Responses to RASTF Data Analysis requests

Patricio Rocha Garrido
Resource Adequacy Planning
RASTF
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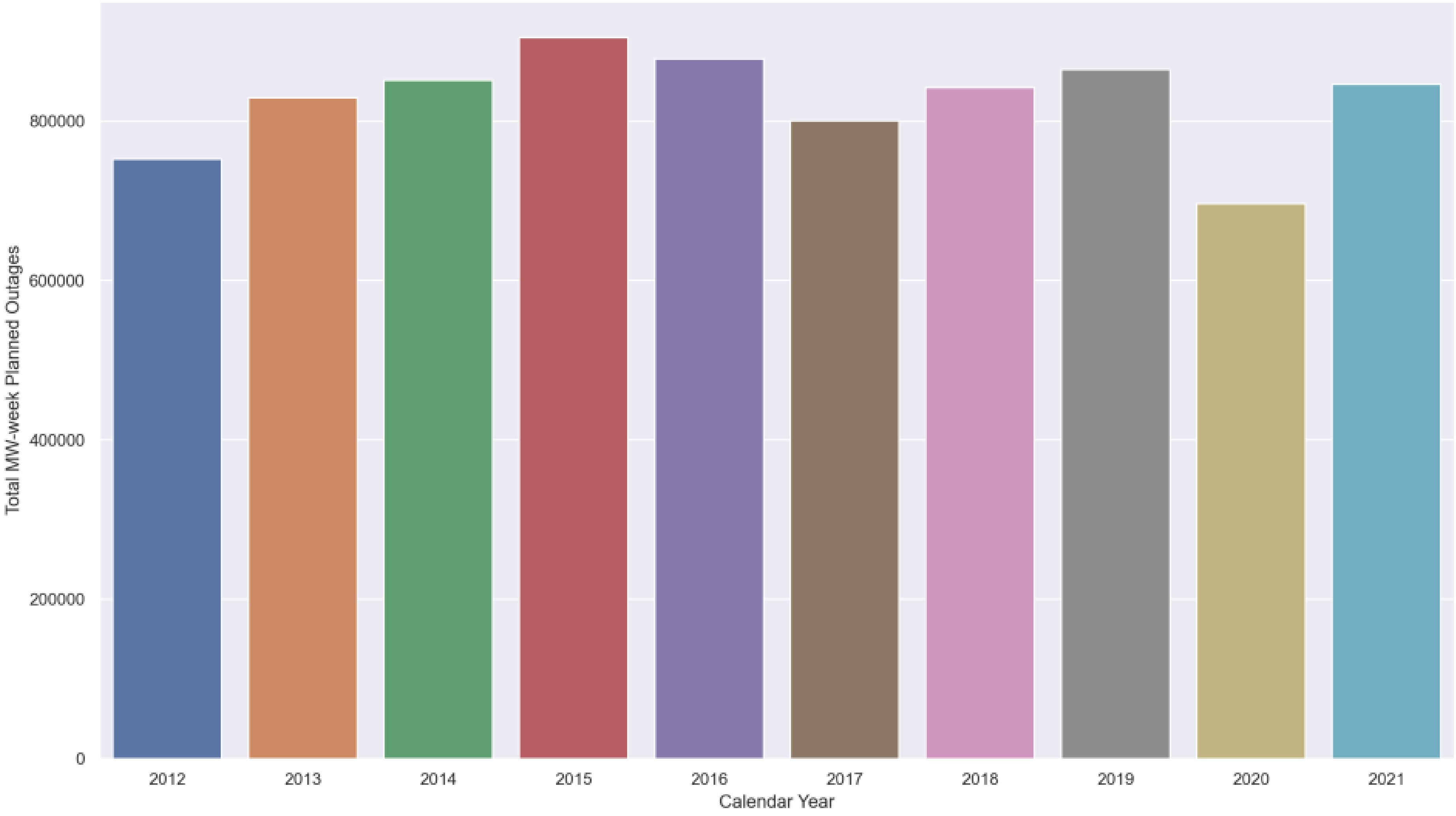
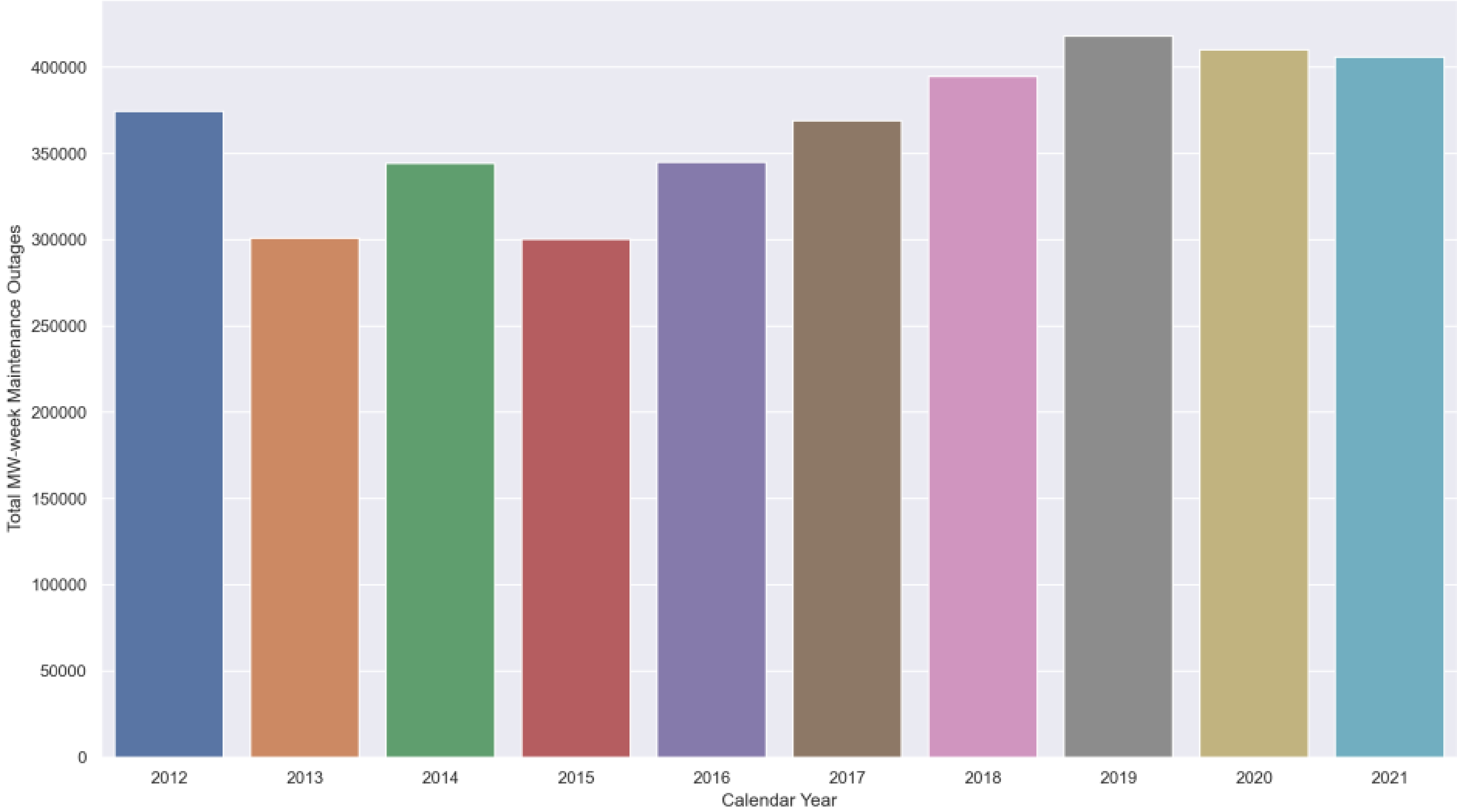
- Correction to two graphs from October 31 presentation
  - Y-axis values in the following two graphs were wrong in the slides presented in the October 31 meeting
    - Total MW-week values were understated by a factor of 24. The error occurred in the conversion from MW-min to MW-week
- NERC definition of planned and maintenance outages
- Clarification about Average PO MW Size x Duration by Year and Primary Fuel in presentation made at previous RASTF meeting
- Planned Outage data (MW-week values) included in presentation made at previous RASTF meeting

Total MW-week of Planned Outages for each Year



Total MW-week of Maintenance Outages for each Year



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Scheduled Outages (cont.)

- Scheduled-type Outages
  - Planned Outage (PO)
    - Outage planned “well in advance”
      - Typically an annual unit overhaul or nuclear refueling outage
      - Typically budgeted with an outage identifier (OID) number
      - Typically scheduled by an outage planning system to balance resources across outages
    - Predetermined duration
    - Can slide PO if approved by ISO, Power Pool or dispatch
  - Maintenance (MO)
    - Deferred beyond the end of the next weekend but before the next planned outage (Sunday 2400 hours)
      - Definition applies if the outage occurs before Friday at 2400 hours
      - If the outage occurs after Friday at 2400 hours and before Sunday at 2400 hours, MO will only apply if the outage can be delayed passed the next, not current, weekend
      - If the outage can not be deferred, the outage is a forced event

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From https://www.nerc.com/pa/RAPA/gads/Training/2019_Conventional_GADS_Training_Module_05_Outage_Event_Reporting.pdf

NERC Definitions

PO **Planned Outage**

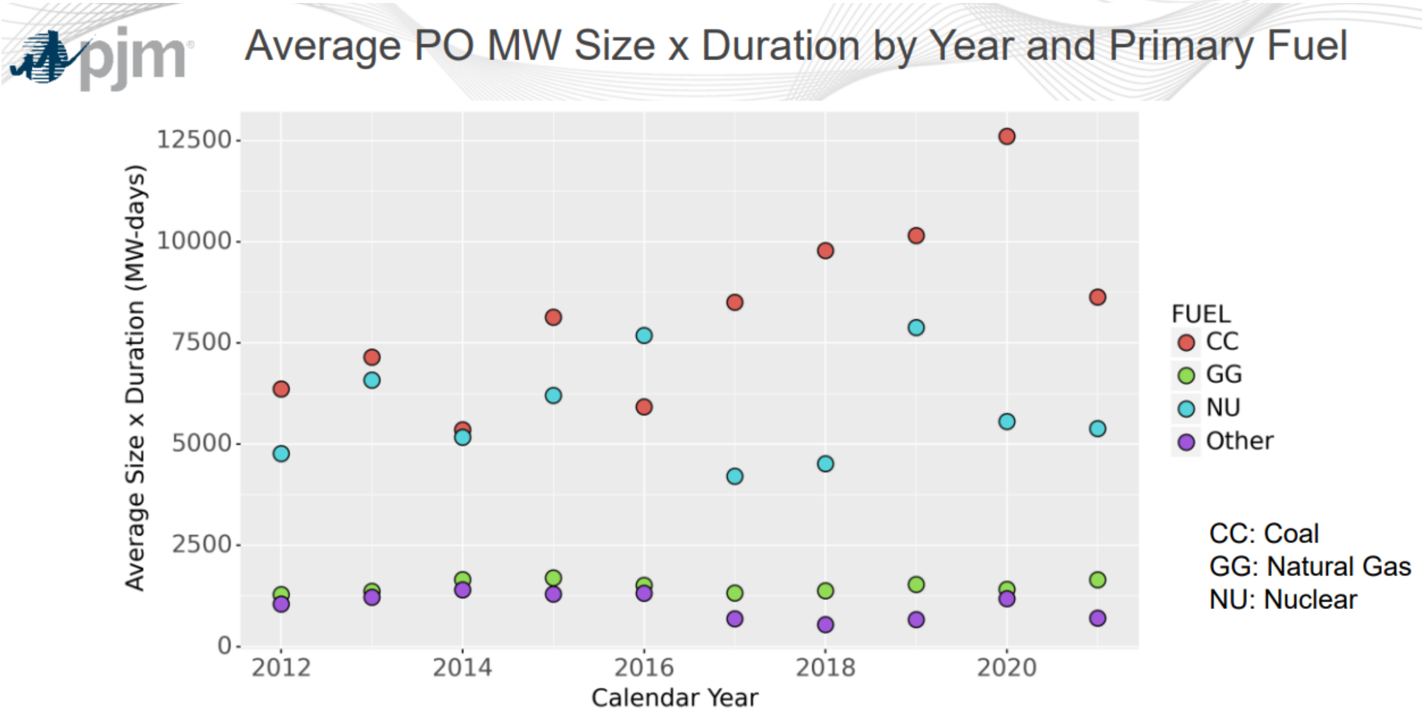
An outage that is scheduled well in advance and is of a predetermined duration, can last for several weeks, and occurs only once or twice a year. Typically, these events are specifically listed in the plant budget. Turbine and boiler overhauls or inspections, testing, and nuclear refueling are typical planned outages. For a planned outage, all of the specific individual maintenance and operational tasks to be performed are determined in advance and are referred to as the "original scope of work." The general task of repairing turbines, boilers, pumps, etc. is not considered a work scope because it does not define the individual tasks to be performed. For example, if a general task such as repair boiler is considered the work scope, it is impossible to conclude that any boiler work falls outside of the original scope of work. Discovery work and re-work which render the unit out of service beyond the estimated PO end date are not considered part of the original scope of work. A planned extension may be used only in instances where the original scope of work requires more time to complete than the estimated time. For example, if an inspection that is in the original scope of work for the planned outage takes longer than scheduled, the extra time should be coded as an extension (PE). However, if damage found during the inspection results in an extension of the outage, the extra time required to make repairs should be coded as a forced outage.

MO **Maintenance Outage**

An outage that can be deferred beyond the end of the next weekend (defined as Sunday at 2400 hours or as Sunday turns into Monday), but requires that the unit be removed from service, another outage state, or Reserve Shutdown state before the next Planned Outage (PO). Characteristically, a MO can occur any time during the year, has a flexible start date, may or may not have a predetermined duration, and is usually much shorter than a PO. Discovery work and re-work which render the unit out of service beyond the estimated MO end date are not considered part of the original scope of work. A maintenance extension may be used only in instances where the original scope of work requires more time to complete than the estimated time. For example, if an inspection that is in the original scope of work for the outage takes longer than scheduled, the extra time should be coded as an extension (ME). If the damage found during the inspection is of a nature that the unit could be put back on-line and be operational past the end of the upcoming weekend, the work could be considered MO. If the inspection reveals damage that prevents the unit from operating past the upcoming weekend, the extended work time should be Forced Outage (U1).

From https://www.nerc.com/pa/RAPA/gads/DataReportingInstructions/2022_GADS_DRI.pdf

Clarification about Average PO MW Size x Duration by Year and Primary Fuel in presentation made at previous RASTF meeting



The information presented in the graph is accurate. It was calculated as illustrated by the following example:

A certain unit, takes the following 3 planned outages:

500 MW for 0.5 days = 250 MW-days
500 MW for 0.25 days = 125 MW-days
500 MW for 0.75 days = 375 MW-days

Average = (250 + 125 + 375) / 3 = 250 MW-days

Note that if the above 3 outages would have involved contiguous periods, we could have had:

500 MW for 1.5 days = 750 MW-days

This produces an average of 750 MW-days which is different from the 250 MW-days.

Several contiguous outages reported to GADS are sometimes reported as multiple entries. Planned derates are also included in the calculation. The above reporting is having an impact on the supplied graph.

Planned Outage data (MW-week) for period 2012-2021

All values in MW-week

Values not provided for July and August because sample size is too low and this raises confidentiality issues

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

- Addresses partially or fully the following requests
  - Typical MW of planned maintenance by week of year, recent years. Maybe a qualitative discussion of how the pattern of weekly planned outage has changed in recent years and may further change as the resource mix changes

- How could the annual planned outage schedule change in the period 2024-2031 as the penetration level of Variable Resources increases?
  - Response: It seems that not that much.
  - Note that this is a **different** question from: How could the annual planned outage schedule impact the annual loss of load risk pattern in the period 2024-2031 as the penetration level of Variable Resources increases? This question will be examined at a future meeting

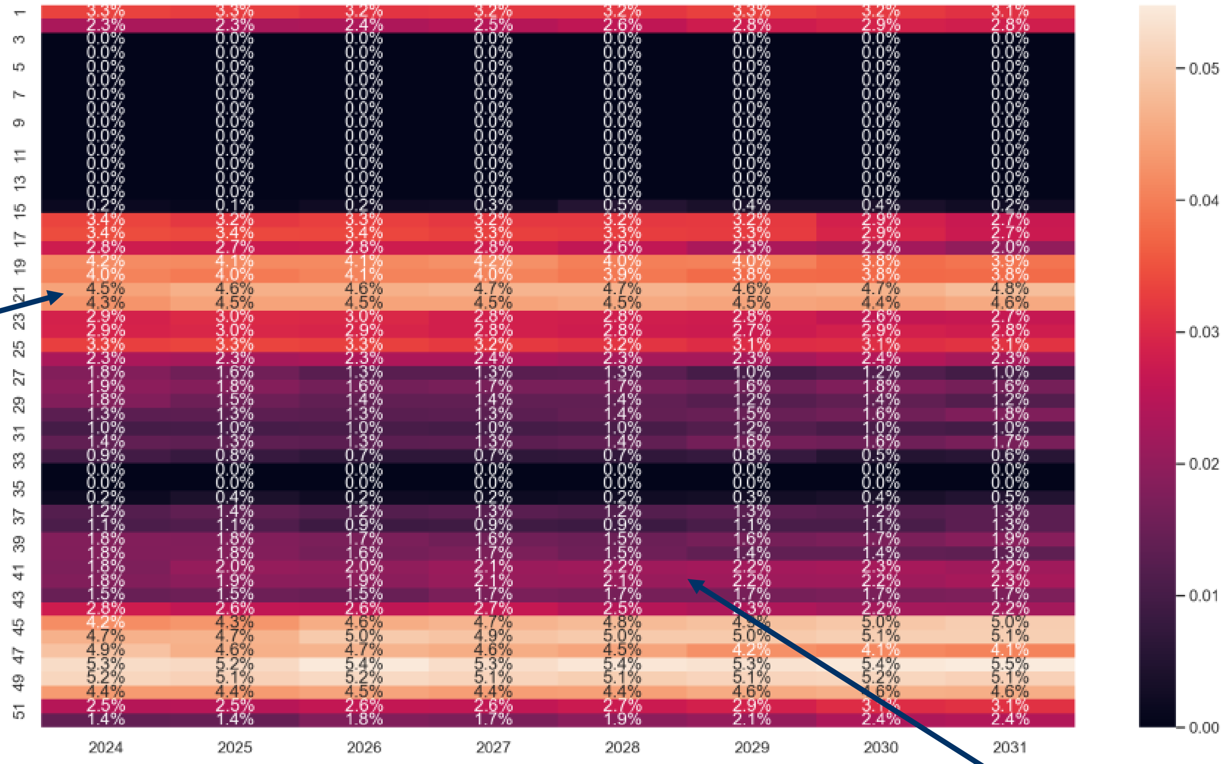
- To assess the potential change in planned outage scheduling due to the changing resource mix, the following procedure was undertaken
  - Use weather shapes from period 2012-2020 to derive hourly load shapes (net of expected BTM solar) for each delivery year in the period 2024-2031. In total, we have 72 hourly load shapes (9 weather shapes x 8 delivery years in look-ahead period)
  - Subtract the expected hourly Variable Resource output from the hourly load shapes for each delivery year in the period 2024-2031. These are the hourly net load shapes. The expected hourly Variable Resource shape will vary due to the different forecasted penetration levels for each year in 2024-2031 (same levels used in ELCC run)

- Calculate the weekly peak for each of the hourly net load shapes.
- Gather the planned outages requirement (in weeks) for each unit in the thermal fleet (for this exercise, we are using the expected thermal fleet for 2024 from the 2021 RRS). Approximately, 720,000 MW-week need to be scheduled
- Determine the planned outage schedule by using a heuristic that seeks to levelize weekly net peak loads throughout each delivery year.

Graph Interpretations - Heatmaps

Y-axis are weeks of a Delivery Year starting on June 1st

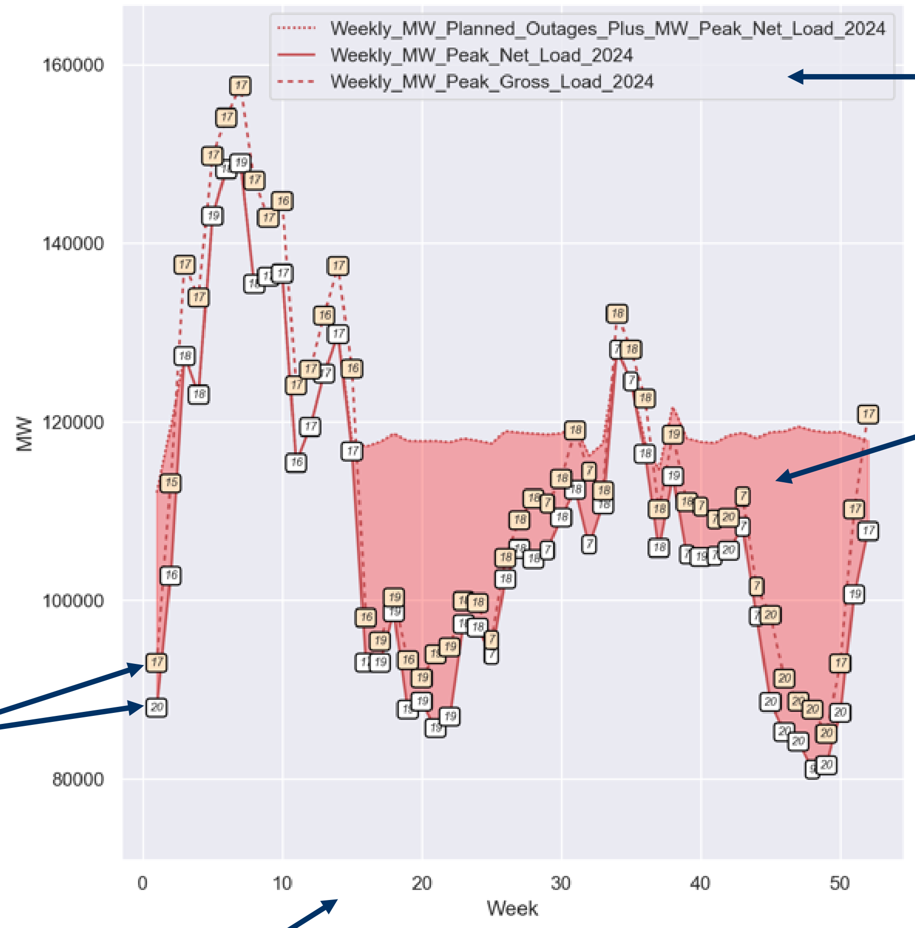
Inspecting a column from top to bottom shows how the share of scheduled planned outages changed throughout the year (darker color means a smaller share while a lighter color means a larger share)



Each column adds up to 100%

Inspecting a column from left to right shows how the share of scheduled planned outages in a week changed throughout the period 2024-2031 as the penetration of Variable Resources increase

Graph Interpretations – Line Graphs



The Gross Peak Loads already account for the impact of expected Behind-the-meter solar penetration while the Net Peak Loads are the Gross Peak Loads minus the Expected Variable Resources output

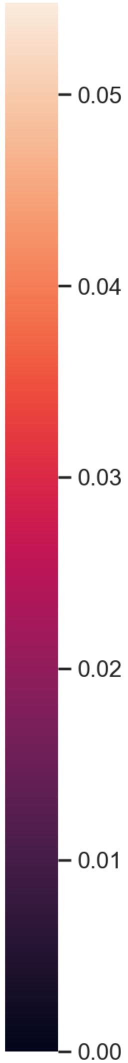
Shaded area represents scheduled planned outages

Light orange squares show the hour (beginning) of the gross peak load for each week while the white squares show the hour (beginning) of the net peak load for each week. Compare the squares located in the same vertical line to determine the impact that the forecasted penetration of Variable Resources is having on shifting the hour of the peak net peak load in each week

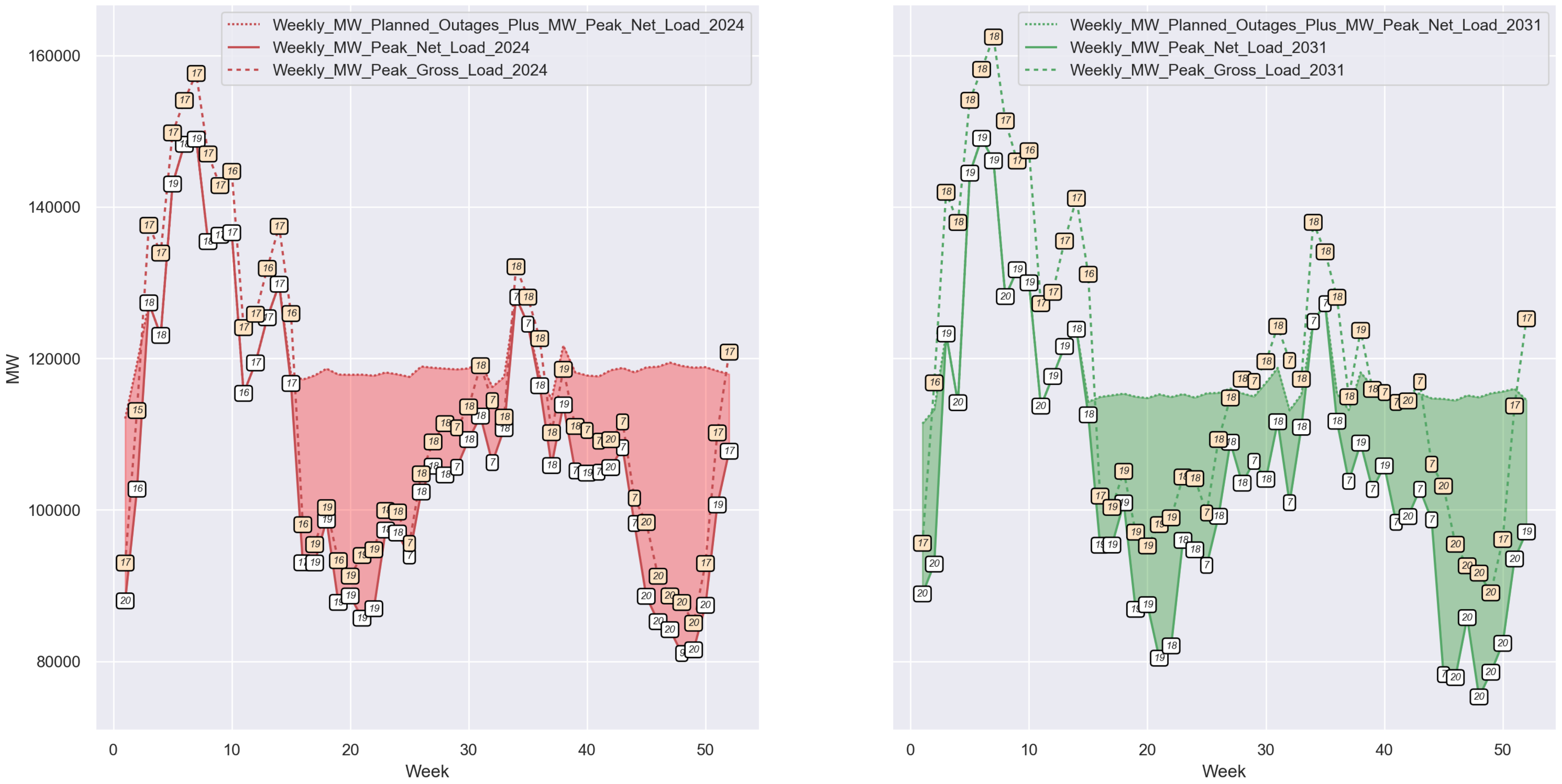
X-axis are weeks of a Delivery Year starting on June 1st

Weekly Share of Planned Outages using Weather Year 2012 for each DY in period 2024-2031

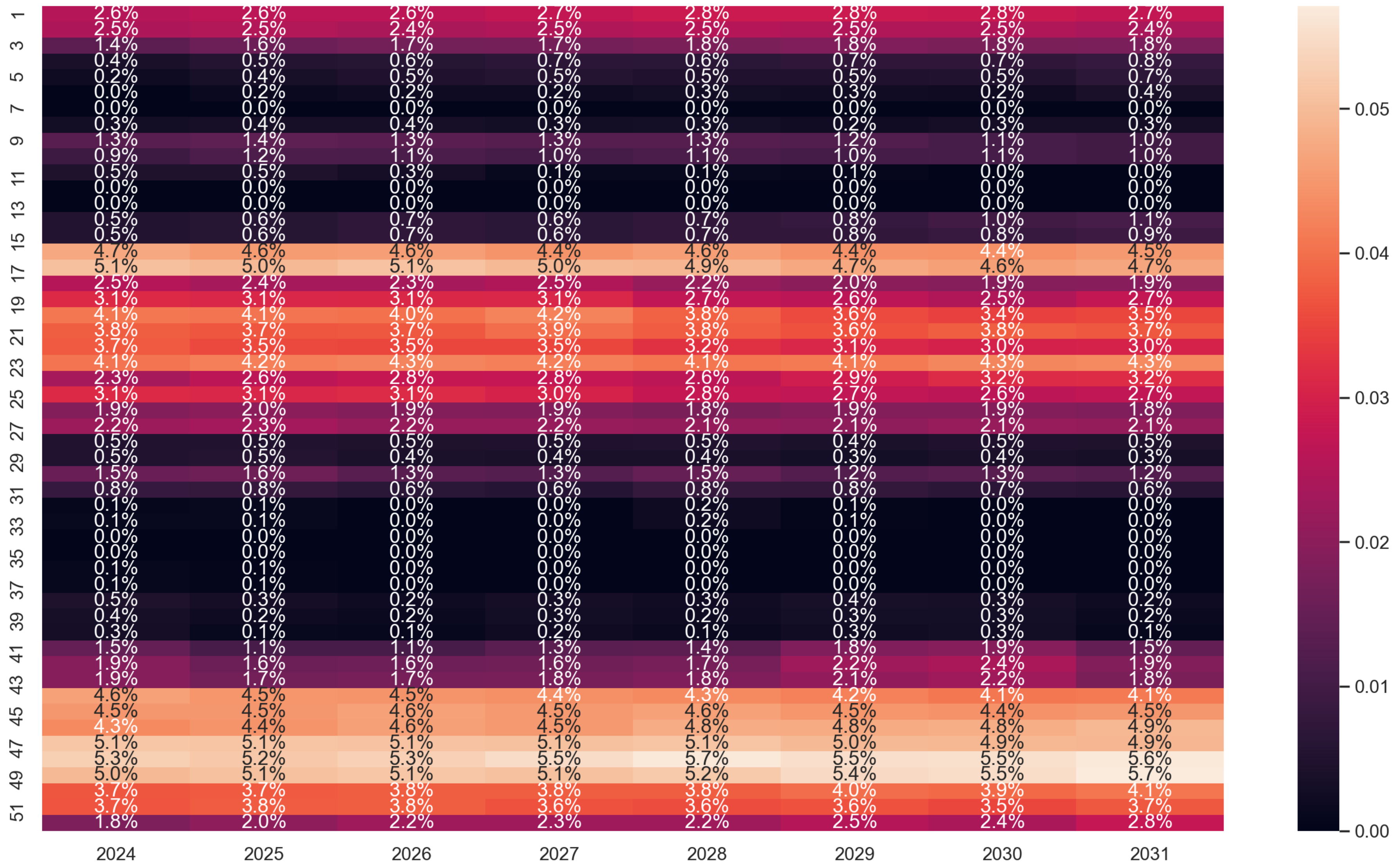
	2024	2025	2026	2027	2028	2029	2030	2031
1	3.3%	3.3%	3.2%	3.2%	3.2%	3.3%	3.2%	3.1%
	2.3%	2.3%	2.4%	2.5%	2.6%	2.8%	2.9%	2.8%
3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
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%	0.0%	0.0%	0.0%	0.0%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
15	0.2%	0.1%	0.2%	0.3%	0.5%	0.4%	0.4%	0.2%
	3.4%	3.2%	3.3%	3.2%	3.2%	3.2%	2.9%	2.7%
17	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	2.9%	2.7%
	2.8%	2.7%	2.8%	2.8%	2.6%	2.3%	2.2%	2.0%
19	4.2%	4.1%	4.1%	4.2%	4.0%	4.0%	3.8%	3.9%
	4.0%	4.0%	4.1%	4.0%	3.9%	3.8%	3.8%	3.8%
21	4.5%	4.6%	4.6%	4.7%	4.7%	4.6%	4.7%	4.8%
	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.6%
23	2.9%	3.0%	3.0%	2.8%	2.8%	2.8%	2.6%	2.7%
	2.9%	3.0%	2.9%	2.8%	2.8%	2.7%	2.9%	2.8%
25	3.3%	3.3%	3.3%	3.2%	3.2%	3.1%	3.1%	3.1%
	2.3%	2.3%	2.3%	2.4%	2.3%	2.3%	2.4%	2.3%
27	1.8%	1.6%	1.3%	1.3%	1.3%	1.0%	1.2%	1.0%
	1.9%	1.8%	1.6%	1.7%	1.7%	1.6%	1.8%	1.6%
29	1.8%	1.5%	1.4%	1.4%	1.4%	1.2%	1.4%	1.2%
	1.3%	1.3%	1.3%	1.3%	1.4%	1.5%	1.6%	1.8%
31	1.0%	1.0%	1.0%	1.0%	1.0%	1.2%	1.0%	1.0%
	1.4%	1.3%	1.3%	1.3%	1.4%	1.6%	1.6%	1.7%
33	0.9%	0.8%	0.7%	0.7%	0.7%	0.8%	0.5%	0.6%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
35	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.2%	0.4%	0.2%	0.2%	0.2%	0.3%	0.4%	0.5%
37	1.2%	1.4%	1.2%	1.3%	1.2%	1.3%	1.2%	1.3%
	1.1%	1.1%	0.9%	0.9%	0.9%	1.1%	1.1%	1.3%
39	1.8%	1.8%	1.7%	1.6%	1.5%	1.6%	1.7%	1.9%
	1.8%	1.8%	1.6%	1.7%	1.5%	1.4%	1.4%	1.3%
41	1.8%	2.0%	2.0%	2.1%	2.2%	2.2%	2.3%	2.2%
	1.8%	1.9%	1.9%	2.1%	2.1%	2.2%	2.2%	2.3%
43	1.5%	1.5%	1.5%	1.7%	1.7%	1.7%	1.7%	1.7%
	2.8%	2.6%	2.6%	2.7%	2.5%	2.3%	2.2%	2.2%
45	4.2%	4.3%	4.6%	4.7%	4.8%	4.9%	5.0%	5.0%
	4.7%	4.7%	5.0%	4.9%	5.0%	5.0%	5.1%	5.1%
47	4.9%	4.6%	4.7%	4.6%	4.5%	4.2%	4.1%	4.1%
	5.3%	5.2%	5.4%	5.3%	5.4%	5.3%	5.4%	5.5%
49	5.2%	5.1%	5.2%	5.1%	5.1%	5.1%	5.2%	5.1%
	4.4%	4.4%	4.5%	4.4%	4.4%	4.6%	4.6%	4.6%
51	2.5%	2.5%	2.6%	2.6%	2.7%	2.9%	3.1%	3.1%
	1.4%	1.4%	1.8%	1.7%	1.9%	2.1%	2.4%	2.4%



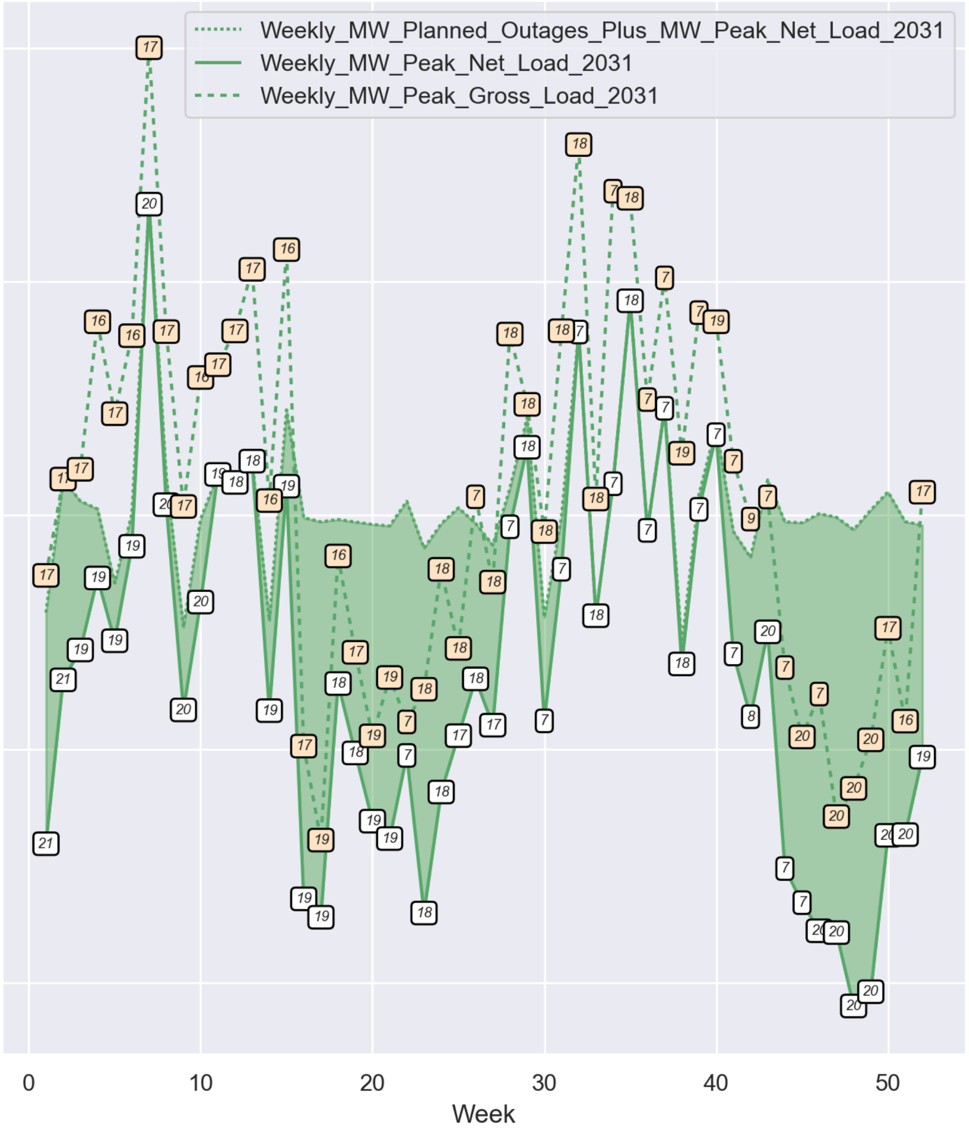
Comparison between 2024 and 2031 Planned Outages Schedule using 2012 weather year



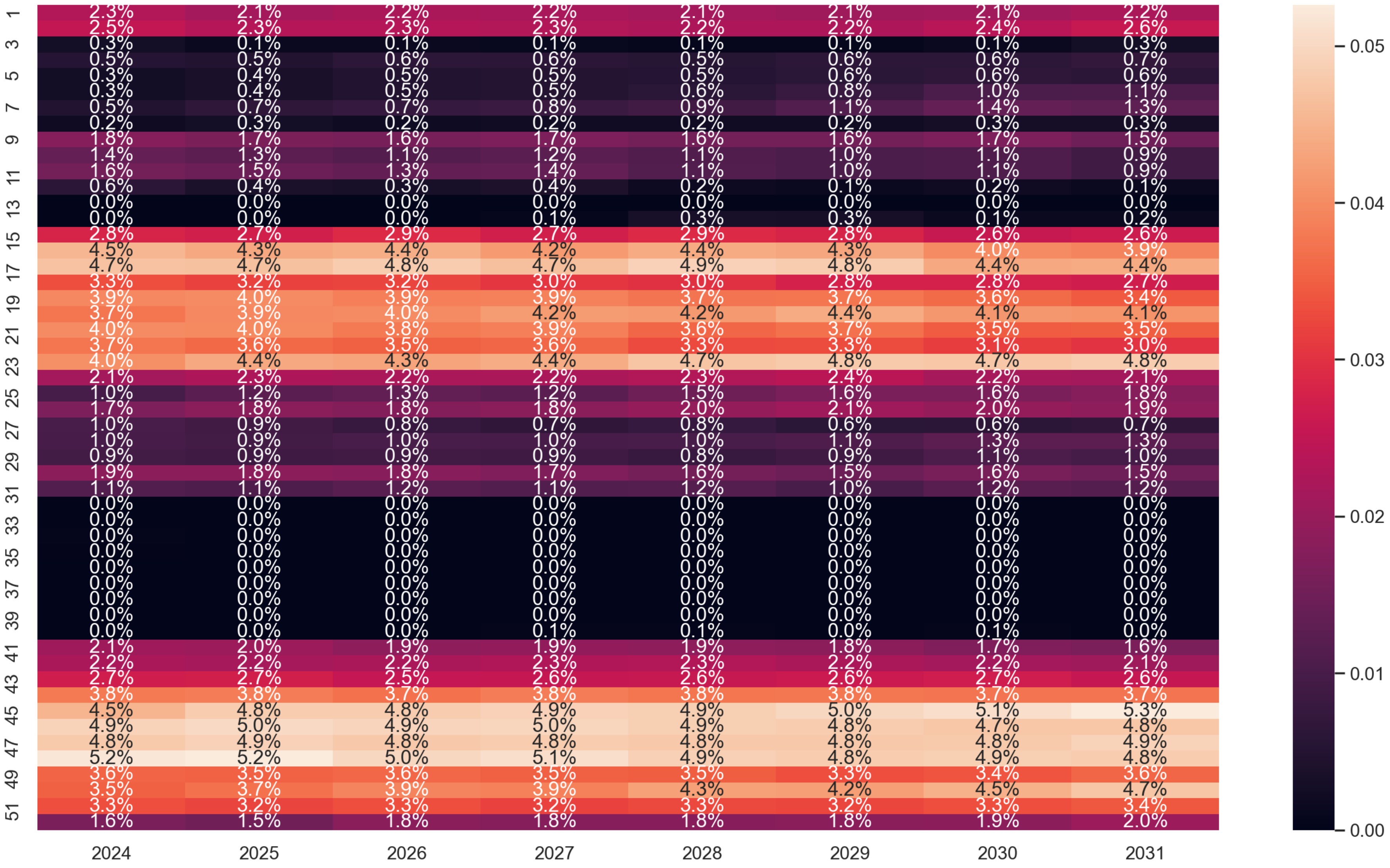
Weekly Share of Planned Outages using Weather Year 2013 for each DY in period 2024-2031



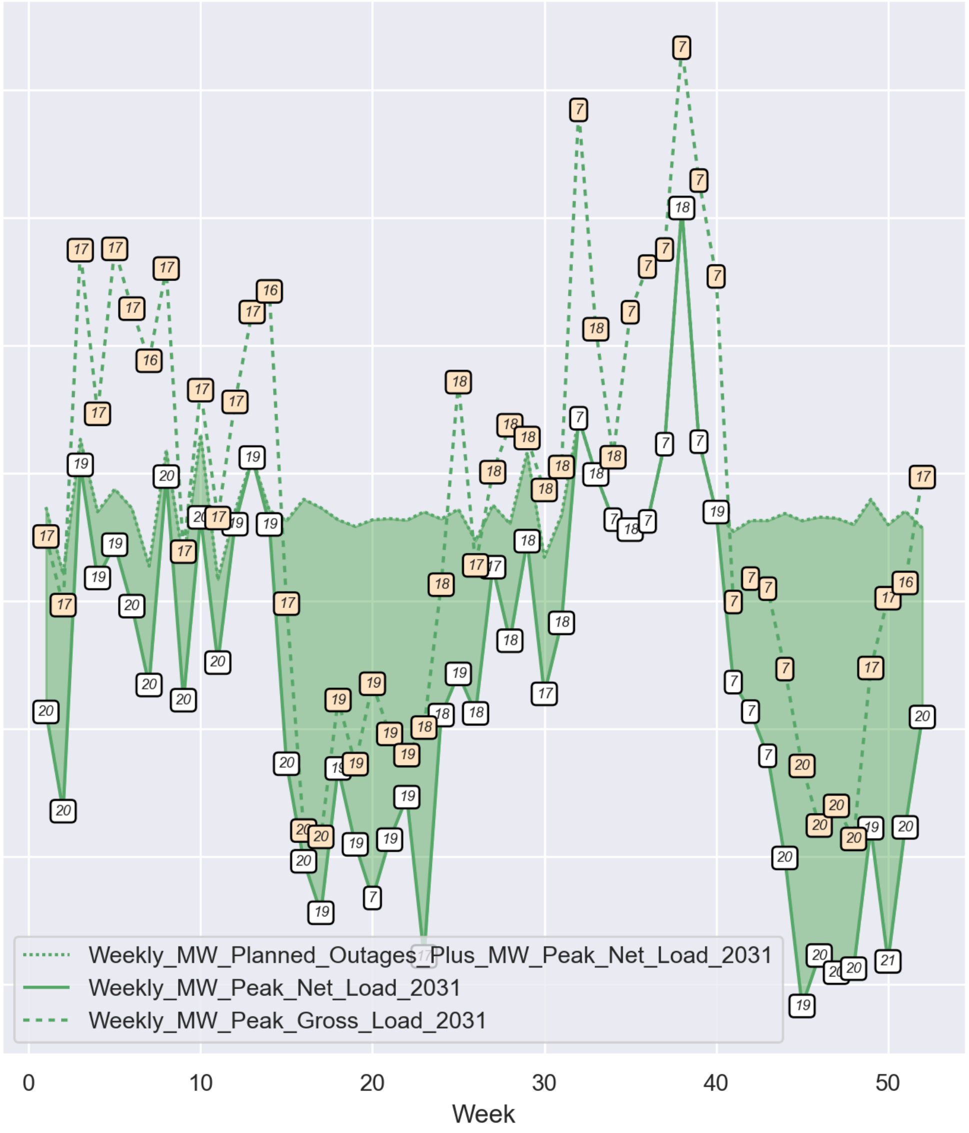
Comparison between 2024 and 2031 Planned Outages Schedule using 2013 weather year



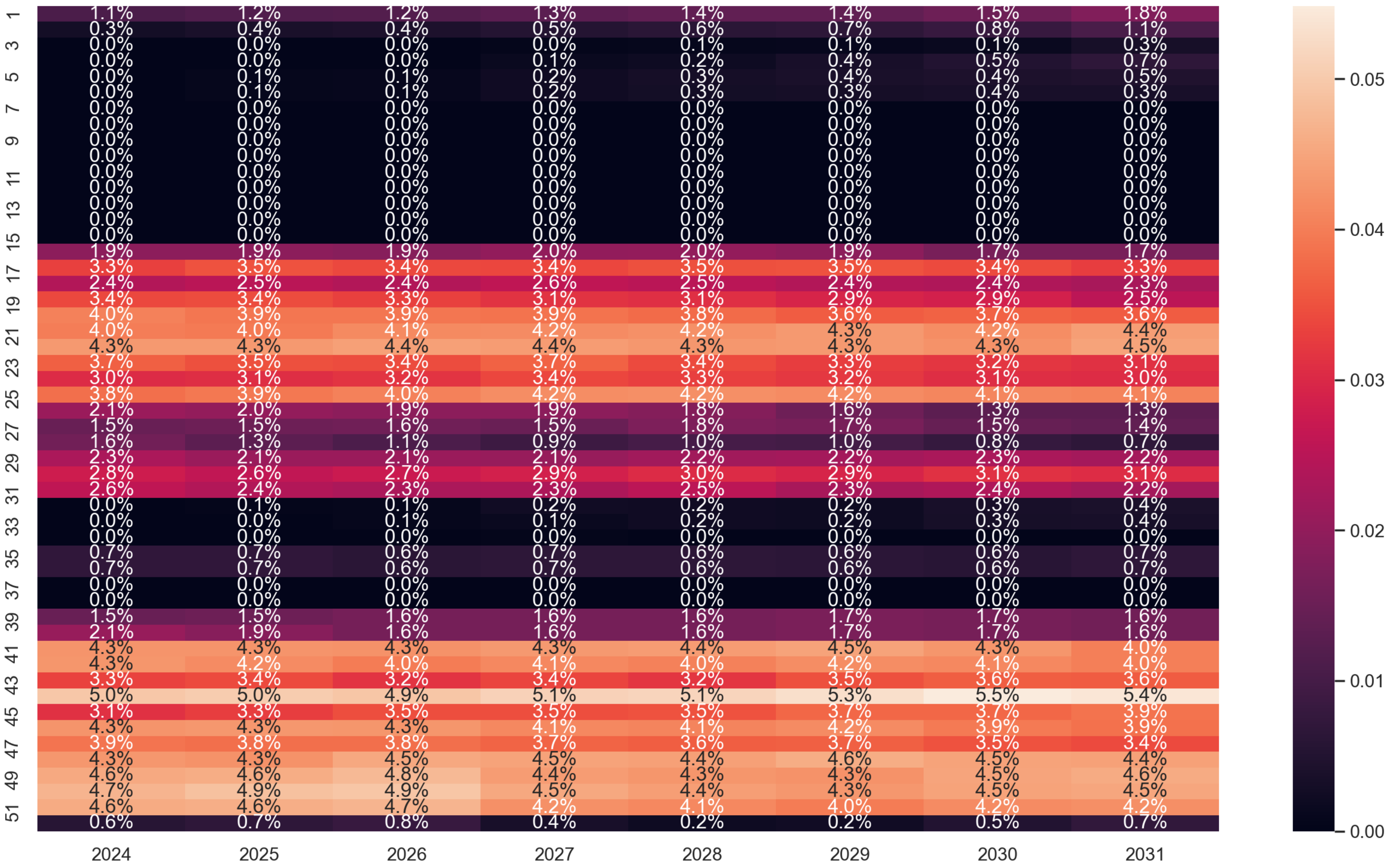
Weekly Share of Planned Outages using Weather Year 2014 for each DY in period 2024-2031



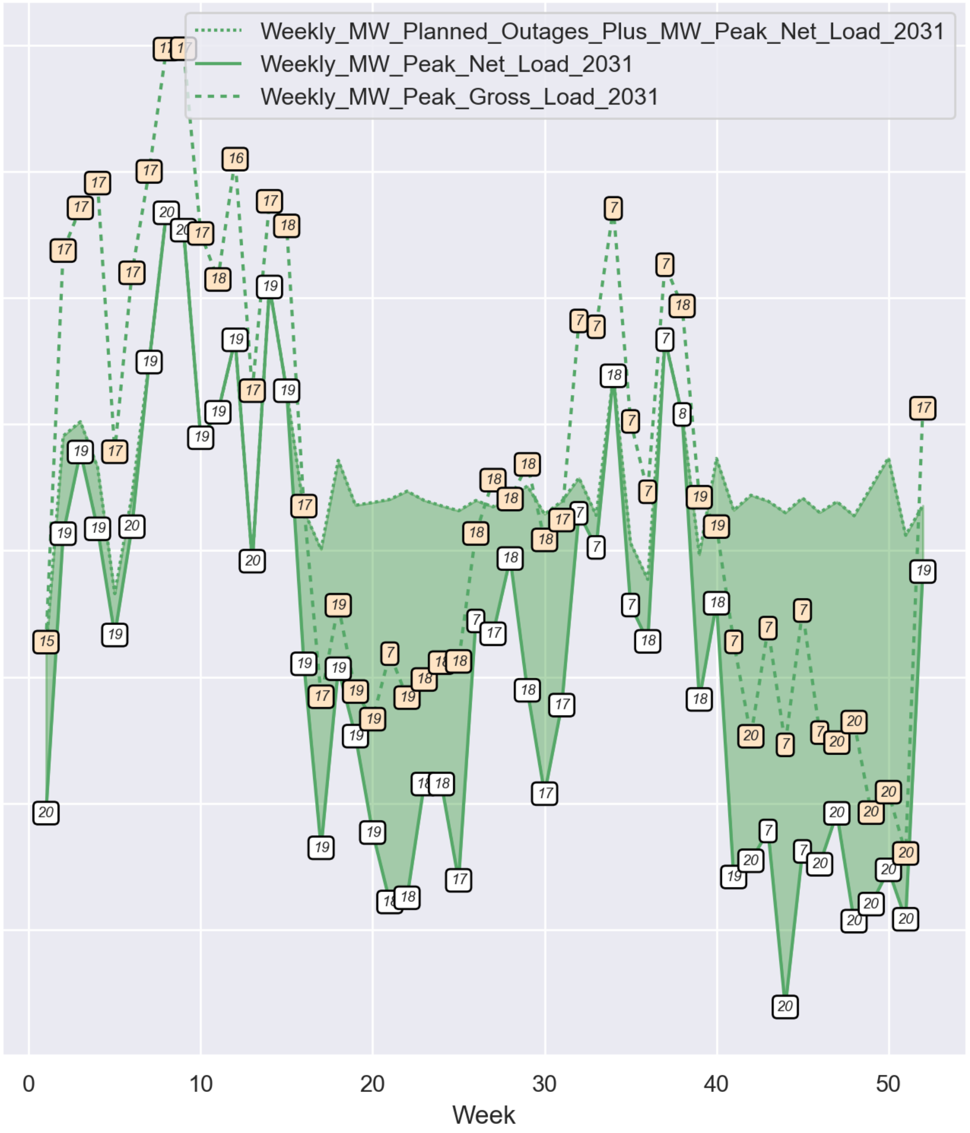
Comparison between 2024 and 2031 Planned Outages Schedule using 2014 weather year



Weekly Share of Planned Outages using Weather Year 2015 for each DY in period 2024-2031



Comparison between 2024 and 2031 Planned Outages Schedule using 2015 weather year

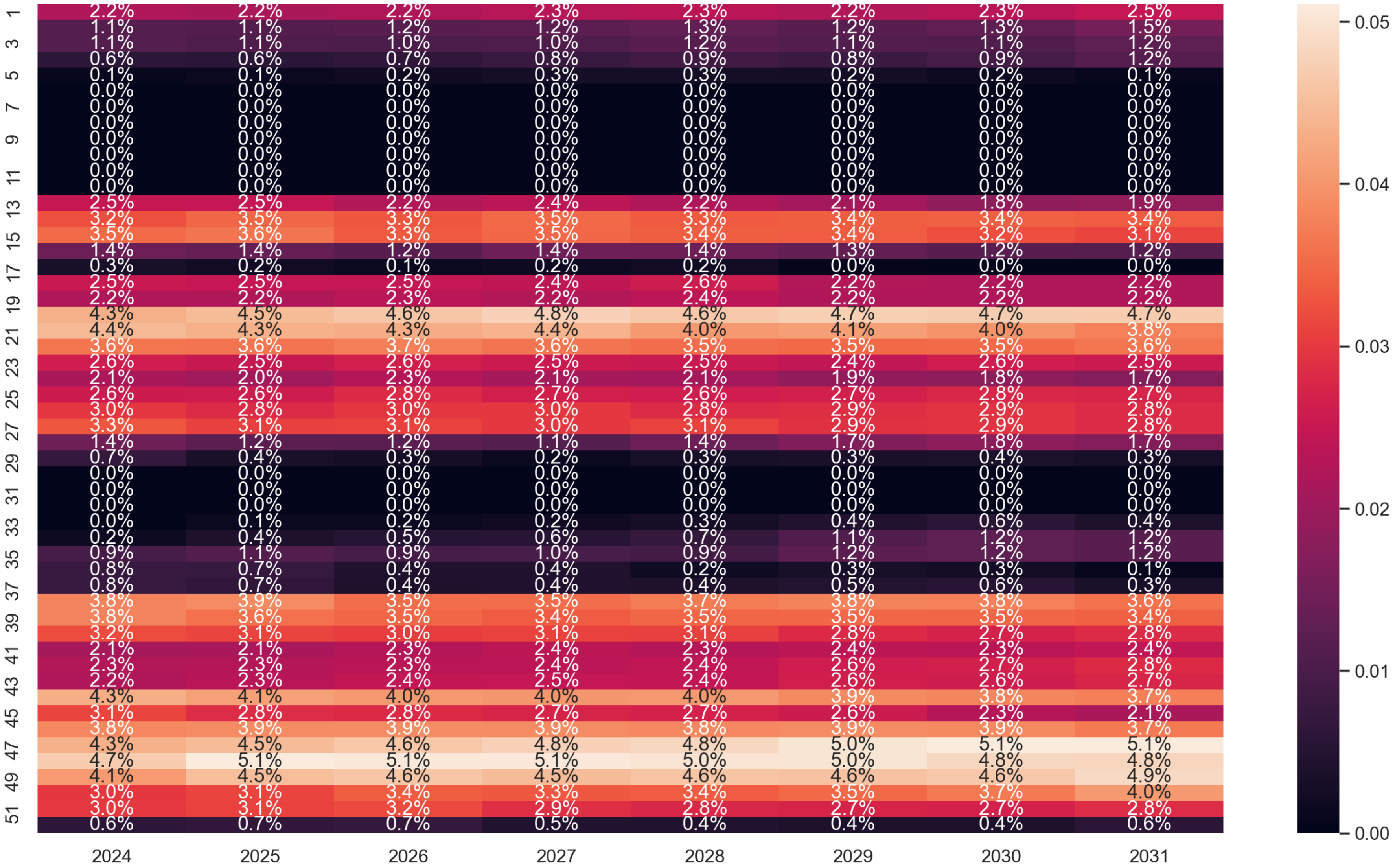


Weekly Share of Planned Outages using Weather Year 2016 for each DY in period 2024-2031

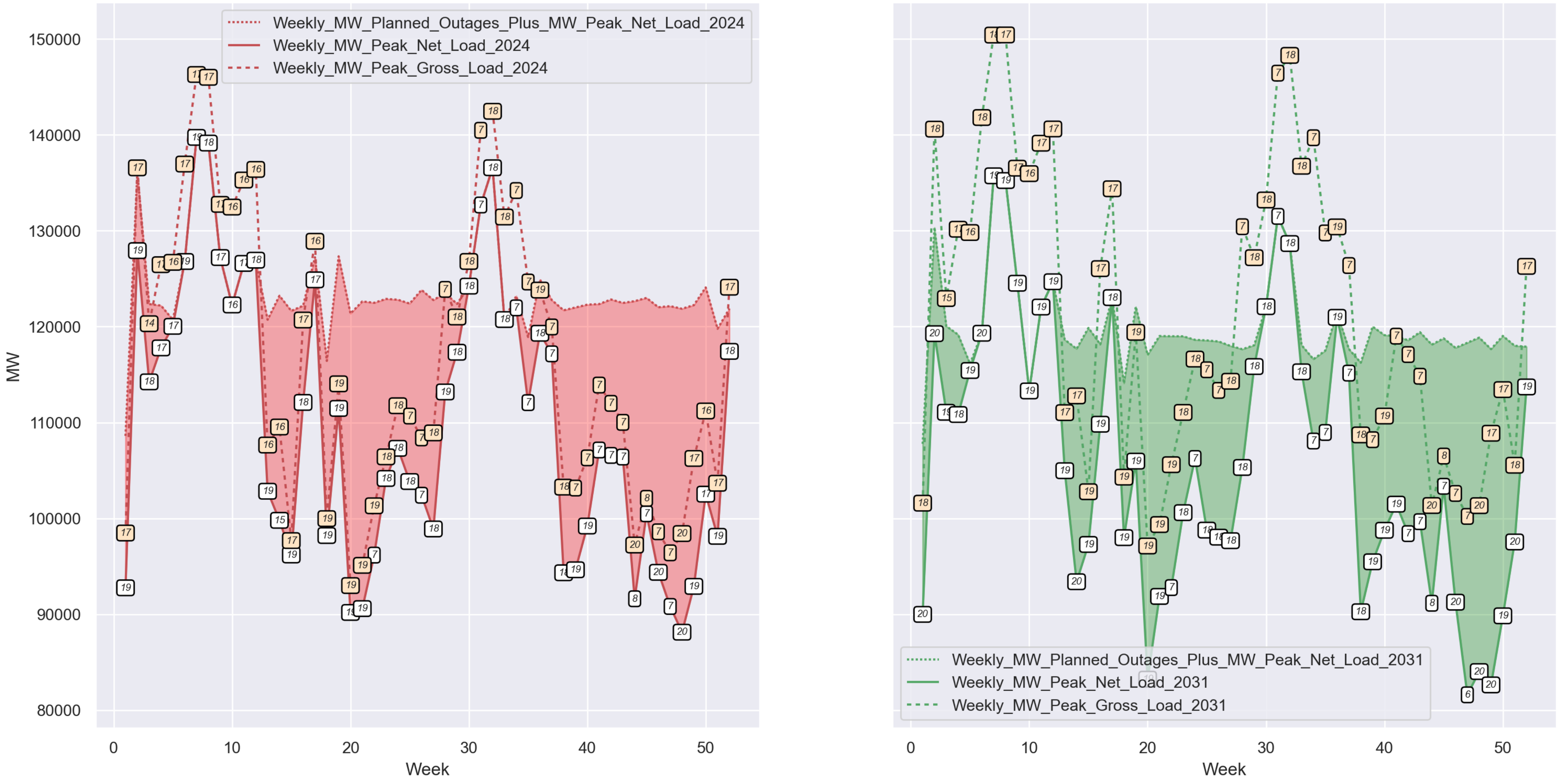
	2024	2025	2026	2027	2028	2029	2030	2031
1	0.5%	0.5%	0.6%	0.6%	0.7%	0.6%	0.6%	0.7%
	0.5%	0.5%	0.6%	0.6%	0.8%	0.8%	1.0%	1.1%
3	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%
	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%
5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
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%	0.0%	0.0%	0.0%	0.0%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.5%	0.5%	0.4%	0.4%	0.3%	0.5%	0.5%	0.4%
17	0.9%	0.8%	0.7%	0.7%	0.7%	0.5%	0.5%	0.4%
	3.2%	3.2%	2.9%	3.0%	2.7%	2.6%	2.6%	2.2%
19	3.4%	3.4%	3.3%	3.5%	3.3%	3.5%	3.6%	3.5%
	2.5%	2.7%	2.7%	2.8%	2.9%	3.0%	3.1%	3.3%
21	2.0%	2.1%	1.9%	1.9%	1.7%	1.7%	1.6%	1.5%
	3.7%	3.8%	4.0%	4.1%	3.9%	3.9%	3.9%	4.0%
23	4.3%	4.2%	4.1%	4.2%	3.9%	3.9%	3.6%	3.7%
	4.0%	3.9%	3.9%	3.9%	3.9%	4.0%	3.7%	3.7%
25	2.5%	2.7%	2.8%	2.9%	2.9%	3.1%	3.1%	3.2%
	3.6%	3.6%	3.4%	3.4%	3.3%	3.2%	3.1%	3.0%
27	2.9%	3.0%	2.9%	2.9%	3.0%	2.7%	2.7%	2.6%
	1.3%	1.4%	1.5%	1.6%	1.6%	1.3%	1.5%	1.3%
29	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
	1.8%	1.8%	1.8%	1.7%	1.7%	1.6%	1.7%	1.8%
31	2.5%	2.4%	2.4%	2.4%	2.6%	2.5%	2.8%	2.7%
	0.6%	0.4%	0.4%	0.3%	0.5%	0.4%	0.4%	0.3%
33	2.5%	2.5%	2.3%	2.3%	2.2%	1.9%	1.9%	1.6%
	2.5%	2.6%	2.4%	2.5%	2.5%	2.4%	2.4%	2.2%
35	1.8%	1.8%	1.7%	1.9%	1.7%	2.0%	1.9%	2.0%
	1.6%	1.6%	1.4%	1.4%	1.3%	1.3%	1.2%	1.2%
37	1.0%	0.8%	0.8%	0.8%	0.9%	1.1%	1.0%	1.2%
	2.2%	2.0%	2.1%	2.1%	2.2%	2.4%	2.5%	2.5%
39	3.2%	2.9%	2.8%	2.7%	2.7%	2.6%	2.7%	2.7%
	2.9%	3.0%	3.0%	3.2%	3.1%	3.2%	3.4%	3.5%
41	1.9%	1.8%	1.7%	1.7%	1.6%	1.7%	1.7%	1.6%
	1.3%	1.3%	1.5%	1.3%	1.4%	1.5%	1.7%	1.8%
43	2.5%	2.5%	2.6%	2.6%	2.6%	2.7%	2.8%	2.8%
	4.4%	4.6%	4.7%	4.6%	4.5%	4.7%	4.6%	4.7%
45	4.0%	4.1%	4.3%	4.3%	4.3%	4.5%	4.5%	4.6%
	4.2%	4.1%	4.0%	3.9%	3.9%	3.9%	3.6%	3.4%
47	4.7%	4.8%	4.8%	4.6%	4.7%	4.7%	4.5%	4.5%
	3.8%	3.8%	3.8%	3.7%	3.5%	3.4%	3.2%	3.4%
49	5.0%	4.9%	4.9%	4.8%	4.7%	4.5%	4.5%	4.5%
	4.2%	4.4%	4.6%	4.6%	4.8%	4.9%	5.0%	5.1%
51	2.2%	2.3%	2.4%	2.5%	2.6%	2.7%	2.8%	2.9%
	3.1%	3.1%	3.2%	3.1%	3.3%	3.2%	3.2%	3.3%

Comparison between 2024 and 2031 Planned Outages Schedule using 2016 weather year

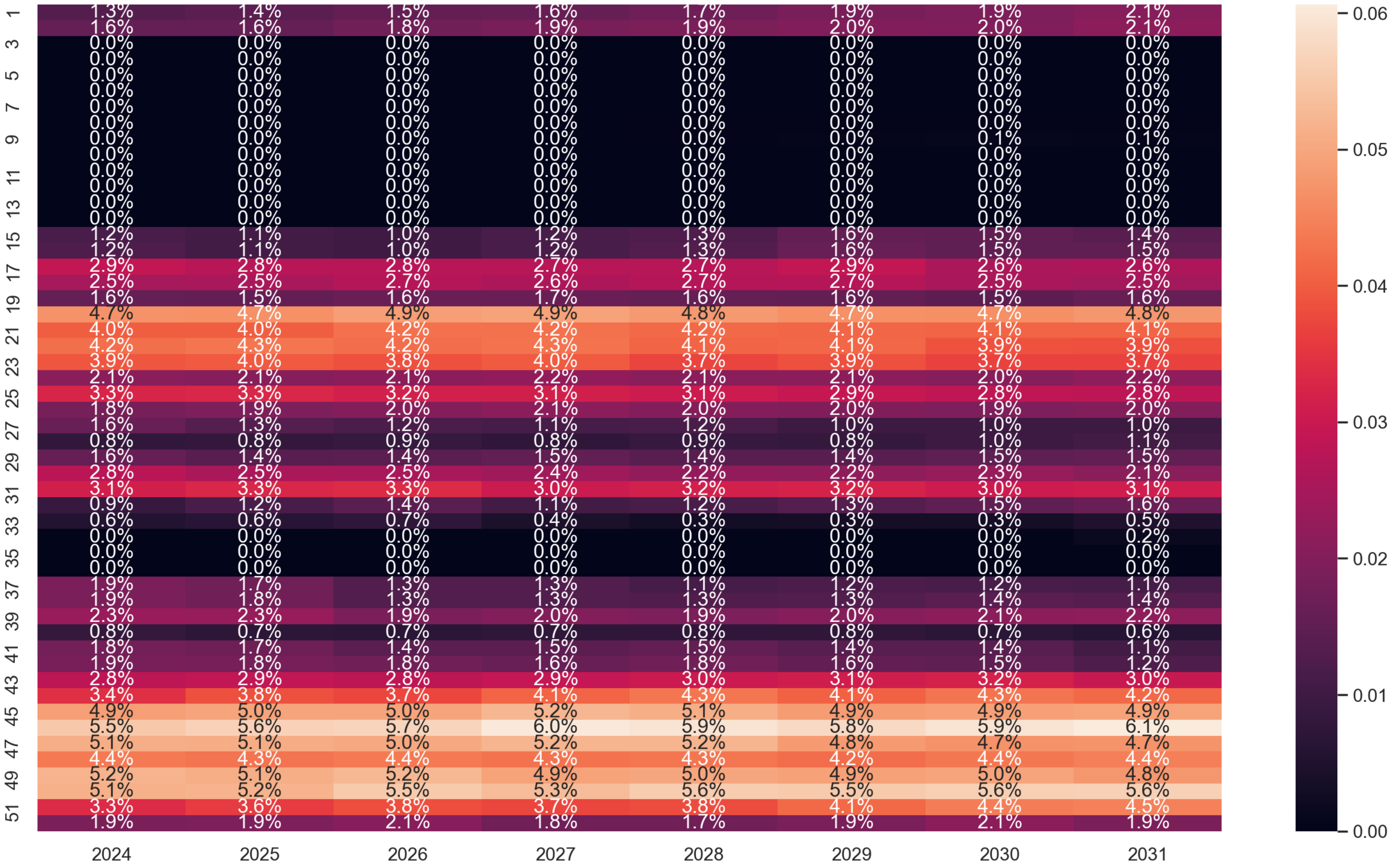
Weekly Share of Planned Outages using Weather Year 2017 for each DY in period 2024-2031



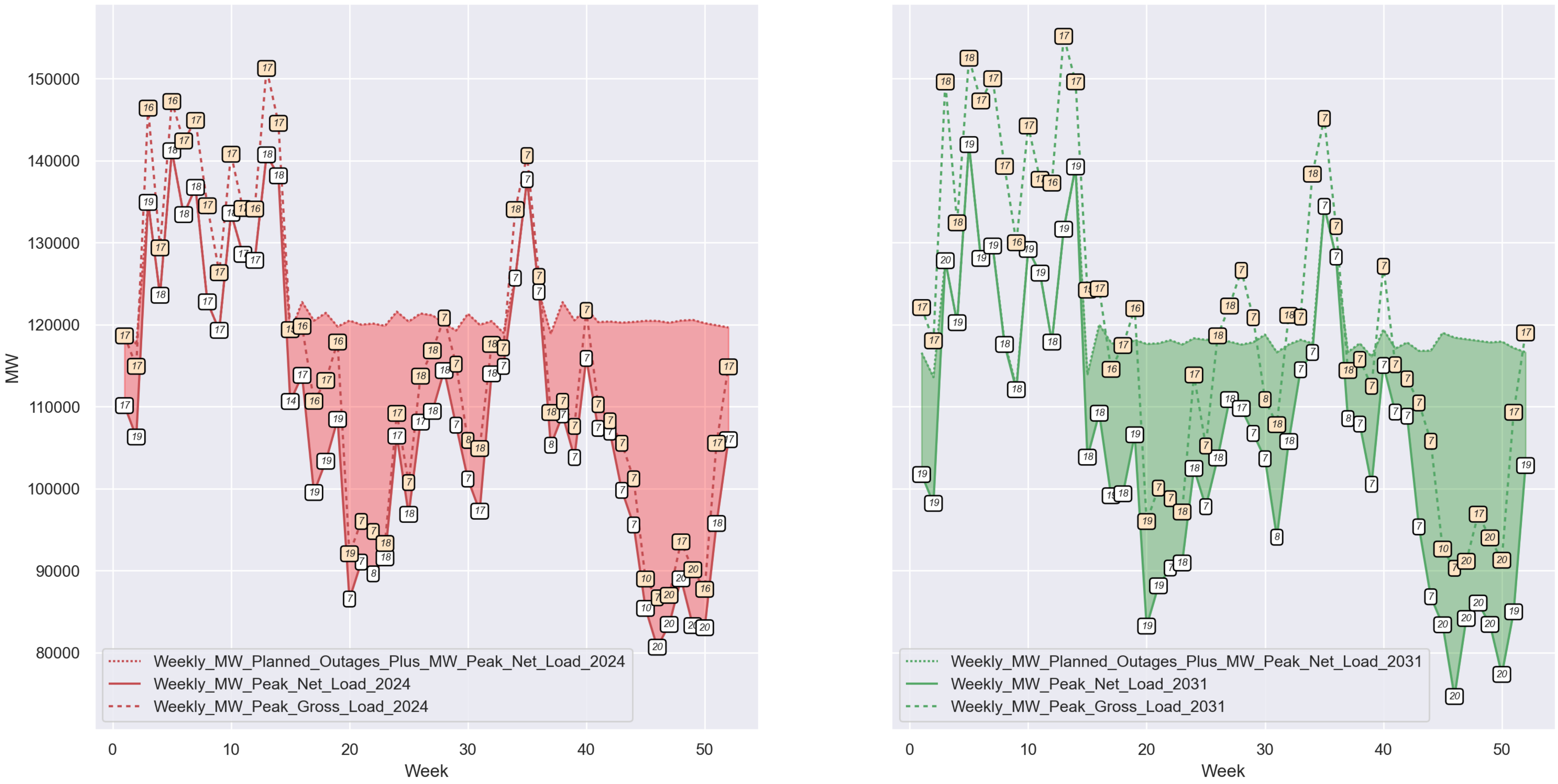
Comparison between 2024 and 2031 Planned Outages Schedule using 2017 weather year



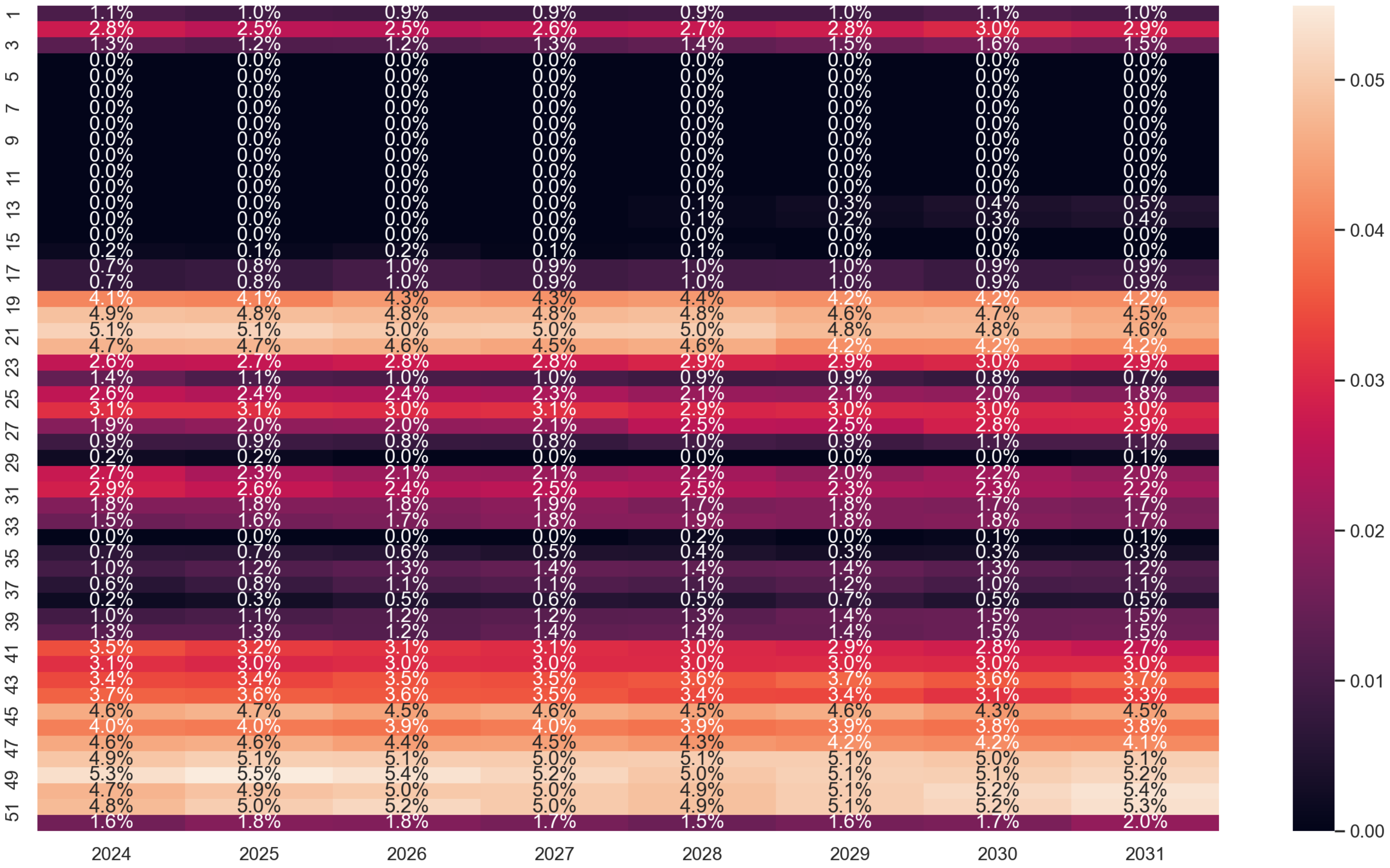
Weekly Share of Planned Outages using Weather Year 2018 for each DY in period 2024-2031



Comparison between 2024 and 2031 Planned Outages Schedule using 2018 weather year

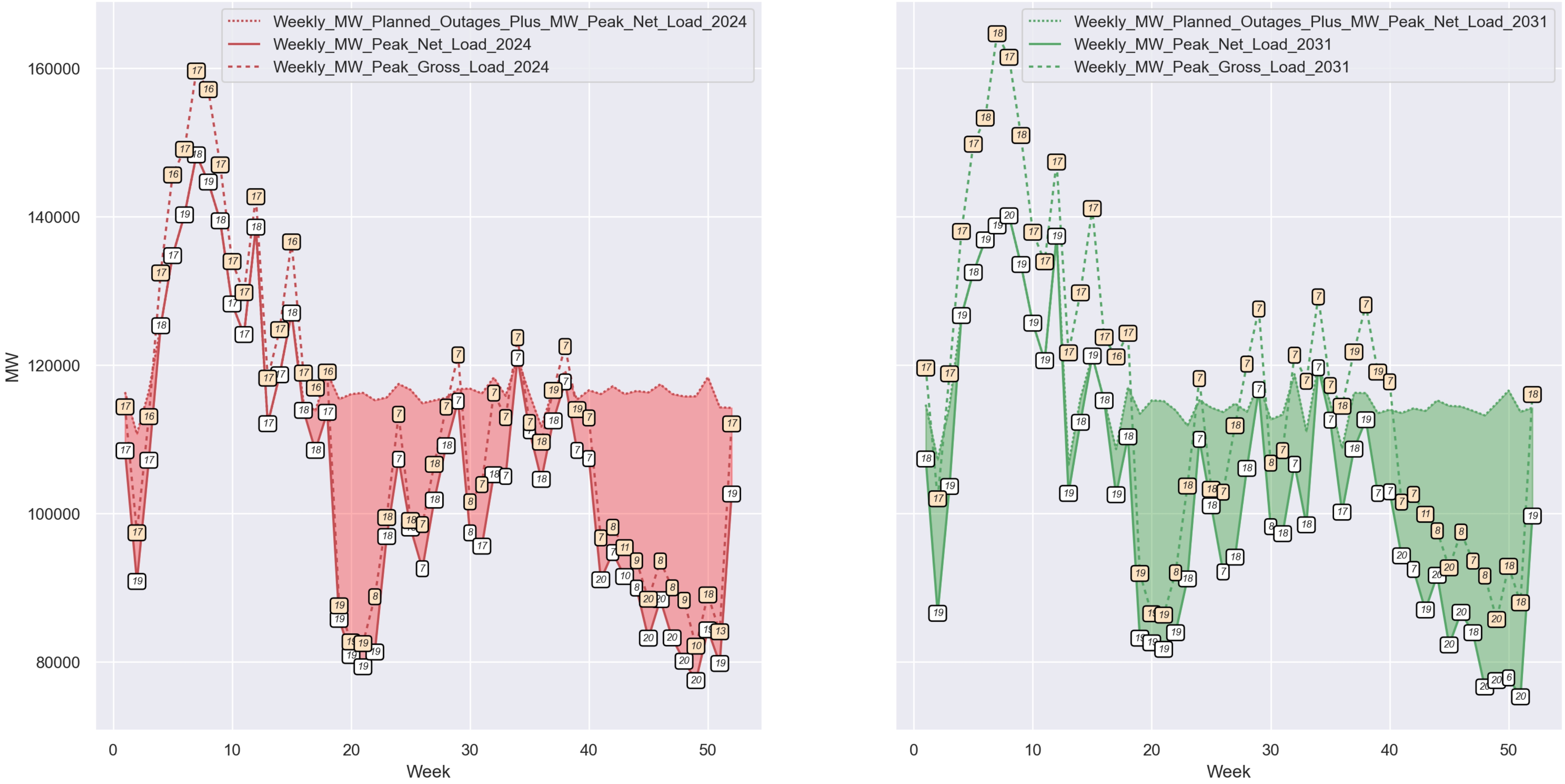


Weekly Share of Planned Outages using Weather Year 2019 for each DY in period 2024-2031



Week	2024	2025	2026	2027	2028	2029	2030	2031
1	1.1%	1.0%	0.9%	0.9%	0.9%	1.0%	1.1%	1.0%
2	2.8%	2.5%	2.5%	2.6%	2.7%	2.8%	3.0%	2.9%
3	1.3%	1.2%	1.2%	1.3%	1.4%	1.5%	1.6%	1.5%
4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
13	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.4%	0.5%
14	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.3%	0.4%
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
16	0.2%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
17	0.7%	0.8%	1.0%	0.9%	1.0%	1.0%	0.9%	0.9%
18	0.7%	0.8%	1.0%	0.9%	1.0%	1.0%	0.9%	0.9%
19	4.1%	4.1%	4.3%	4.3%	4.4%	4.2%	4.2%	4.2%
20	4.9%	4.8%	4.8%	4.8%	4.8%	4.6%	4.7%	4.5%
21	5.1%	5.1%	5.0%	5.0%	5.0%	4.8%	4.8%	4.6%
22	4.7%	4.7%	4.6%	4.5%	4.6%	4.2%	4.2%	4.2%
23	2.6%	2.7%	2.8%	2.8%	2.9%	2.9%	3.0%	2.9%
24	1.4%	1.1%	1.0%	1.0%	0.9%	0.9%	0.8%	0.7%
25	2.6%	2.4%	2.4%	2.3%	2.1%	2.1%	2.0%	1.8%
26	3.1%	3.1%	3.0%	3.1%	2.9%	3.0%	3.0%	3.0%
27	1.9%	2.0%	2.0%	2.1%	2.5%	2.5%	2.8%	2.9%
28	0.9%	0.9%	0.8%	0.8%	1.0%	0.9%	1.1%	1.1%
29	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
30	2.7%	2.3%	2.1%	2.1%	2.2%	2.0%	2.2%	2.0%
31	2.9%	2.6%	2.4%	2.5%	2.5%	2.3%	2.3%	2.2%
32	1.8%	1.8%	1.8%	1.9%	1.7%	1.8%	1.7%	1.7%
33	1.5%	1.6%	1.7%	1.8%	1.9%	1.8%	1.8%	1.7%
34	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.1%
35	0.7%	0.7%	0.6%	0.5%	0.4%	0.3%	0.3%	0.3%
36	1.0%	1.2%	1.3%	1.4%	1.4%	1.4%	1.3%	1.2%
37	0.6%	0.8%	1.1%	1.1%	1.1%	1.2%	1.0%	1.1%
38	0.2%	0.3%	0.5%	0.6%	0.5%	0.7%	0.5%	0.5%
39	1.0%	1.1%	1.2%	1.2%	1.3%	1.4%	1.5%	1.5%
40	1.3%	1.3%	1.2%	1.4%	1.4%	1.4%	1.5%	1.5%
41	3.5%	3.2%	3.1%	3.1%	3.0%	2.9%	2.8%	2.7%
42	3.1%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
43	3.4%	3.4%	3.5%	3.5%	3.6%	3.7%	3.6%	3.7%
44	3.7%	3.6%	3.6%	3.5%	3.4%	3.4%	3.1%	3.3%
45	4.6%	4.7%	4.5%	4.6%	4.5%	4.6%	4.3%	4.5%
46	4.0%	4.0%	3.9%	4.0%	3.9%	3.9%	3.8%	3.8%
47	4.6%	4.6%	4.4%	4.5%	4.3%	4.2%	4.2%	4.1%
48	4.9%	5.1%	5.1%	5.0%	5.1%	5.1%	5.0%	5.1%
49	5.3%	5.5%	5.4%	5.2%	5.0%	5.1%	5.1%	5.2%
50	4.7%	4.9%	5.0%	5.0%	4.9%	5.1%	5.2%	5.4%
51	4.8%	5.0%	5.2%	5.0%	4.9%	5.1%	5.2%	5.3%
52	1.6%	1.8%	1.8%	1.7%	1.5%	1.6%	1.7%	2.0%

Comparison between 2024 and 2031 Planned Outages Schedule using 2019 weather year

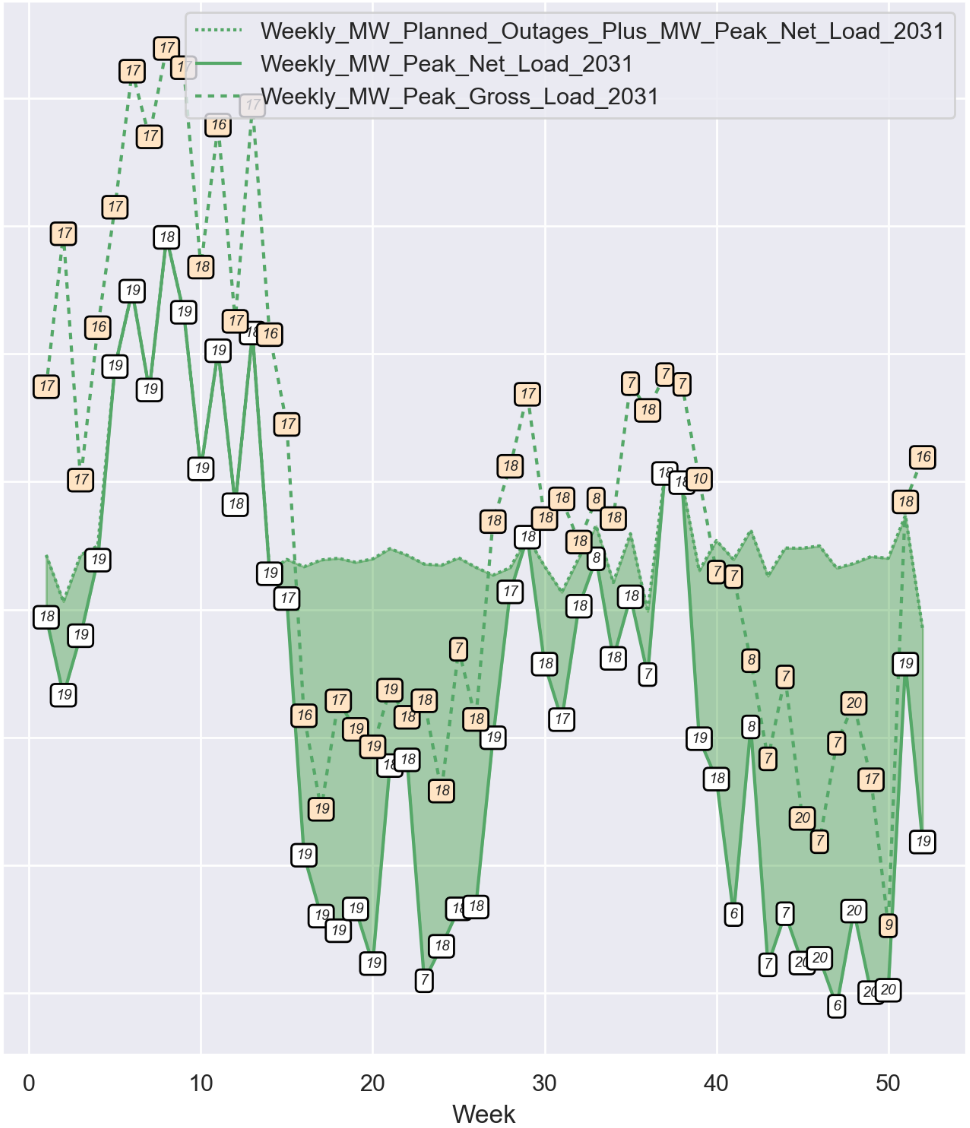


Weekly Share of Planned Outages using Weather Year 2020 for each DY in period 2024-2031

	2024	2025	2026	2027	2028	2029	2030	2031
1	0.0%	0.2%	0.0%	0.1%	0.3%	0.5%	0.5%	0.7%
	0.2%	0.4%	0.4%	0.5%	0.7%	0.8%	1.0%	1.0%
3	0.4%	0.5%	0.4%	0.5%	0.7%	0.8%	0.9%	0.9%
	0.0%	0.2%	0.0%	0.1%	0.2%	0.2%	0.2%	0.2%
5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
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%	0.0%	0.0%	0.0%	0.0%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.2%	0.0%	0.0%	0.1%	0.2%	0.2%	0.2%	0.0%
15	0.8%	0.6%	0.5%	0.4%	0.6%	0.4%	0.4%	0.4%
	3.7%	3.6%	3.5%	3.6%	3.5%	3.4%	3.3%	3.1%
17	4.5%	4.4%	4.2%	4.2%	4.2%	4.0%	4.2%	3.9%
	3.7%	3.9%	3.9%	3.9%	4.0%	4.0%	4.1%	4.0%
19	3.8%	3.8%	3.8%	3.7%	3.8%	3.7%	3.8%	3.8%
	4.4%	4.5%	4.4%	4.5%	4.5%	4.4%	4.4%	4.4%
21	3.1%	3.0%	3.0%	2.7%	2.6%	2.5%	2.5%	2.4%
	3.3%	3.1%	3.0%	2.7%	2.7%	2.4%	2.4%	2.2%
23	4.0%	4.0%	4.1%	4.0%	4.2%	4.3%	4.5%	4.5%
	3.9%	3.9%	4.0%	4.1%	4.1%	4.1%	4.2%	4.1%
25	3.1%	3.3%	3.5%	3.5%	3.5%	3.7%	3.6%	3.8%
	3.4%	3.3%	3.6%	3.6%	3.6%	3.7%	3.6%	3.7%
27	1.9%	1.6%	1.6%	1.6%	1.6%	1.8%	1.9%	1.8%
	0.9%	0.6%	0.4%	0.2%	0.3%	0.4%	0.5%	0.3%
29	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
	1.3%	1.0%	0.7%	0.6%	1.0%	1.1%	1.3%	1.1%
31	2.1%	2.0%	1.8%	1.6%	1.7%	1.6%	1.7%	1.4%
	1.3%	1.2%	1.2%	1.0%	1.0%	0.7%	0.7%	0.5%
33	1.1%	1.0%	0.8%	0.7%	0.5%	0.5%	0.3%	0.4%
	1.7%	1.4%	1.3%	1.1%	0.9%	0.9%	0.8%	0.8%
35	0.4%	0.5%	0.5%	0.4%	0.4%	0.6%	0.5%	0.7%
	0.4%	0.5%	0.5%	0.4%	0.4%	0.6%	0.5%	0.7%
37	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
39	1.9%	2.0%	2.2%	2.0%	2.0%	1.8%	1.7%	1.8%
	2.1%	2.2%	2.5%	2.4%	2.5%	2.5%	2.5%	2.6%
41	3.2%	3.1%	3.3%	3.3%	3.4%	3.4%	3.7%	3.8%
	2.8%	2.5%	2.5%	2.3%	2.1%	2.0%	2.0%	2.1%
43	4.3%	4.5%	4.4%	4.4%	4.4%	4.5%	4.3%	4.2%
	3.1%	3.3%	3.3%	3.8%	3.6%	3.8%	3.6%	4.0%
45	4.7%	4.7%	4.7%	5.0%	4.6%	4.5%	4.2%	4.5%
	4.8%	4.8%	4.7%	5.1%	4.6%	4.6%	4.3%	4.5%
47	3.9%	4.1%	4.3%	4.6%	4.5%	4.6%	4.7%	4.8%
	3.2%	3.3%	3.5%	3.7%	3.5%	3.5%	3.7%	3.8%
49	4.5%	4.6%	4.7%	4.6%	4.7%	4.7%	4.5%	4.7%
	5.3%	5.2%	5.2%	5.0%	5.1%	4.9%	4.6%	4.7%
51	1.4%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
	1.3%	1.7%	2.0%	2.1%	2.3%	2.3%	2.3%	2.3%

0.05 0.04 0.03 0.02 0.01 0.00

Comparison between 2024 and 2031 Planned Outages Schedule using 2020 weather year



Conclusion

- The expected increase in Variable Resources penetration in the period 2024-2031 does not significantly alter the weekly net peak loads; in particular, the shoulder seasons still have the lower weekly net peak loads. Therefore, using a heuristic that levelizes weekly net peak loads, the majority of the planned outages are scheduled during the shoulder season for the delivery years in the period 2024-2031.

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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