Recreating Mosaic Requirement for Imbalance Reserves

With Data Available in OASIS

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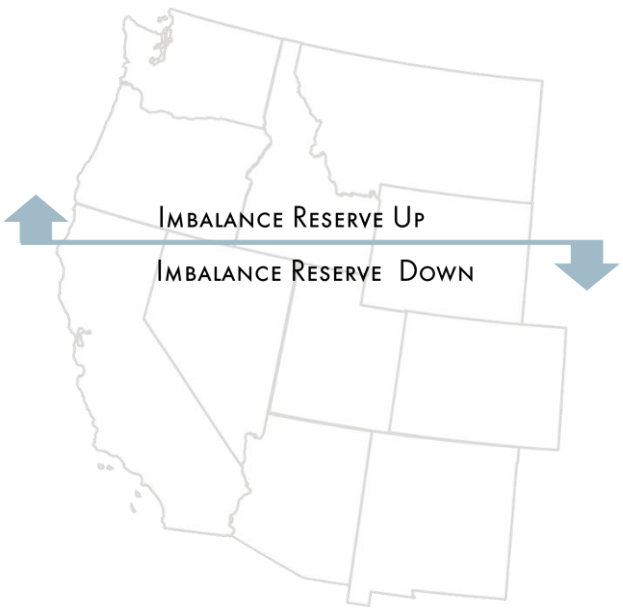
Rev: 12/5/2025

Outline

- Introduction
- How to recreate mosaic requirement with data available in OASIS
  - This will have a companion Excel spreadsheet
- Recreating requirement for
  - Trade Date: 10/5/25
  - HE 15 (hour-ending 15)
  - ‘DAM’ (Day-Ahead Market)

Imbalance Reserves (IR)



- Imbalance reserve products provide the market with a mechanism to address each BAA's expected range of uncertainty when comparing the **day-ahead** load forecast to **real-time** consumption and comparing solar and wind **forecasts** to their **real-time outputs**.
- Procurement of reserves will be done on an hourly basis for each BA from the bids that are submitted by SCs across the EDAM footprint.
- SCs submit bids for **imbalance reserve up** and **imbalance reserve down** and may receive hourly awards for **one or both** products.

Mosaic

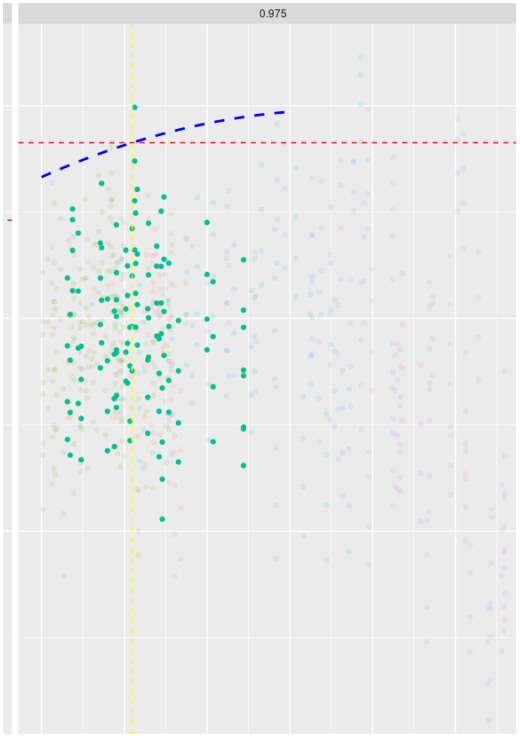
- Construct the mosaic variable as

$$mosaic = NL_h + (L_q - L_h) - (W_q - W_h) - (S_q - S_h)$$

- Perform a quantile regression

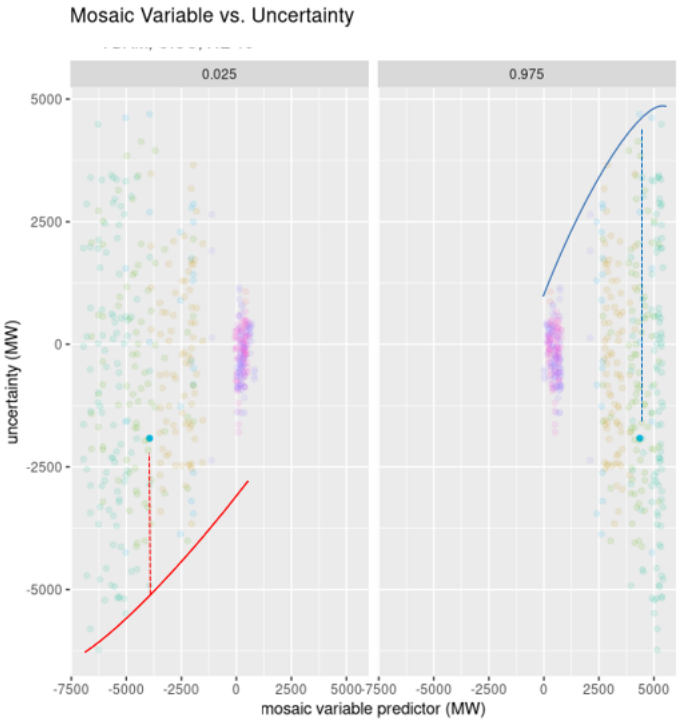
$$NL_M = a_m + b_m * mosaic + c_m * mosaic^2$$

Mosaic (cont'd)



Stage 1 – Component Level Quantile Regression

Stage 2 – Net-Demand Level Quantile Regression



Open-Access Same-Time Information System (OASIS) provides a publications schedule of reports

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OASIS Publications Schedule

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OASIS Section	Report Name	Report Description	Group Name	Market	Publication Type	Publication Interval	Description
ENERGY	AGG_BAA_LVL_FINAL_BIND	EDAM BAA RSE Test	DAM_AGG_BAA_LVL_FINAL_BIND_GRP	DAM	Daily	Every 30min between 6am and 10am	Published at TD+1 , Advisory is 6:00 AM through 9:30 AM ,Binding is 10:00 AM
ENERGY	CAP_REQ_AWRD	Imbalance Reserve Requirements and Imbalance Reserve/Reliability Capacity Awards	DAM_CAP_REQ_AWRD_GRP	DAM	Daily	13:00	BAA Hourly IRU/IRD Awards
ENERGY	CB_NODAL_LIMITS	Convergence Bidding Nodal MW Limits	CB_NODAL_LMT_GRP	DAM	N/A	Daily	Displays the MW limits used by the ISO in formulating nodal MW constraints in conjunction with convergence bidding
ENERGY	CMMT_RA_MLC	Resource Adequacy and Minimum Load	N/A	DAM	Daily	T+1 9:00am	ISO Committed resource data for the DAM
ENERGY	CMMT_RMR	RMR	DAM1_GRP	DAM	Daily	13:00	Pre-Dispatched and MPM Determined RMR
ENERGY	EDAM_NET_EXP_TRNS_CNSTR_INP_PRM	EDAM Net Export Transfer Constraint	EDAM_NET_EXP_TRNS_CNSTR_INP_PRM_GRP	DAM	Daily	13:00	Displays input parameters to the Net EDAM Export Transfer Constraint for each EDAM BAA (ISO BAA inclusive), Trade
ENERGY	EDAM_WND_SLR_FORECAST	EDAM Wind and Solar Forecast	EDAM_WND_SLR_FORECAST_GRP	DAM	Daily	Every 30min between 6am and 10am	Publishes the DA VER forecasts for EDAM entities for each RSE run
ENERGY	ENE_BASE_NSI	BAA Base NSI	N/A	DAM	Daily	Prior to the close of the DAM	DAM and RTM hourly base NSI for each EIM BAA. All data shall be from the latest DAM and the first RTPD 15-minute m
ENERGY	ENE_CB_AWARDS	Day Ahead Aggregate Convergence Bidding Awards	N/A	DAM	Daily	T-1 13:00	Displays Day Ahead Aggregate Convergence Bidding Awards for Energy.
ENERGY	ENE_CB_CLR_AWARDS	Net Cleard Convergence Bidding Awards	N/A	DAM	Daily	T 22:00	Displays Net Cleared MW for Virtual Bids for every Virtual Bidding Node per Trade Hour within a Trading Day.
ENERGY	ENE_CB_MKT_SUM	Day Ahead Market Summary Report	N/A	DAM	Daily	T-1 17:00	Displays the summary of the Day Ahead market data.
ENERGY	ENE_LOSS	Marginal Losses	DAM1_GRP	DAM	Daily	13:00	CAISO Total Marginal Losses for the DAM
ENERGY	ENE_MPM	Market Power Mitigation Status	DAM1_GRP	DAM	Daily	13:00	Mitigation Indicator flag
ENERGY	ENE_SCHED_BY_TIE	Schedule By Tie	DAM_ENE_SCH_BY_TIE_GRP	DAM	Daily	13:00	Publish gross import and export by tie and by direction for CAISO BAA only.
ENERGY	ENE_SLRS	System Load and Resource Schedules	DAM1_GRP	DAM	Daily	13:00	Load, Gen, Import/Export Schedules for the DAM
ENERGY	IMB_RSV_DC	Imbalance Reserve Demand Curves	DAM_IMB_RSV_DC_GRP	DAM	Daily	Hourly	Reports the IRU/IRD Demand Curves for next Trade Days (D+1, D+2, and D+3)
ENERGY	IMB_RSV_FCST	Imbalance Reserve Forecasts	DAM_IMB_RSV_FCST_GRP	DAM	Daily	Hourly	BAA Hourly IRU/IRD Forecasts
ENERGY	IMB_RSV_REQ_INP_POLY	Imbalance Reserve Requirements Input Polynomials	DAM_IMB_RSV_REQ_INP_POLY_GRP	DAM	Daily	Hourly	Reports the IRU/IRD Requirements Input Polynomials for next Trading day (D+1)
ENERGY	IMB_RSV_REQ_THRSH	Imbalance Reserve Requirement Thresholds	DAM_IMB_RSV_REQ_THRSH_GRP	DAM	Daily	Hourly	Reports the IRU/IRD BAA Hourly Requirements Thresholds for the next Trading day (D+1)
ENERGY	IMB_RSV_REQ_UNC_HSG	Imbalance Reserve Requirements Uncertainty Histograms	DAM_IMB_RSV_REQ_UNC_HSG_GRP	DAM	Daily	Hourly	Reports the IRU/IRD BAA Hourly Uncertainty histograms for the next Trading day (D+1)

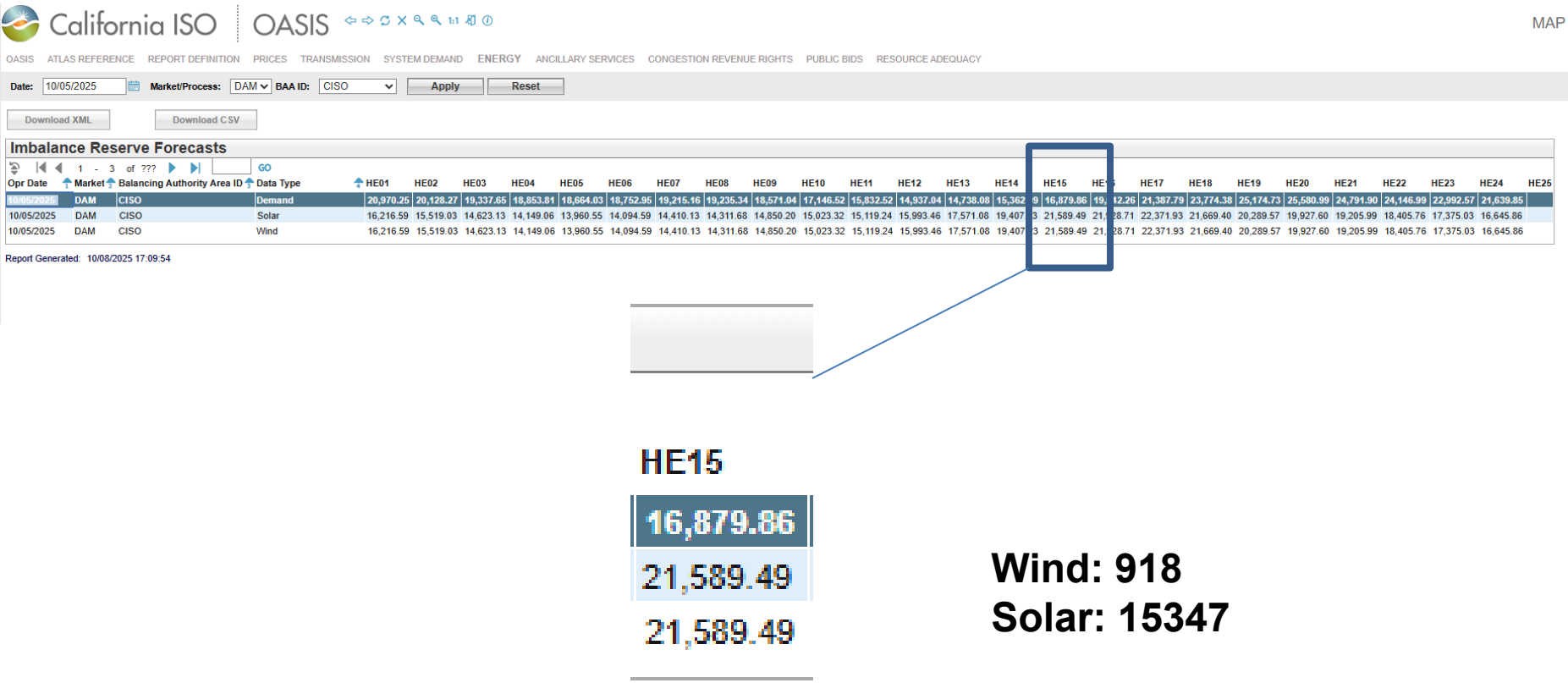
3 Steps to Recreate Mosaic Requirement

- Gather Relevant Information from OASIS
- Perform two stages of calculations in line with the BPM
- Validate IR calculation with report in OASIS

GRAB INPUT FORECASTS

Market/Process= ‘DAM’

HE15



HE15

16,879.86

21,589.49

21,589.49

Wind: 918

Solar: 15347

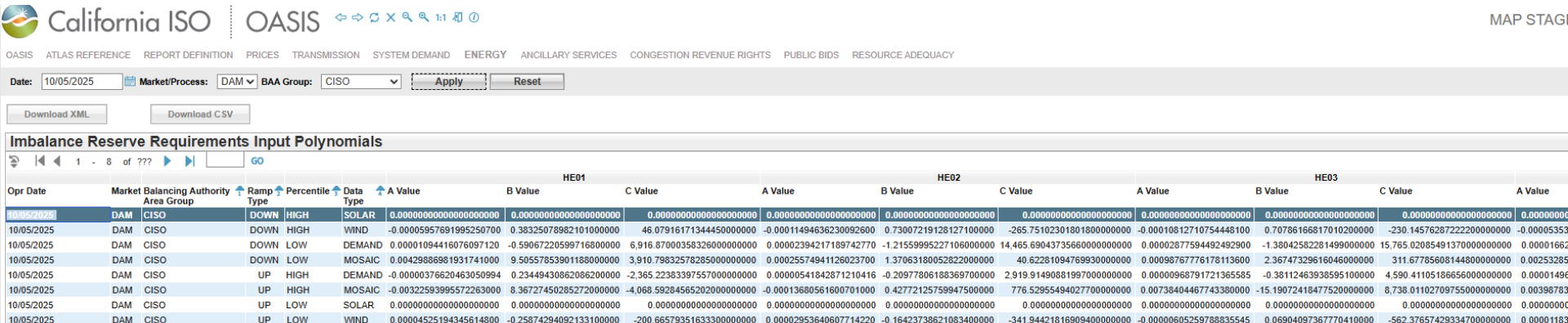
**Due to defect in Mapstage OASIS, not ready for replication – will be resolved in coming weeks*

GRAB INPUT POLYNOMIALS

Market/Process= ‘DAM’

HE15

Ignore Percentile



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MAP STAGI

OASIS ATLAS REFERENCE REPORT DEFINITION PRICES TRANSMISSION SYSTEM DEMAND ENERGY ANCILLARY SERVICES CONGESTION REVENUE RIGHTS PUBLIC BIDS RESOURCE ADEQUACY

Date: 10/05/2025 Market/Process: DAM BAA Group: CISO Apply Reset

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Imbalance Reserve Requirements Input Polynomials

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						HE01			HE02			HE03			
Opr Date	Market	Balancing Authority Area Group	Ramp Type	Percentile	Data Type	A Value	B Value	C Value	A Value	B Value	C Value	A Value	B Value	C Value	A Value
10/05/2025	DAM	CISO	DOWN	HIGH	SOLAR	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000
10/05/2025	DAM	CISO	DOWN	HIGH	WIND	-0.0000595769199525070	0.38325078982101000000	46.079161713444500000	-0.0001149463623009260	0.73007219128127100000	-265.75102301801800000000	-0.0001081271075444810	0.70786166817010200000	-230.14576287222200000000	-0.0000535
10/05/2025	DAM	CISO	DOWN	LOW	DEMAND	0.0000109441607609712	-0.59067220599716800000	6,916.870003583260000000	0.0000239421718974277	-1.21559995227106000000	14,465.690437356600000000	0.0000287759449249290	-1.38042582281499000000	15,765.020854913700000000	0.0000166
10/05/2025	DAM	CISO	DOWN	LOW	MOSAIC	0.0042988698193174100	9.50557853901188000000	3,910.798325782850000000	0.0002557494126023700	1.37063180052822000000	40.622810947699300000	0.0009876777617811360	2.36747329616046000000	311.67785608144800000000	0.0025328
10/05/2025	DAM	CISO	UP	HIGH	DEMAND	-0.0000037662046305099	0.23449430862086200000	-2,365.223833975570000000	0.0000054184287121041	-0.20977806188369700000	2,919.914908819970000000	0.0000096879172136558	-0.38112463938595100000	4,590.411051866560000000	0.0000149
10/05/2025	DAM	CISO	UP	HIGH	MOSAIC	-0.0032259399557226300	8.36727450285272000000	-4,068.592845652020000000	-0.0001368056160070100	0.42772125759947500000	776.529554940277000000	0.0073840446774338000	-15.190724184775200000	8,738.011027097550000000	0.0039878
10/05/2025	DAM	CISO	UP	LOW	SOLAR	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000000000000000	0.0000000
10/05/2025	DAM	CISO	UP	LOW	WIND	0.0000452519434561480	-0.25874294092133100000	-200.665793516333000000	0.0000295364060771422	-0.16423738621083400000	-341.944218169094000000	-0.0000060525978835545	0.06904097367770410000	-562.376574293347000000	0.0000118

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Opr Date	Market	Balancing Authority Area Group	Ramp Type	Percentile	Data Type
10/05/2025	DAM	CISO	DOWN	HIGH	SOLAR
10/05/2025	DAM	CISO	DOWN	HIGH	WIND
10/05/2025	DAM	CISO	DOWN	LOW	DEMAND
10/05/2025	DAM	CISO	DOWN	LOW	MOSAIC
10/05/2025	DAM	CISO	UP	HIGH	DEMAND
10/05/2025	DAM	CISO	UP	HIGH	MOSAIC
10/05/2025	DAM	CISO	UP	LOW	SOLAR
10/05/2025	DAM	CISO	UP	LOW	WIND

HE15		
A Value	B Value	C Value
0.0000040689265209530	-0.54105166453521300000	9,411.164332549940000000
0.0002452259267861000	-1.18675699177526000000	2,046.843625886400000000
-0.0000049164006176079	0.17790410554572300000	-3,528.459952318490000000
0.0001140072268380550	0.71524140700814000000	-1,902.798566193920000000
-0.0000021976440677839	0.12556687968351200000	84.000585105054600000
-0.0000060953514513056	0.84316440043783400000	838.154462459485000000
0.0001008744941887660	-3.09585793851105000000	21,018.641815819100000000
0.0001397111868653130	-0.92120745774938800000	325.257408159546000000

GRAB HISTOGRAM VALUES

- Market/Process= ‘DAM’
- HE15
- Ignore Percentile

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MAP STAGE

OASIS ATLAS REFERENCE REPORT DEFINITION PRICES TRANSMISSION SYSTEM DEMAND ENERGY ANCILLARY SERVICES CONGESTION REVENUE RIGHTS PUBLIC BIDS RESOURCE ADEQUACY

Date: 10/05/2025 Market/Process: DAM BAA Group: CISO Apply Reset

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Imbalance Reserve Requirements Uncertainity Histograms

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Opr Date	Market	Balancing Authority Area Group	Ramp Type	Percentile	Data Type	HE01	HE02	HE03	HE04	HE05	HE06	HE07	HE08	HE09	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24	HE25
10/05/2025	DAM	CISO	DOWN	HIGH	SOLAR	0.00	0.00	0.00	0.00	0.00	534.62	3,414.13	4,062.59	2,076.18	948.10	928.35	1,203.61	1,266.81	1,375.1	1,536.76	1,367.81	2,228.82	4,467.97	4,453.76	2,553.03	108.15	0.00	0.00	0.00	
10/05/2025	DAM	CISO	DOWN	HIGH	WIND	616.14	778.29	811.38	753.76	850.01	955.67	1,102.43	1,141.97	1,182.52	1,256.00	1,119.79	833.60	855.91	741.5	764.24	619.19	607.16	652.15	623.41	532.95	534.22	641.07	763.86	865.35	
10/05/2025	DAM	CISO	DOWN	LOW	DEMAND	-986.87	-859.25	-691.67	-551.80	-462.72	-719.42	-822.98	-688.41	-1,271.53	-1,389.86	-1,519.29	-1,321.14	-1,834.98	-2,177.9	-2,392.74	-2,748.25	-2,997.89	-2,475.28	-2,150.70	-1,945.26	-1,912.80	-1,930.32	-1,975.53	-1,466.28	
10/05/2025	DAM	CISO	DOWN	LOW	NET-DEMAND	-1,227.39	-1,291.16	-1,096.99	-837.32	-972.10	-1,334.85	-3,736.91	-4,853.66	-2,555.22	-2,072.68	-2,005.09	-2,015.24	-2,054.13	-2,489.1	-2,601.47	-3,027.03	-3,475.85	-5,174.95	-5,993.05	-3,029.16	-1,923.78	-2,144.57	-2,093.96	-1,632.71	
10/05/2025	DAM	CISO	UP	HIGH	DEMAND	1,186.06	1,074.92	930.46	721.12	700.41	768.31	862.43	808.21	1,016.76	1,640.14	1,981.98	1,723.19	1,473.80	1,756.3	1,846.76	1,935.84	1,949.54	1,707.75	1,331.93	1,145.55	1,324.28	1,463.19	1,652.69	1,437.23	
10/05/2025	DAM	CISO	UP	HIGH	NET-DEMAND	1,297.45	1,092.99	994.30	832.40	802.32	867.98	2,741.33	4,004.16	3,076.23	2,905.29	2,702.06	2,210.05	2,186.74	2,502.7	2,704.57	2,822.83	3,061.28	3,950.40	4,493.10	2,660.62	1,673.42	1,623.46	1,777.75	1,677.43	
10/05/2025	DAM	CISO	UP	LOW	SOLAR	0.00	0.00	0.00	0.00	0.00	-162.82	-2,729.98	-4,001.58	-3,030.67	-2,583.83	-1,947.91	-2,090.12	-1,726.23	-1,970.6	-1,996.44	-2,443.82	-1,827.39	-2,991.56	-3,436.34	-2,184.05	-10.86	0.00	0.00	0.00	
10/05/2025	DAM	CISO	UP	LOW	WIND	-460.12	-464.48	-412.26	-435.99	-371.88	-399.47	-366.72	-349.39	-356.81	-381.22	-337.32	-537.84	-679.71	-856.5	-929.09				-801.88	-819.21	-795.99	-734.65	-707.46	-747.39	

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Opr Date	Market	Balancing Authority Area Group	Ramp Type	Percentile	Data Type	HE15
10/05/2025	DAM	CISO	DOWN	HIGH	SOLAR	1,536.76
10/05/2025	DAM	CISO	DOWN	HIGH	WIND	764.24
10/05/2025	DAM	CISO	DOWN	LOW	DEMAND	-2,392.74
10/05/2025	DAM	CISO	DOWN	LOW	NET-DEMAND	-2,601.47
10/05/2025	DAM	CISO	UP	HIGH	DEMAND	1,846.76
10/05/2025	DAM	CISO	UP	HIGH	NET-DEMAND	2,704.57
10/05/2025	DAM	CISO	UP	LOW	SOLAR	-1,996.44
10/05/2025	DAM	CISO	UP	LOW	WIND	-929.09

Report Generated: 10/08/2025 17:18:36

(Stage 1)
Calculate “q” variable for load, solar and wind, using input forecasts and polynomial coefficients

SUM | =E6+B4*E5+(B4^2)*E4

	A	B	C	D	E	F	G	H	I	J
1	**INPUTS**									
2	SOURCE	OASIS			OASIS				CALCULATED	
3		**ADVISORY FORECAST**			**Down Coefficients**	**Up Coefficients**			**DOWN q variables**	**UP q variables**
4	LOAD	16879.86		A_LOAD	-4.9164E-06	-2.19764E-06		LOAD	=E6+B4*E5+(B4^2)*E4	1577.377928
5	SOLAR	15347		B_LOAD	0.177904106	0.12556688		SOLAR	2066.000365	-2734.479093
6	WIND	918		C_LOAD	-3,528.46	84.00058511		WIND	1164.058481	-402.6730678
7				A_SOLAR	4.06893E-06	0.000100874				
8	HE	15		B_SOLAR	-0.541051665	-3.095857939				
9	INT	1		C_SOLAR	9,411.16	21,018.64				
10	2:15			A_WIND	0.000245226	0.000139711				
11				B_WIND	-1.186756992	-0.921207458				
12				C_WIND	2,046.84	325.2574082				
13										
14										

(Stage 2)
Calculate “m” variable for net load, using histograms and “q” variables

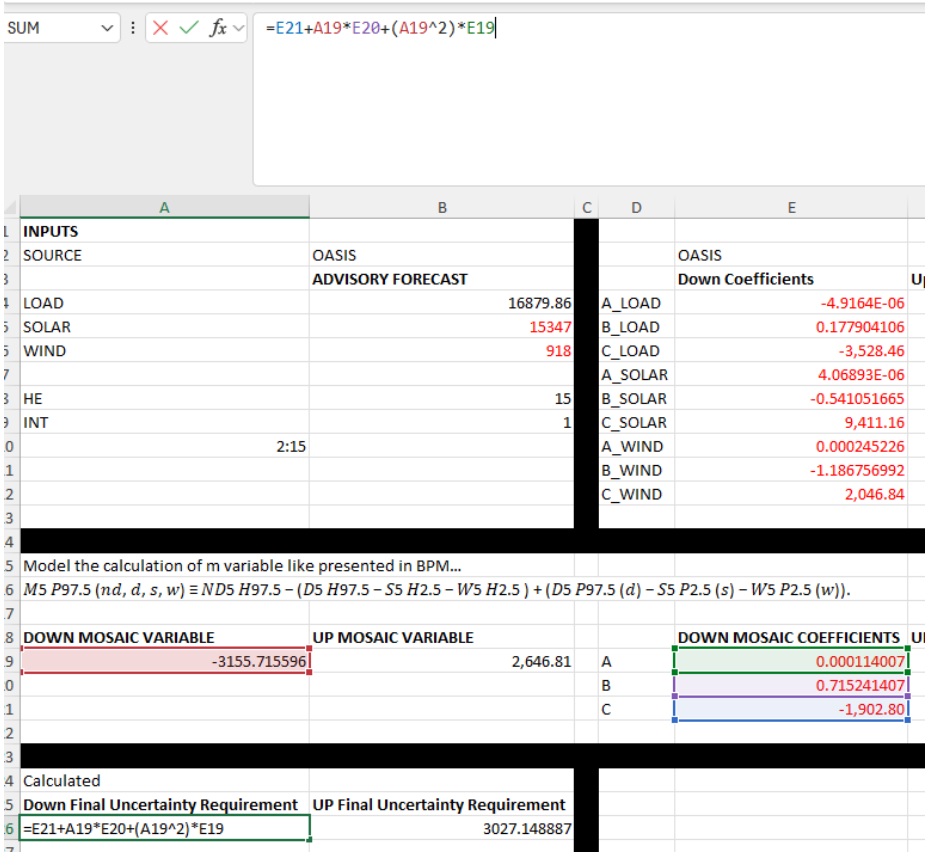
SUM

=M4-(M5-M6-M7)+(I4-I5-I6)

	A	B	C
1	**INPUTS**		
2	SOURCE	OASIS	
3		**ADVISORY FORECAST**	
4	LOAD	16879.86	
5	SOLAR	15347	
6	WIND	918	
7			
8	HE	15	
9	INT	1	
10	2:15		
11			
12			
13			
14			
15	Model the calculation of m variable like presented in BPM...		
16	$M5\ P97.5\ (nd, d, s, w) \equiv ND5\ H97.5 - (D5\ H97.5 - S5\ H2.5 - W5\ H2.5) + (D5\ P9$		
17			
18	**DOWN MOSAIC VARIABLE**	**UP MOSAIC VARIABLE**	
19	=M4-(M5-M6-M7)+(I4-I5-I6)	2,646.81	
20			
21			
22			
23			

	H	I	J	K	L	M	N	O
		CALCULATED				OASIS		
		DOWN q variables	**UP q variables**			**DOWN histogram**	**Up histogram**	
	LOAD	-1926.291981	1577.377928		NET LOAD	1,536.76	2,704.57	
	SOLAR	2066.000365	-2734.479093		LOAD	-2,392.74	1,846.76	
	WIND	1164.058481	-402.6730678		SOLAR	672.6052301	-1,996.44	
					WIND	-2,601.47	-929.09	

(Stage 2 cont.)
Calculate Mosaic Net Load requirement, using m variables and polynomial coefficients



SUM

=E21+A19*E20+(A19^2)*E19

	A	B	C	D	E
1	**INPUTS**				
2	SOURCE	OASIS			OASIS
3		**ADVISORY FORECAST**			**Down Coefficients**
4	LOAD	16879.86		A_LOAD	-4.9164E-06
5	SOLAR	15347		B_LOAD	0.177904106
6	WIND	918		C_LOAD	-3,528.46
7				A_SOLAR	4.06893E-06
8	HE	15		B_SOLAR	-0.541051665
9	INT	1		C_SOLAR	9,411.16
10	2:15			A_WIND	0.000245226
11				B_WIND	-1.186756992
12				C_WIND	2,046.84
13					
14					
15	Model the calculation of m variable like presented in BPM...				
16	$M5\,P97.5\,(nd, d, s, w) \equiv ND5\,H97.5 - (D5\,H97.5 - S5\,H2.5 - W5\,H2.5) + (D5\,P97.5\,(d) - S5\,P2.5\,(s) - W5\,P2.5\,(w))$.				
17					
18	**DOWN MOSAIC VARIABLE**	**UP MOSAIC VARIABLE**			**DOWN MOSAIC COEFFICIENTS**
19	-3155.715596	2,646.81		A	0.000114007
20				B	0.715241407
21				C	-1,902.80
22					
23					
24	Calculated				
25	**Down Final Uncertainty Requirement**	**UP Final Uncertainty Requirement**			
26	=E21+A19*E20+(A19^2)*E19	3027.148887			

Confirm calculation of IR requirement within OASIS

Pay Attention to the Publication Timestamp, As Input Forecasts Should align with Binding as Reported on OASIS

OASIS ATLAS REFERENCE REPORT DEFINITION PRICES TRANSMISSION SYSTEM DEMAND ENERGY ANCILLARY SERVICES CONGESTION REVENUE RIGHTS PUE

Date: 10/05/2025 Market/Process: DAM BAA ID: CISO Apply Reset

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Imbalance Reserve Results

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Market	Publication Timestamp	Opr Date	Hour Ending	Balancing Authority Area Group ID	Product	Calculated Reserve	Diversity Benfit	Reserve Requirement
DAM	10/04/2025 15:09	10/05/2025	15	CISO	IRD	2,943.24	538.06	2,405.17
DAM	10/04/2025 15:09	10/05/2025	15	CISO	IRU	3,128.73	1,245.70	1,882.94
DAM	10/04/2025 15:39	10/05/2025	15	CISO	IRD	2,943.24	537.76	2,405.48
DAM	10/04/2025 15:39	10/05/2025	15	CISO	IRU	3,128.73	1,245.30	1,883.37
DAM	10/04/2025 16:09	10/05/2025	15	CISO	IRD	2,943.24	493.44	2,449.79
DAM	10/04/2025 16:09	10/05/2025	15	CISO	IRU	3,026.42	1,104.50	1,921.90
DAM	10/04/2025 16:39	10/05/2025	15	CISO	IRD	2,943.24	493.32	2,449.91
DAM	10/04/2025 16:39	10/05/2025	15	CISO	IRU	3,027.19	1,105.10	1,922.06
DAM	10/04/2025 21:55	10/05/2025	15	CISO	IRD	2,943.24	493.32	2,449.91
DAM	10/04/2025 21:55	10/05/2025	15	CISO	IRU	3,027.19	1,105.10	1,922.06
DAM	10/04/2025 13:11	10/05/2025	16	CISO	IRD	3,101.75	299.46	2,802.29
DAM	10/04/2025 13:11	10/05/2025	16	CISO	IRU	3,171.32	361.16	2,810.15
DAM	10/04/2025 13:40	10/05/2025	16	CISO	IRD	3,101.75	299.43	2,802.31
DAM	10/04/2025 13:40	10/05/2025	16	CISO	IRU	3,171.32	360.85	2,810.46
DAM	10/04/2025 14:09	10/05/2025	16	CISO	IRD	3,101.75	299.48	2,802.27
DAM	10/04/2025 14:09	10/05/2025	16	CISO	IRU	3,171.32	357.82	2,813.49
DAM	10/04/2025 14:39	10/05/2025	16	CISO	IRD	3,101.75	299.48	2,802.27
DAM	10/04/2025 14:39	10/05/2025	16	CISO	IRU	3,171.32	357.82	2,813.49
DAM	10/04/2025 15:09	10/05/2025	16	CISO	IRD	3,101.75	299.56	2,802.19
DAM	10/04/2025 15:09	10/05/2025	16	CISO	IRU	3,171.32	354.59	2,816.73

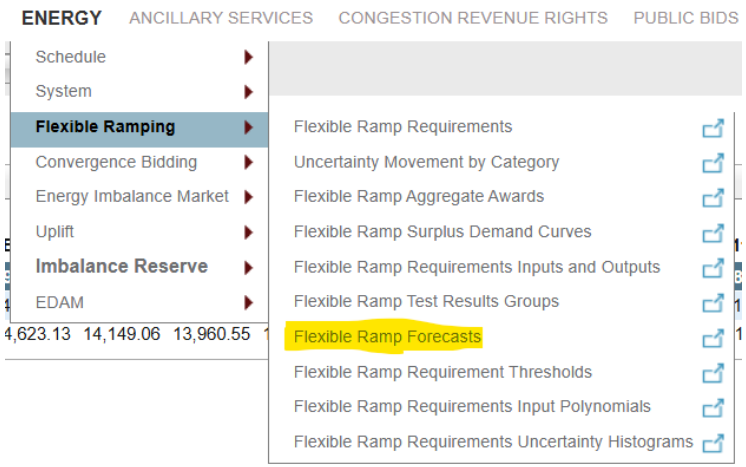
Report Generated: 10/09/2025 18:08:58

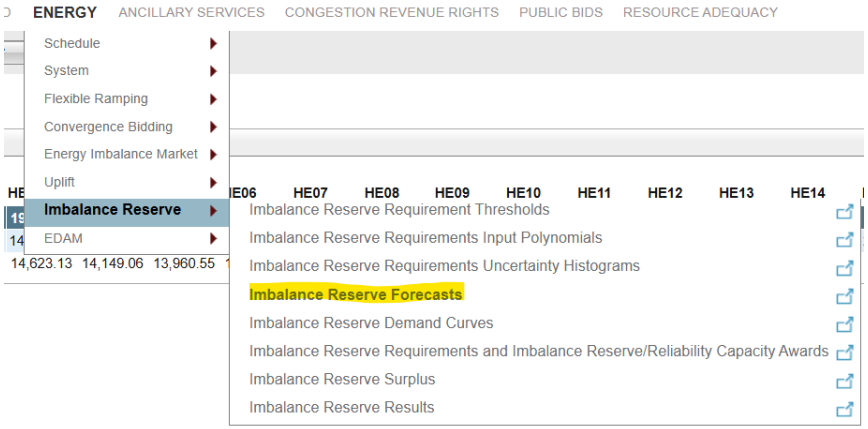
Other Considerations / Dependencies

- Putting in different scenario forecasts, with the same coefficients and other input data
- Advisory values, e.g. D2 and D3 are still predicting D1 uncertainty
- Reports not available in Stage and Production OASIS – results may be intermittent during market sim
- Calculating uncertainty (for validating performance)

DAM Realized Uncertainty must be derived

DAM uncertainty (RTPD binding – DAM)





Additional references

- California ISO - Imbalance Reserves Mosaic Parameter Requirements

For questions, please reach out to Short-Term Forecasting via CIDI

Recommended ticket details
Subject: Imbalance Reserves Requirement OASIS Training
Category: Forecasts

Thank you for your participation!

For other questions or stakeholder specific questions or concerns use one of these methods:

- Submit a CIDI ticket
- Contact your Scheduling Coordinator
- Use the "Contact us" page on caiso.com to submit questions