

Breaking Flexibility Down

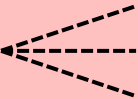
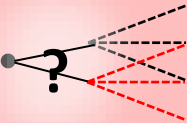
ESIG Tutorial

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Two options to manage operational flexibility: Change reserve or change scheduling design

Cause	Type	Resolve in Scheduling	Approximating Reserve Examples
Variability	Between Intervals 		Flexible ramping reserve
Variability	Within Interval 		Frequency control reserves – regulation
Uncertainty	Between Intervals 	 	Flexible ramping reserve
Uncertainty	Within Interval 	 	Frequency control reserves – contingency
Uncertainty	Before First Interval 	 	None currently proposed

Key



Closer Gate Closure



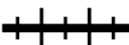
Stochastic or Robust Scheduling



Increased Scheduling Frequency

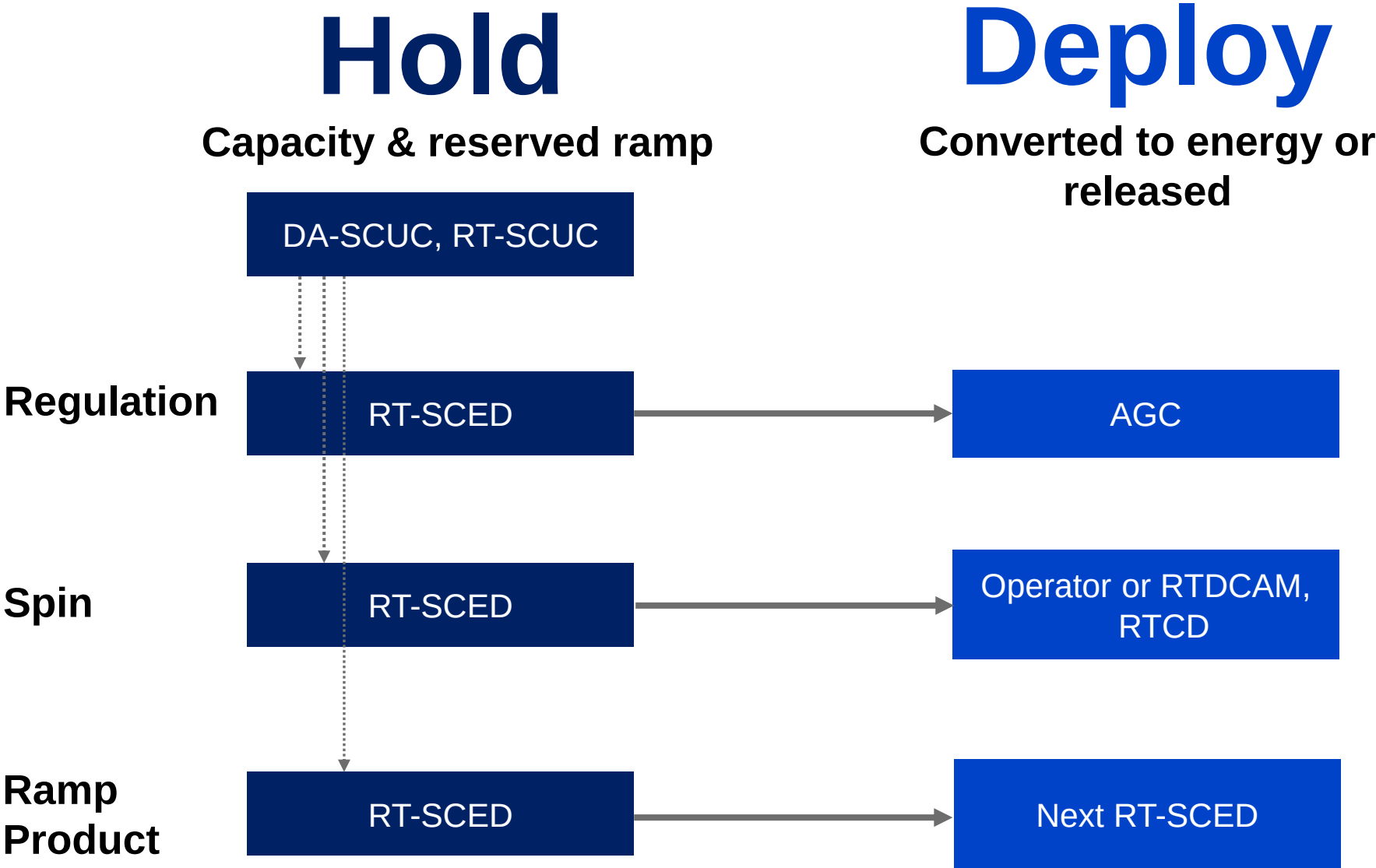


Multi Period Scheduling with Look Ahead



Shorter Scheduling Intervals

Reserve types should be defined by scheduling process



Additional aspect: congestion relief

Cause	Type	Resolve in Scheduling	Approximating Reserve Examples
Variability	Changes in congestion pattern	 	Minimum zonal reserve requirements
Uncertainty	Changes in congestion pattern	 	None currently proposed

Key



Closer Gate Closure



Stochastic or Robust Scheduling



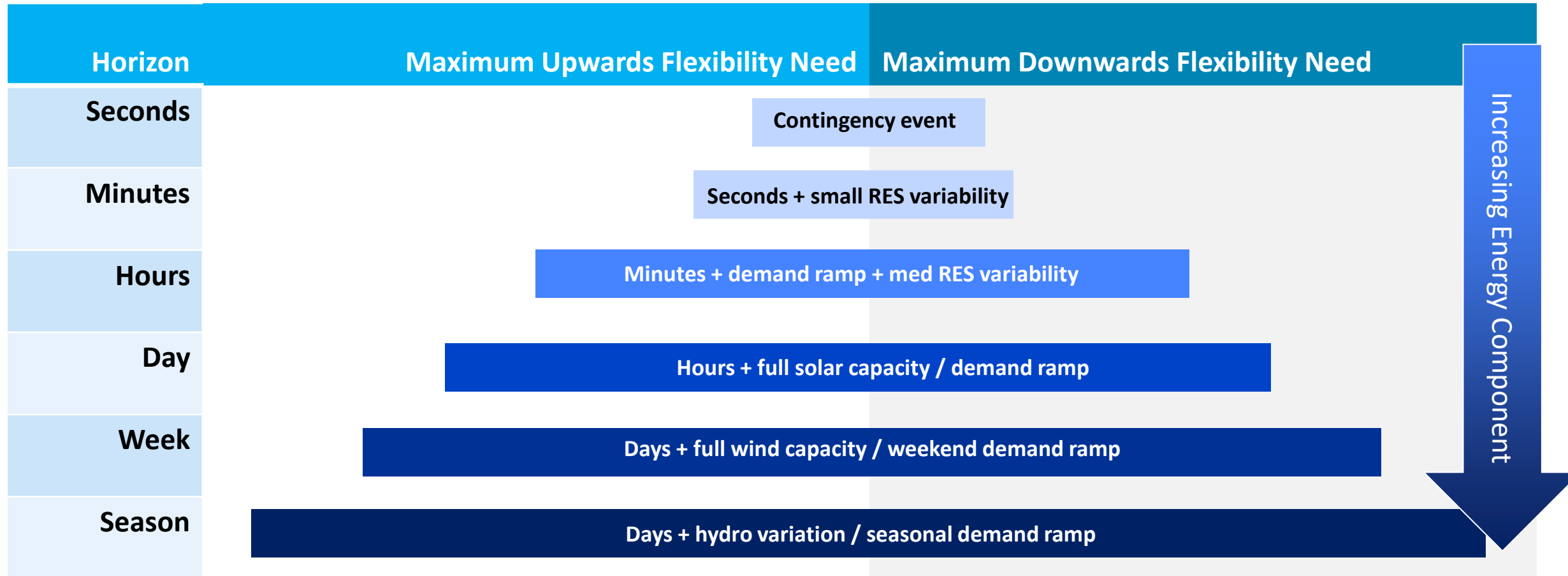
Multi Period Scheduling with Look Ahead



Security Constrained Dispatch

Can also be influenced by reactive power provision

Two Dimensions of Timescales: Horizons



Significantly larger flexible capacity need at seasonal level than at second level

Two Dimensions of Timescales: Acquisition Timeline

Investment



» Adequacy assessments:

- Flexibility integrated into LOLE / EUE calcs

» Flexible Capacity Requirements

- California FRAC-MOO

» Flexible Capability Payments

- EirGrid DS3

Ops. Planning



» DA Market constraints

- MISO Flexiramp

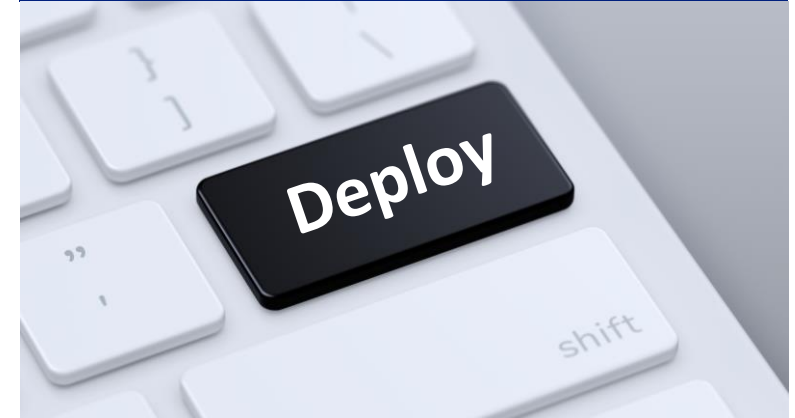
» Balance Responsibility

- EU portfolio markets

» Flexibility markets

- Piclo, Nodes, GOPACS, DA/RE, Equigy

RT. Ops

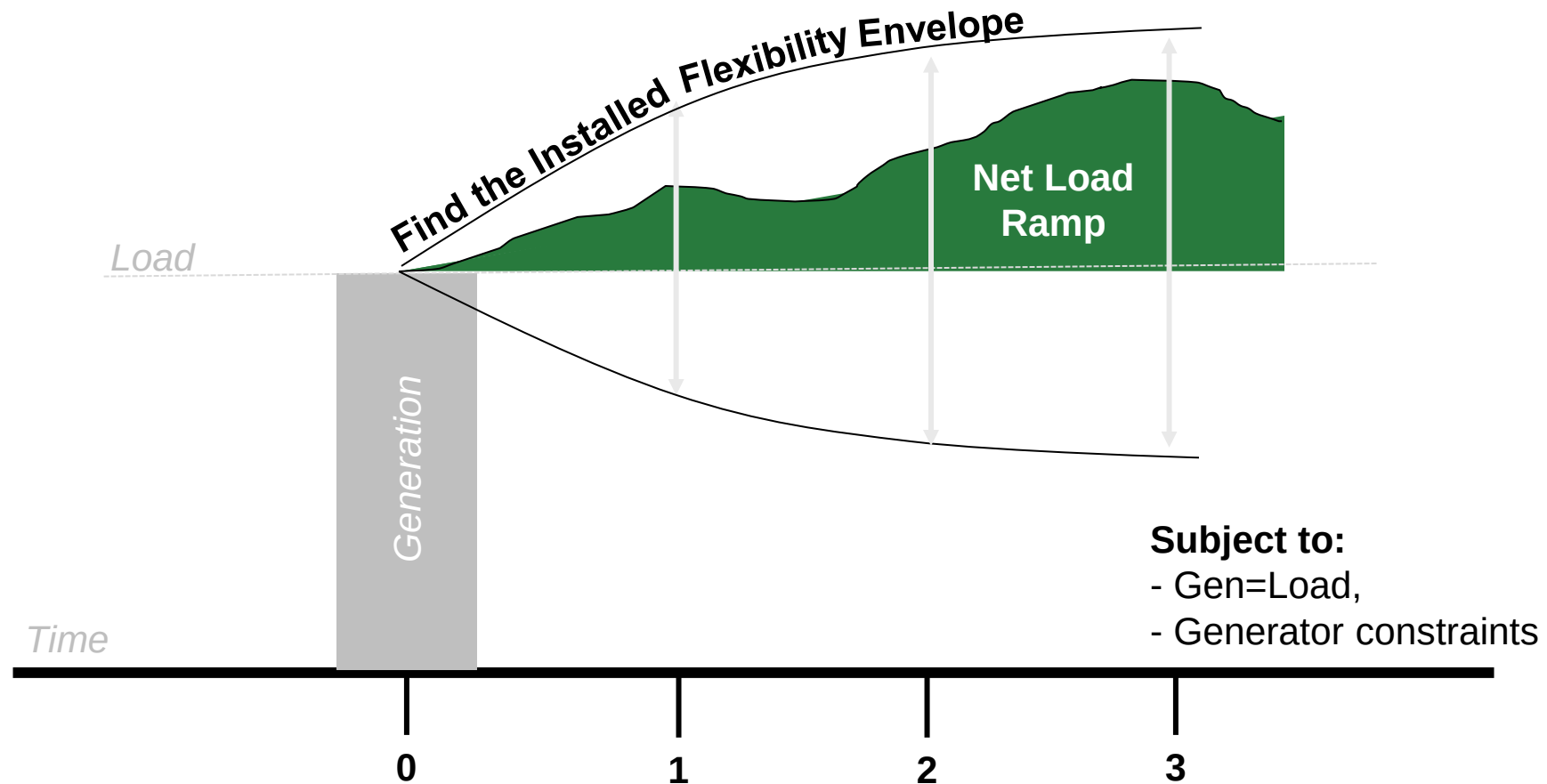


» RT Market deployment

- RT Dispatch
- Self-balancing

Installed Flexibility (IFLEX) model

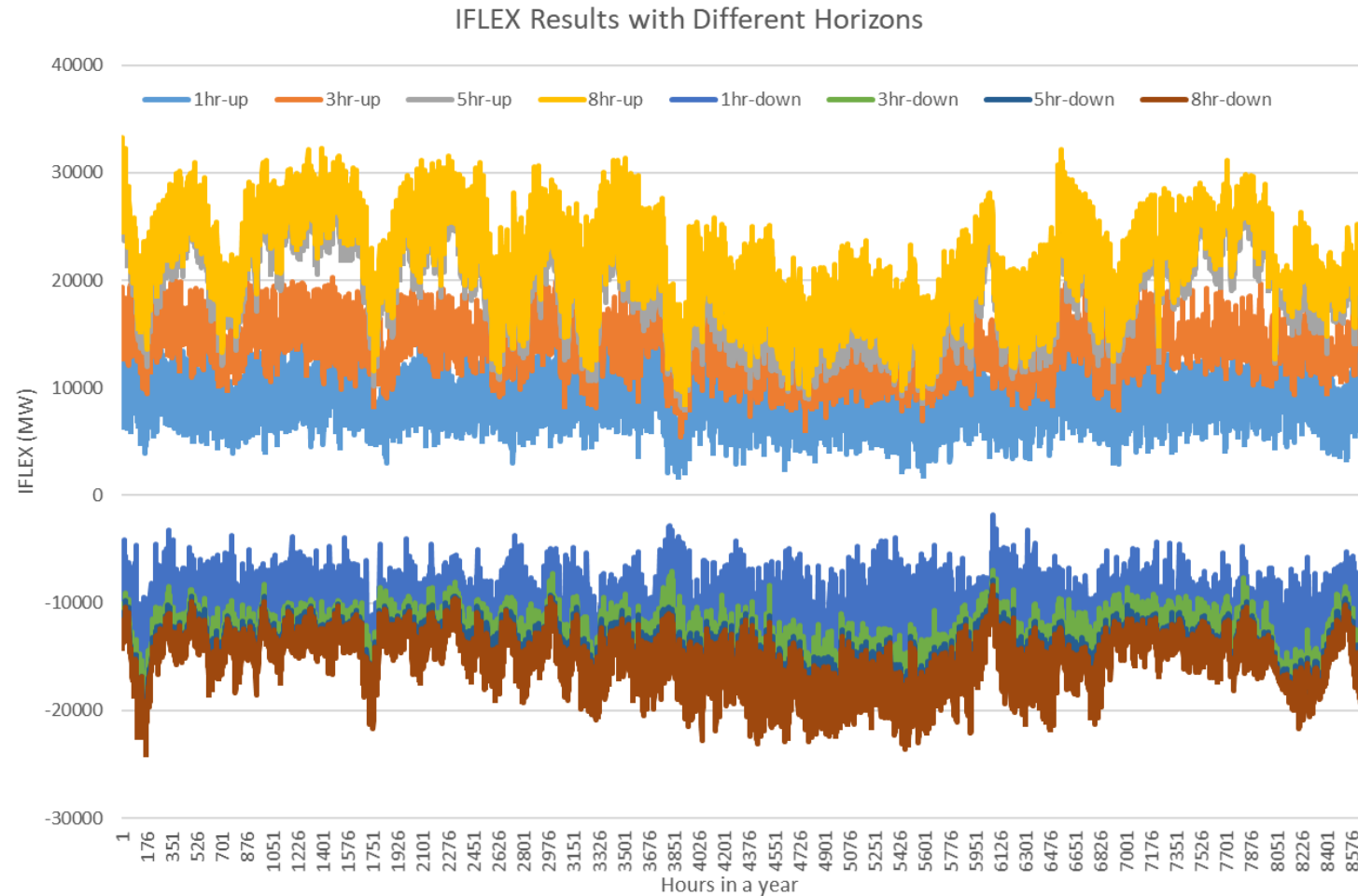
- » Find the installed flexibility envelope
 - Sufficient flexibility if net load ramp is within the envelope



IFLEX by Time Horizon

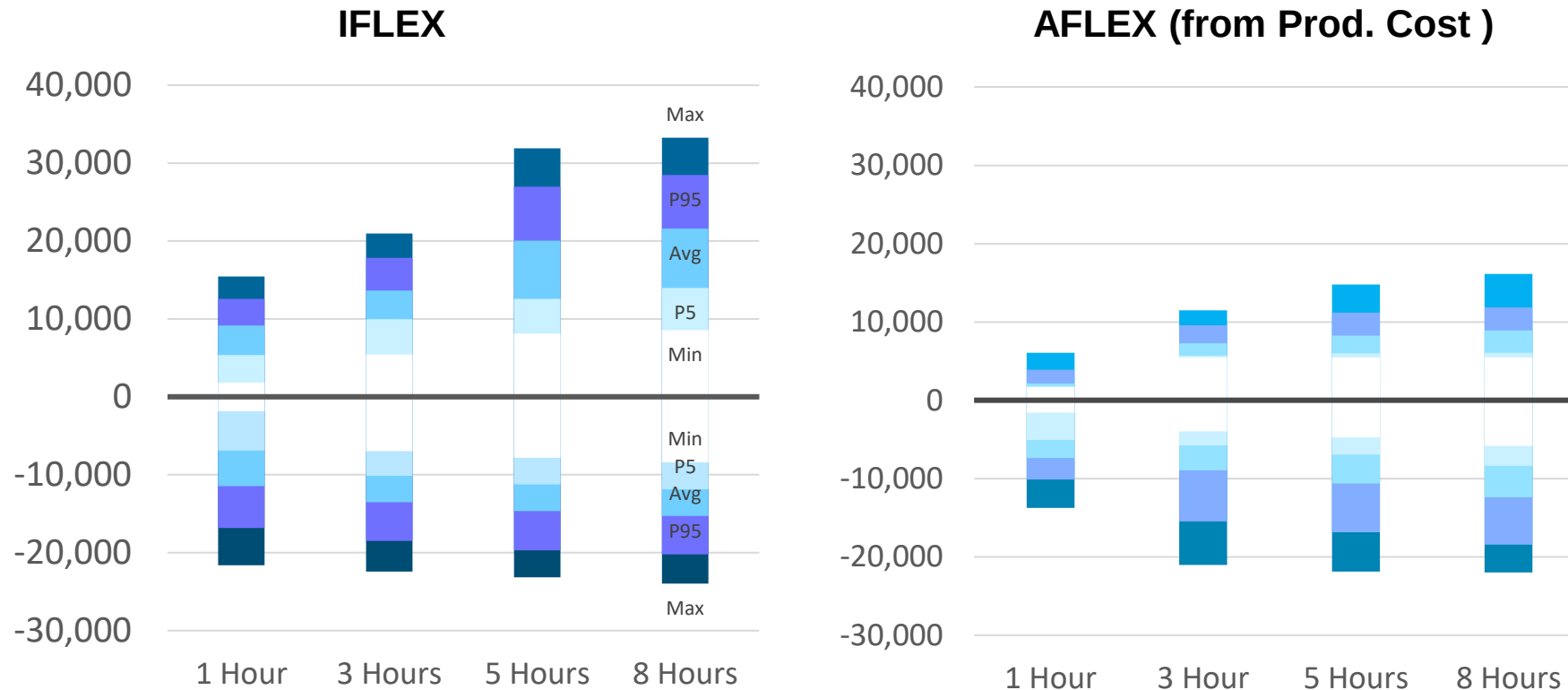
(From the 1,3,5,8 up & down run)

» IFLEX by horizon in both upward and downward directions



Comparison of IFLEX and Available FLEX by horizon

»Compares the flexibility that could be got vs. that which is provided by economic dispatch and conventional reserve.



A blue-tinted photograph of four people, two men and two women, standing in a row. They are all wearing white lab coats with the EPRI logo on the left chest. The woman on the far right is also wearing a white hard hat. They are all smiling and looking towards the camera. The background is a solid blue color.

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