Technical Workshop on Hydraulic Modeling Input Data Development

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Receipt Point Utilization

- What is Receipt Point Utilization (RPU)?
- The Importance of Receipt Point Utilization
- CPUC and Stakeholders input
- Which gas cycle to analyze?
- Historical trends
- Conclusions
- Discussion

What is Receipt Point utilization (RPU)

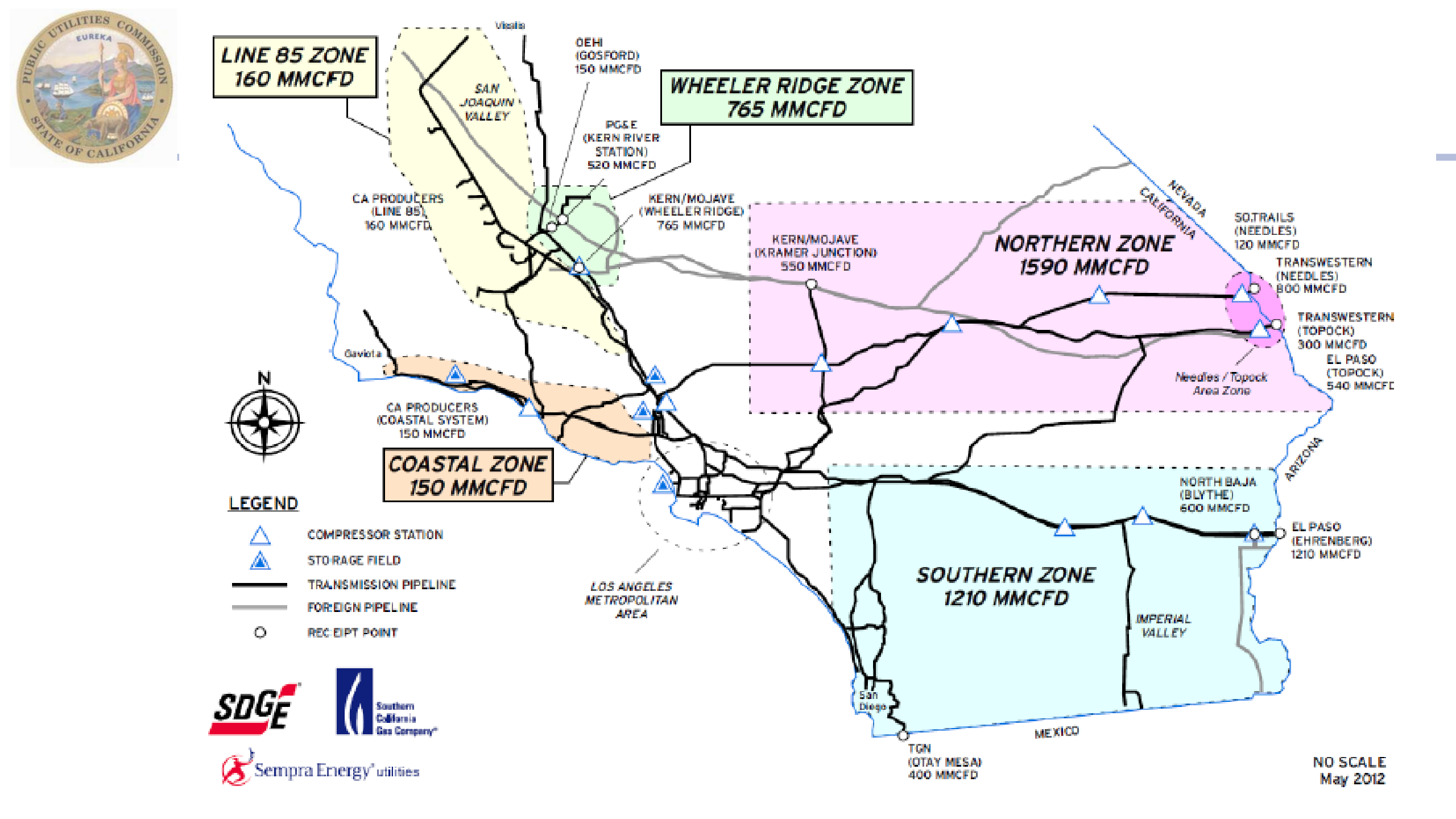
- 2 interpretations exist among stakeholders and proceeding documents:

$$RPU_{ref} = \frac{\text{Quantity of gas actually flowing (scheduled flow rate) (e.g. MMcfd, Mcfh, or Bcfd)}}{\text{Nominal or reference value (also a flow rate)}}$$

$$RPU_{opr} = \frac{\text{Quantity of gas actually flowing (scheduled flow rate) (e.g. MMcfd, Mcfh, or Bcfd)}}{\text{Available operating capacity (also a flow rate)}}$$

After discounting or subtracting outages

Example: Outage on Northern Zone reducing its Nominal Capacity of 1,590 MMcfd by 10% (159 MMCFD) and supplies are 795 MMCFD.
RPU_{ref} = 795/1590 = 50%. RPU_{opr} = (795)/(0.9*1,590) = 55.56%.
RPU_{opr} = RPU_{ref} / (1-reduction ratio due to outages).


LINE 85 ZONE
160 MMCFD
WHEELER RIDGE ZONE
765 MMCFD
NORTHERN ZONE
1590 MMCFD
COASTAL ZONE
150 MMCFD
SOUTHERN ZONE
1210 MMCFD
Visalia
SAN JOAQUIN VALLEY
OEHI
(GOSFORD)
150 MMCFD
PG&E
(KERN RIVER
STATION)
520 MMCFD
CA PRODUCERS
(LINE 85)
160 MMCFD
KERN/MOJAVE
(WHEELER RIDGE)
765 MMCFD
KERN/MOJAVE
(KRAMER JUNCTION)
550 MMCFD
NEVADA
CALIFORNIA
SOTRAILS
(NEEDLES)
120 MMCFD
TRANSWESTERN
(NEEDLES)
800 MMCFD
TRANSWESTERN
(TOPOCK)
300 MMCFD
EL PASO
(TOPOCK)
540 MMCFD
Needles / Topock
Area Zone
Gaviota
CA PRODUCERS
(COASTAL SYSTEM)
150 MMCFD
ARIZONA
NORTH BAJA
(BLYTHE)
600 MMCFD
EL PASO
(EHRENBERG)
1210 MMCFD
IMPERIAL
VALLEY
LOS ANGELES
METROPOLITAN
AREA
San
Diego
MEXICO
TGN
(OTAY MESA)
400 MMCFD
N
LEGEND
COMPRESSOR STATION
STORAGE FIELD
TRANSMISSION PIPELINE
FOREIGN PIPELINE
RECEIPT POINT
SDGE
Southern
California
Gas Company
Sempra Energy utilities
NO SCALE
May 2012

The Importance of Receipt Point Utilization

- Hydraulic modeling perspective:
  - Receipt Point Utilization is a boundary condition to the hydraulic model and must be specified as an input. Otherwise, one must simulate pipelines in neighboring states (which would require boundary conditions at their respective borders or boundaries). RPU can be specified by way of a prescribed flow rate or a prescribed pressure at the boundary.
- Natural gas storage and reliability perspective:
  - Lower RPU will require more frequent use of storage fields.
  - Higher RPU will require less frequent use of storage fields.
  - Stakeholders tend to propose higher or lower RPU based on their preferred outcome.

CPUC and Stakeholders Input in Scenarios Framework 1

CPUC

new rules went into effect, the system has never been more than 8% underdelivered on a high sendout day when a Low OFO was called. Given the new balancing rules, Energy Division suggests that 85% receipt point utilization is sufficiently conservative to cover the impacts of underdeliveries and planned and unplanned maintenance, despite being higher than the historical average.

Herbert S. Emmrich

6. Is 85% gas receipt point utilization a reasonable assumption? Answer: 85% is not reasonable for a 4 day peak day event. In the past, on peak days little or no gas in excess of core supplies were available. Gas supplies available during past peak day or close to peak day events, such as 1-in-10 events, should be used.

LA County

believes that 85%—8% below the lowest level of receipts during an OFO event under new balancing rules— is an appropriate lower bound; as an upper bound, Commission should consider modeling the system assuming 100% receipt point utilization. Not only will this approach help address the inherent range of uncertainty in this key assumption, but it will also

CPUC and Stakeholders Input in Scenarios Framework 1 (June 2017)

- Summary of comments on RPU
  - Herbert S. Emmrich: 85% is not reasonable. Use peak demand days data.
  - LA County: Sensitivity 85%-100%. Analyze historical data.
  - Environmental Defense Fund: 95% when demand > 4Bcfd, 85% otherwise.
  - Issam Najm: 90%.
  - ORA/PAO: 85% for summer, analyze for winter.
  - Southern California Edison: 85% provided high demand days are analyzed.
  - Sierra Club: No input.
  - The Utility Reform Network: At least one sensitivity during winter with RPU < 85%.
  - Southern California Gas: 85% is unreasonable. Historical is 60%-80%. Use a probabilistic approach.
- Stakeholders bounds: 60%-100%
  - Translates to 40% variation of 3.875 Bcfd (nominal) = 1.55 Bcfd

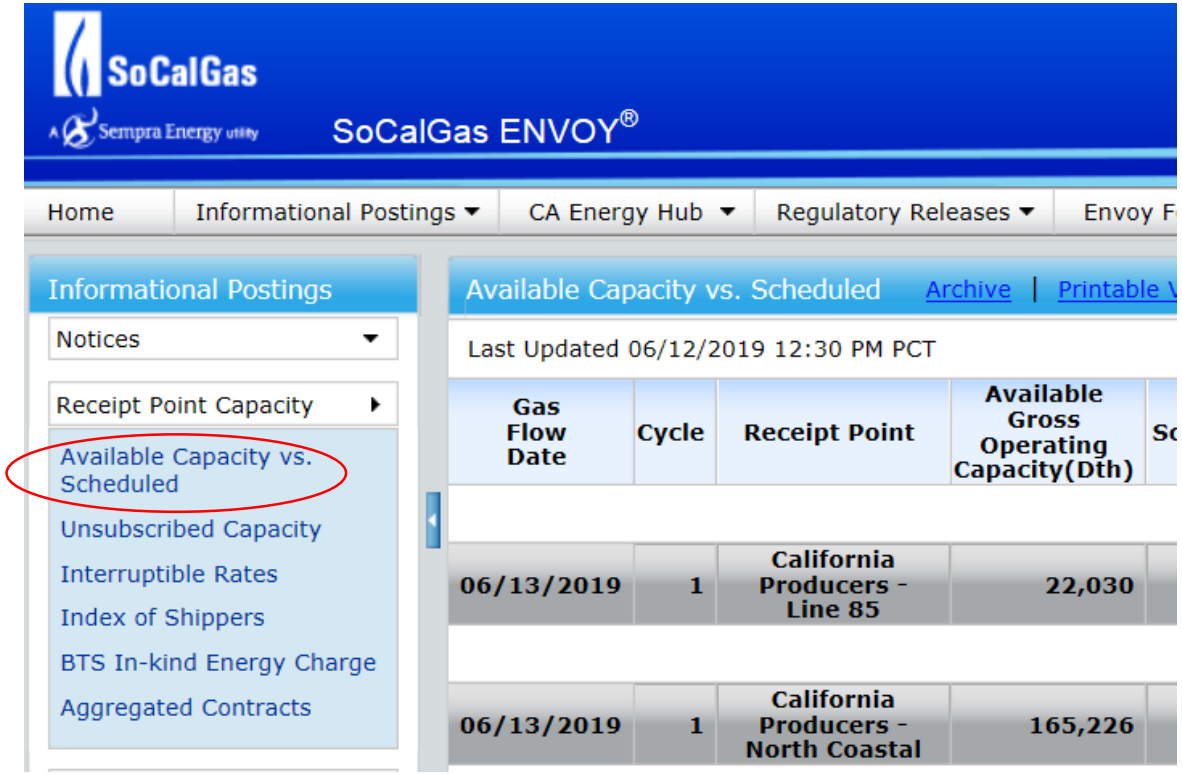
CPUC and Stakeholders Input in Scenarios Framework 1

Party	Proposed RPU	Notes
Herbert S. Emmrich	Not 85%	Use peak demand days data
LA County	85%-100%	Analyze historical data
Environmental Defense Fund	85%	95% when demand > 4Bcfd
Issam Najm	90%	
Public Advocates Office	85%	Only for Winter. Need analysis of Summer.
Southern California Edison	85%	But need high demand days to be analyzed
The Utility Reform Network		Sensitivity with RPU < 85%
SoCalGas	60%-80%	As per historical data

- In the final framework, CPUC suggested 85% RPU for the Northern and Southern zones, and 100% for the Wheeler Ridge zone. CPUC also included a sensitivity at 100%.

Data Set: Data Request #7

- Data request #7 provides historical data from ENVOY> Receipt Point Capacity> Available Capacity vs. Scheduled tab.
- Data set contains available capacity, nominations, and scheduled quantities (Firm, within zone, outside zone and interruptible) by cycle number and receipt point, subzone and zone.
- Data was received for the period 10/01/2008-03/27/2019 (10.5 years).



Which Gas Cycle to Analyze?

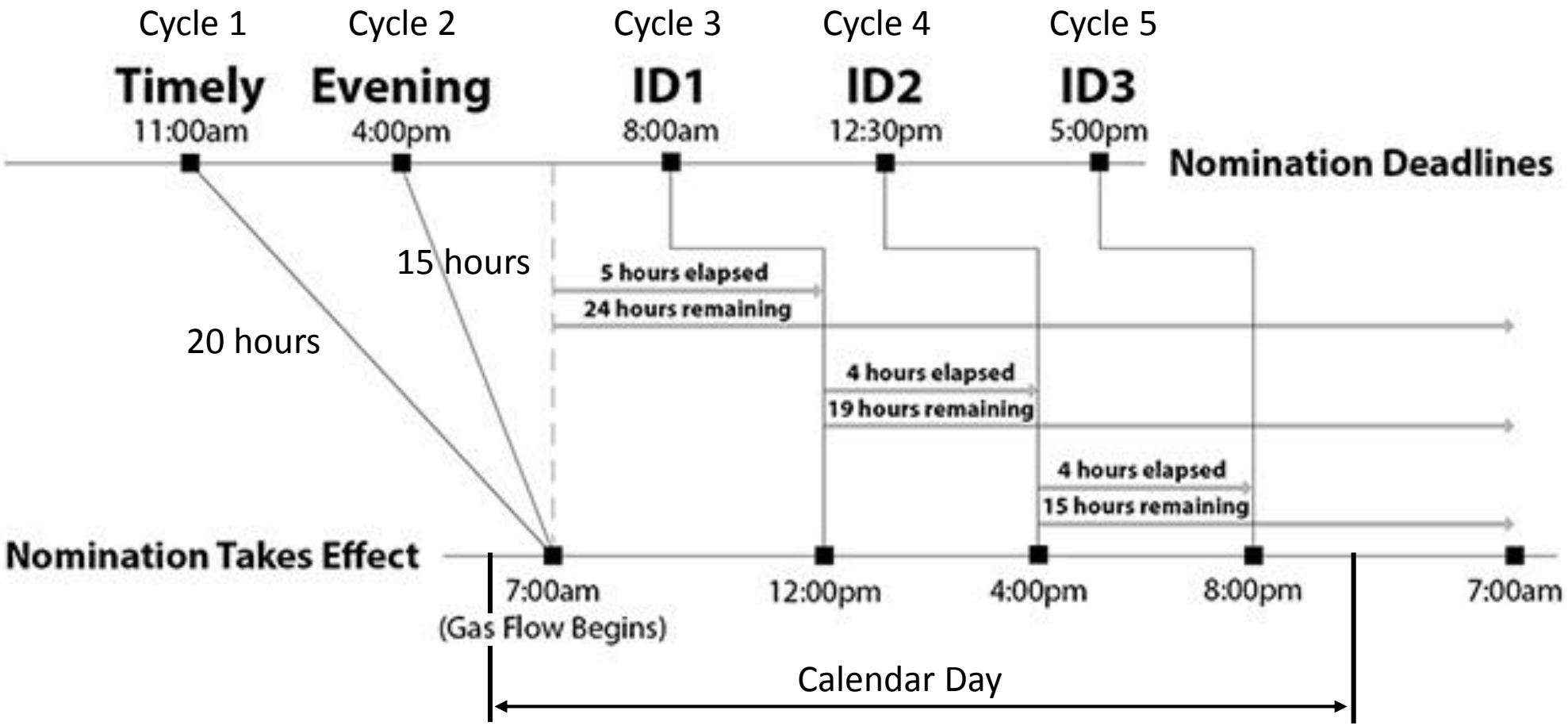
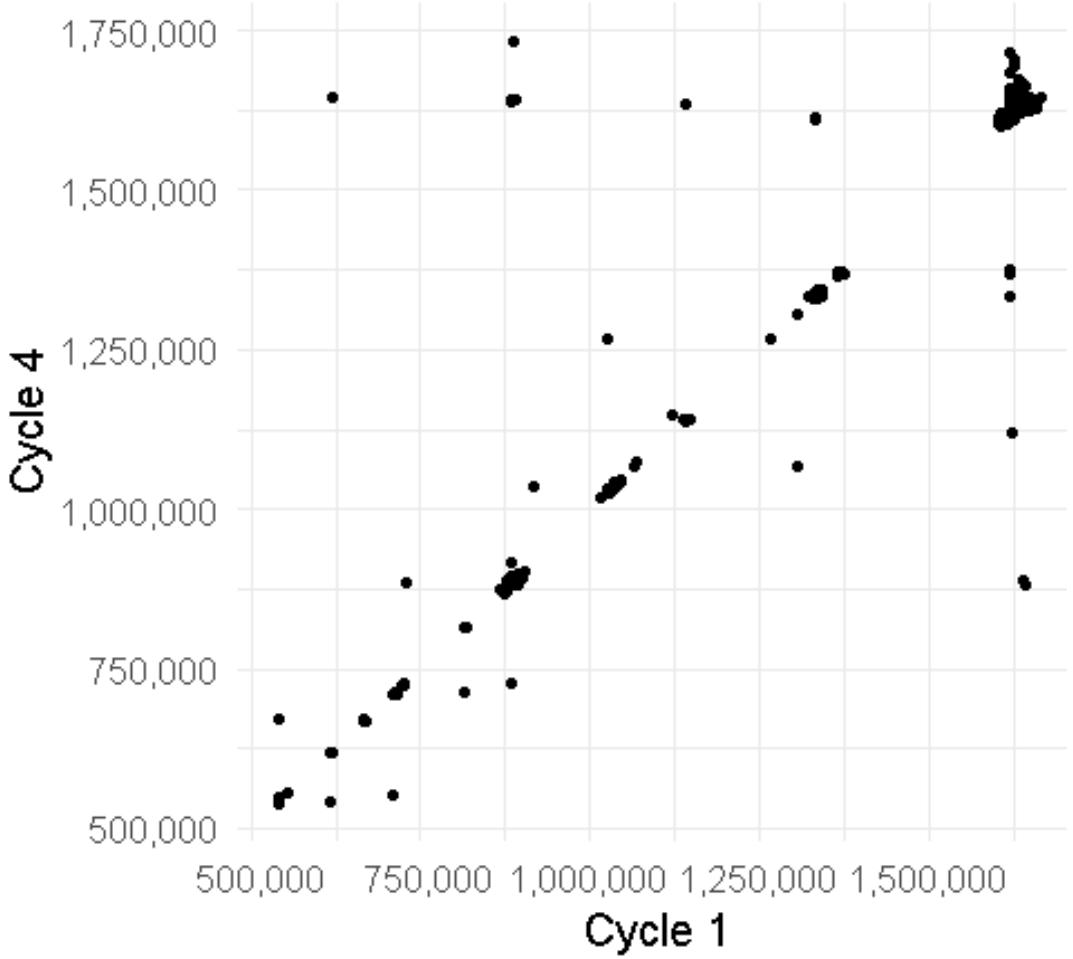


*Illustration from: https://www.pge.com/pipeline_resources/images/graphs/NomDeadlineWideSm.png

Cycle 6 has been recently introduced for nominations from storage

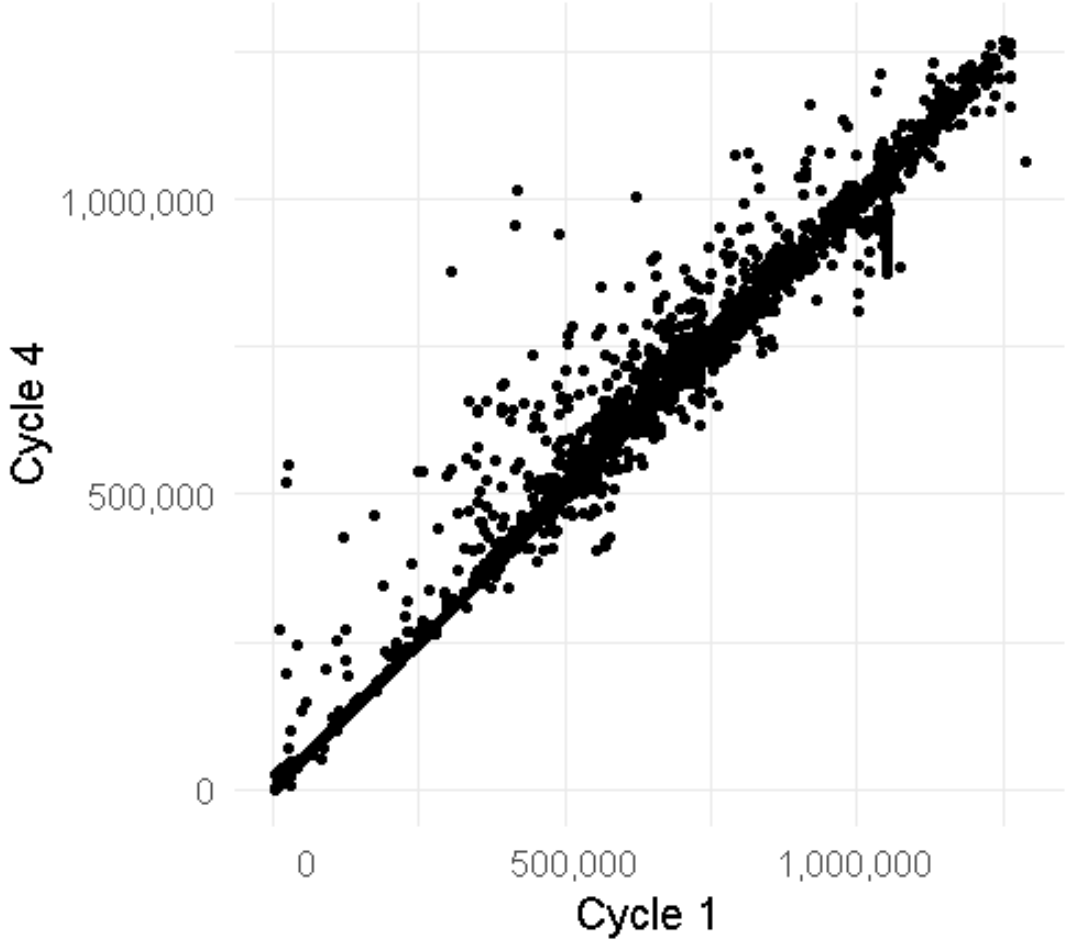
Which Gas Cycle to Analyze?

- Northern Zone Available Capacity:
- Example: Cycle 1 vs Cycle 4:
  - Observations: 3,830
  - Correlation coefficient: 0.989
  - Slope: 0.99
  - P-value of linear model: <2.2e-16
  - F-statistic: 3.1e+05



Which Gas Cycle to Analyze?

- Southern Zone Firm Nominations:
- Example: Cycle 1 vs Cycle 4:
  - Observations: 3,830
  - Correlation coefficient: 0.988
  - Slope: 0.998
  - P-value of linear model: <2.2e-16
  - F-statistic: 1.5e+05



Which Gas Cycle to Analyze?

Statistics of Available Operating Capacity

Cycle	1	2	3	4	5
1	1.000	0.997	0.994	0.994	0.993
2	0.997	1.000	0.996	0.995	0.994
3	0.994	0.996	1.000	0.998	0.995
4	0.994	0.995	0.998	1.000	0.994
5	0.993	0.994	0.995	0.994	1.000

Table A: Correlation coefficients across all 5 cycles

Cycle	1	2	3	4	5
1	0.20	0.29	0.32	0.58	0.58
2	0.20	0.00	0.20	0.24	0.43
3	0.29	0.20	0.00	0.11	0.33
4	0.32	0.24	0.11	0.00	0.30
5	0.58	0.43	0.33	0.30	0.00

Table B: % difference across all 5 cycles
(sum of absolute difference divided by sum)

Which Gas Cycle to Analyze?

Statistics of Scheduled Capacity

Cycle	1	2	3	4	5
1	1.000	0.974	0.944	0.936	0.916
2	0.974	1.000	0.972	0.964	0.934
3	0.944	0.972	1.000	0.993	0.984
4	0.936	0.964	0.993	1.000	0.994
5	0.916	0.934	0.984	0.994	1.000

Table A: Correlation coefficients across all 5 cycles

Cycle	1	2	3	4	5
1	0.00	2.21	3.26	3.60	3.39
2	2.21	0.000	1.85	2.25	2.78
3	3.26	1.85	0.00	0.92	1.25
4	3.60	2.25	0.92	0.00	0.69
5	3.39	2.78	1.26	0.69	0.00

Table B: % difference across all 5 cycles
(sum of absolute difference divided by sum)

Which Gas Cycle to Analyze?

- Similar correlation across various cycles for other quantities and receipt points (nominations and scheduled quantities).
- Analysis was also done visually (Tableau).
- Cycle 5 was introduced only 3 years ago (04/01/2016-03/27/2019).
- Conclusions:
  - RPU Analysis is not strongly dependent on gas cycle.
  - Do not use Cycle 5 as long as longer historical data is required.
  - Use Cycle 4 instead (Nomination deadline is 12:30pm).

Available Gross Operating Capacity

Northern Zone, Southern Zone, Wheeler Ridge Zone, and California Production

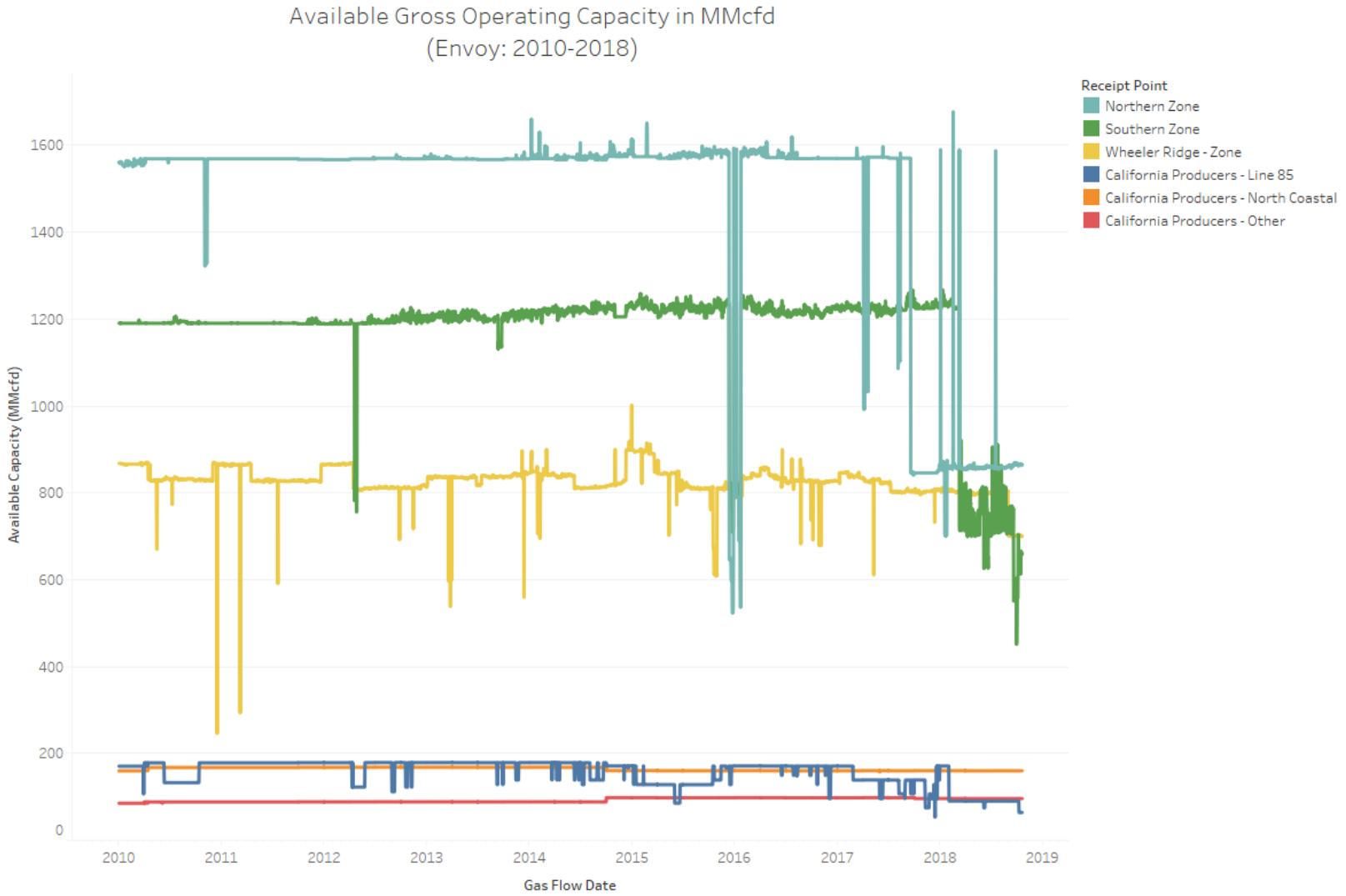
Available Gross Operating Capacity by Zone

Northern Zone

Southern Zone

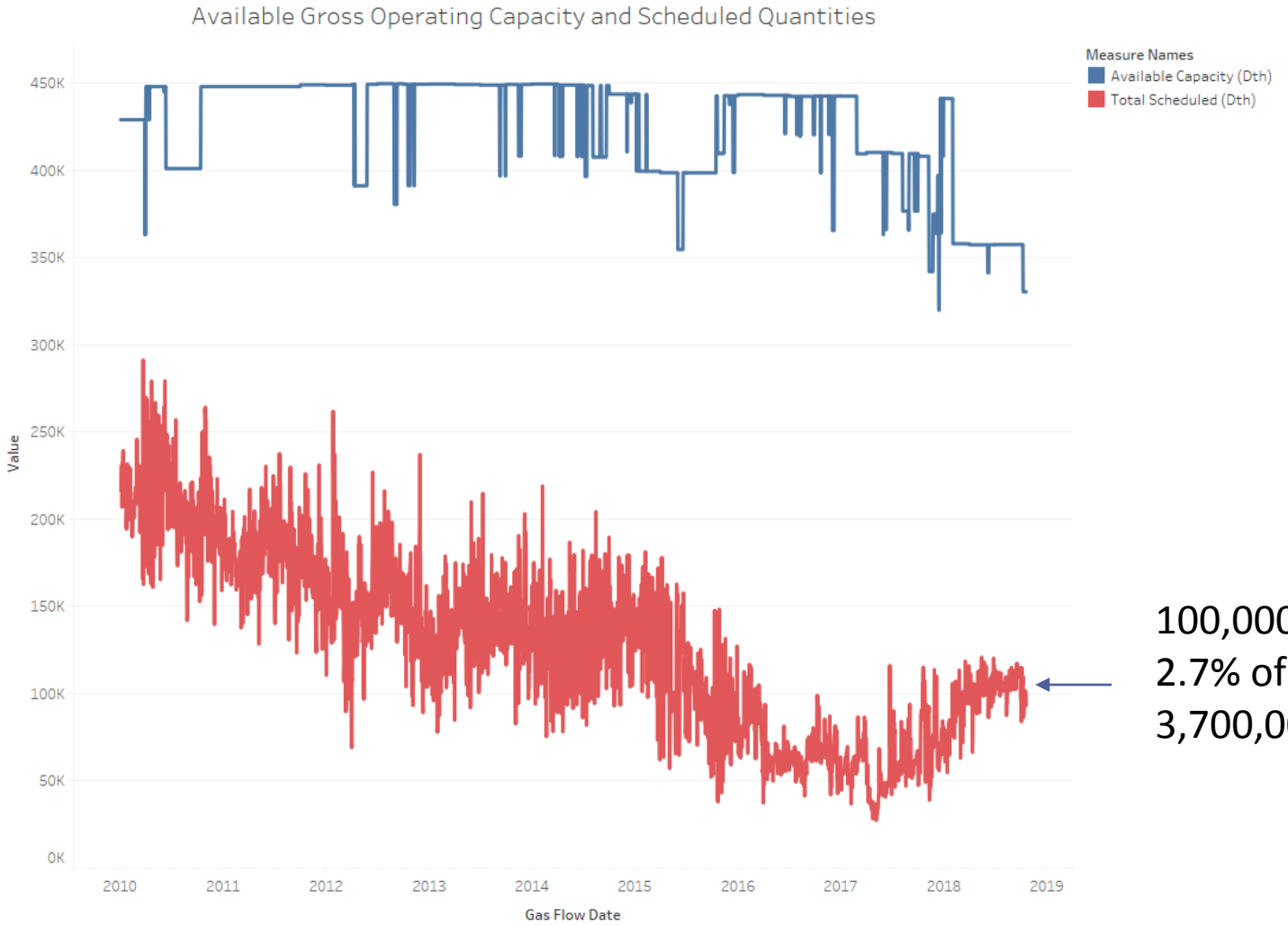
Wheeler Ridge Zone

California Production



The trend of Available Capacity (MMcfd) for Gas Flow Date. Color shows details about Receipt Point. The data is filtered on Cycle, which keeps 4. The view is filtered on Receipt Point, which keeps 6 of 22 members.

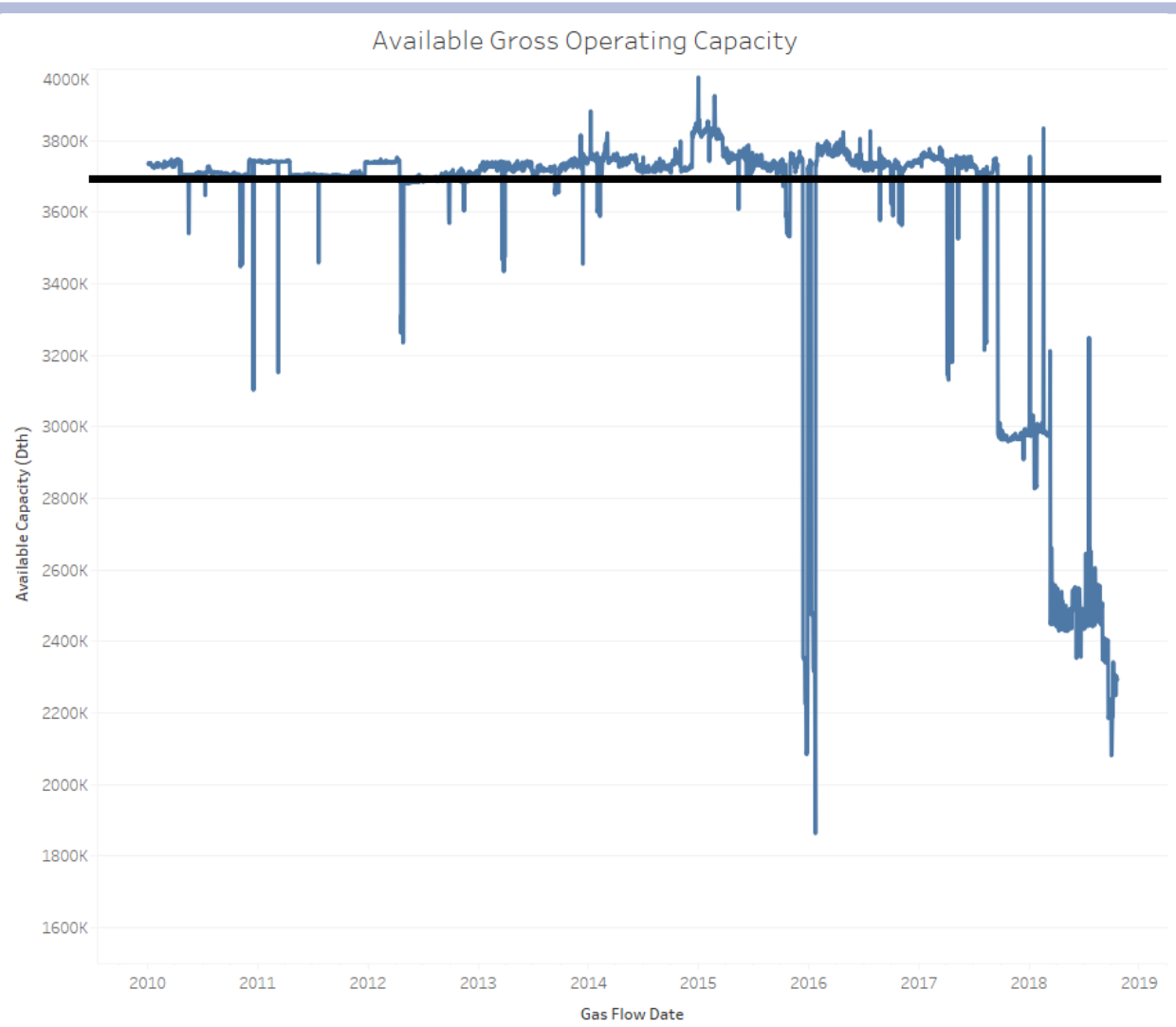
California Production



100,000 Dth
2.7% of
3,700,000 Dth

The trends of Available Capacity (Dth) and Total Scheduled (Dth) for Gas Flow Date. Color shows details about Available Capacity (Dth) and Total Scheduled (Dth). The data is filtered on Cycle, Receipt Point (copy) (group) and Gas Flow Date Day. The Cycle filter keeps 4. The Receipt Point (copy) (group) filter keeps California Producers - Line 85, California Producers - North Coastal, California Producers - Other. The Gas Flow Date Day filter ranges from January 1, 2010 to October 19, 2018.

Available Gross Operating Capacity



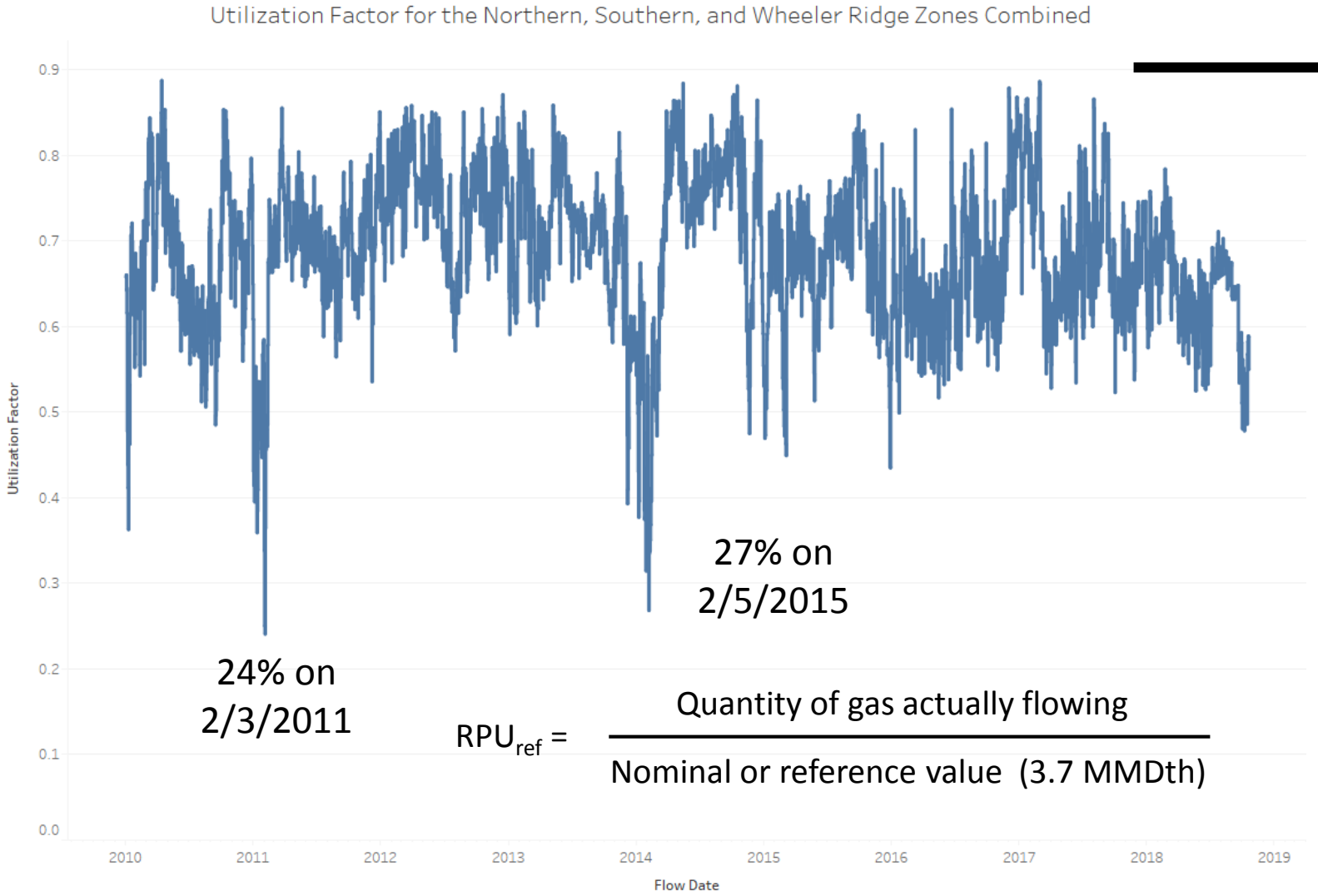
The trend of Available Capacity (Dth) for Gas Flow Date. Color shows details about Available Capacity (Dth). The data is filtered on Cycle, Receipt Point (copy) (group) and Gas Flow Date Day. The Cycle filter keeps 4. The Receipt Point (copy) (group) filter keeps System. The Gas Flow Date Day filter ranges from January 1, 2010 to October 19, 2018.

Nominal Value =
3.7 MMDth (~ 3.575 MMcfd)
Also the mode for the current data set.

RPU (Receipt Point Utilization)

Historical Data

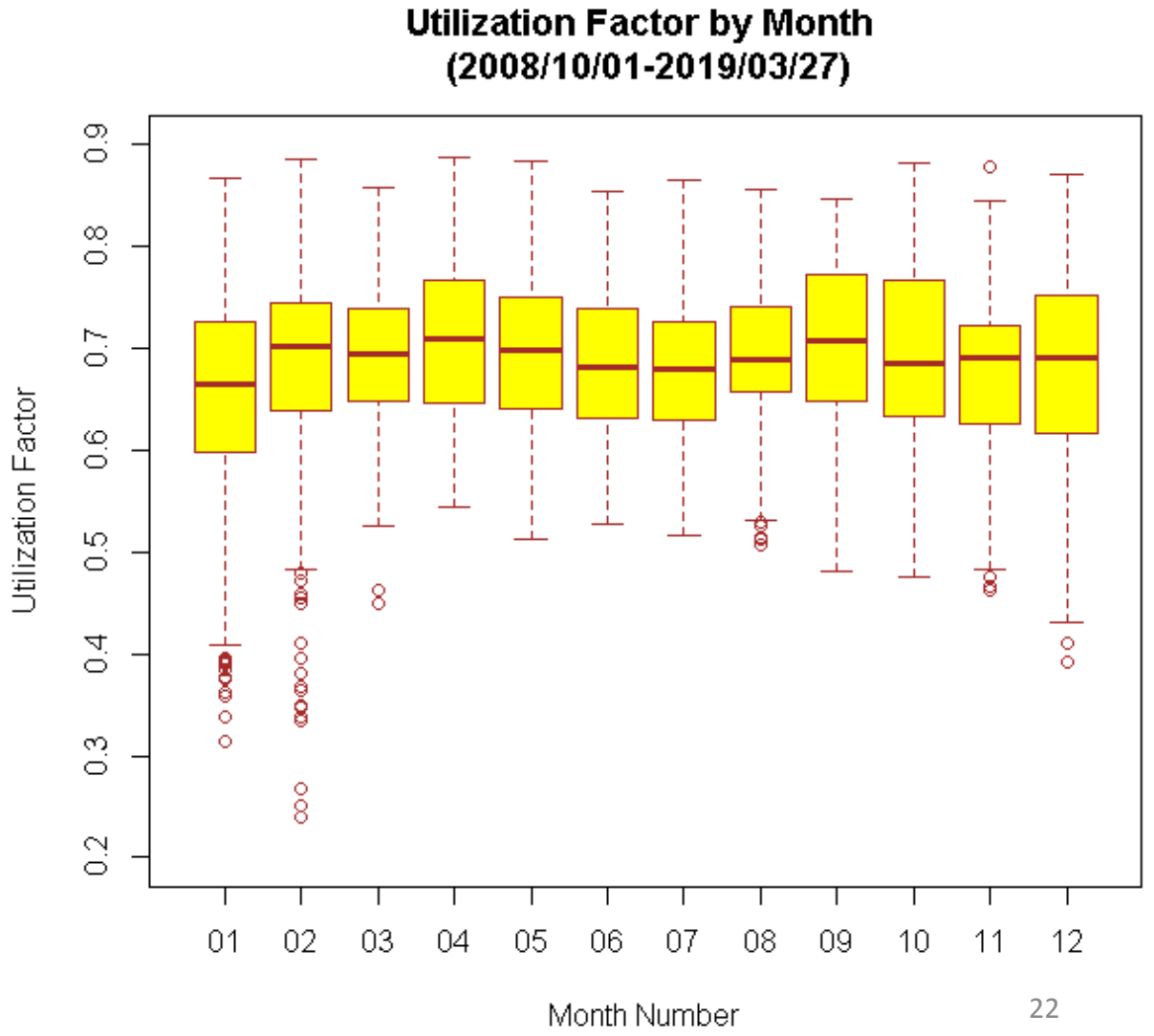
RPU (Receipt Point Utilization)

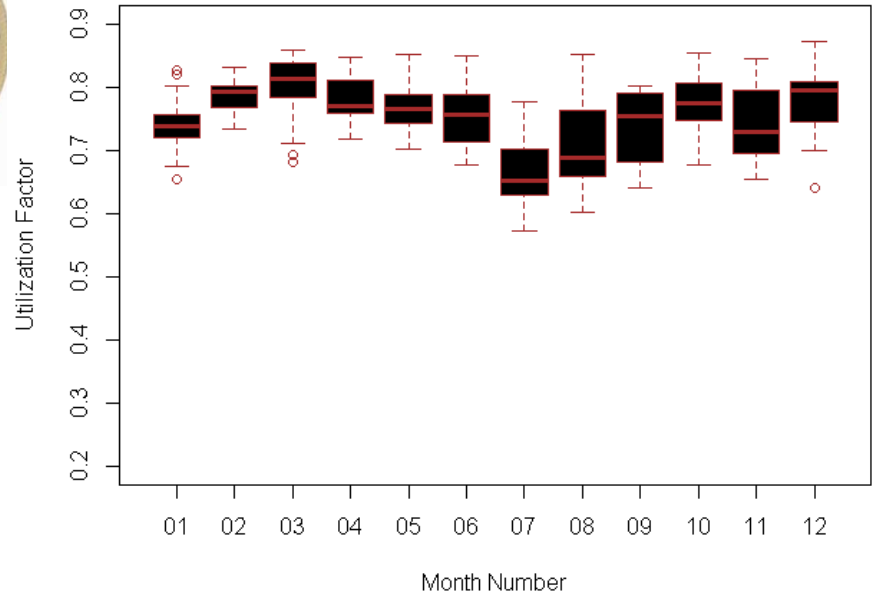


The trend of sum of Utilization Factor for Flow Date. The data is filtered on Cycle and Receipt Point. The Cycle filter keeps 4. The Receipt Point filter keeps Northern Zone, Southern Zone and Wheeler Ridge - Zone.

Utilization Factor (Statistics)

- For the full data set (2008/10/01-2019/03/27):
  - Mean: 0.686
  - Median: 0.691
  - Minimum: 0.241
  - Maximum: 0.888
  - Standard deviation: 0.085 (12.4% of mean)




Utilization Factor Pre-Aliso by Month (2012)
Utilization Factor
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
01
02
03
04
05
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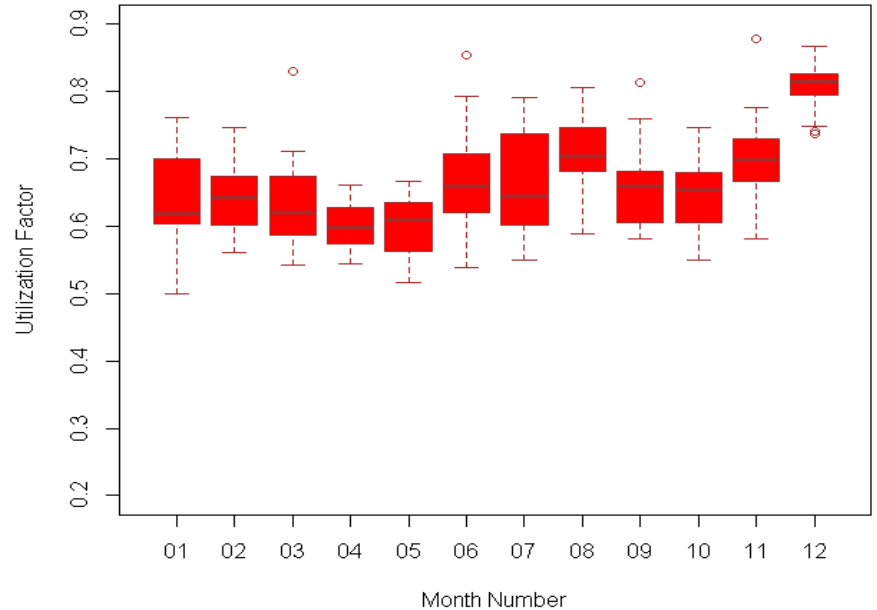
07
08
09
10
11
12
Month Number


Utilization Factor Post-Aliso by Month (2016)
Utilization Factor
0.2
0.3
0.4
0.5
0.6
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0.8
0.9
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02
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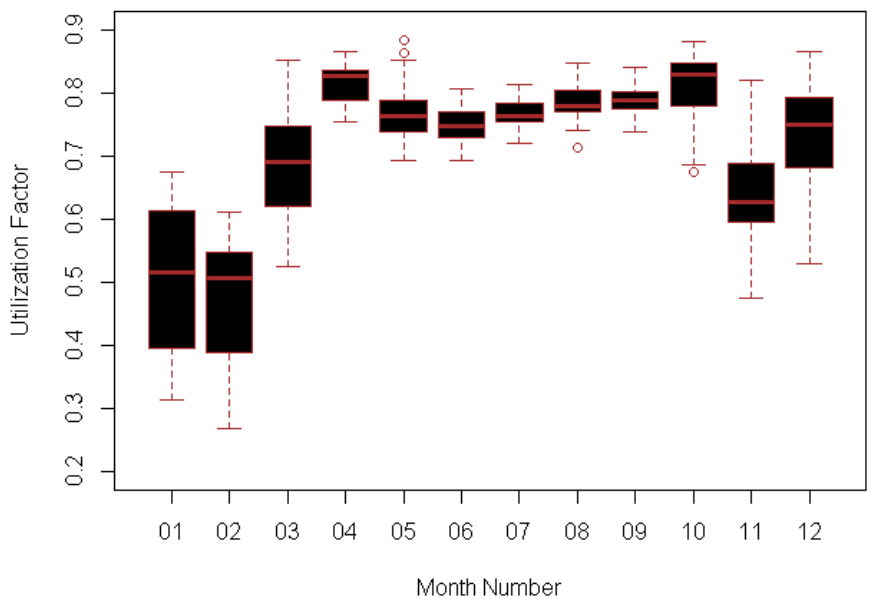
11
12
Month Number


Utilization Factor Pre-Aliso by Month (2014)
Utilization Factor
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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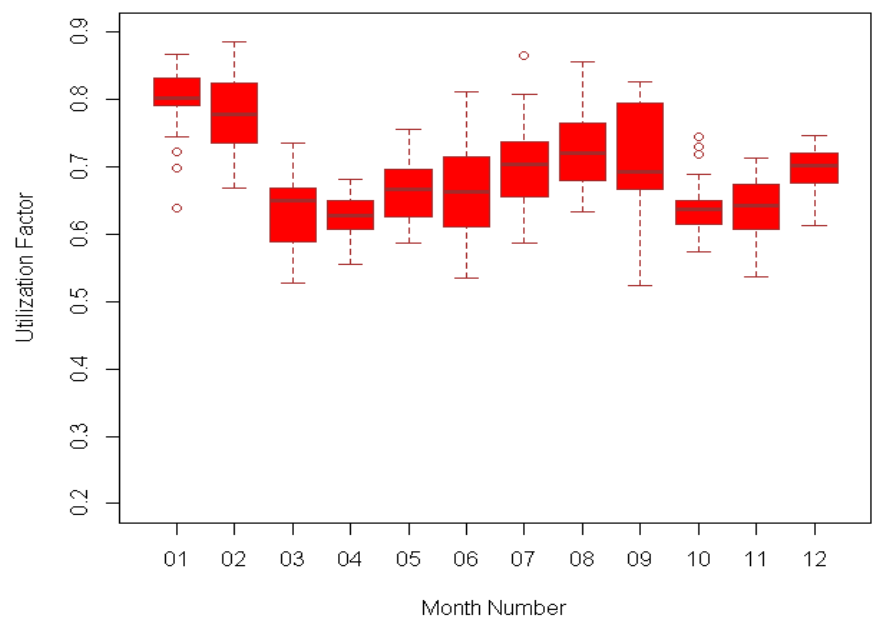
11
12
Month Number


Utilization Factor Post-Aliso by Month (2017)
Utilization Factor
0.2
0.3
0.4
0.5
0.6
0.7
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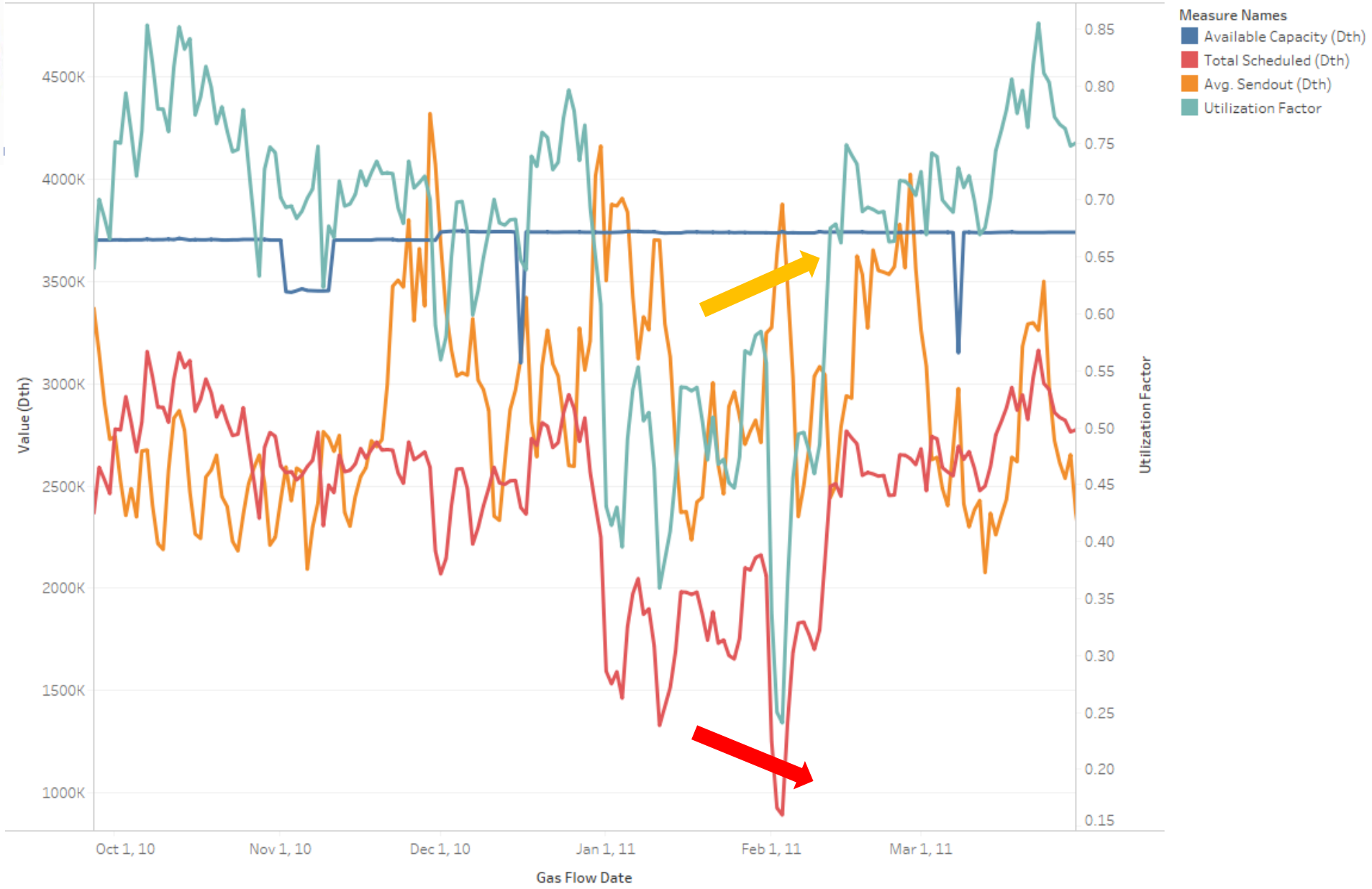
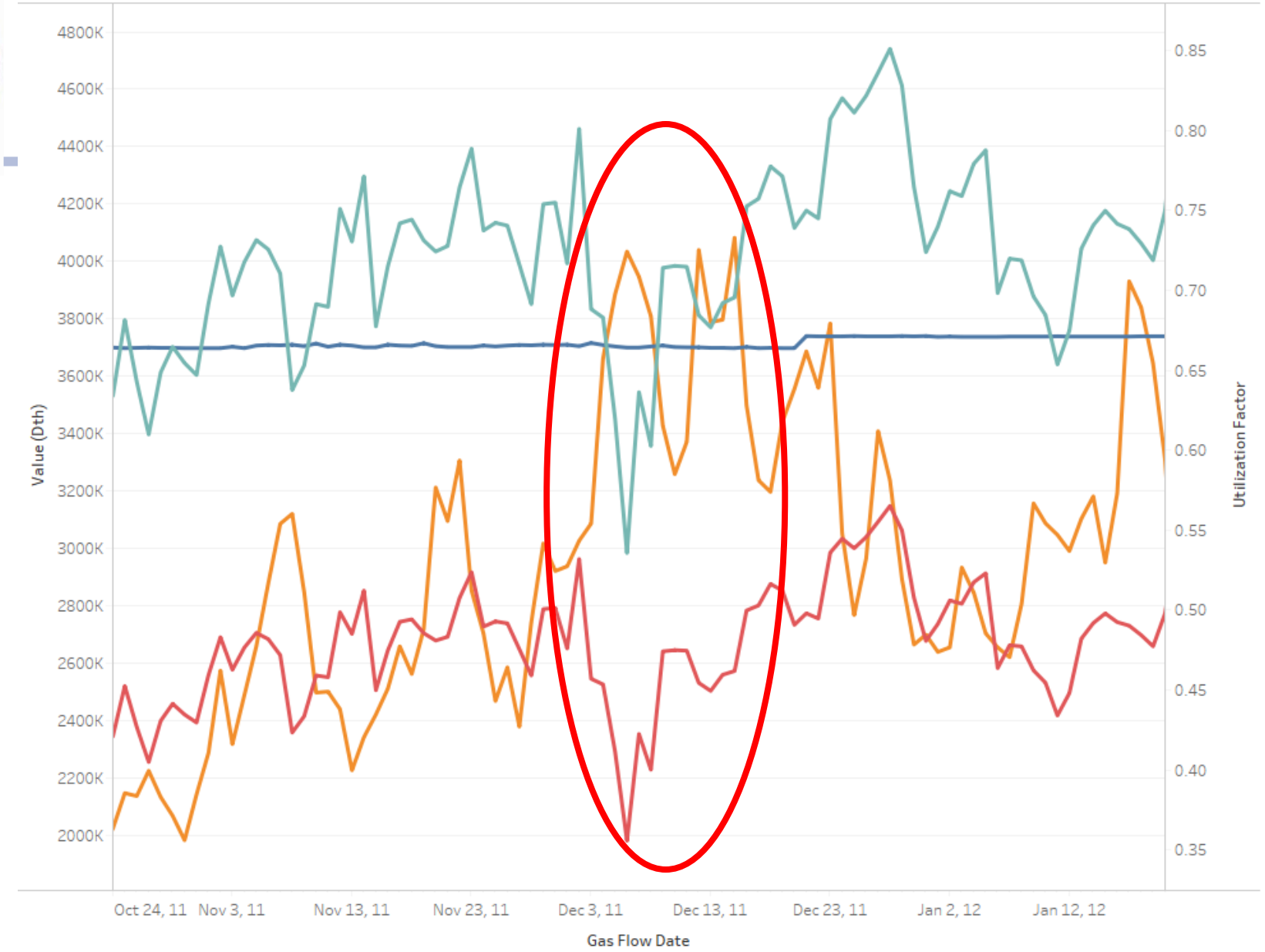
12
Month Number

Available Gross Operating Capacity, Scheduled, Sendout, and Utilization Factor



The trends of Available Capacity (Dth), Total Scheduled (Dth), Avg. Sendout (Dth), Utilization Factor and Utilization Factor for Gas Flow Date. Color shows details about Available Capacity (Dth), Total Scheduled (Dth), Avg. Sendout (Dth) and Utilization Factor. The data is filtered on Cycle, Receipt Point (copy) (group) and Gas Flow Date Day. The Cycle filter keeps 4. The Receipt Point (copy) (group) filter keeps System. The Gas Flow Date Day filter ranges from January 1, 2010 to October 19, 2018.

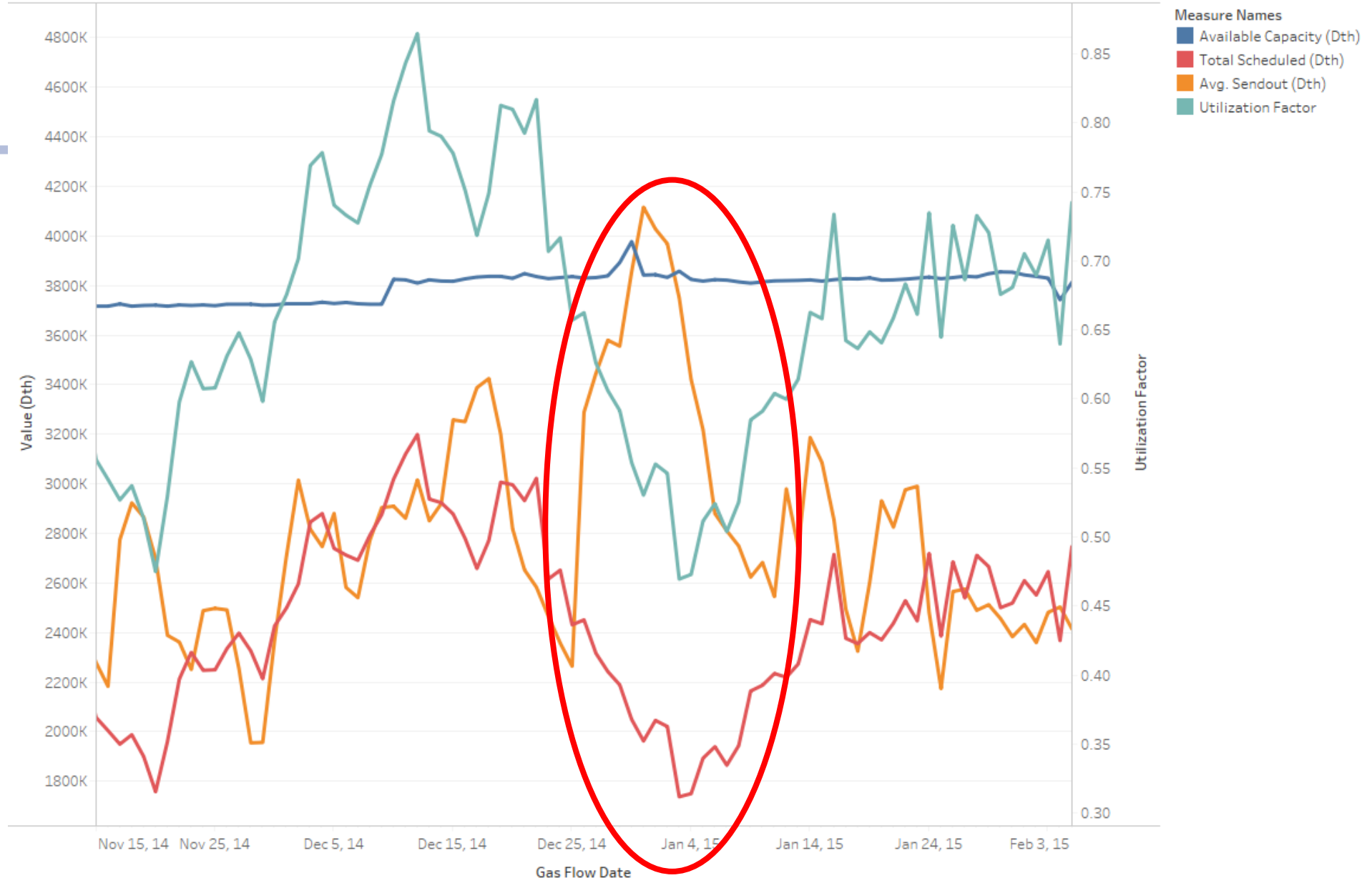
Available Gross Operating Capacity, Scheduled, Sendout, and Utilization Factor



High sendout on:
12/6/2011
12/12,2011
12/15/2011

The trends of Available Capacity (Dth), Total Scheduled (Dth), Avg. Sendout (Dth), Utilization Factor and Utilization Factor for Gas Flow Date. Color shows details about Available Capacity (Dth), Total Scheduled (Dth), Avg. Sendout (Dth) and Utilization Factor. The data is filtered on Cycle, Receipt Point (copy) (group) and Gas Flow Date Day. The Cycle filter keeps 4. The Receipt Point (copy) (group) filter keeps System. The Gas Flow Date Day filter ranges from January 1, 2010 to October 19, 2018.

Available Gross Operating Capacity, Scheduled, Sendout, and Utilization Factor



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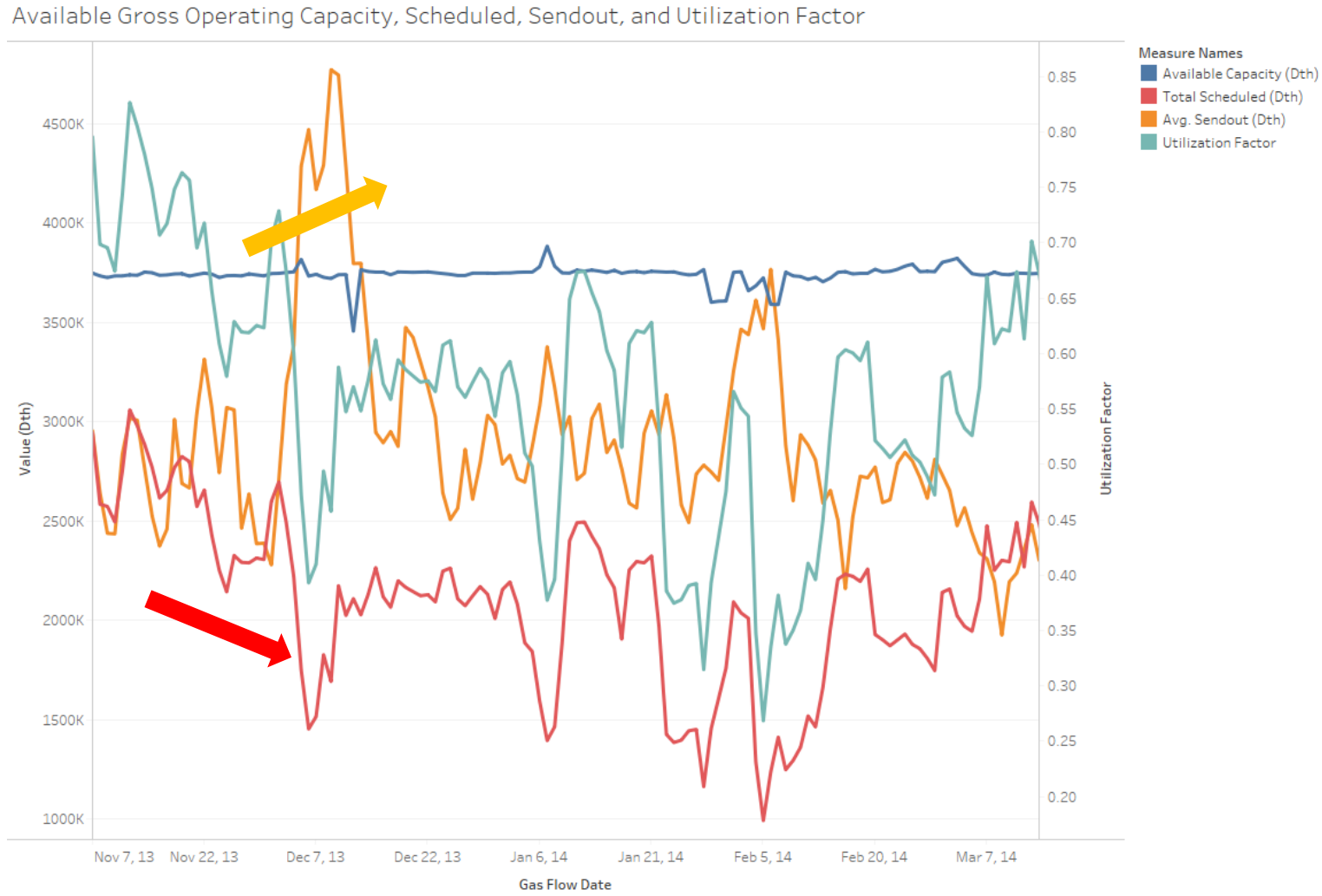
High Sendout Days

Utilization Factor on High Sendout Days

Days when sendout is higher than 4 Bcfd

Record	Date	Month	Year	Aliso	UF	Sendout
#	mm/dd/yyyy	mm	yy	Pre/post	(-)	MMcfd
1	11/29/2010	11	10	Pre	0.70	4,180
2	12/31/2010	12	10	Pre	0.61	4,027
3	12/19/2012	12	12	Pre	0.81	4,015
4	12/20/2012	12	12	Pre	0.80	4,064
5	1/11/2013	1	13	Pre	0.76	4,183
6	1/12/2013	1	13	Pre	0.70	4,313
7	1/13/2013	1	13	Pre	0.70	4,267
8	1/14/2013	1	13	Pre	0.69	4,782
9	1/15/2013	1	13	Pre	0.62	4,664
10	12/5/2013	12	13	Pre	0.47	4,145
11	12/6/2013	12	13	Pre	0.39	4,323
12	12/7/2013	12	13	Pre	0.41	4,031
13	12/8/2013	12	13	Pre	0.49	4,149
14	12/9/2013	12	13	Pre	0.46	4,614
15	12/10/2013	12	13	Pre	0.59	4,588
16	12/11/2013	12	13	Pre	0.55	4,139

Utilization Factor in winter 2013-2014



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Utilization Factor on High Sendout Days

Days when sendout was higher than 3,875 MMcfd and lower than 4,000 MMcfd

Record	Date	Month	Year	Aliso	UF	Sendout
#	mm/dd/yyyy	mm	yy	Pre/Post	(-)	MMcfd
1	11/30/2010	11	10	Pre	0.59	3,941
2	12/30/2010	12	10	Pre	0.65	3,888
3	2/27/2011	2	11	Pre	0.71	3,893
4	12/6/2011	12	11	Pre	0.54	3,902
5	12/12/2011	12	11	Pre	0.68	3,908
6	12/15/2011	12	11	Pre	0.70	3,949
7	1/16/2013	1	13	Pre	0.62	3,940
8	12/31/2014	12	14	Pre	0.53	3,981
9	1/1/2015	12	14	Pre	0.55	3,896
10	12/15/2015	12	15	Post	0.62	3,913
11	12/16/2015	12	15	Post	0.60	3,907
12	12/17/2015	12	15	Post	0.60	3,892
13	1/24/2017	1	17	Post	0.82	3,944
14	1/26/2017	1	17	Post	0.83	3,954

Utilization Factor on High Sendout Days

- In this data set, there were 97 days where sendout was greater than 3,575 MMcfd.
  - 79 days are pre-Aliso with RPU average of 64%.
    - The highest RPU is 87%, which occurred on 12/14/2012.
    - The lowest RPU is 24%, which occurred on 02/03/2011.
  - 18 days are post-Aliso with RPU average of 70%.
    - The highest RPU is 87%, which occurred on 01/23/2017.
    - Ignoring the months around the incident, the lowest RPU is 72% occurring on 02/20/2018.
    - For the 6 days in 2017 with high sendout, the average RPU is 84%, though sendout never exceed 4 Bcfd in 2017.

Conclusions I

- RPU is a highly uncertain quantity and sensitivity analysis on RPU must be an integral part of the investigation and the decision making.
- A rigorous approach to calculate RPU must involve multi-state modeling by knowing supply and demand along the pipelines from the basins and all the way to California as well as firm rights contracted by gas shippers and also the different behavior of gas shippers. If such analysis is undergone, it will have to be probabilistic and will yield a probability distribution on the receipt capacity rather than a single value.
- RPU may be an indication of supply availability.

Conclusions II

- Historical data may not be the best approach to calculate the RPU since historically gas shippers have relied on storage and historical data shows lower RPU during higher sendout days highlighting two possibilities:
  - Economics (gas prices are higher during multistate events and therefore favoring storage withdrawals rather than scheduling from out of state).
  - Not enough interstate supplies or lower priority with California being at the downstream end of the western natural gas network.
- An upper bound of RPU is 95% given that 100% requires:
  1) Perfect forecasting from ALL shippers on the pipeline network.
  2) Not relying or scheduling from storage (ignoring price of gas).
  3) Interstate supply availability.

Questions and Discussion Points

- Ideas to enhance the analysis of RPU within the CPUC jurisdiction.
- Lower bound of sensitivity analysis.
- Switch modeling priority to sensitivity on RPU on high demand days rather than a monthly schedule?
- How to increase scheduling during high sendout days and will it contradict with GCIM (Gas Cost Incentive Mechanism)?
- Gas day vs. Calendar day.

Thank you