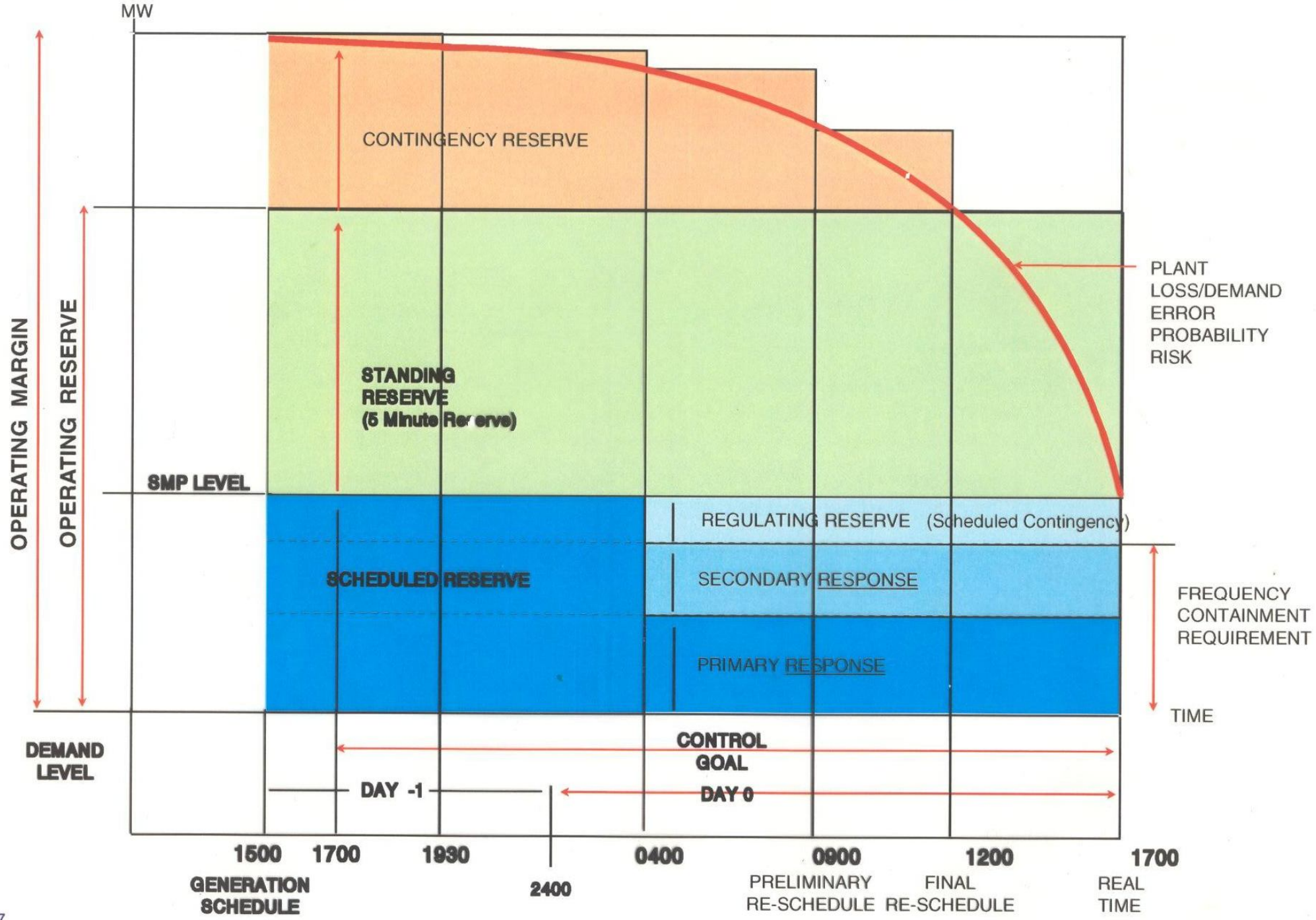
- Balancing services is the complex design with multiple variables, divergent policy objectives of security of supply and economics.
- Widely used modelling framework
  - Centralised Dispatch
  - Self Dispatch – Balance Responsible parties

Balancing - Techniques



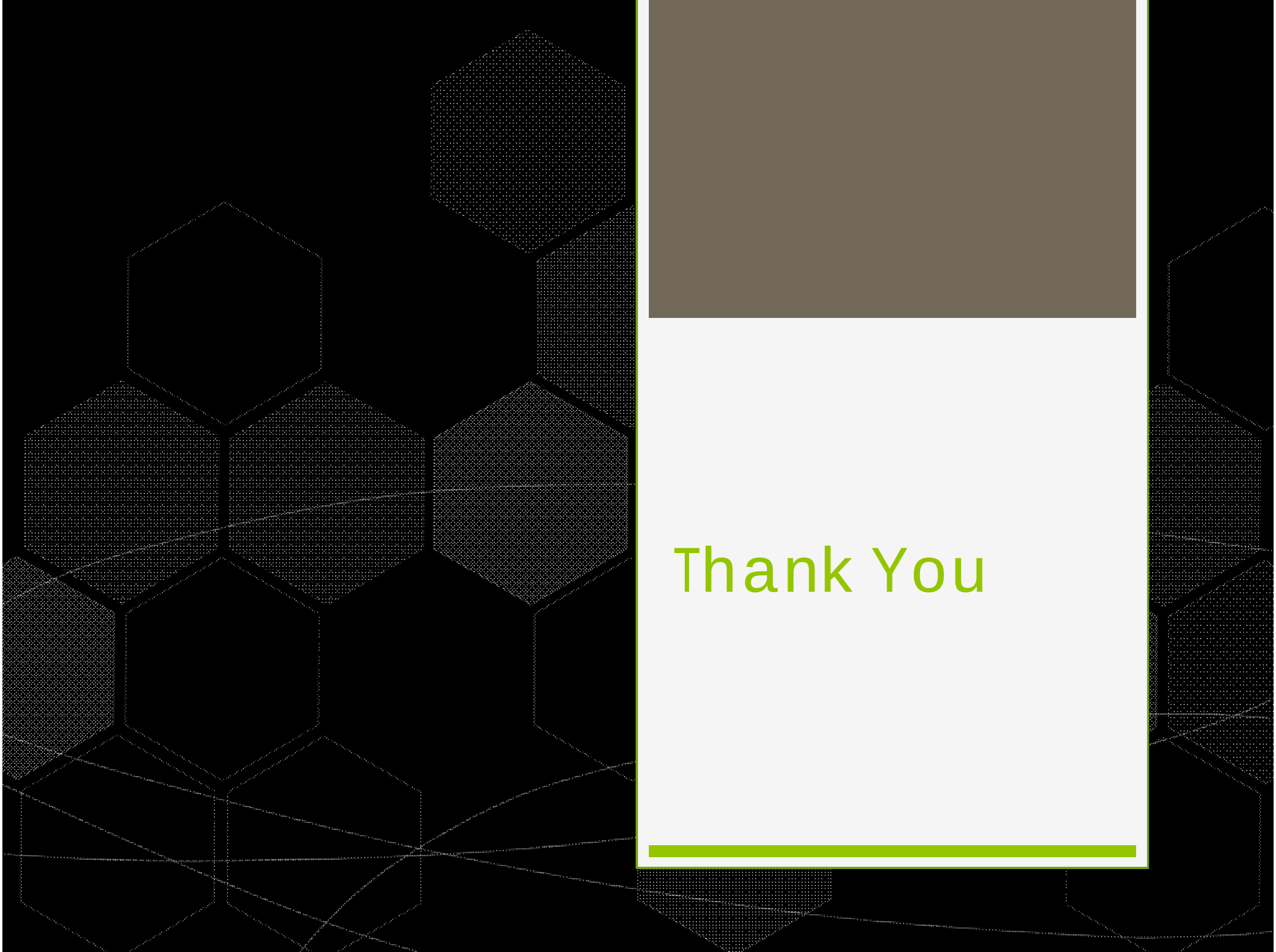
Source: NREL

Reserve/Response Definitions Diagram



Ancillary services

- Focus on providing ancillary services for balancing is on
  - Hydro power plants
  - Open cycle Gas plants
  - Flexible Thermal Fleet
- Wind and solar power plants can also participate in balancing with right incentive


Thank You