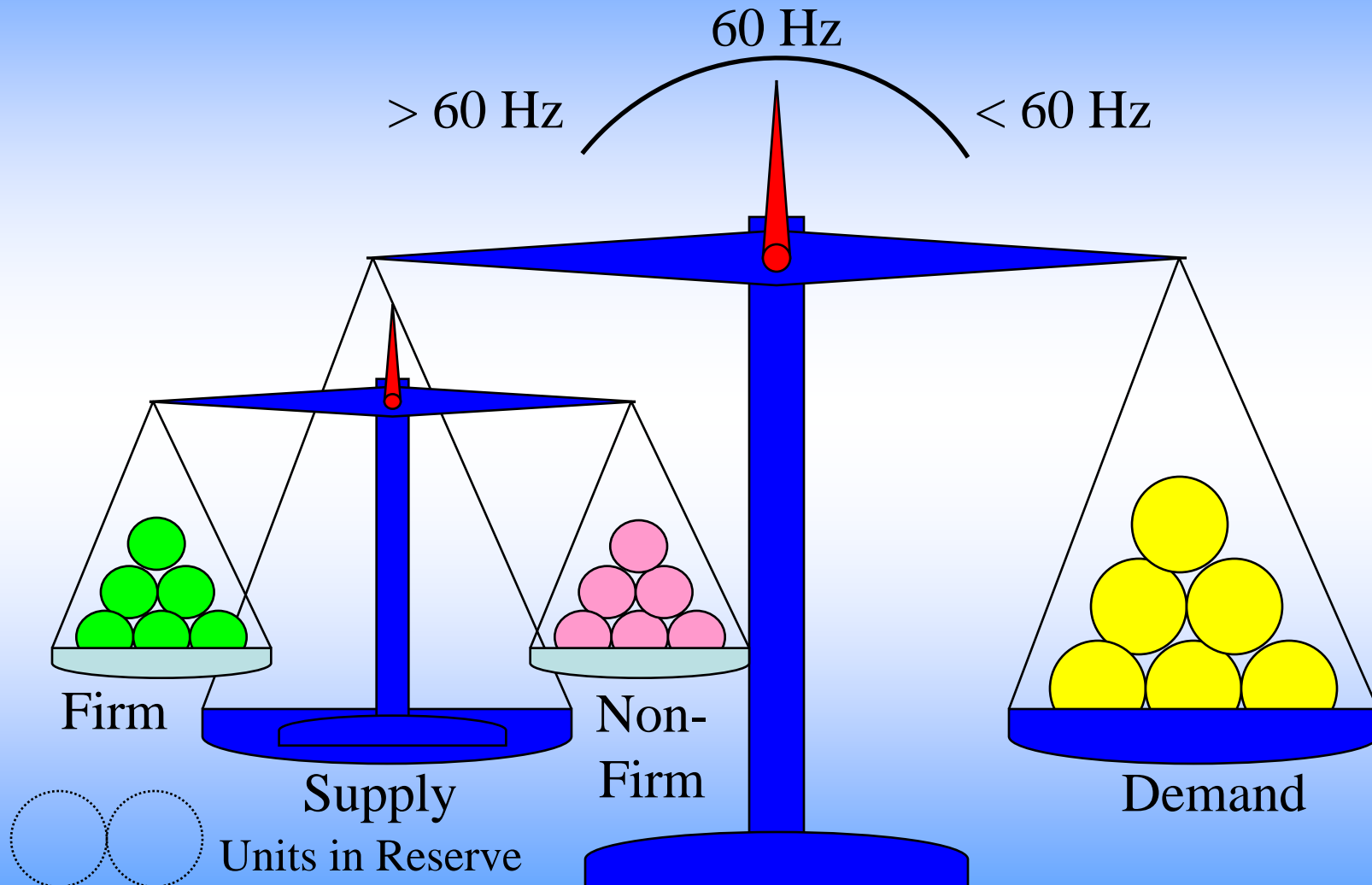


Ramp Rate Performance Standard for Intermittent Generation on the HECO System



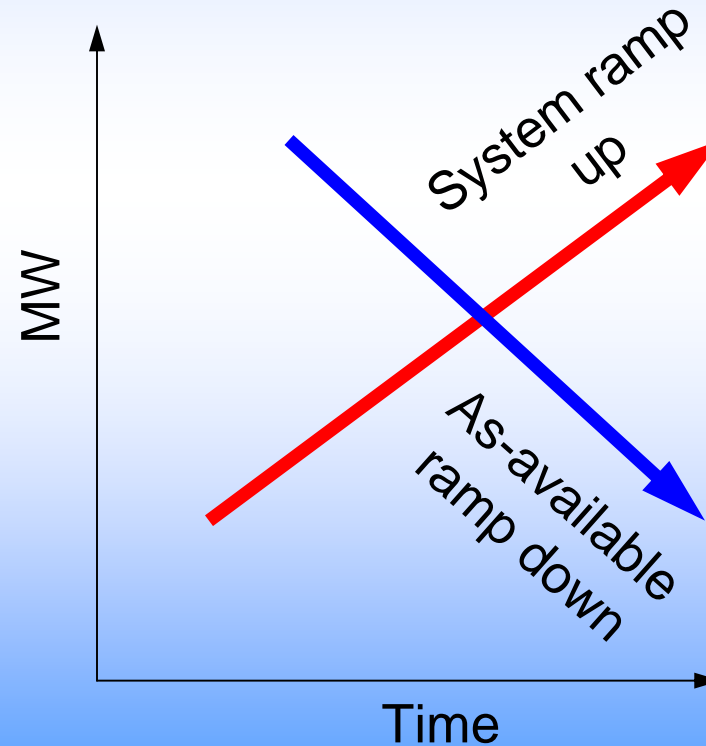
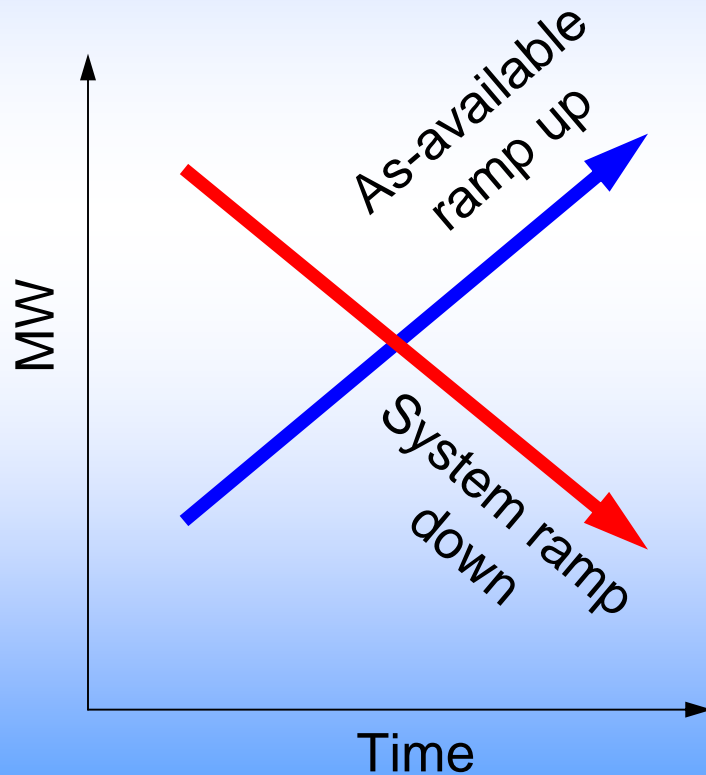
Increased Challenge with As-Available Generation



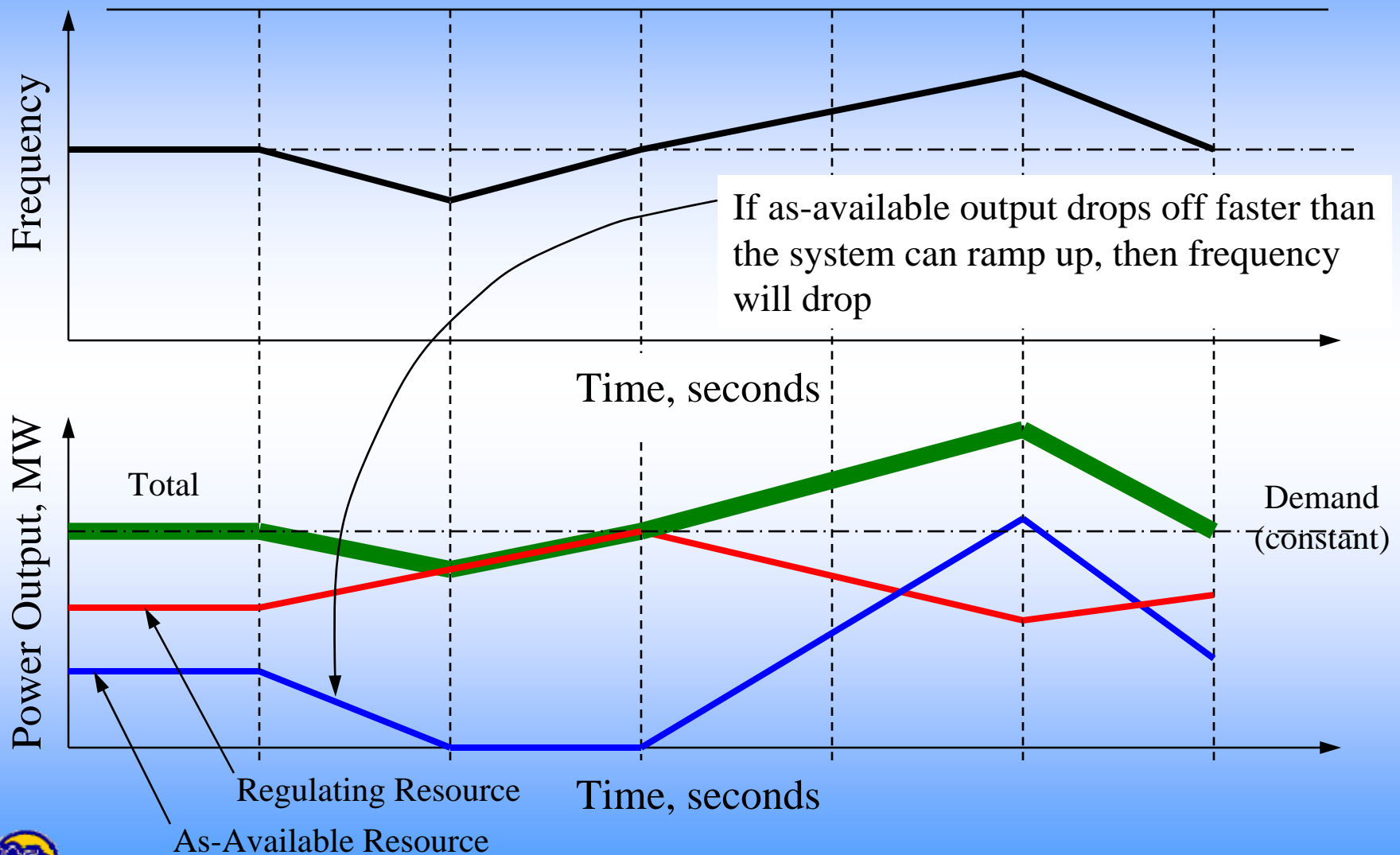
Ramp Rate Overview

(Illustrative – Not to Scale)

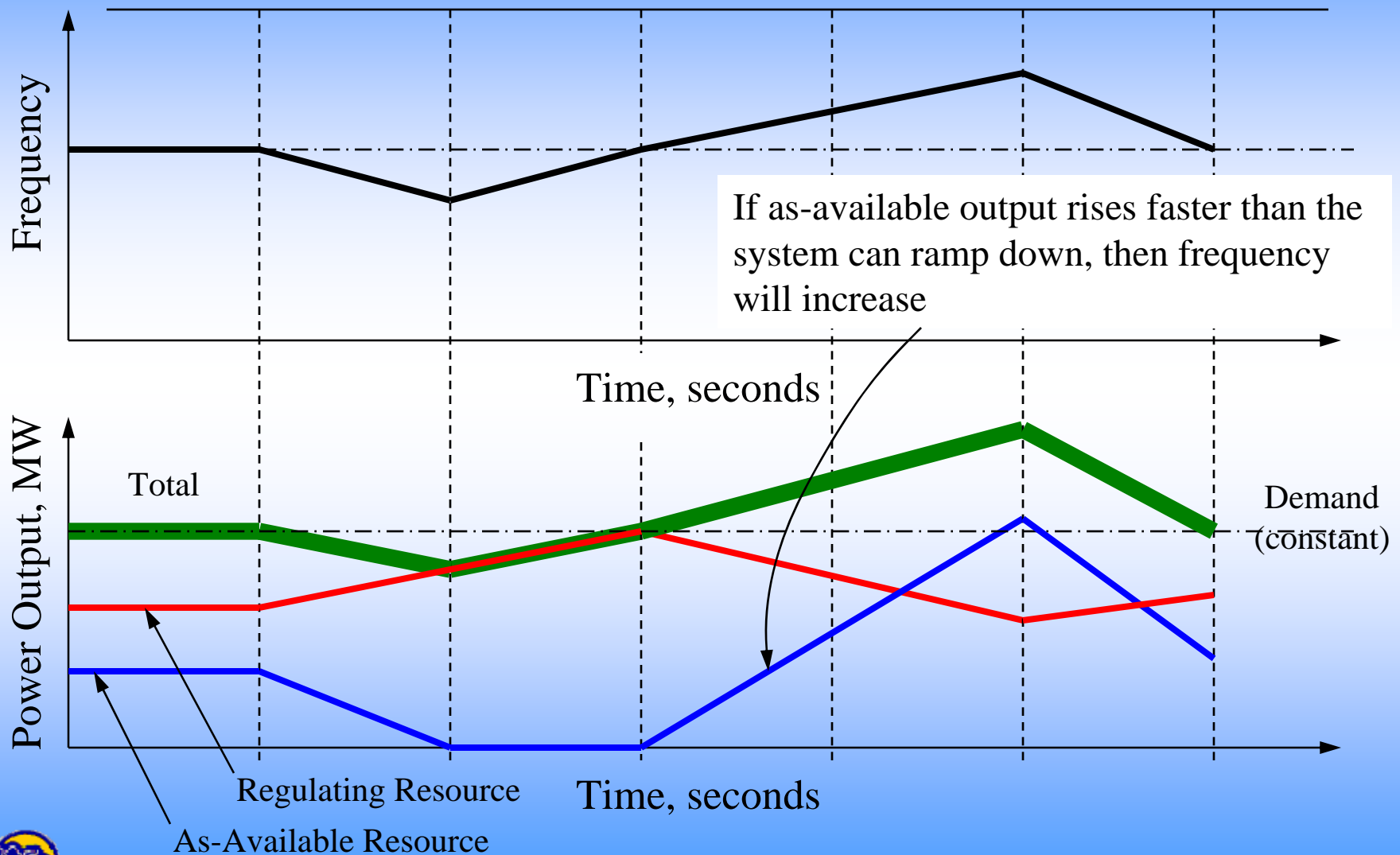
Seller's ramp up rate cannot exceed system's ability to ramp down and vice versa



Ramp Rate Overview



Ramp Rates (continued)



Ramp Rates (continued)

- System ramp rate capability depends on various factors such as:
 - which units are on-line
 - which on-line units are capable of regulating;
and
 - where the units are operating within their load range



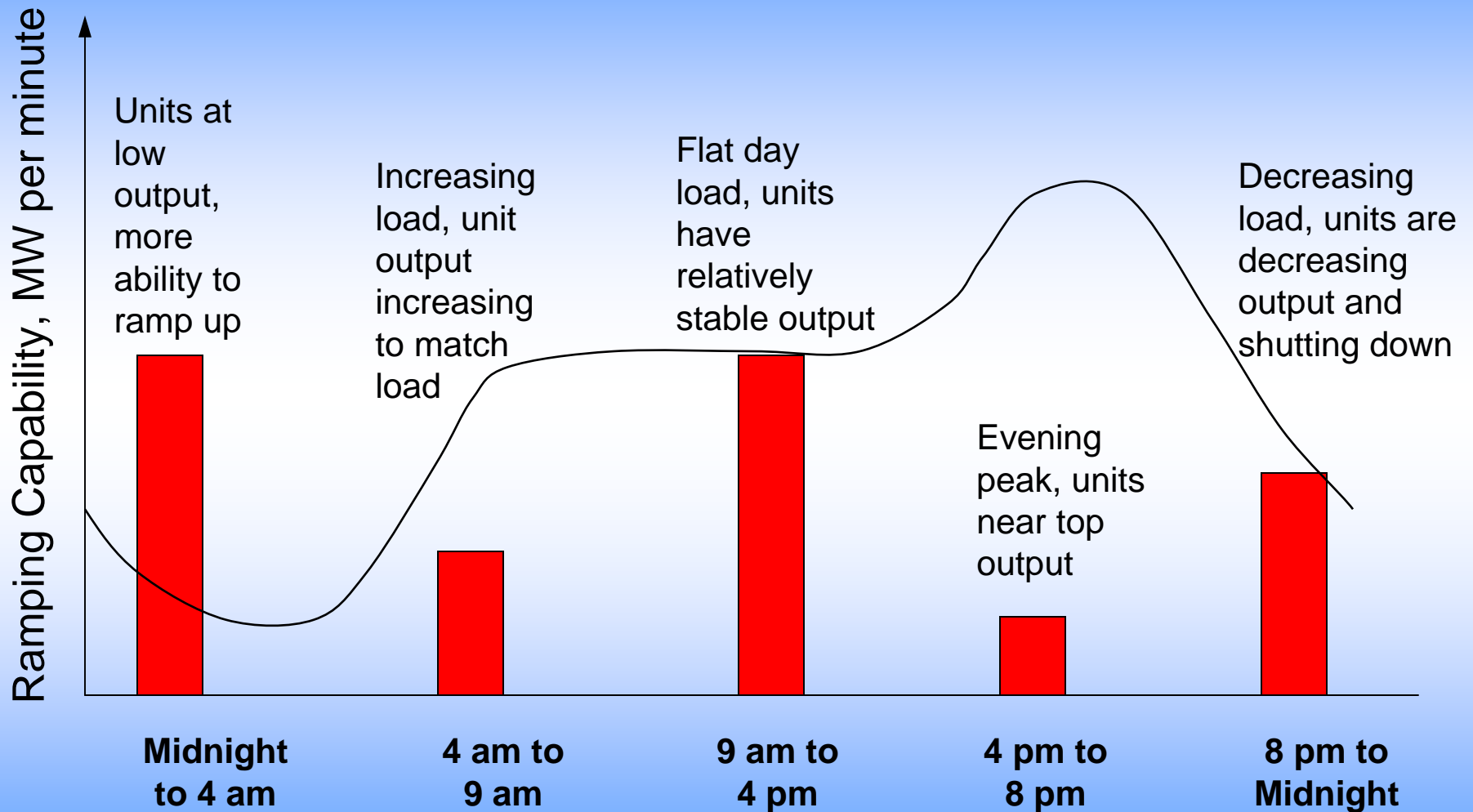
Target Average Ramp Rates of HECO Units in MW/minute

Unit	Ramp Rates
K1	2.3
K2	2.3
K3	2.3
K4	2.3
K5	2.5
K6	2.5
W3	0.9
W4	0.5
W5	1.4
W6	1.4
W7	2.3
W8	2.3
W9	3
W10	3
H8	1.4
H9	1.4
AES	2.5
KCT1	2.5
KCT2	2.5



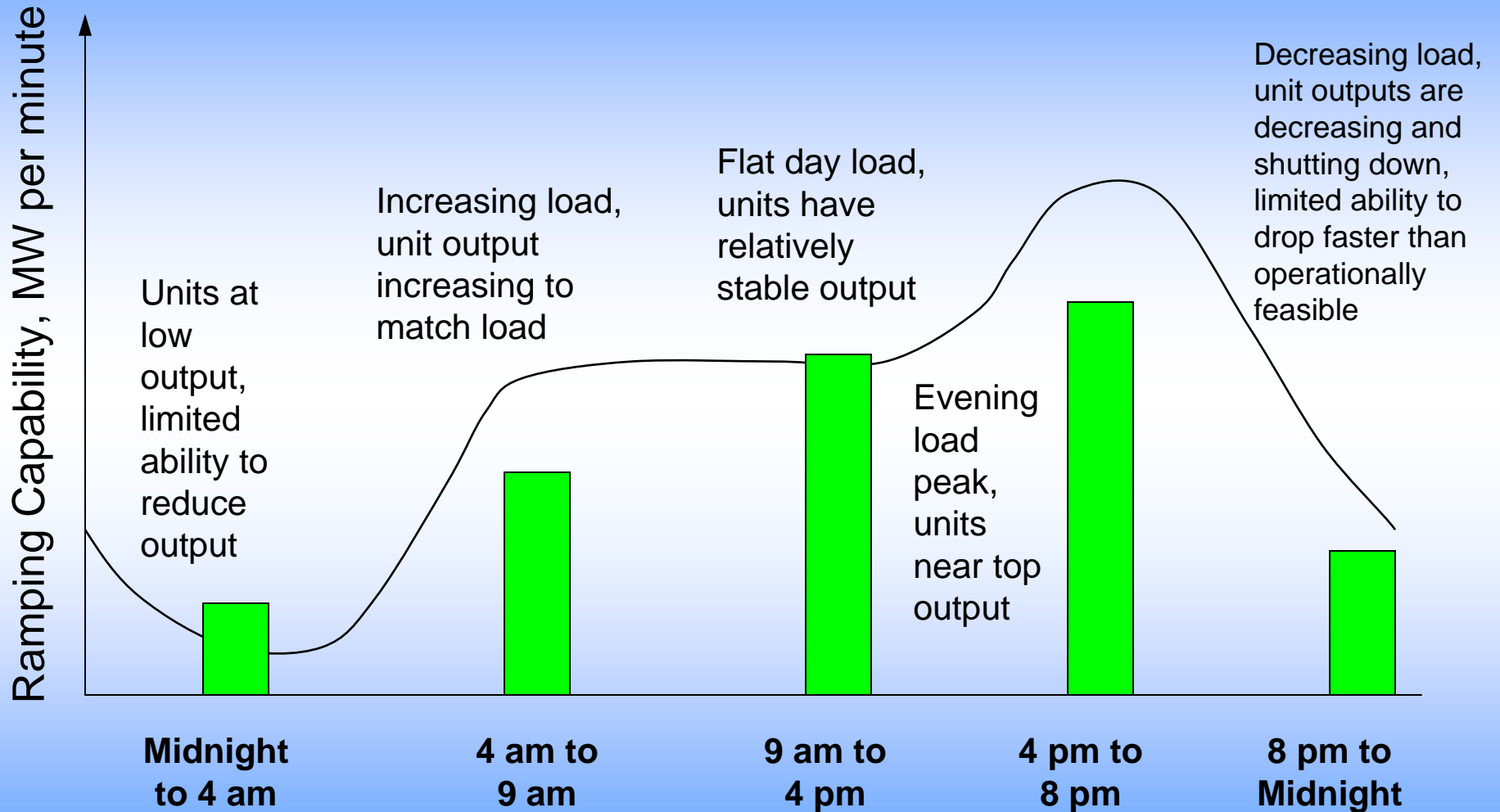
System Ramp Up Capability

(Illustrative – Not to Scale)



System Ramp Down Capability

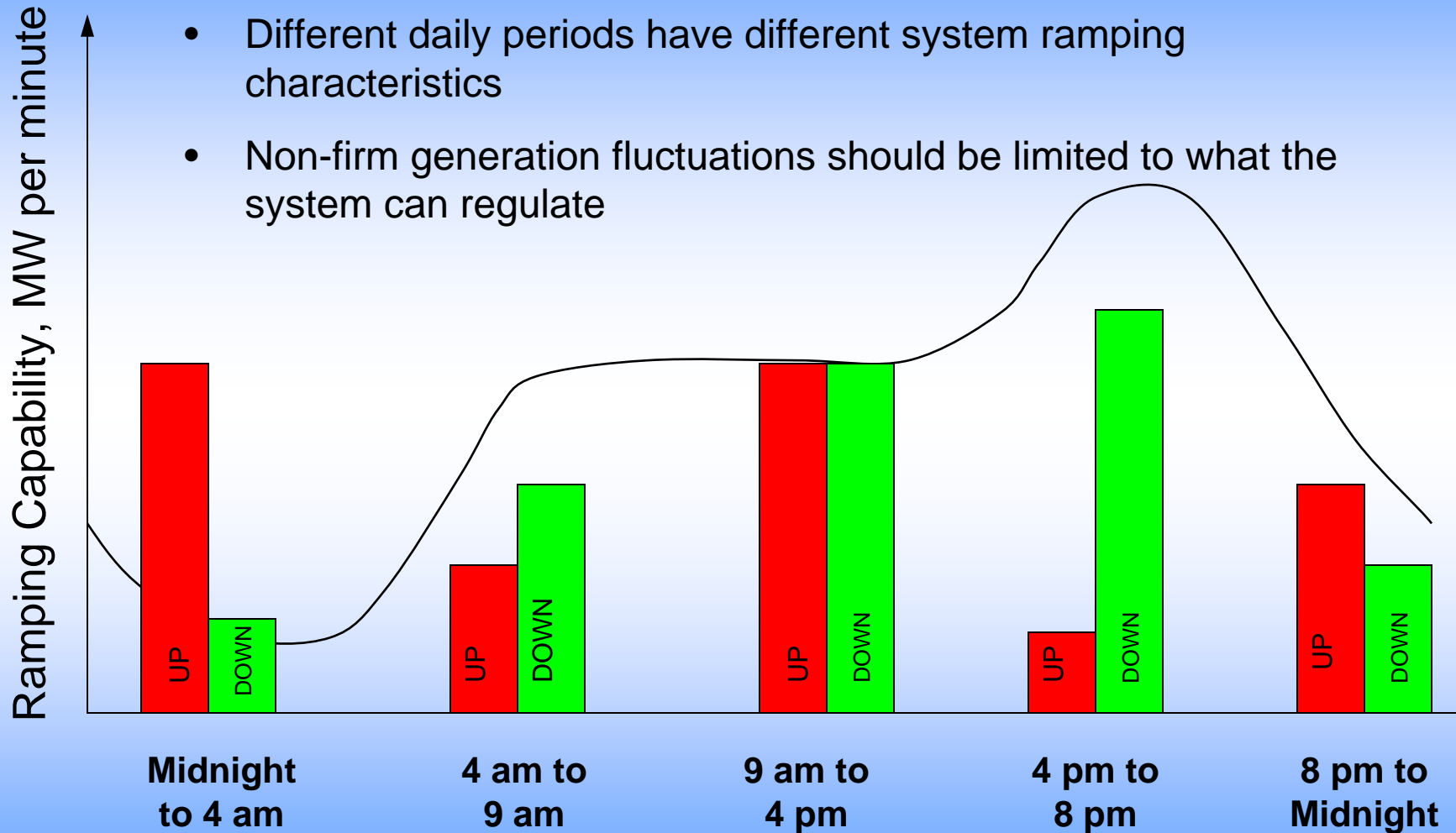
(Illustrative – Not to Scale)



System Ramping Capability Comparison

(Illustrative – Not to Scale)

- Different daily periods have different system ramping characteristics
- Non-firm generation fluctuations should be limited to what the system can regulate

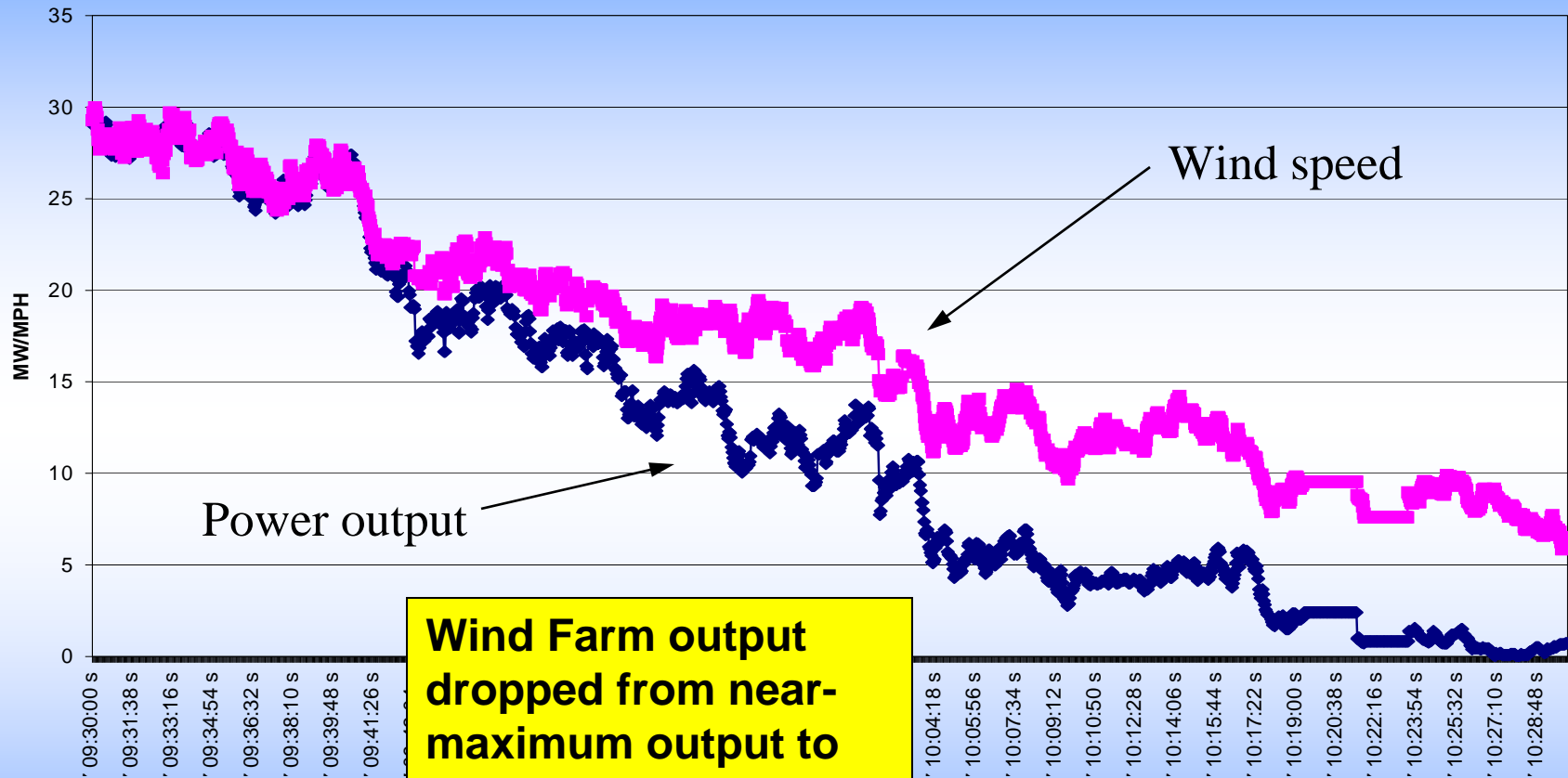


Responding to Sustained Ramp-Down of As-Available Output

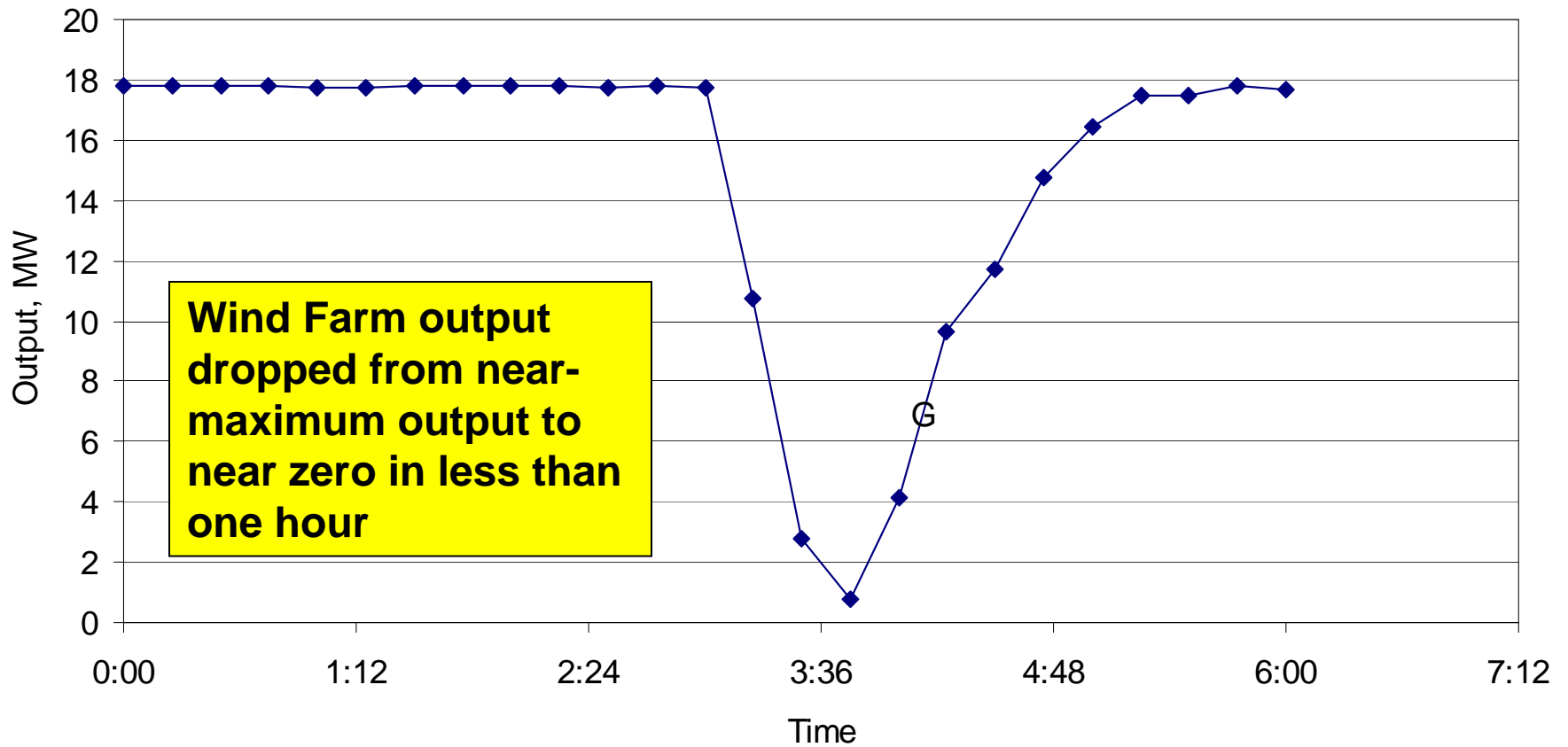
- Problem that can occur on a longer time scale
 - Tens of minutes to an hour, rather than minute to minute
- HECO also included a 10 minute ramp up and down standard



Maui Wind Farm Output



Big Island Wind Farm Output



Ramp Rates

- Refer to Draft PPA
Appendix B, Section 3.C
- Ramp rate pricing scenarios for wind farm projects less than 50 MW in capacity, between 50 MW and 100 MW capacity, and non-wind generation projects
RFP Appendix B, Section 4



Example of Ramp Rate Standard for Wind Farm Projects less than 50 MW in capacity

- 1) Maximum ramp rate upward of 2 MW per minute for all periods except during early morning low load periods:

Typically Midnight to 4 am, maximum ramp rate upwards of 1 MW per minute

- 2) Maximum ramp rate downward of 2 MW per minute for all periods except during evening peak periods:

Typically 4 pm to 8 pm, maximum ramp rate downwards of 1 MW per minute

- 3) Sustained upward or downward ramp rate of 10 MW per 10 minute period



Thank You

