Existing Hydro Installed Base – Already Integrating Intermittent Renewables – But at what cost?
Renewables are mainstream power generation

Projected generation mix (’17-’26)

- Hydro: 9%
- Nuclear: 4%
- Fossil Steam: 19%
- Gas Engines: 2%
- Battery: 11%
- Wind: 20%
- Solar: 30%
- Other REN: 2%

Renewables 64% of new global capacity over next 10 years

Resource planning by state driving generation change

- 93% RPS (includes large hydro)
- 50% RPS by 2040
- 50% RPS by 2030 and CO2 free by 2045
- 60% RPS by 2030 and CO2 free by 2045
- 20% RPS goal by 2025
- 15% RPS by 2025
- 40% RPS by 2040, CO2 free by 2045

Source: GE, BNEF, IEA, NWPP

Declining subsidies, more auctions, aggressive RPS, competition with solar
The flexibility market
Peaking / Low load operation / Spinning Reserve / Cycling / Start-Stop / Frequency regulation...

Energy Imbalance Market
New Power and Frequency Regulation Requirements

Operation Outside usual Francis Optimal Zone

Approximate output range
40%-60%
20%-40%
0%-20%
Through the plant cycling issues