Responses to RASTF Data Analysis requests

Patricio Rocha Garrido
Resource Adequacy Planning
RASTF
November 30, 2022

Planned Outage data (MW-week) for period 2012-Summer 2022

Jim Wilson request

All values in MW-week
Values not provided for July and August because sample size is too low and this raises confidentiality issues
NA: Information is not available

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Jan	12,500	12,145	11,467	9,509	12,945	4,115	8,634	7,882	11,933	6,499	5,601
Feb	20,396	31,427	23,872	22,425	25,087	13,714	17,114	10,140	17,974	6,240	14,369
Mar	104,374	120,459	107,435	117,021	113,799	100,307	97,941	112,725	74,666	81,537	90,009
Apr	152,439	186,054	162,112	192,333	214,974	167,117	200,125	190,168	107,546	168,503	184,453
May	125,268	130,992	164,891	149,238	136,064	142,369	144,658	124,940	101,267	126,853	118,712
Jun	17,116	23,116	19,548	19,500	14,670	10,002	12,523	10,765	9,277	16,415	16,649
Jul											
Aug											
Sep	49,321	52,094	62,324	51,100	46,877	62,210	51,711	54,132	43,169	60,693	NA
Oct	114,122	139,940	154,544	162,054	161,403	162,162	155,732	179,009	166,622	199,576	NA
Nov	109,701	101,494	111,044	137,986	113,967	110,152	119,845	141,069	128,100	146,533	NA
Dec	43,764	27,068	31,424	41,680	35,723	26,675	34,126	33,608	35,433	33,230	NA

Average Planned Outage Factor for Coal units > 200 MW

Paul Sotkiewicz request

Historical Time Period Analyzed	Planned Outage Factor (Weeks per Year)
2017-2021	5
2016-2020	5
2015-2019	3
2014-2018	5
2013-2017	5
2012-2016	5

Information collected from the last 6 Reserve Requirement Study reports available at https://www.pjm.com/planning/resource-adequacy-planning/reserve-requirement-dev-process

Impact of DR on how Planned Outages are scheduled

Gregory Carmean request

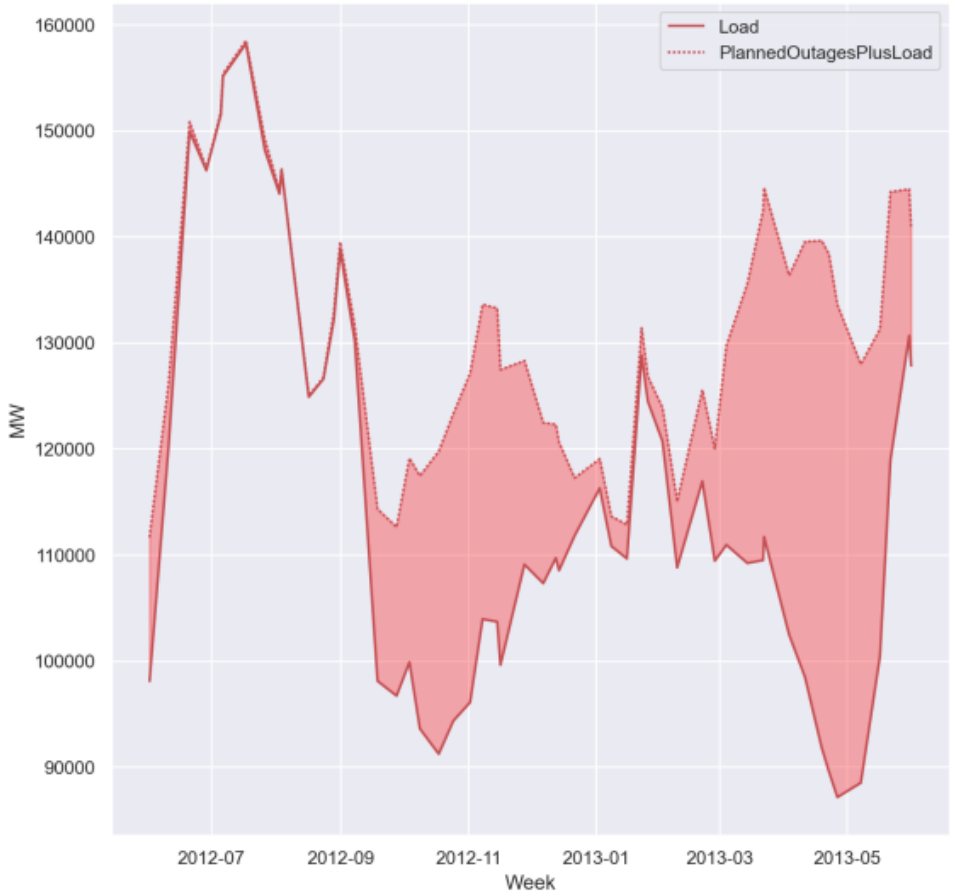
- PJM's generation and transmission outage analysis process is designed to avoid the need to enter into emergency conditions. PJM Manual 13 Section 2.3.2 lists emergency procedure warnings and actions, including the calling of DR which triggers a PAI. PJM currently does not account for DR in the scheduling of planned outages to avoid emergency conditions requiring DR.

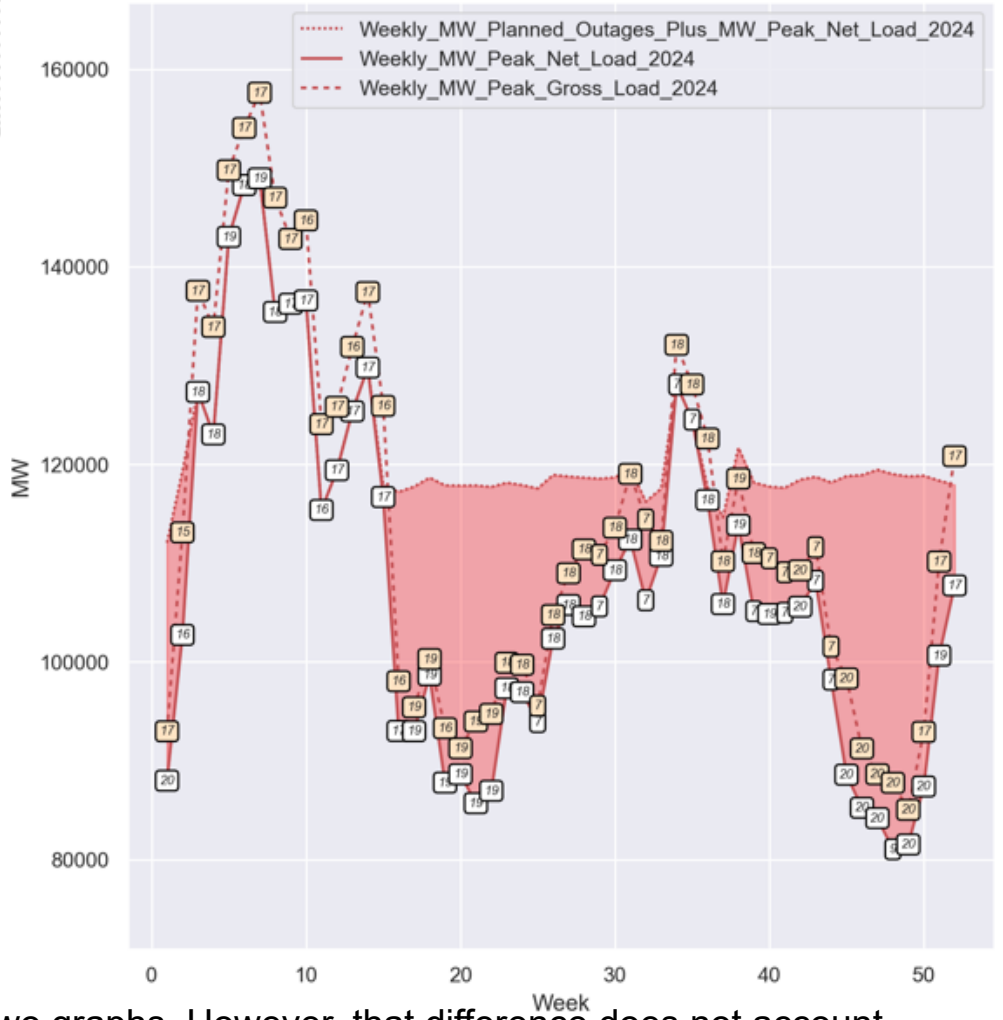
Historical Planned Outages Schedules

Mark Spencer request

- The following slides show two graphs:
  - The left-hand graph shows the actual maximum weekly value of “gross load plus planned outages” for the corresponding delivery year as well as the gross load (shaded area represents historical planned outages)
  - The right-hand graph shows how a heuristic would schedule planned outages if the weather from a past historical year were to repeat itself in 2024 (presented at previous RASTF)
- The main take-way from the comparison between left-hand and right-hand graphs is that historically and using the heuristic, the majority of the planned outages are scheduled in the shoulder period. However, the historical schedule is significantly less smooth.

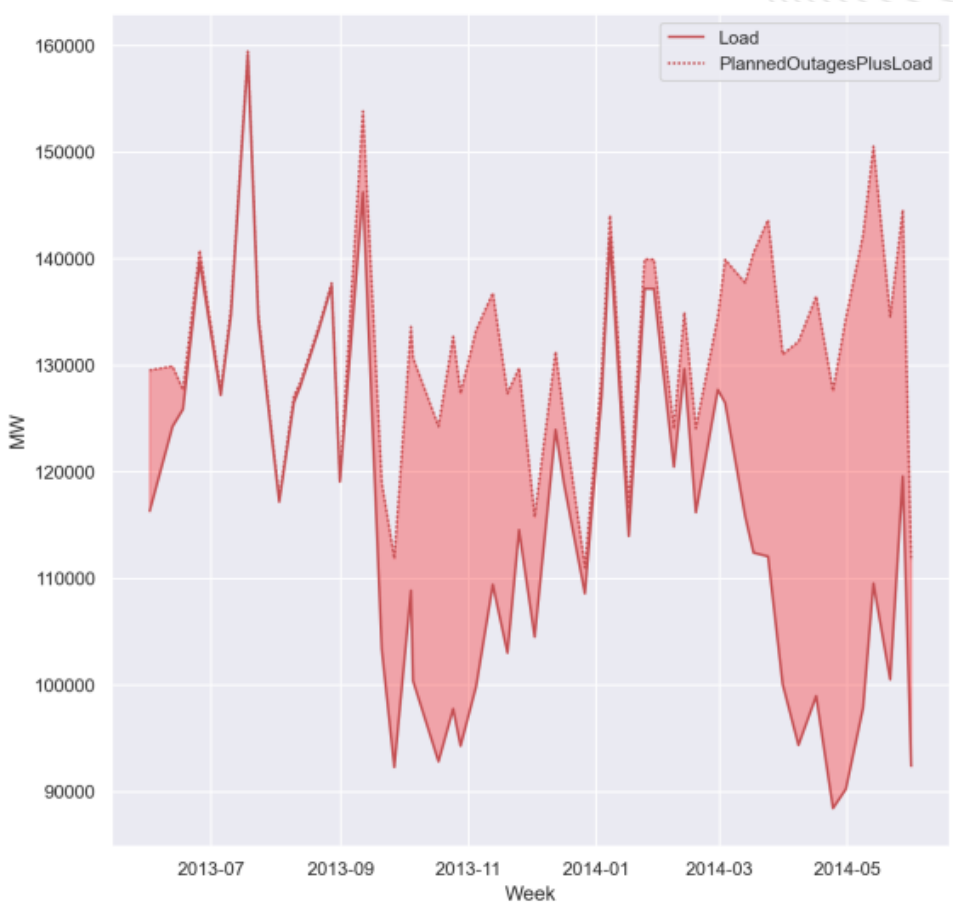
Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2012





NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2013



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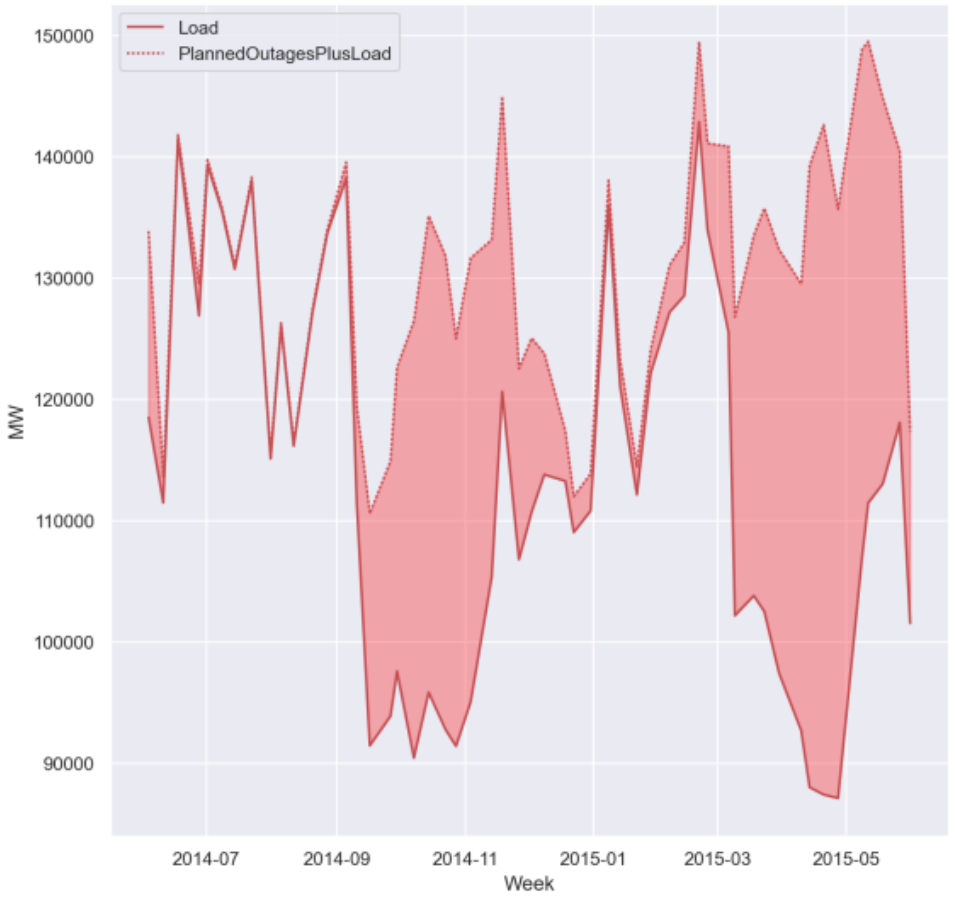
Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2014



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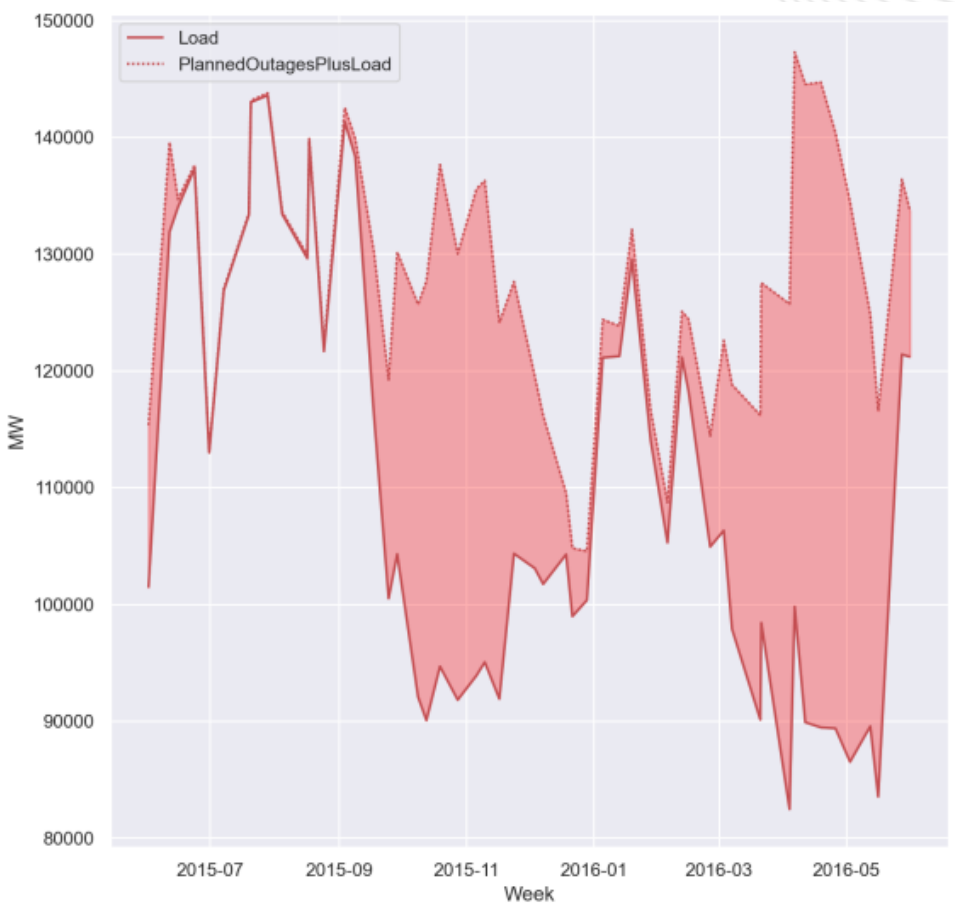
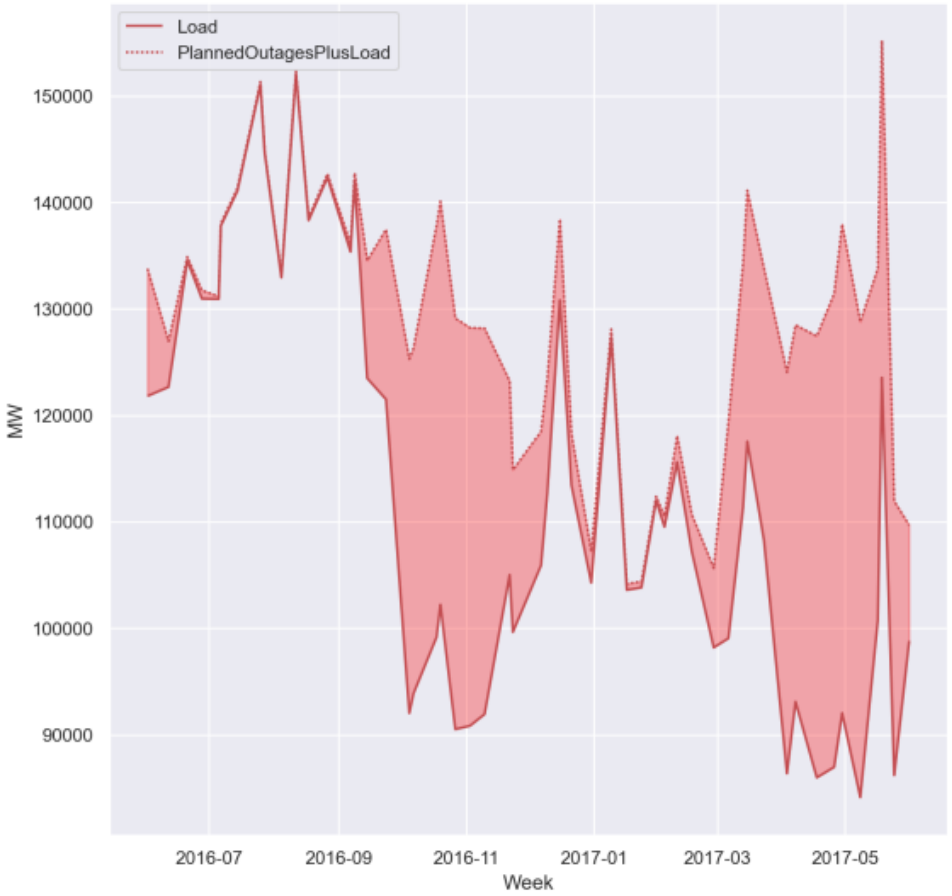
Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2015



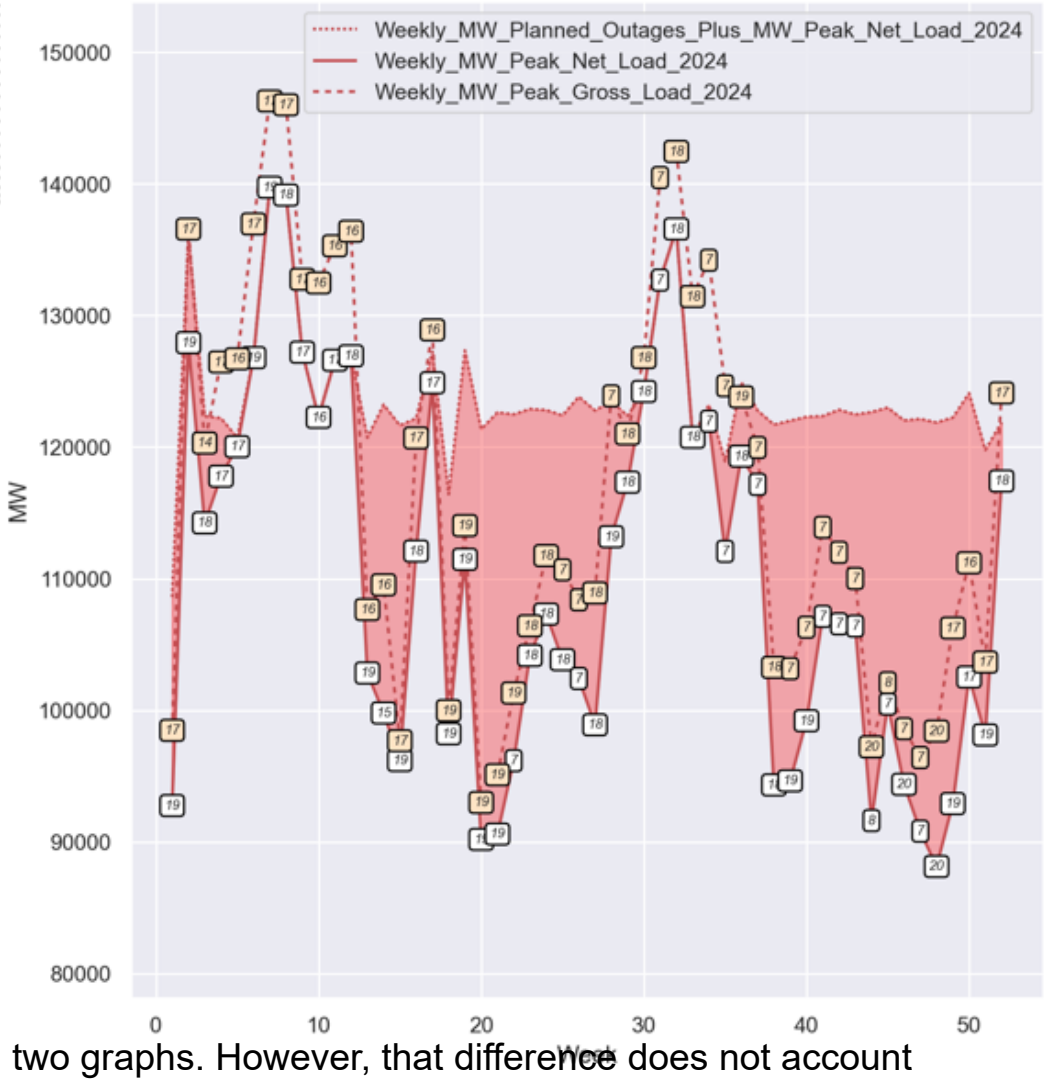
NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2016



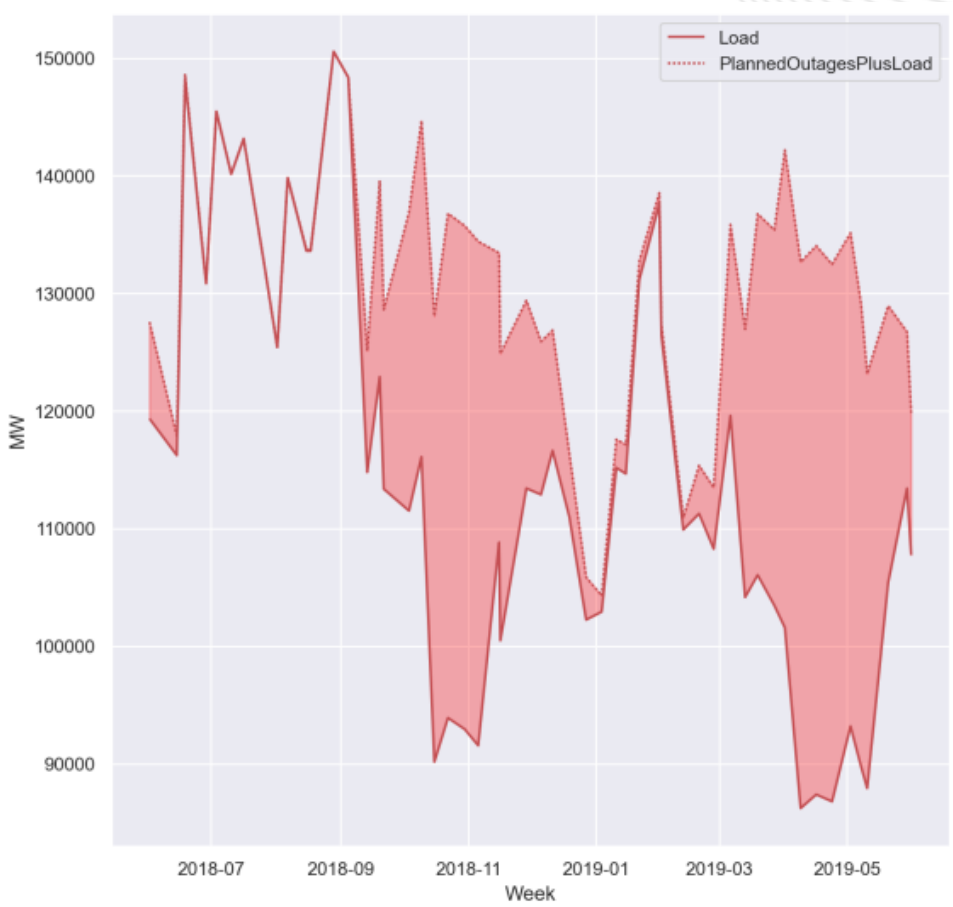
NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

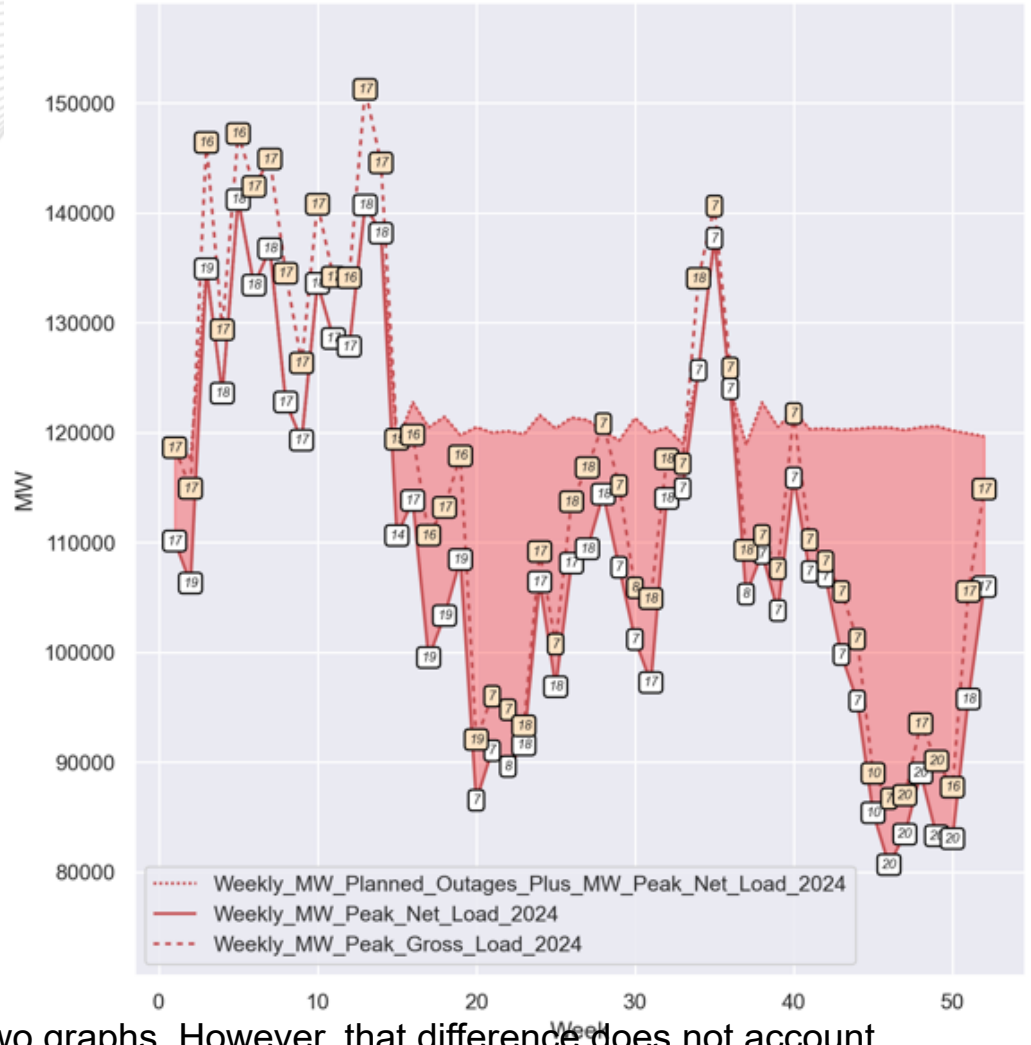
Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2017



NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2018





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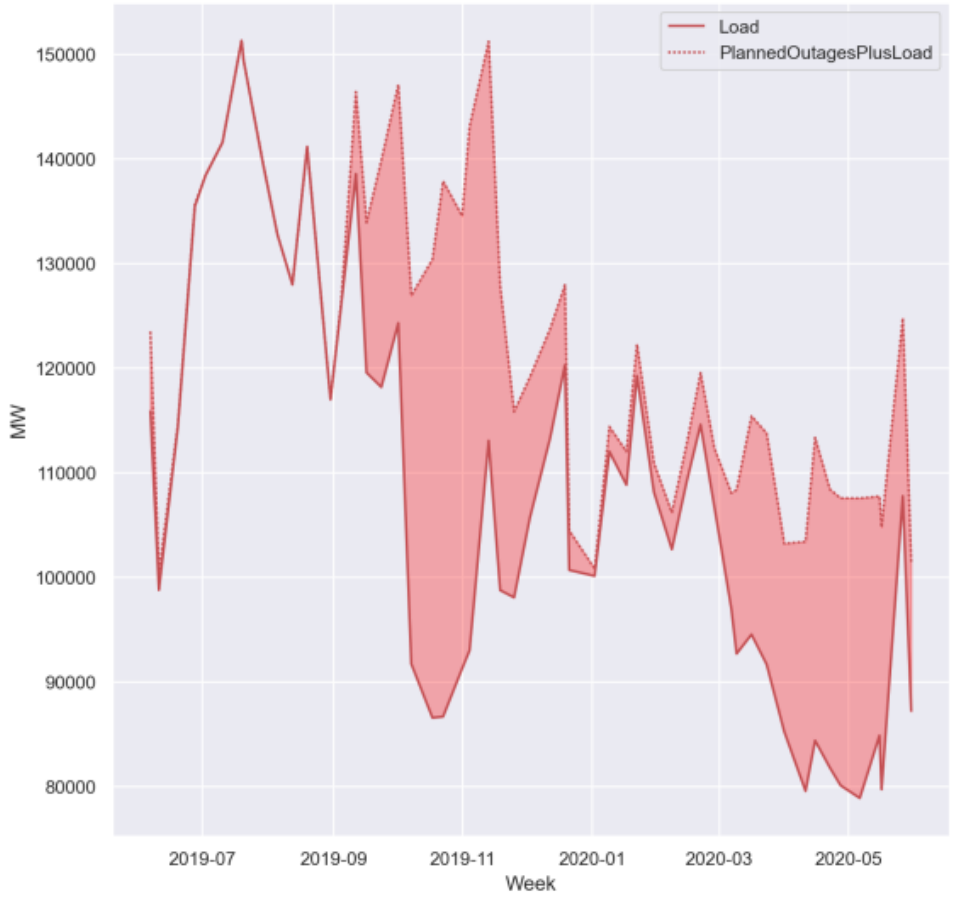
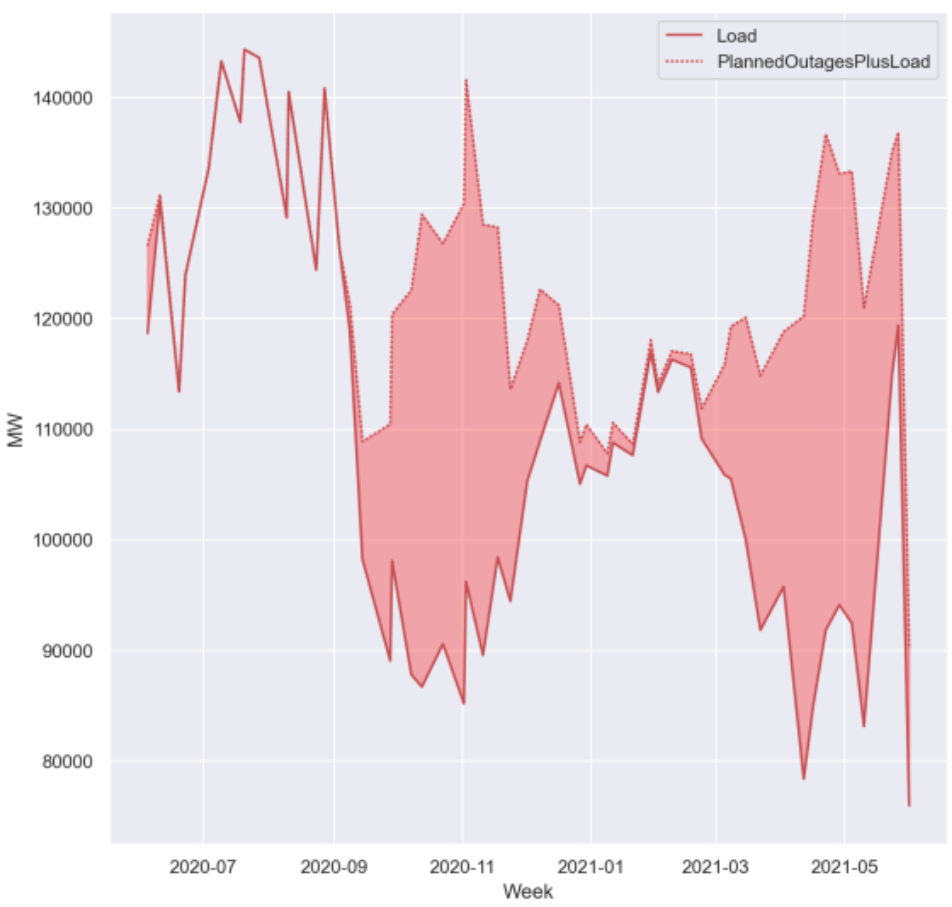
Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2019



NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

Historical Planned Outage Schedule vs Prospective Schedule derived with heuristic – DY 2020



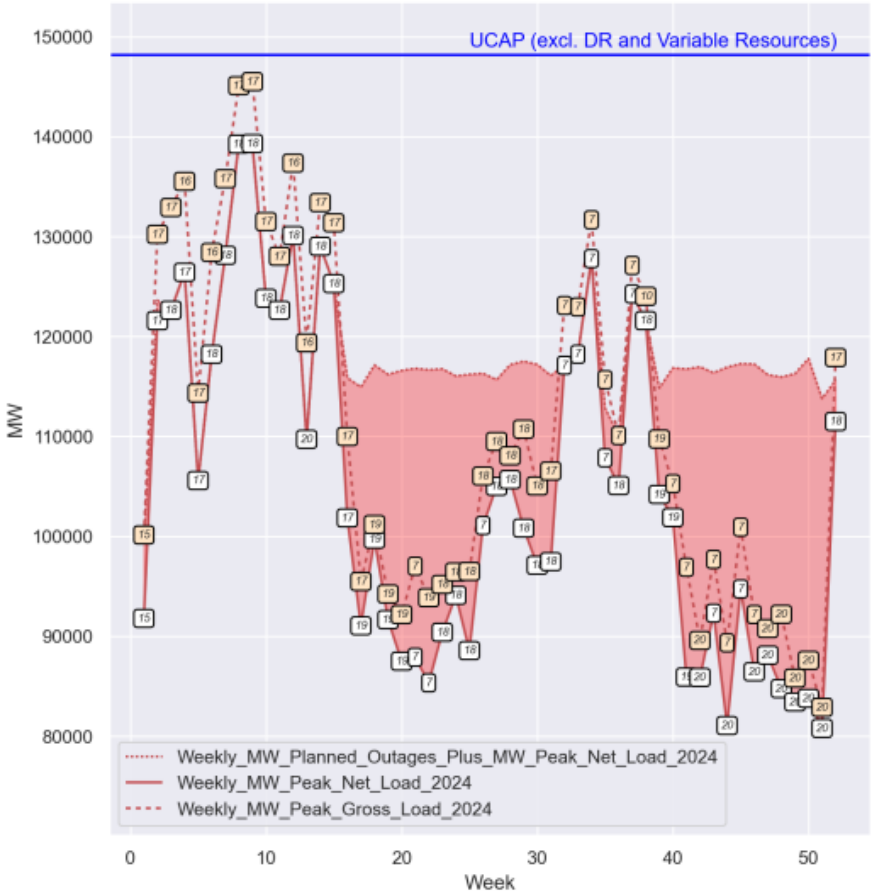
NOTE: the amount of planned outages is different in the two graphs. However, that difference does not account for the difference in the level of smoothness of the schedules.

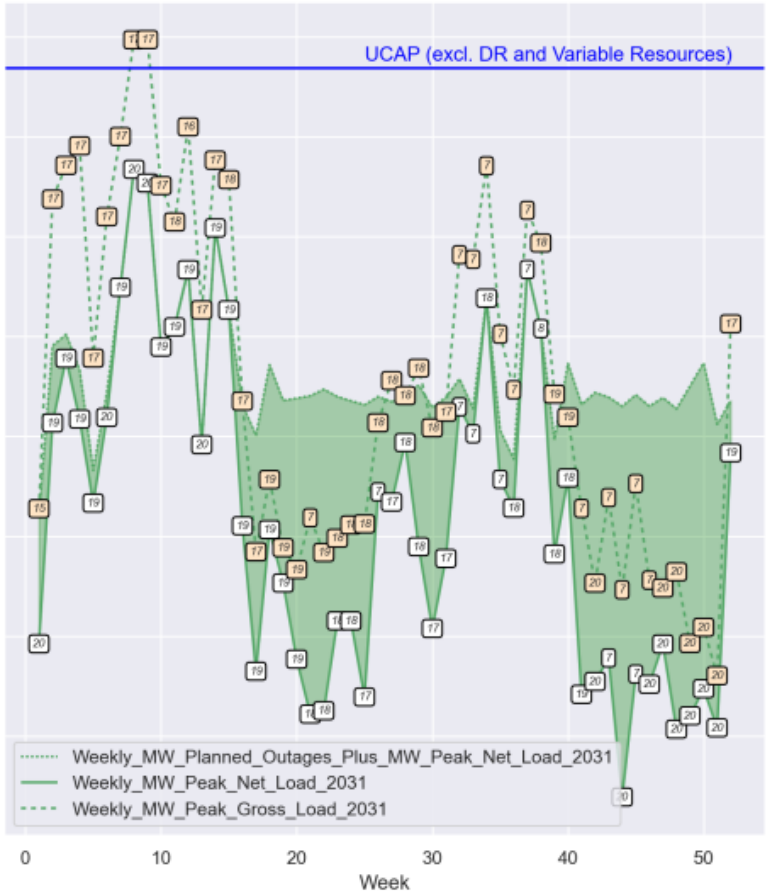
2024 vs 2031 Loss of Load Risk due to Planned Outage Schedule and Variable Resource penetration

Jim Wilson request

- At the previous meeting, we showed graphs comparing 2024 and 2031 if different historical weather years were to re-occur.
  - We also reflected the expected level of Variable Resources and used a heuristic to develop a Planned Outage schedule
- We concluded that the heuristic would place the majority of the outages in the shoulder season in 2024 and 2031
- The next slide addresses the question about changes in loss of load risk in 2031 vs 2024 under an annual RPM construct

2024 and 2031 Planned Outages Schedule using 2015 weather year





	DY 2024	DY 2031
50/50 Peak Load	150,309	154,275
FPR	1.09	1.09
Reliability Requirement (UCAP MW)	163,837	168,160
Total Variable Resources UCAP (MW)	7,949	13,401
Total DR UCAP (MW)	7,743	7,886
Total Other Generation UCAP (MW)	148,144	146,872

2024 vs 2031 Loss of Load Risk due to Planned Outage Schedule and Variable Resource penetration

- Under an annual construct, increasing Variable resource penetration in 2031 does not seem to alter significantly the loss of load risk due to planned outage scheduling
  - Compare distance between blue lines and top of the shaded areas in both graphs
- This occurs because the difference in Total Other Generation UCAP between 2024 and 2031 is only ~1,200 MW
  - However, differences in the composition of the Other Generation group of resources could trigger differences in loss of load risk patterns between 2031 and 2024 (which would be captured in the ELCC model and reflected via lower accreditation)

Would a seasonal construct modify the impact of planned outages scheduling on loss of load risk?

Jim Wilson request

- A seasonal construct is likely to modify the impact of planned outages scheduling on loss of load risk
  - The extent of this impact will depend on the number of seasons and how the reliability requirement of each season is determined (i.e. the reliability criteria for each season)
- The following slides illustrate the above by using Delivery Year 2024 if the weather from Delivery Year 2013 were to re-occur under different seasonal constructs and reliability requirements

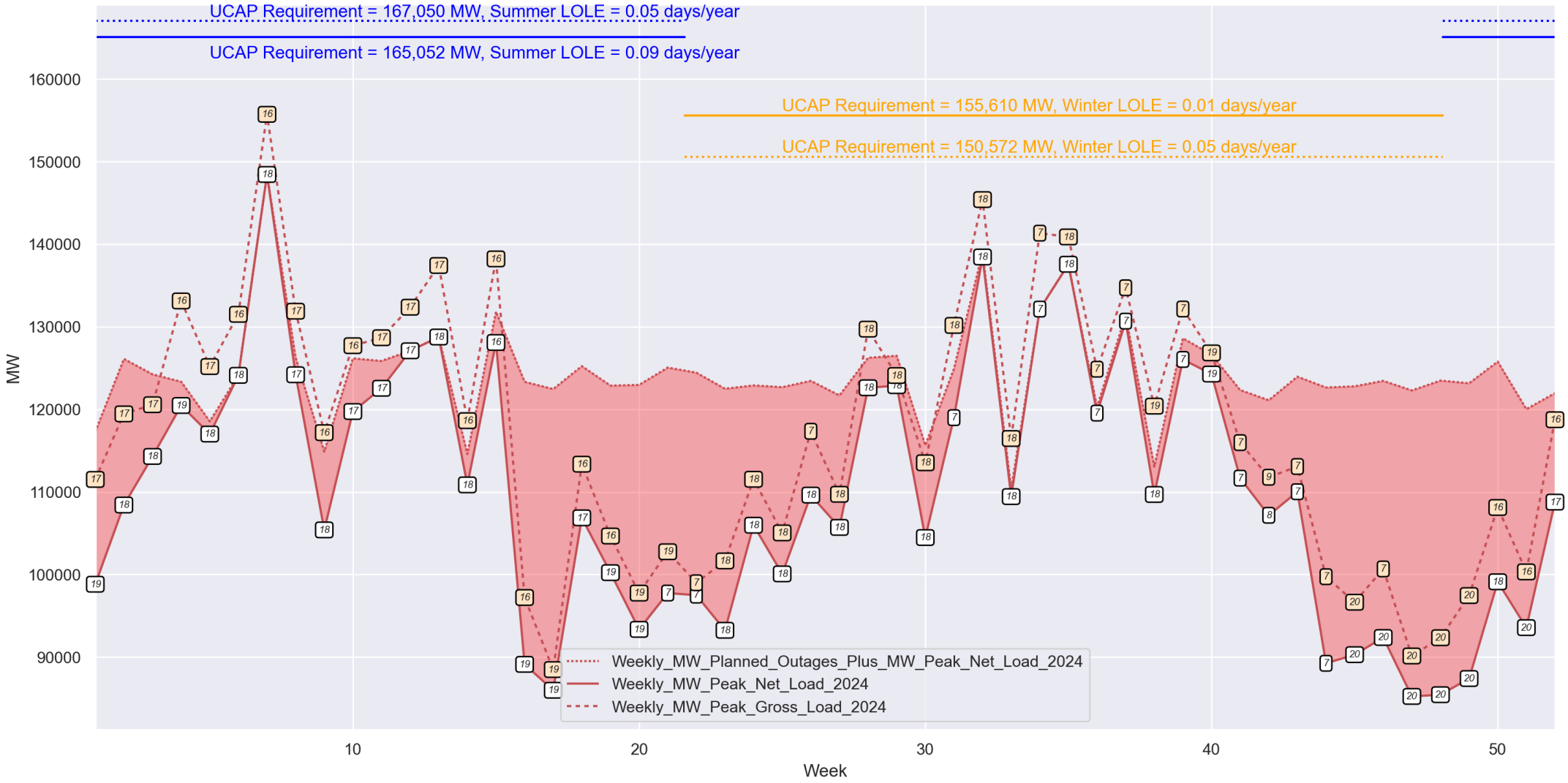
Would a seasonal construct modify the impact of planned outages scheduling on loss of load risk?

- The following Cases and Scenarios are examined

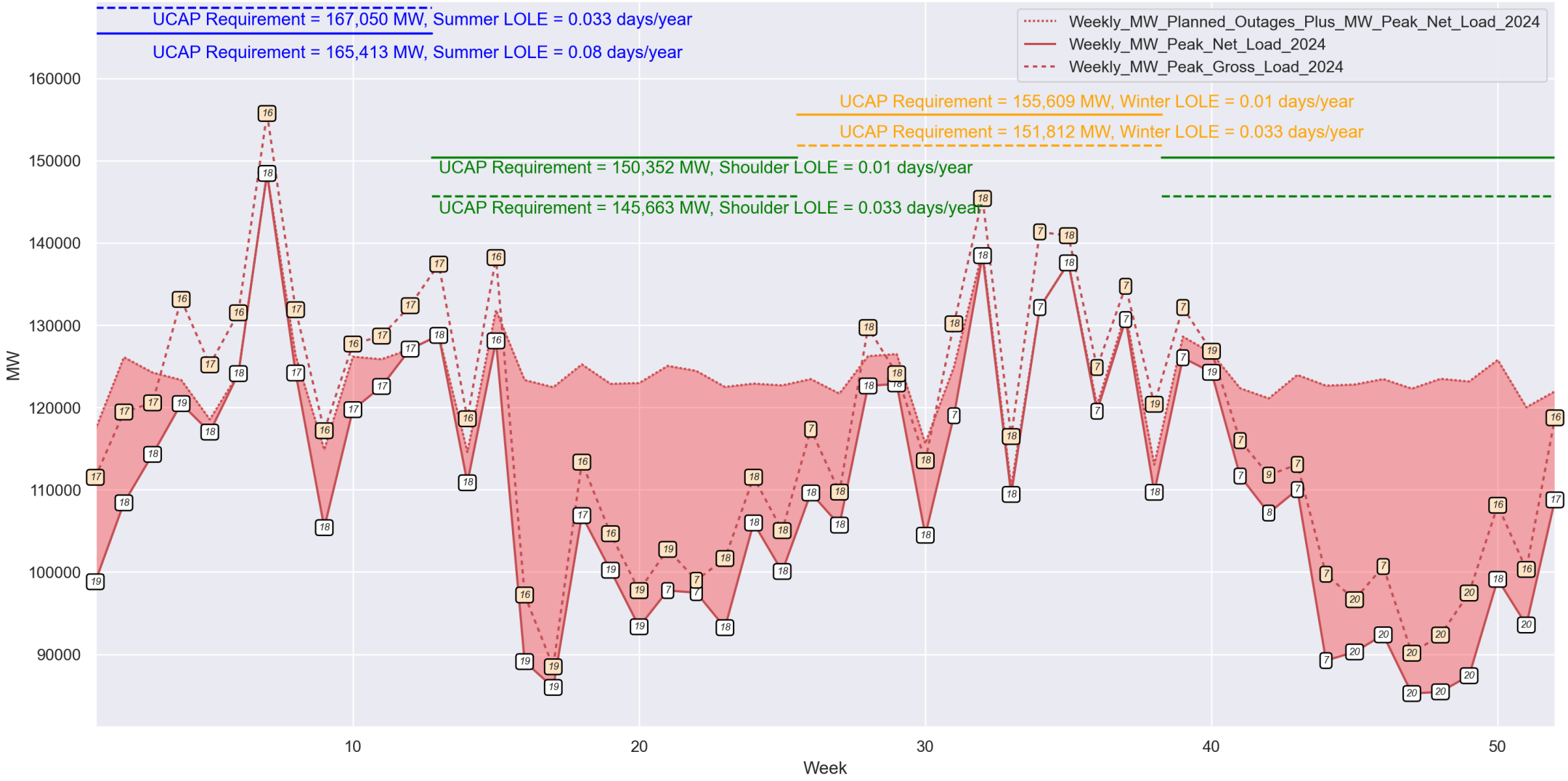
Case	Season Definition	Scenarios
Two Seasons	Summer: June - October and May, Winter: November-April	Scenario 1: Summer LOLE: 0.09 days/year, Winter LOLE: 0.01 days/year, Scenario 2: Summer LOLE: 0.05 days/year, Winter LOLE: 0.05 days/year
Three Seasons	Summer: June - August, Winter: December-February, Shoulder: September-November plus March-May	Scenario 1: Summer LOLE: 0.08 days/year, Winter LOLE: 0.01 days/year, Shoulder LOLE: 0.01 days/year Scenario 2: Summer LOLE: 0.033 days/year, Winter LOLE: 0.033 days/year, Shoulder LOLE: 0.033 days/year

- Caveats:
  - UCAP Requirements (“Reliability Requirements”) are calculated in terms of “Perfect Capacity” using the hourly ELCC model
    - Therefore, UCAP requirement is only driven by load uncertainty, which means that all supply-side uncertainties are reflected in the accreditation
    - UCAP requirements are driven by load uncertainty in 2022 PJM Load Forecast
  - Zero emergency assistance from neighbors is considered in the UCAP Requirement

Would a seasonal construct modify the impact of planned outages scheduling on loss of load risk? – Two Seasons Case



Would a seasonal construct modify the impact of planned outages scheduling on loss of load risk? – Three Seasons Case



Contact

SME/Presenter:

Patricio Rocha-Garrido

Patricio.Rocha-Garrido@pjm.com

Responses to RASTF Data Analysis requests

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

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