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Unit Commitment and Dispatch

Intermediate Wholesale Electricity Markets (IWEM)



Slides containing quiz questions or classroom exercises are hidden in the printed and posted versions of this presentation.

Ke Ma

Lead Analyst, Advanced Technologies Solutions



Objectives

At the end of this session, you will be able to:

- Define unit commitment
- Describe the goal of unit commitment
- Describe the commitment process
- Describe how the unit commitment and selection process affects the operating day
- Describe the effect of changing bid and offer parameters have on commitment



Topics

- Commitment and Dispatch Review
- Impacts to Commitment or Dispatch
 - Resource Characteristics
- Commitment and Economic Dispatch Example
- Full Day Market Example

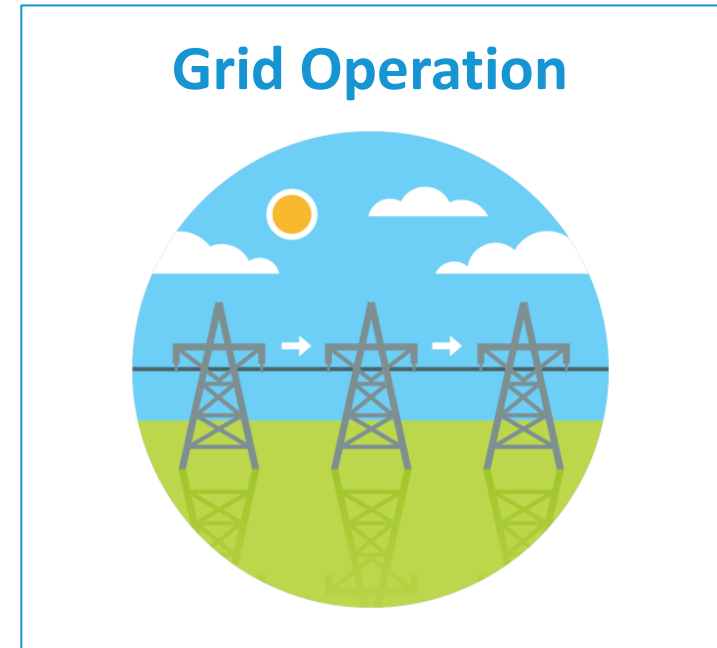


Commitment and Dispatch Review



Operating a Safe and Cost-Effective Grid

- Minimize cost of electricity production
- Determine least-cost security-constrained **commitment** and **dispatch**
 - Serve load at different locations in the area based on:
 - Forecasted or actual conditions
 - Prices participants offered to supply and consume energy



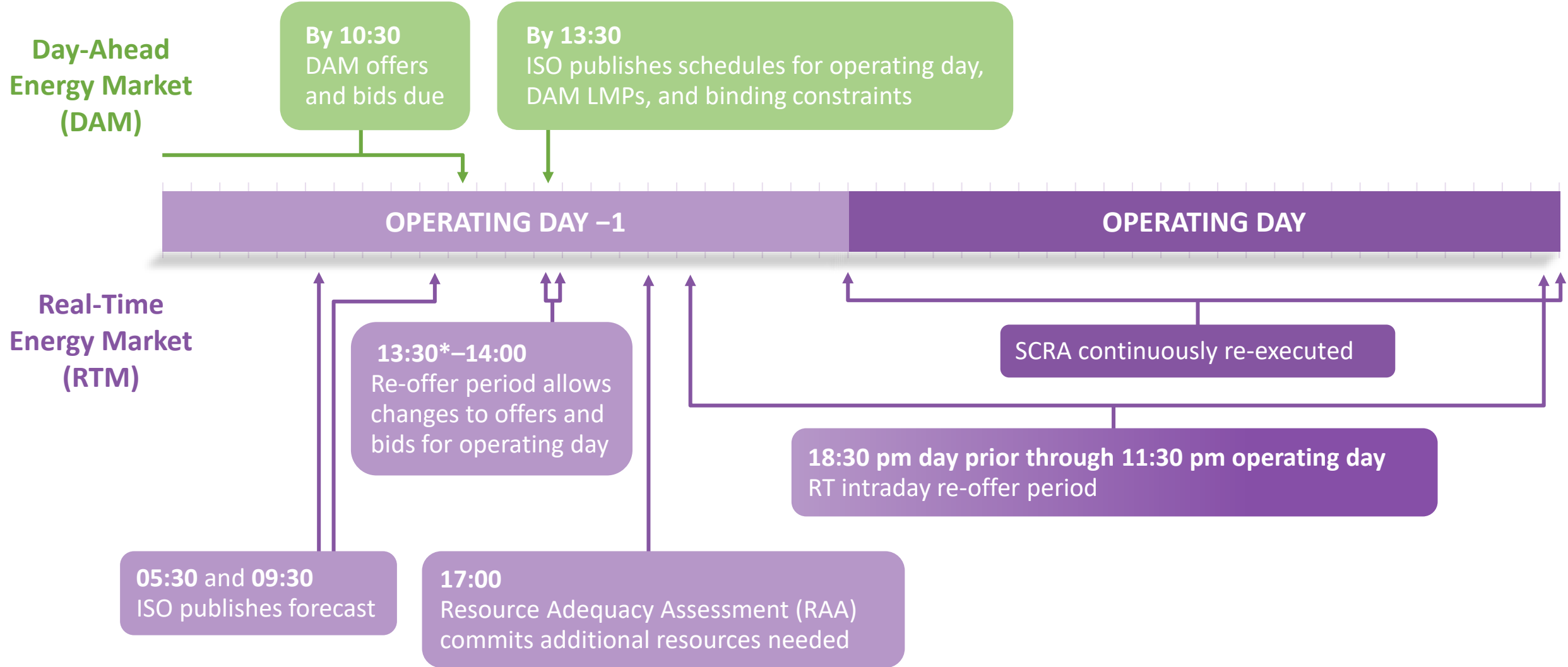
How to operate the power system is one of ISO's responsibilities

Commitment Overview



- Decision making process
- **ON** or **OFF** for defined period
- In place since 1970s
- Algorithm-based decisions

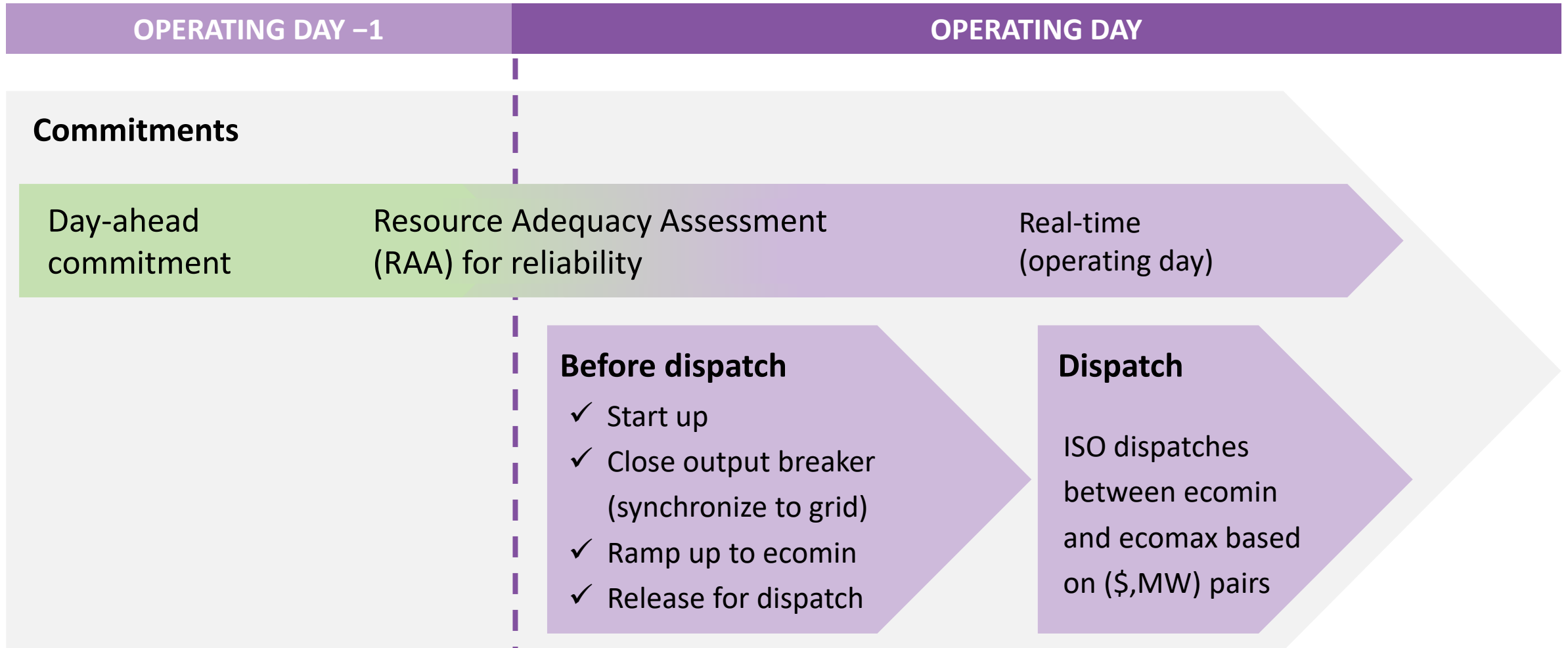
Day-Ahead and Real-Time Energy Market Timeline



[See eMarket User Guide](#) for more detail

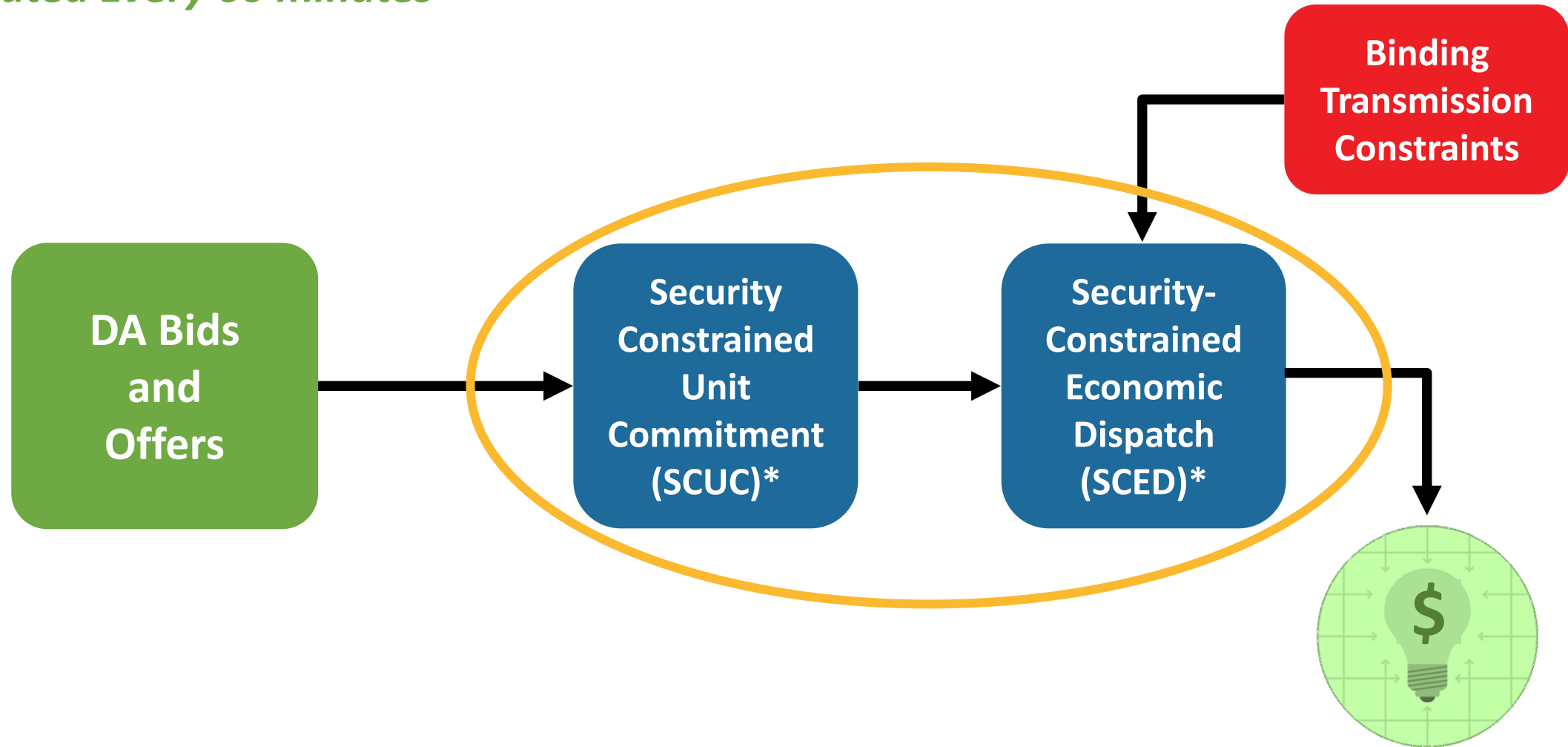
Perpetual Cycle of Unit Commitment and Dispatch

A Day in the Life of a Resource



Commitment and Dispatch is Part of Calculating Day-Ahead (DA) LMPs

Calculated Every 60 minutes

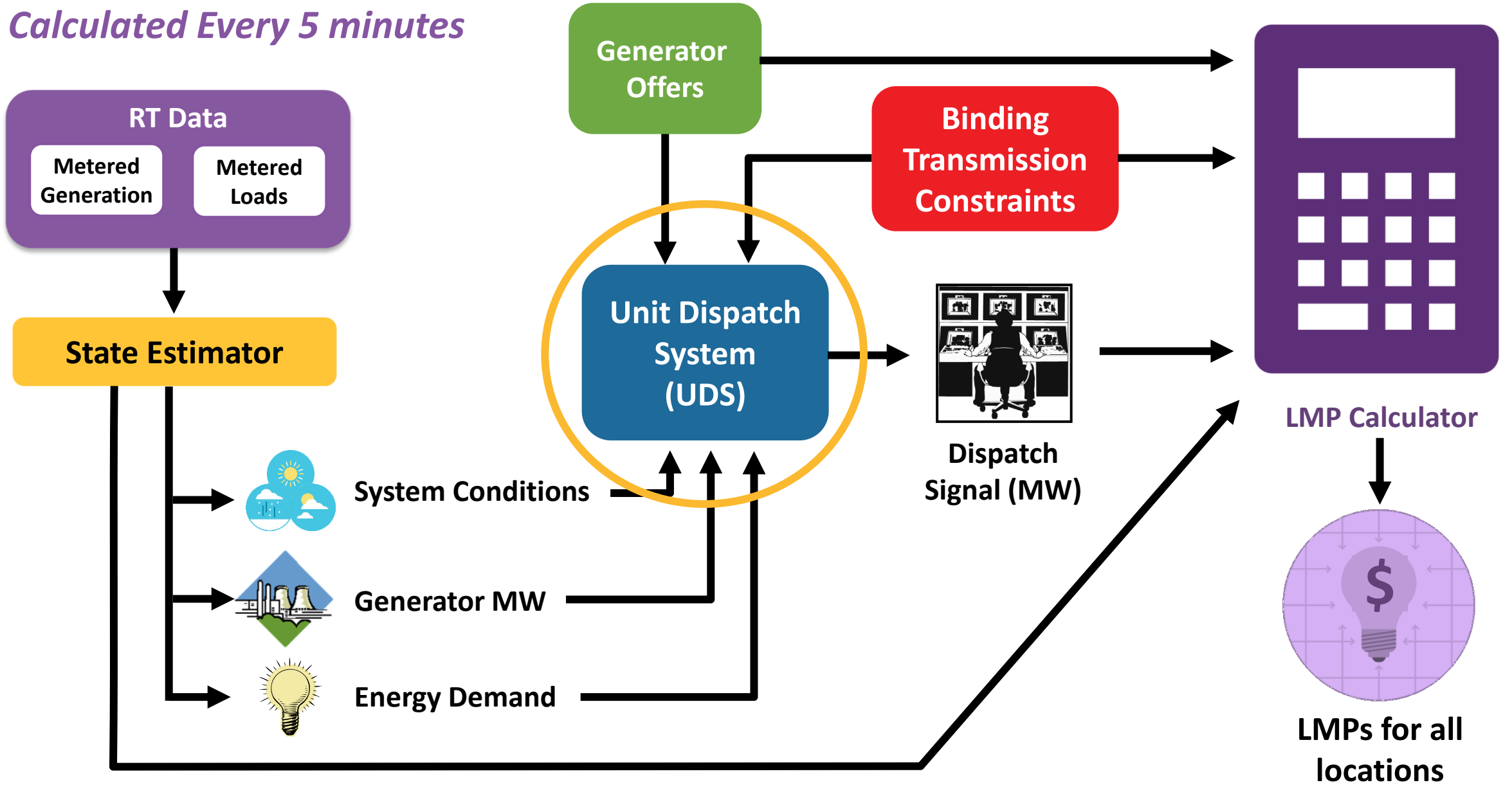


DA LMPs for all locations

** SCUC is also known as Resource Scheduling & Commitment (RSC)
SCED is also known as Unit Dispatch System (UDS)*

Commitment and Dispatch is Part of Calculating Real-Time (RT) LMPs

Calculated Every 5 minutes





Factoring Commitment into Economic Dispatch

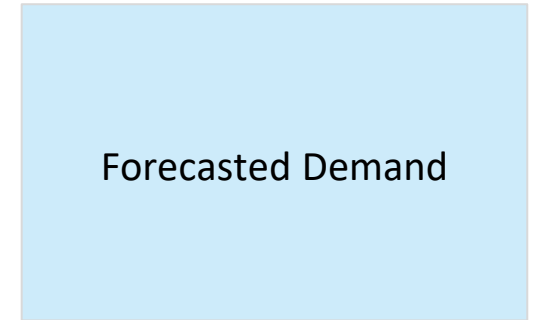
Day-Ahead Market (DAM)



Economic dispatch:

- Maximizes **social welfare** in both the day-ahead and real-time markets
- Uses the **least-cost** of the committed resources to meet demand
- Does not use intertemporal parameters*
- Determines LMPs (not commitment)

Real-Time Market (RTM)

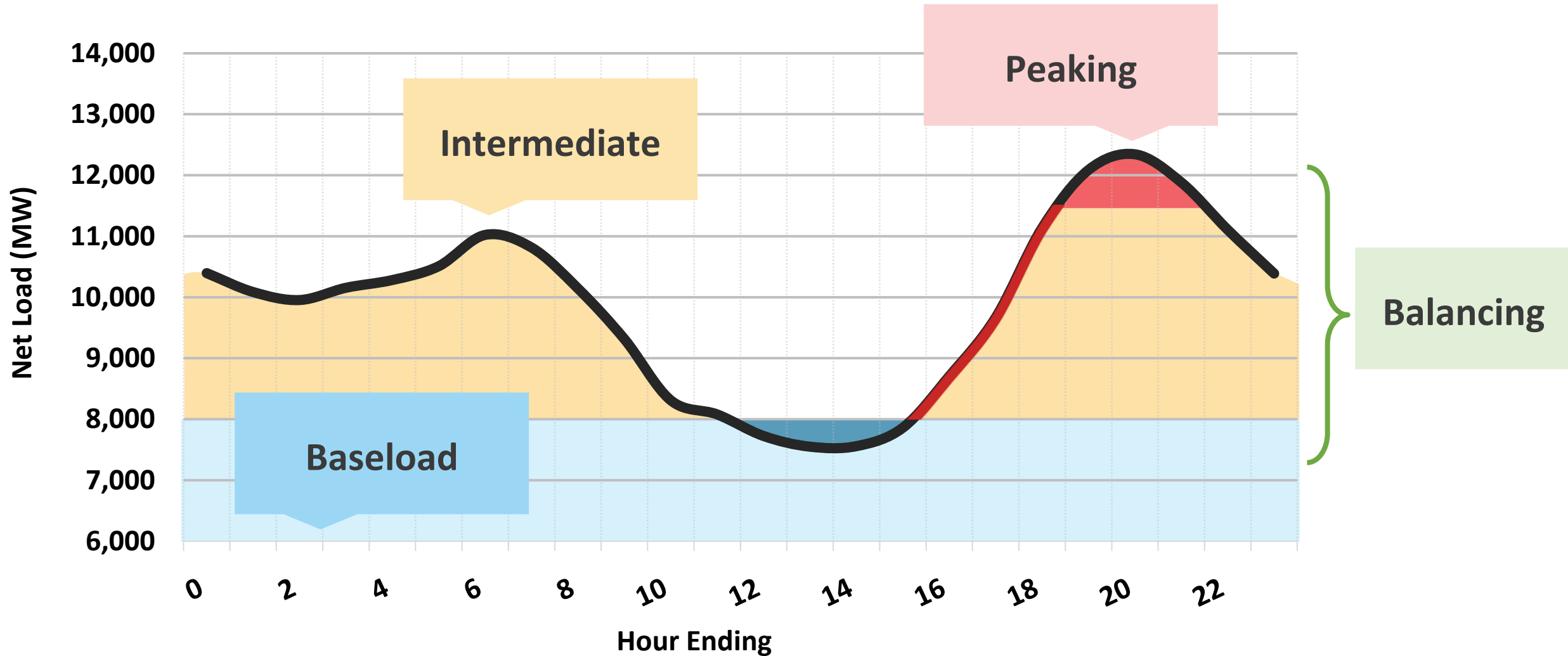


* Intertemporal parameters are enforced by unit commitment

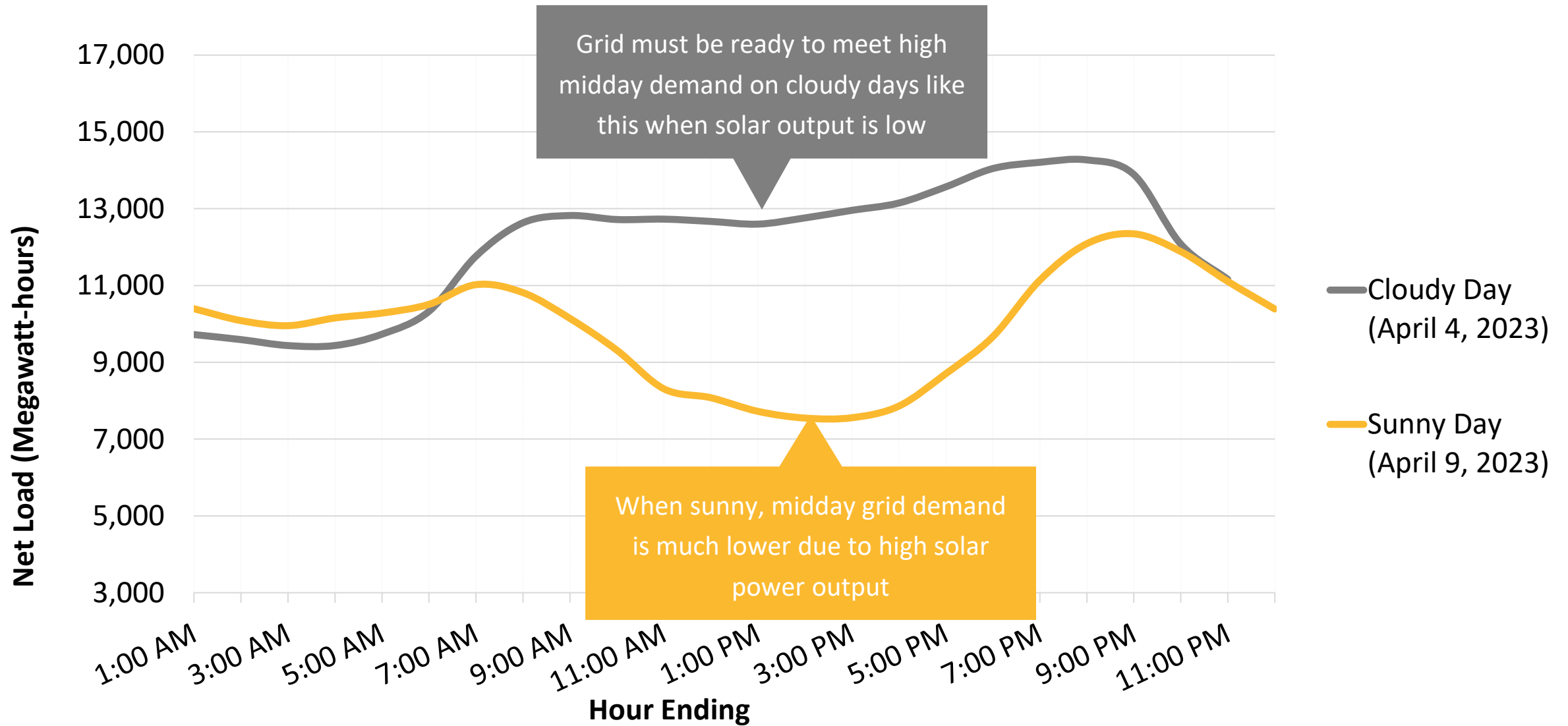
Impacts to Commitment or Dispatch

Resource Classifications Are Changing

Load Curve for April 9, 2023

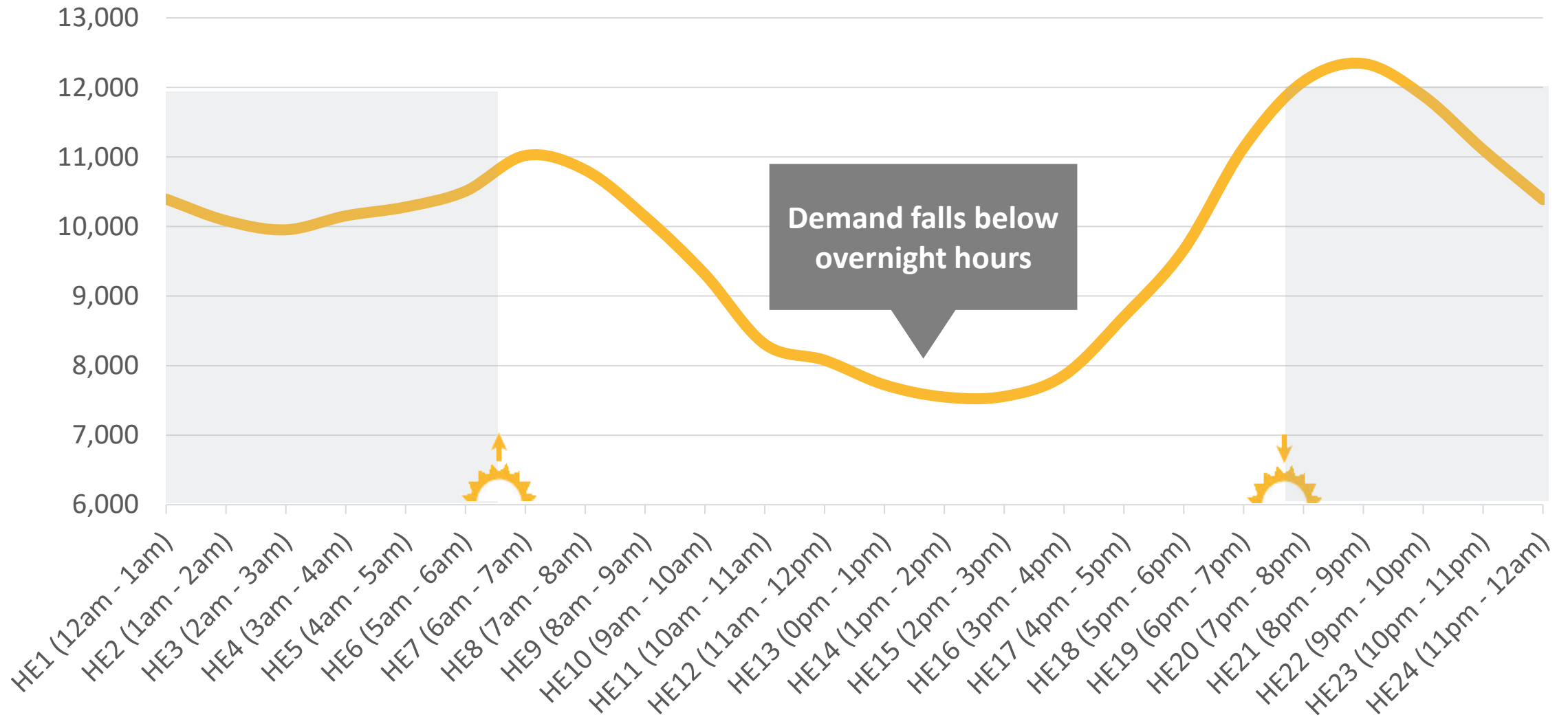


Weather Affects Photovoltaic Output



Learn more at: <https://www.iso-ne.com/about/what-we-do/in-depth/solar-power-in-new-england-locations-and-impact>

— April 9, 2023



ISO uses **hour ending (HE)** to describe the hours in a day. Hours 1-24 are the hours from midnight one day through midnight the next day. For example, HE 1 is from 12 a.m. to 1 a.m., HE 2 is from 1 a.m. to 2 a.m., and so on.

Offer Parameters Impact Commitment and Dispatch

Parameters that Could Impact Unit Commitment or Dispatch



Parameters for generators



Parameters for active demand response resources

Active demand resources* are dispatched economically based on their energy market offers, just like power plants and other supply resources

Economic

- Incremental energy offer curves
- Start-up costs
- No-load costs

- Incremental offers
- Interruption costs

Physical Limits

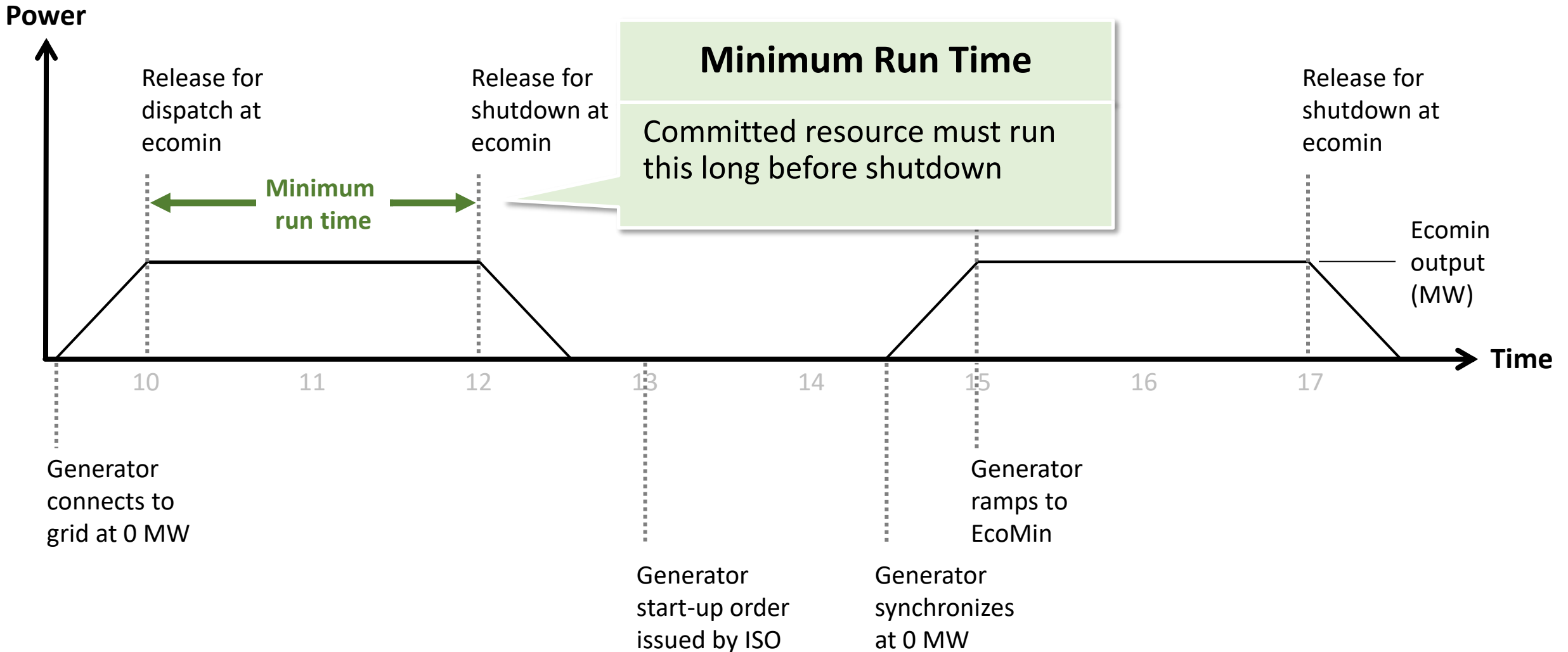
- Start-up time
- Notification time
- Minimum run time
- Minimum down time
- Economic minimum (ecomin)
- Economic maximum (ecomax)

- Start-up time
- Notification time
- Minimum reduction time
- Minimum time between reductions
- Maximum reduction
- Minimum reduction

* *Passive demand resources, which are not dispatchable, are ineligible to participate in the energy markets. Learn more at <https://www.iso-ne.com/markets-operations/markets/demand-resources/about>.*

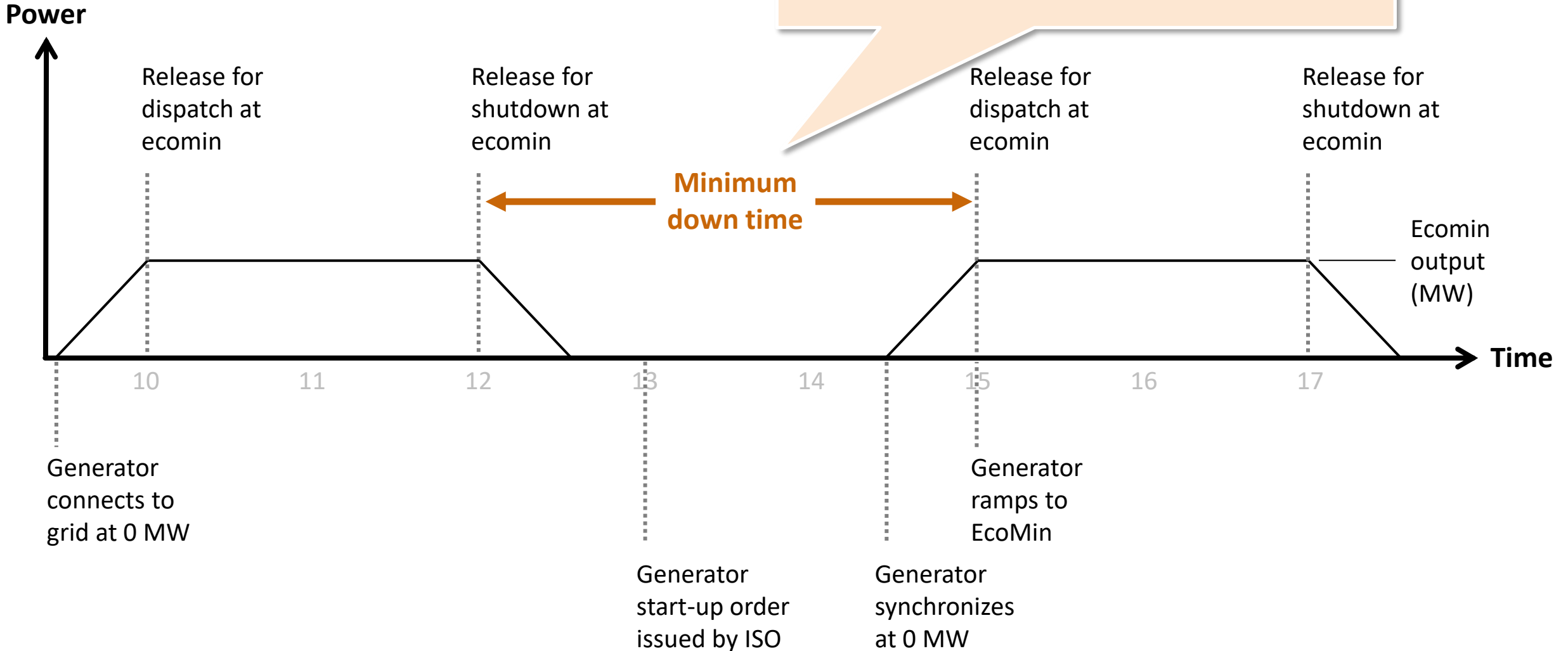
Intertemporal Parameters

Minimum Run Time



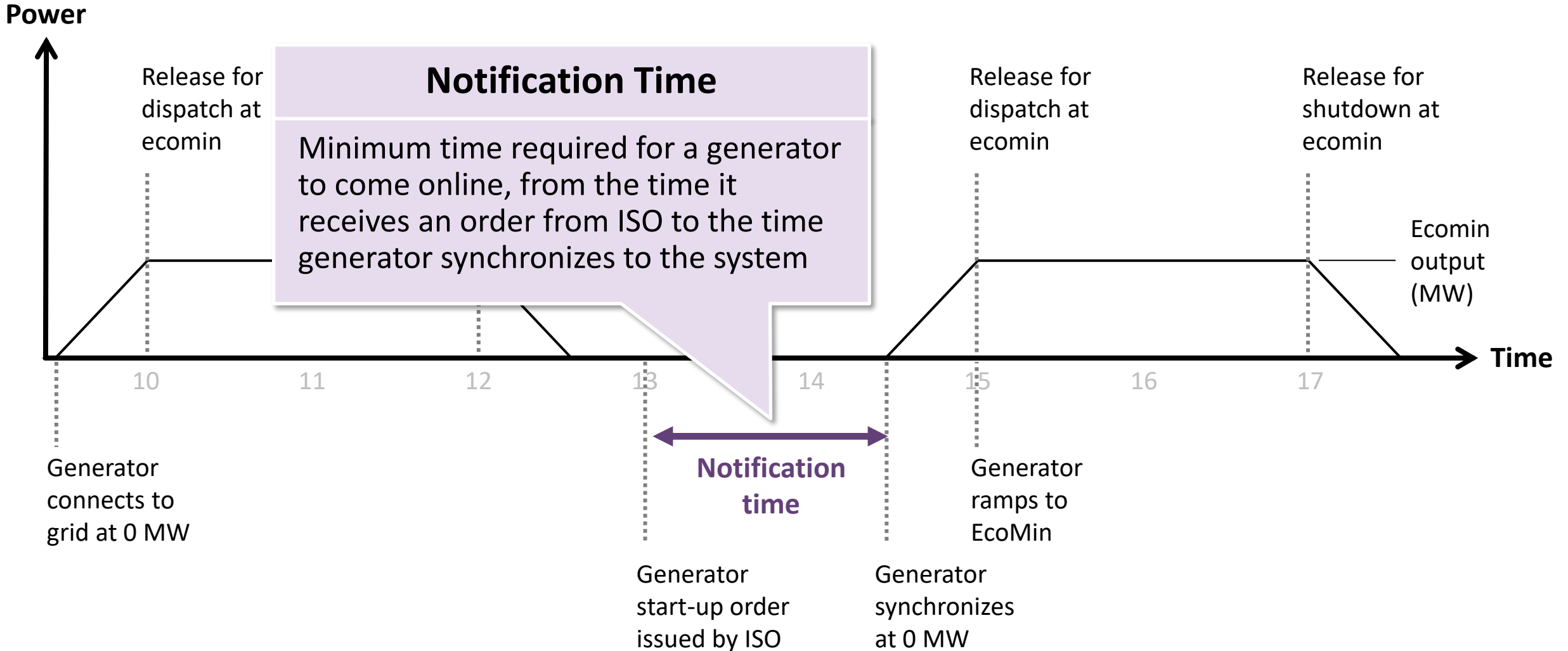
Intertemporal Parameters

Minimum Down Time



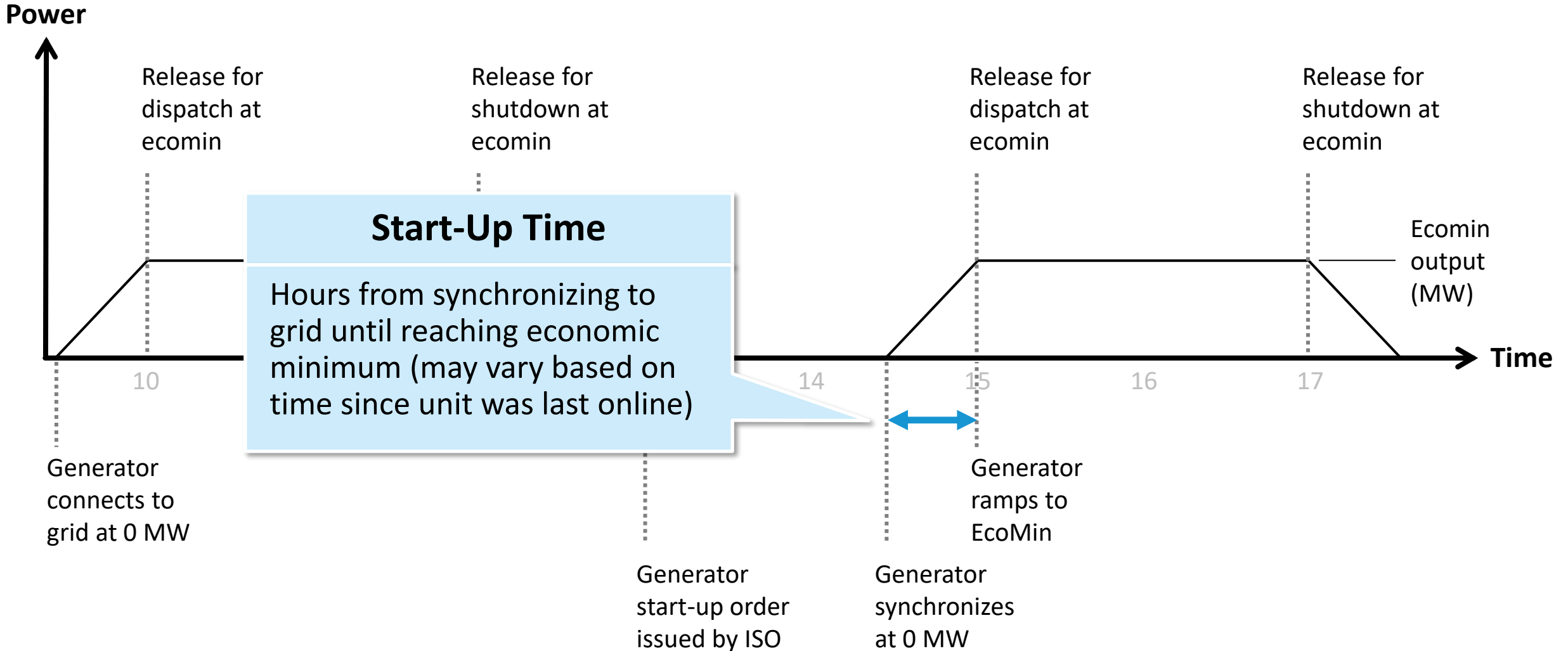
Intertemporal Parameters

Notification Time



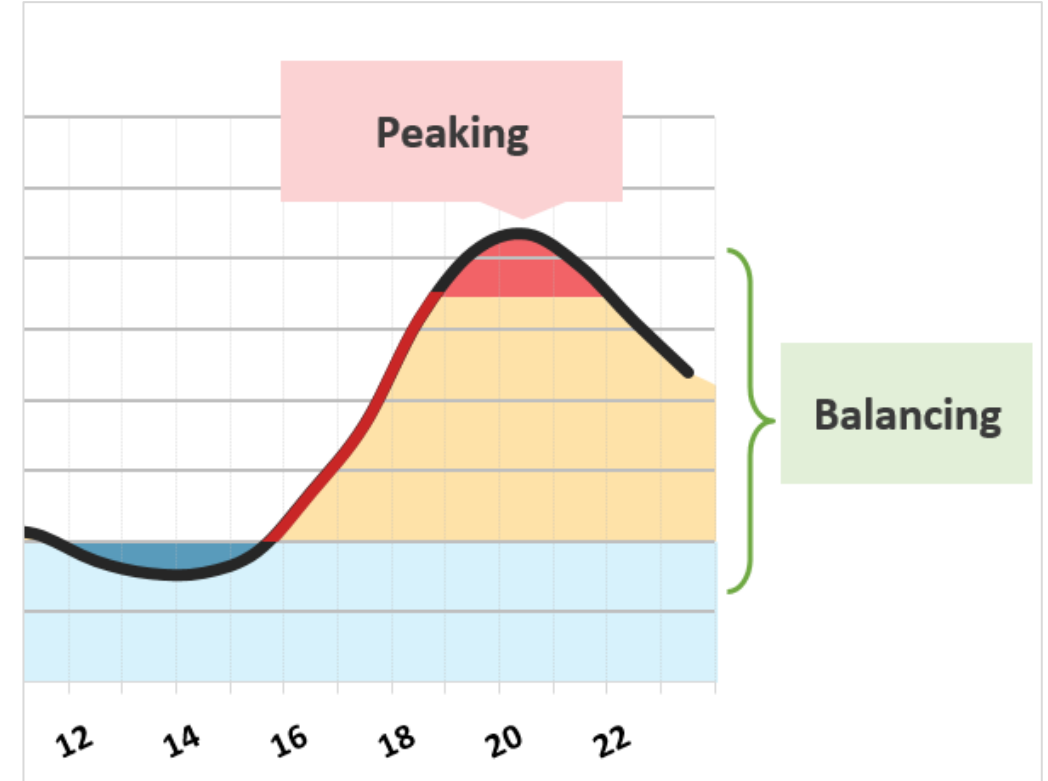
Intertemporal Parameters

Start-Up Time



Fast-Start Qualified Offers

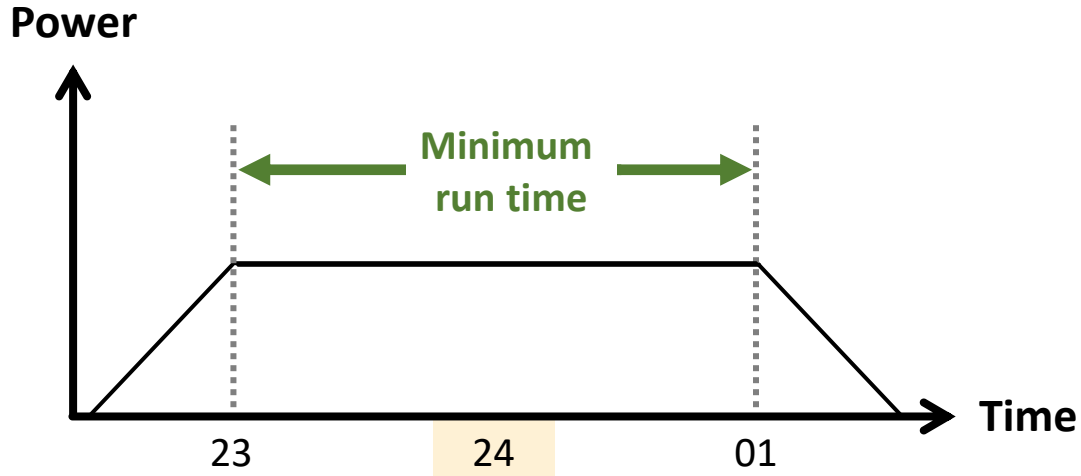
- Fast-start qualified offer
 - Minimum run time ≤ 1 hour
 - Minimum down time ≤ 1 hour
 - Notification time plus start-up time ≤ 30 minutes
- Only resources with fast-start qualified offers may be designated for off-line reserves



Fast-Start vs. Non Fast-Start Commitment and Dispatch

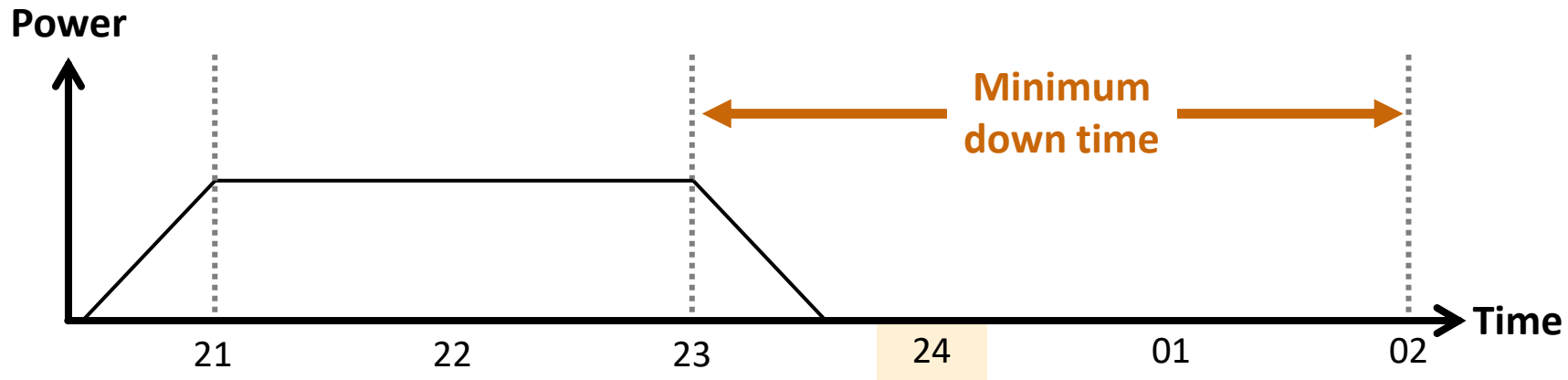
	Day-Ahead Market (DAM)	Real-Time Market (RTM)
Fast-Start	<ul style="list-style-type: none">• Purely financial commitment (not physical)• Economic obligation but not an actual dispatch	<ul style="list-style-type: none">• May be committed (or not) regardless of their day-ahead clearing status• Resources that follow dispatch instructions are “made whole” to their offers
Non Fast-Start (Slow-Start)	<ul style="list-style-type: none">• ON or OFF in each hour• Understood to be an actual dispatch• Expected to be at ecomin at the top of the first cleared hour• Resource Adequacy Assessment may commit additional slow-start resources for reliability	<ul style="list-style-type: none">• Initial commitment schedule is from DAM• Dispatched between ecomin and ecomax based on economic offer

Long Minimum Run Times / Minimum Down Times



End-of-horizon effect: Commitment decisions at hour 24 can impact the commitment at the beginning of the next day

- Long minimum run times can cause over-commitment
- Long minimum down times can cause under-commitment



Starting Status for Hour 1 of Commitment Impacts Commitment and Dispatch

Commitment starts with status from the previous day

- On or Off
- Number of hours in that state

Status based on two values:

- Previous day's DAM commitment
- Changes made to the current commitment schedule by the:
 - RAA process
 - Participant self-scheduling additional or decommitting before next DAM



Limited Energy Resources and Commitment

- Resources with limited amount of energy (quantity submitted by resource owner) are committed to optimize the overall cost of the daily dispatch
- Resources may or may not be used in the most expensive hours of the day (or those with the highest LMPs) since the commitment is using this resource in conjunction with other resources towards maximizing social welfare
- Commitment will not necessarily optimize the profit of that generator but will optimize social welfare and respect generator offer





Questions?

Commitment and Economic Dispatch Example

Use Three Resources to Commit 100 MW of Load in One Location



Our Example Versus a Typical Day Market

Three resources
(X, Y, and Z)

For a single hour with three assets...

Possible combos = $(2^3)^1$

One
hour



Two combinations
(on=1 or off=0)

Number of hours	Number of assets	Number of possible combinations
1	3	$(2^3)^1 = 8$
4	3	$(2^3)^4 = 8^4 = 4,096$
24	32	$(2^{32})^{24} = 4294967296^4 = 1.55e+231$

- Typically 10 – 50 resources committed for each hour of day
- Trying every possible combination by hand would take a long time
- Mathematical techniques are used to determine a solution

Full day with 32 assets...

Example – Commit Lowest Cost Resource(s) to Serve 100 MW of Load

Resource (Asset)	Cost \$/MWh	Ecomin MW	Ecomax MW	Start up and no load costs \$/hour
X	\$10	50	100	\$2,000
Y	\$30	100	150	\$1,000
Z	\$40	75	300	\$0

Note: For training purposes, the start up and no load costs are combined

Scenario assumptions:

- 1 hour (hour XX)
- 1 location
- Intertemporal parameters are all the same
- All resources are available
- All resources are off

Step 1 List all Combination(s) of Resources that Could Supply a Given Load

For a single hour with three assets...

Possible combos = $(2^3)^1$

Three resources
(X, Y, and Z)

One
hour



Two combinations
(on=1 or off=0)

Number of hours	Number of assets	Number of possible combinations
1	3	$(2^3)^1 = 8$

0 = Off

1 = On

	Combination	On/off status		
		X	Y	Z
1	none	0	0	0
2	X	1	0	0
3	Y	0	1	0
4	Z	0	0	1
5	X, Y	1	1	0
6	X, Z	1	0	1
7	Y, Z	0	1	1
8	X, Y, Z	1	1	1

Step 2 Find Total Ecomin and Ecomax for Each Combination

Asset	Ecomin (MW)	Ecomax (MW)
X	50	100
Y	100	150
Z	75	300



Combo #	Ecomin (Assets On)	Total Ecomin	Ecomax (Assets On)	Total Ecomax
1	–	0	–	0
2	X = 50	50	X = 100	100
3	Y = 100	100	Y = 150	150
4	Z = 75	75	Z = 300	300
5	X = 50 Y = 100	150	X = 100 Y = 150	250
6	X = 50 Z = 75	125	X = 100 Z = 300	400
7	Y = 100 Z = 75	175	Y = 150 Z = 300	450
8	X = 50 Y = 100 Z = 75	225	X = 100 Y = 150 Z = 300	550

Range of achievable load levels

Sum the ecomin and ecomax for the resources which are **ON** in each combination



Step 3 Determine Which Combination(s) Can Supply 100 MW of Load

Range is the total ecomin to total ecomax found in step 2

	Combo	Total Ecomin	Total Ecomax	Feasible?
1	-	0	0	
2	X	50	100	
3	Y	100	150	
4	Z	75	300	
5	X, Y	150	250	
6	X, Z	125	400	
7	Y, Z	175	450	
8	X, Y, Z	225	550	

Asset	Ecomin (MW)	Ecomax (MW)
X	50	100
Y	100	150
Z	75	300

If the load (100 MW) is not within a combo's range, then the combo is **not feasible**

- If load is greater than total ecomax, it is not feasible due to a *deficit*
- If total load is less than total ecomin, it is not feasible due to a *surplus*

Step 4 Determine Least Cost Combo to Meet 100 MW of Load

	Total ecomin to total ecomax	Start up and no load costs	Dispatch cost calculation	Dispatch cost	Total cost
1 (none)	0 – 0	–	–	–	
2 (X)	50 – 100	X = \$2,000			
3 (Y)	100 – 150	Y = \$1,000			
4 (Z)	75 – 300	Z = \$0			
5 (X, Y)	150 – 250	X = \$2,000 Y = \$1,000			
6 (X, Z)	125 – 400	X = \$2,000 Z = \$0			
7 (Y, Z)	175 – 450	Y = \$1,000 Z = \$0			
8 (X, Y, Z)	225 – 550	X = \$2,000 Y = \$1,000 Z = \$0			

	Cost per MWh	Eco-min	Eco-max	Start up and no load costs
X	\$10	50	100	\$2,000
Y	\$30	100	150	\$1,000
Z	\$40	75	300	\$0

- 1 List all possible combinations of resources
- 2 For each resource combination, calculate total ecomin and ecomax
- 3 Determine if each of the combinations can satisfy load (are they feasible?)
- 4 Determine least cost feasible combination

What If We Needed to Commit 101 MW of Load?

	Total ecomin to total ecomax	Start up and no load costs	Dispatch cost calculation	Dispatch cost	Total cost
1 (none)	0 – 0	–	–	–	
2 (X)	50 – 100	X = \$2,000			
3 (Y)	100 – 150	Y = \$1,000			
4 (Z)	75 – 300	Z = \$0			
5 (X, Y)	150 – 250	X = \$2,000 Y = \$1,000			
6 (X, Z)	125 – 400	X = \$2,000 Z = \$0			
7 (Y, Z)	175 – 450	Y = \$1,000 Z = \$0			
8 (X, Y, Z)	225 – 550	X = \$2,000 Y = \$1,000 Z = \$0			

	Cost per MWh	Eco-min	Eco-max	Start up and no load costs
X	\$10	50	100	\$2,000
Y	\$30	100	150	\$1,000
Z	\$40	75	300	\$0

- 1 List all possible combinations of resources
- 2 For each resource combination, calculate total ecomin and ecomax
- 3 Determine if each of the combinations can satisfy load (are they feasible?)
- 4 Determine least cost feasible combination

What If We Needed to Commit 170 MW of Load?

	Total ecomin to total ecomax	Start up and no load costs	Dispatch cost calculation	Dispatch Cost	Total cost
1 (none)	0 – 0	–	–	–	
2 (X)	50 – 100	X = \$2,000			
3 (Y)	100 – 150	Y = \$1,000			
4 (Z)	75 – 300	Z = \$0			
5 (X, Y)	150 – 250	X = \$2,000 Y = \$1,000			
6 (X, Z)	125 – 400	X = \$2,000 Z = \$0			
7 (Y, Z)	175 – 450	Y = \$1,000 Z = \$0			
8 (X, Y, Z)	225 – 550	X = \$2,000 Y = \$1,000 Z = \$0			

	Cost per MWh	Eco-min	Eco-max	Start up and no load costs
X	\$10	50	100	\$2,000
Y	\$30	100	150	\$1,000
Z	\$40	75	300	\$0

- 1 List all possible combinations of resources
- 2 For each resource combination, calculate total ecomin and ecomax
- 3 Determine if each of the combinations can satisfy load (are they feasible?)
- 4 Determine least cost feasible combination

TEAM EXERCISE: Find the most economical combination to serve the loads below.

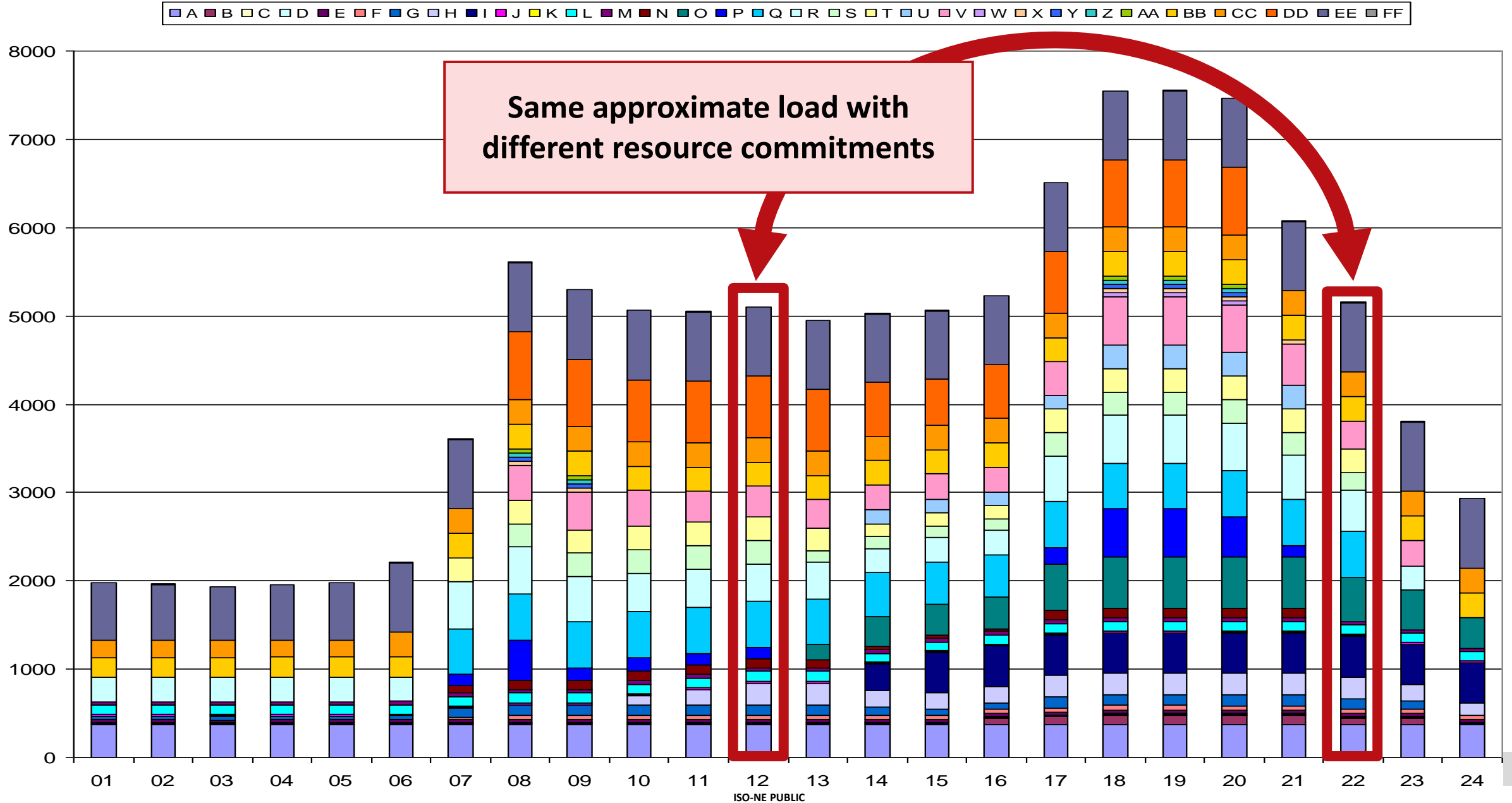
Use the worksheet to help you calculate the least cost solution. Provide each resource's megawatt output and the total cost to serve the load.

Resource	Cost (\$/MWh)	Ecomin (MW)	Ecomax (MW)	Start up/no load (\$/hour)
X	\$10	50	100	\$2,000
Y	\$30	100	150	\$1,000
Z	\$40	75	300	\$0

Note: All resources were initially OFF

Load* MW	X MW Costs	Y MW Costs	Z MW Costs	Total Cost

Economically Committed Resources



Two Types of Commitment (Both Day Ahead or Real Time)

ISO Committed (Pool Schedule)

- ISO tells resource to come online
- Costs will be covered through locational marginal price (LMP) or Net Commitment Period Compensation (NCPC)

Self Committed (Self Schedule)

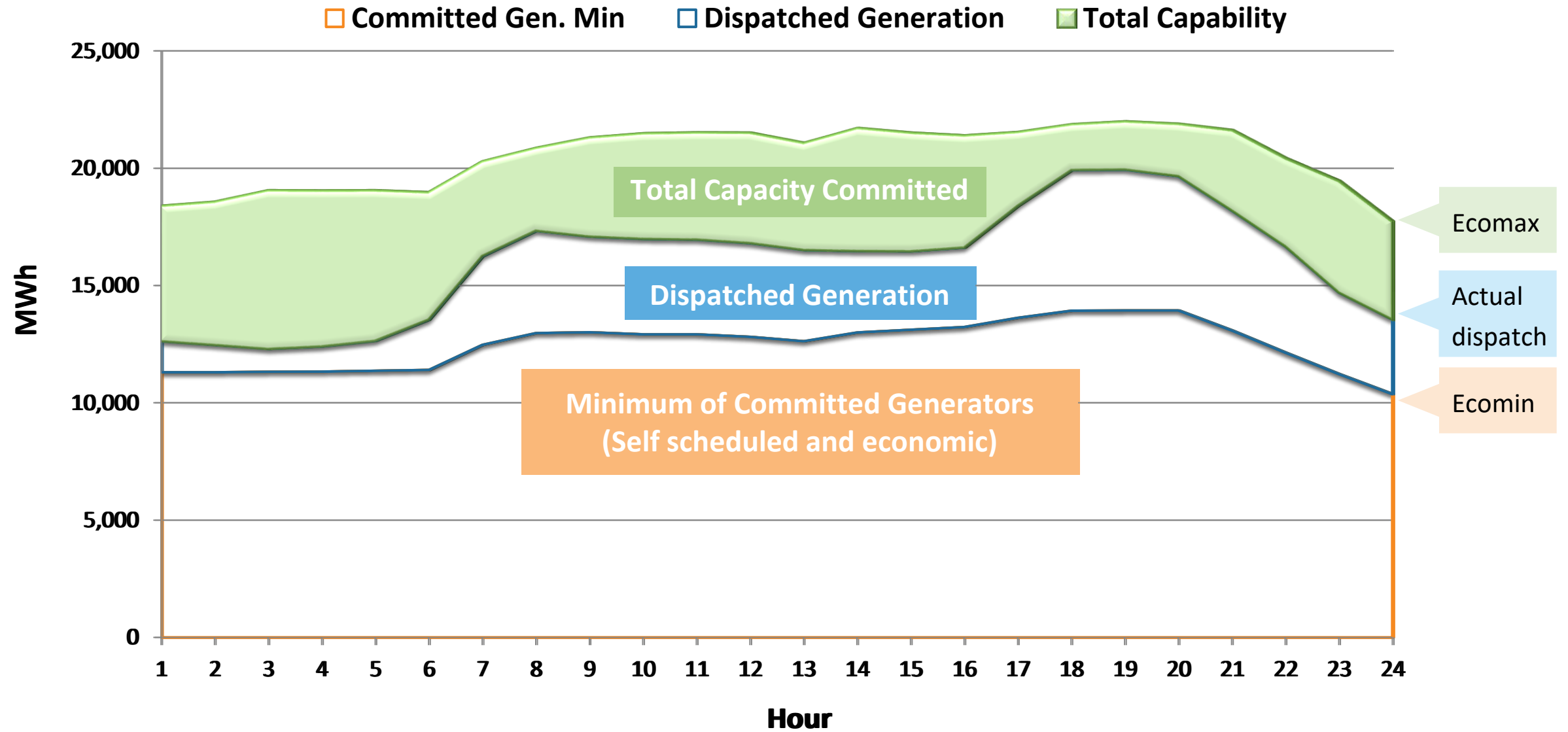
- Resource decides to come online
- Costs *may or may not* be covered through LMP
 - Not eligible for NCPC
- Price taker (at ecomin)

Self-Dispatch

Resource chooses specific minimum output level

- A self-dispatch request is effectively an intra-hour reoffer at the energy offer floor or energy offer cap for the MW requested by the participant
- Must be done at least 30 minutes before operating hour
- Can be dispatched above the chosen minimum output if economical (LMP cannot be lower than offer price)

Dispatched Generation

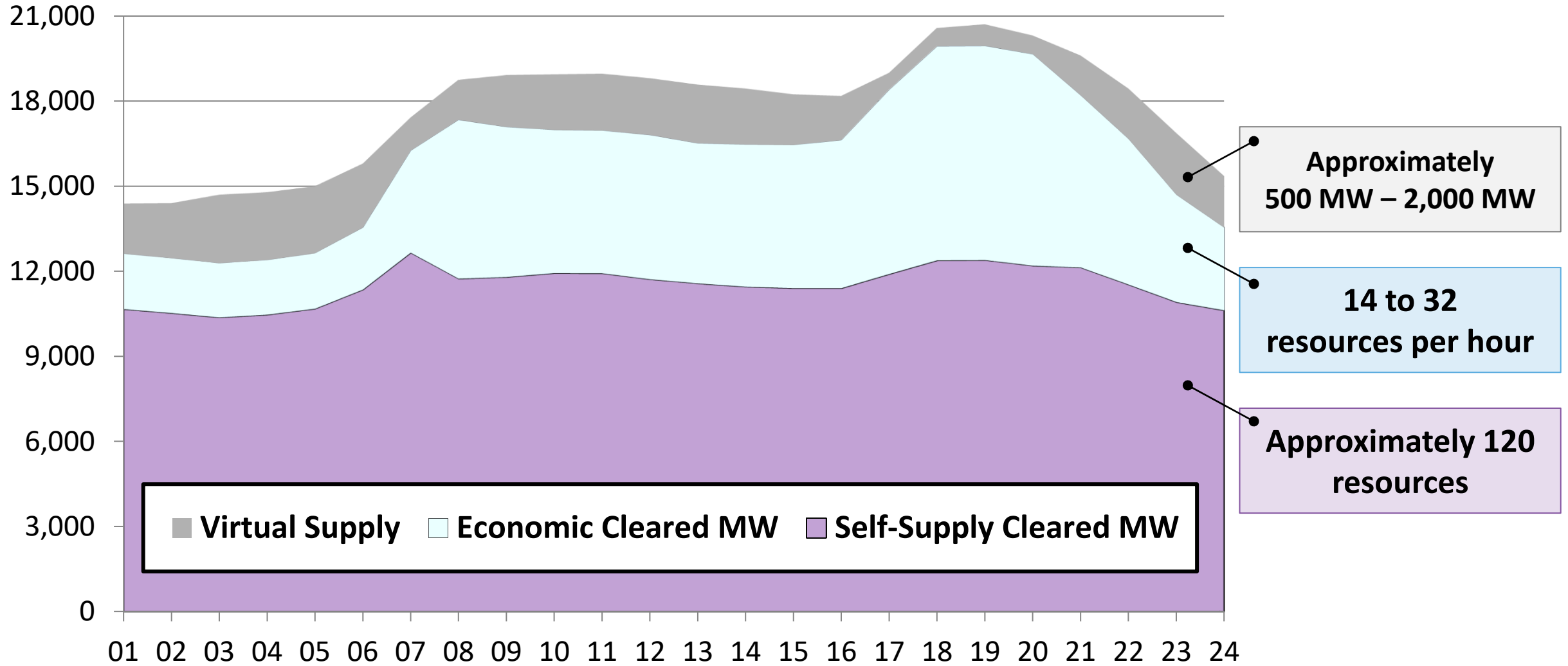


Full-Day Market Example

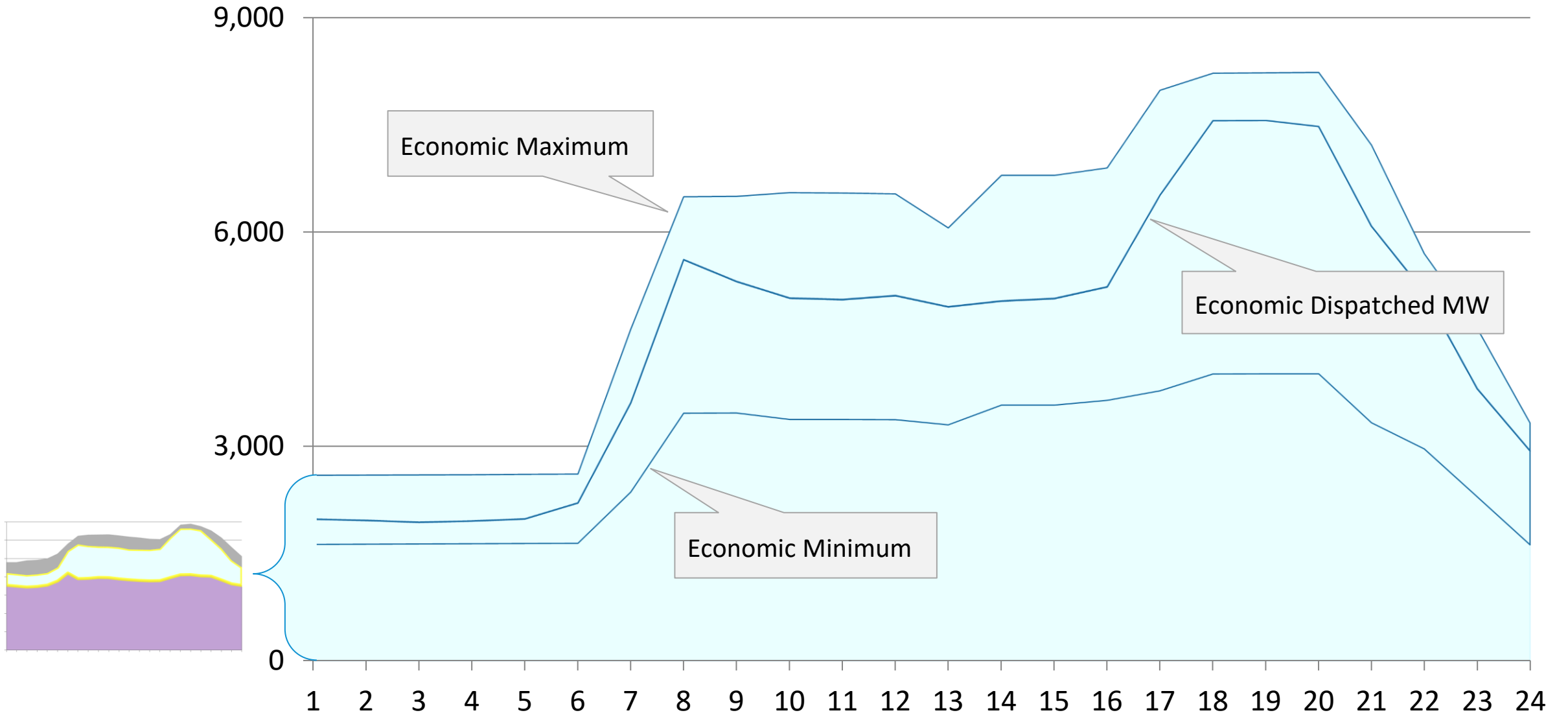
Assumptions

- All demand and supply are in the same location
- There is no congestion

Full-Day Market Example



14-32 Economically Committed Resources (Day-Ahead Cleared MW)



Commitment Schedule for 32 Economically Committed Resources

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T	12	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q	13	7	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
I	14	8	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
H	16	64	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
V	15	7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F	6	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R	13	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
G	16	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Each of the committed resources will need to be economically dispatched between the resource's minimum and maximum every hour.

0 = Off for this Hour 1 = On for this Hour

Committed Baseload Resources

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T	12	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q	13	7	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
I	14	8	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
H	16	64	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
V	15	7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F	6	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R	13	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
G	16	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
J												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

**These resources have a 24 hour minimum run time.
 Once committed must be run for the day
 (unless they were running the previous day).**

0 = Off for this Hour 1 = On for this Hour

Committed Baseload Resources

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T	12	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
PP	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
R	12	12	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
V	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Y	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
G	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

These resources have < 24 hour minimum run time, but due to economics are committed for whole day (some even have little to no minimum run/down times).

0 = Off for this Hour 1 = On for this Hour

Committed Intermediate Resources

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T	12	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q	13	7	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
			0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
			0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

- These resources have 8 to 12 hour min runs and total (min run + min down) < 24
- These resources generally have the ability to come on for one period a day (during peak)

0 = Off for this Hour 1 = On for this Hour

Committed Peaking Resources

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24										
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0										
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0										
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0										
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0										
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0										
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0										
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0										
B	8	6	0	0	0	0	0	0	0	0	0	Peaking (Fast Start) resources offer 1 hour or less minimum run and minimum down times.										1	1	1	0											
N	8	9	0	0	0	0	0	0	1	1	1											1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	12	8	0	0	0	0	0	0	0	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T	12	8	0	0	0	0	0	0	0	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DD	12	12	0	0	0	0	0	0	0	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Q	13	7	0	0	0	0	0	0	0	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
I	14	8	0	0	0	0	0	0	0	0	0											0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
H	16	64	0	0	0	0	0	0	0	0	0											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
V	15	7	0	0	0	0	0	0	0	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F	6	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
R	13	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0										
G	16	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0										
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										

0 = Off for this Hour 1 = On for this Hour

End-of-Horizon Effect (Commitment of the Current Day)

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0
B			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
N			0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O			0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S			0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T			0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD			0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q			0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
I			0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
H			0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
V	15	7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F	6	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R	13	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
G	16	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Resources V, R, and G have not run for Hour 24, so they will need to meet minimum down time the *next* day before running again.

0 = Off for this Hour 1 = On for this Hour

End-of-Horizon Effect (Infeasible Commitment of Next Day)

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0
U	8	4	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	8	9	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	10	04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
G	16	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
F	6	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

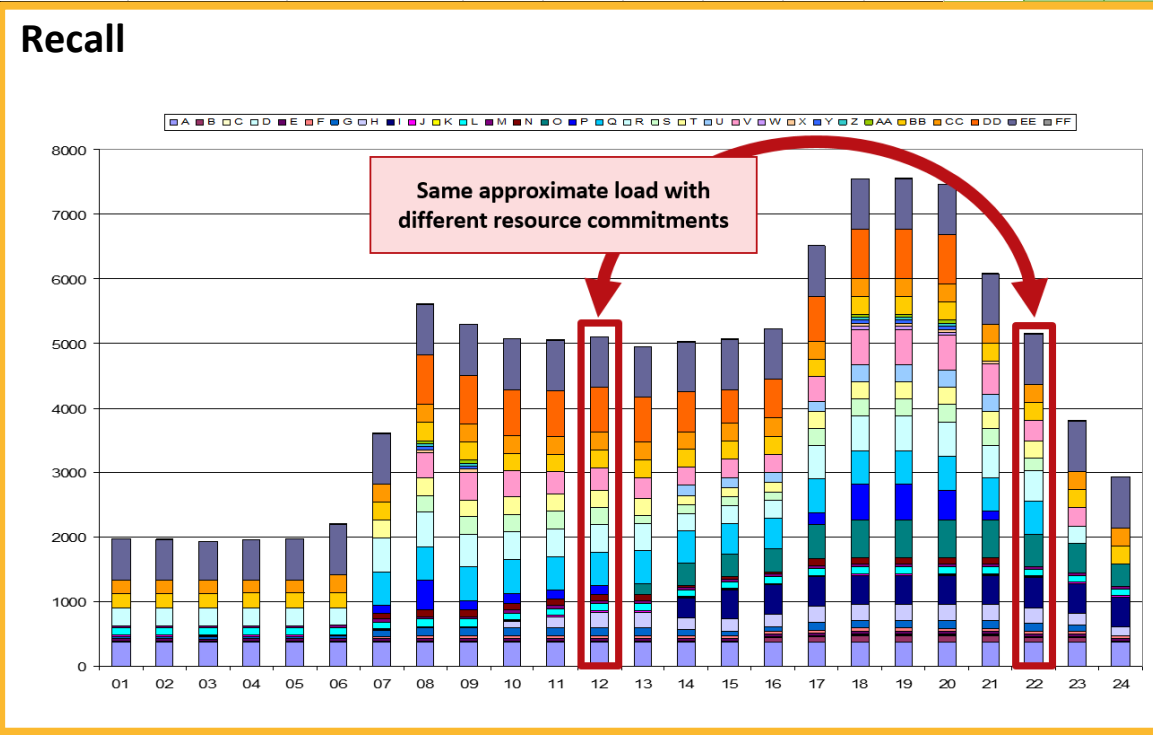
Resources R and G met their minimum down time. What about resource V?

To address the end-of-horizon effect, we perform a 36-hour unit commitment to meet the load of a single day and the morning of the next day

0 = Off for this Hour 1 = On for this Hour

Comparison of Economically Committed Resources – Hours 12 and 22

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T												1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD												1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q														1	1	1	1	1	1	1	1	1	1	0	0	0
I														1	1	1	1	1	1	1	1	1	1	1	1	1
H														1	1	1	1	1	1	1	1	1	1	1	1	1
V														1	1	1	1	1	1	1	1	1	1	1	1	1
F														1	1	1	1	1	1	1	1	1	1	1	1	1
R														1	1	1	1	1	1	1	1	1	1	1	1	1
G														1	1	1	1	1	1	1	1	1	1	1	1	1
J														1	1	1	1	1	1	1	1	1	1	1	1	1
K														1	1	1	1	1	1	1	1	1	1	1	1	1
FF														1	1	1	1	1	1	1	1	1	1	1	1	1
C														1	1	1	1	1	1	1	1	1	1	1	1	1
D														1	1	1	1	1	1	1	1	1	1	1	1	1
M														1	1	1	1	1	1	1	1	1	1	1	1	1
E														1	1	1	1	1	1	1	1	1	1	1	1	1
BB														1	1	1	1	1	1	1	1	1	1	1	1	1
CC														1	1	1	1	1	1	1	1	1	1	1	1	1
A														1	1	1	1	1	1	1	1	1	1	1	1	1
L														1	1	1	1	1	1	1	1	1	1	1	1	1
EE														1	1	1	1	1	1	1	1	1	1	1	1	1



0 = Off for this Hour 1 = On for this Hour

What If P Was a Limited Energy Resource?

Unit Name	Min Run	Min Down	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	1	0.2	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
W	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
X	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Y	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Z	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
AA	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
U	8	4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0
B	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
N	8	9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
O	8	11	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
S	12	8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
T	12	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
DD	12	12	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Q	13	7	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
I	14	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
H	16	64	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
V	15	7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F	6	8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R	13	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
G	16	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
J	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
K	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FF	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	12	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BB	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC	14	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	24	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EE	24	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

What if this resource only had 6 hours of full output available?

0 = Off for this Hour 1 = On for this Hour

Summary

In this session, we learned how to:

- Define commitment
- Describe the goal of commitment
- Describe the commitment process
- Describe the effect that changing parameters have on commitment



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