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UPDATE & ELABORATION OF FLEXIBILITY ASSESSMENT STUDY FOR DIFFERENT RES PENETRATION SCENARIOS

FINAL REPORT

UKRAINE ENERGY SECURITY PROJECT

CONTRACT NO. 72012118C00003

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USAID
MR. ŞÜKRÜ BOĞUT
TASK ORDER CONTRACTING OFFICER'S REPRESENTATIVE
USAID/UKRAINE
KIEV, UKRAINE

TETRA TECH ES, INC.
MERCADOS ARIES INTERNATIONAL
1320 NORTH COURTHOUSE ROAD
SUITE 600
ARLINGTON, VA 22201
TEL: +703-387-2990
WWW.TETRATECH.COM

LIST OF ACRONYMS AND ABBREVIATIONS

AC	Alternative Current
CAPEX	Capital Expenditures
CAGR	Compound Annual Growth Rate
CF	Capacity Factor
CHPP	Combined Heat and Power Plant
DC	Direct Current
DR	Demand Response
ENSO-E	European Network of Transmission System Operators for Electricity
EPRI	Electric Power Research Institute
ESP	Energy Security Project
EUR	Expected Unserved Ramping
HPP	Hydro Power Plant
IPS	Integrated Power System
GW	Gigawatt
GWh	Gigawatt-hour
MW	Megawatt
MWh	Megawatt-hour
NGPP	Natural Gas Power Plant
NPP	Nuclear Power Plant
OPEX	Operational Expenses
RE	Renewable Energy
REPI	RES Energy Penetration Index
RES	Renewable Energy Sources
RES-CMS	RES Curtailment Management System
RL	Residual Load
RLPI	RES Load Penetration Index
RTU	Remote Terminal Unit
PFD	Period of Flexibility Deficit
PS	Power System
PSHPP	Pump Storage Hydro Power Plant
PP	Power Plant
PV	Photovoltaic
REPI	RES Energy Penetration Index
RLPI	RES Load Penetration Index
SCADA	Supervisory Control and Data Acquisition
SPP	Solar Power Plant
STLFS	Short Term Load Forecast System
STRESFS	Short Term RES Forecasting System
TPP	Thermal Power Plant
TSO	Transmission System Operator
TWh	Terawatt-hour
USAID	U.S. Agency for International Development
WPP	Wind Power Plant

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1. EXECUTIVE SUMMARY

1.1. OVERVIEW OF STUDY RESULTS

Based on Ukrenergo's request, USAID conducted an independent assessment of different scenarios regarding penetration level of RES (Renewable Energy Sources). The study has been conducted between April 2020 and August 2020, with Ukrenergo technical teams' close collaboration.

Increasing roll-out of intermittent renewable energy sources (i.e. wind and photovoltaic solar power plants) brings in accumulating challenges in terms of matching the variations in the load/generation patterns in Ukraine power system. As further RES is integrated into IPS of Ukraine, flexibility requirements of the system will be increased to sustain secure operation of the power network.

In this study, flexibility has been assessed through calculation of metrics for;

- system residual load (RL) characteristics (Criteria: Residual load to be non-negative for all hours of the year),
- RES ramps as percentage of load (Criteria: RES ramps not to exceed ±10% of the load for all hours of the year),
- and adequacy of system resources for ramp (up/down) requirements (Criteria: Downward deficit to be lower than 1% of the load for 99% of the hours).

For the analysis, hourly flexibility capacities for each power plant of different characteristics (in the granularity of units for TPPs) are modelled, and a systemwide synthetic flexibility capacity is computed, to be balanced against the ramping requirement due to RES and load ramps.

This study does not include any economic optimization and purely focuses on technical assessment; with estimated hourly dispatch of future generation based on an objective function that maximizes flexibility in the system.

Scenarios have been developed for;

- Years of 2021 and 2025
- Different levels of WPP & SPP penetration (installed capacity)
    - For 2021 Scenarios: WPP: 1,500MW – 2,600MW, SPP: 5,000MW – 8,000MW
    - For 2025 Scenarios: WPP: 2,500MW – 5,000MW, SPP: 5,000MW – 13,000MW
- Annual load growth rates: No growth, 0.5% and 1.2% annual increase of demand
- Mode of operation of the power system
    - Existence of as-is interconnections
    - Isolated mode of operation

Simulation results were impacted by three assumption groupings: Future uncertainty, data quality and the need for simplification.

The applied scenarios allow comparison between different RES penetration levels and load growth rates. The summary of the results is presented in the following table below for different scenarios:

- Each row of the table corresponds to a scenario that the flexibility assessment has been performed.

- Annual load growth of 0.5% is used for 2021 and 1.2% is used for 2025 in the summary table (detailed results, as well as calculation outputs for other scenarios are provided in *Chapter 4 RESULTS of the ANALYSES* of this document.)
- For each of the criteria, if the results are within the defined ranges, that cell has been highlighted in green. If the results are violating the limits, they are highlighted in yellow. Limit violations should be interpreted as an indication of the inadequacy of the flexibility of the existing system for the selected RES penetration level (for certain hours) and the power system will be unable to accommodate it without making some adjustments. Some examples of additional flexibility capabilities that can be considered are;
    - increased hydro pumping,
    - battery storage, demand-side management,
    - curtailment/limiting of renewables.
- The violations are presented both in number of hours in violation, as well energy (MWh) for the hours of violation.

Table 1: Results Summary Sheet for 2021 and 2025 RES Penetration Scenarios (hours)

Scenario No	Year of Calculation	Yearly Load Growth	Mode of Operation	RES Penetration Levels: Max WPP Generation (MW)	RES Penetration Levels: Max SPP Generation (MW)	# of Hours with Negative Residual Load	# of hours with RES Ramp beyond ±10% of the system load	Violation # of hours & Violation Ramping Deficit (MWh)	Violation # of hours & Violation Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Tertiary System Reserves (MW): 95% of all hours	Tertiary System Reserves (MW): Minimum of all hours	Reduction of Yearly Nuclear Generation
R21,0.5,SQ-1	**2021**	**0.5%**	**Intercon.**	**2,585**	**6,241**	**0**	**5**	**104 & 149,009**	**30 & 10,555**	**491**	**1000**	**695**	**7.5%**
R21,0.5,SQ-2	2021	0.5%	Intercon.	2,000	7,000	1	7	144 & 205,151	33 & 11,063	501	1000	694	7.5%
R21,0.5,SQ-3	2021	0.5%	Intercon.	1,500	5,000	0	0	32 & 49,846	21 & 7,607	411	1000	959	7.5%
R21,0.5,SQ-4	2021	0.5%	Intercon.	1,500	6,000	0	0	52 & 78,076	27 & 9,015	453	1000	838	7.5%
R21,0.5,SQ-5	2021	0.5%	Intercon.	2,000	6,000	0	1	110 & 166,384	30 & 9,268	460	1000	775	7.5%
R21,0.5,SQ-6	2021	0.5%	Intercon.	1,500	7,000	0	5	74 & 116,717	30 & 10,904	495	1000	744	7.5%
R21,0.5,SQ-7	2021	0.5%	Intercon.	2,500	6,000	0	1	216 & 299,994	27 & 9,500	467	1000	721	7.5%
R21,0.5,SQ-8	2021	0.5%	Intercon.	2,500	7,000	15	15	254 & 340,164	33 & 11,207	510	1000	651	7.5%
R21,0.5,SQ-9	2021	0.5%	Intercon.	2,000	7,500	15	13	170 & 233,520	39 & 12,162	520	1000	660	7.5%
R21,0.5,SQ-10	2021	0.5%	Intercon.	2,500	7,500	9	21	130 & 189,212	39 & 13,302	544	1000	620	12.5%
R21,0.5,SQ-11	2021	0.5%	Intercon.	2,000	8,000	7	25	100 & 151,534	39 & 14,558	560	1000	628	12.5%
R25,1.2,SQ-1	2025	1.2%	Intercon.	2,500	7,500	0	11	46 & 82,024	35 & 17,478	622	800	368	10.0%
R25,1.2,ISO-1	2025	1.2%	Isolated	2,500	7,500	0	11	106 & 193,784	125 & 66,882	1,191	600	146	10.0%
R25,1.2,SQ-2	**2025**	**1.2%**	**Intercon.**	**3,000**	**9,500**	**40**	**105**	**124 & 196,248**	**53 & 26,306**	**727**	**800**	**295**	**10.0%**
R25,1.2,ISO-2	**2025**	**1.2%**	**Isolated**	**3,000**	**9,500**	**40**	**105**	**250 & 380,343**	**198 & 95,718**	**1,351**	**600**	**117**	**10.0%**
R25,1.2,SQ-3	2025	1.2%	Intercon.	7,500	12,000	78	598	278 & 445,365	260 & 120,687	1,204	800	182	50.0%
R25,1.2,ISO-3	2025	1.2%	Isolated	7,500	12,000	141	598	574 & 902,952	613 & 288,100	1,969	600	0	40.0%
R25,1.2,SQ-4	2025	1.2%	Intercon.	2,000	8,000	0	13	48 & 84,612	38 & 19,523	652	800	373	10.0%
R25,1.2,ISO-4	2025	1.2%	Isolated	2,000	8,000	0	13	118 & 191,249	133 & 74,129	1,218	600	148	10.0%
R25,1.2,SQ-5	2025	1.2%	Intercon.	3,500	9,000	45	70	192 & 257,236	50 & 24,035	698	800	292	10.0%
R25,1.2,ISO-5	2025	1.2%	Isolated	3,500	9,000	45	70	328 & 490,116	170 & 87,336	1,327	600	116	10.0%
R25,1.2,SQ-6	2025	1.2%	Intercon.	4,000	10,000	43	172	140 & 212,712	68 & 36,449	811	800	260	20.0%
R25,1.2,ISO-6	2025	1.2%	Isolated	4,000	10,000	69	172	346 & 514,868	240 & 117,590	1,453	600	103	15.0%
R25,1.2,SQ-7	2025	1.2%	Intercon.	5,000	10,000	54	213	174 & 269,079	85 & 42,116	846	800	240	25.0%
R25,1.2,ISO-7	2025	1.2%	Isolated	5,000	10,000	129	208	550 & 792,909	248 & 119,071	1,494	600	95	15.0%
R25,1.2,SQ-8	2025	1.2%	Intercon.	4,000	12,000	54	427	190 & 283,366	133 & 68,221	985	800	230	30.0%
R25,1.2,ISO-8	2025	1.2%	Isolated	4,000	12,000	148	434	400 & 602,984	363 & 182,415	1,594	600	91	20.0%
R25,1.2,SQ-9	2025	1.2%	Intercon.	4,500	12,500	38	541	176 & 266,070	208 & 98,435	1,092	800	216	30.0%
R25,1.2,ISO-9	2025	1.2%	Isolated	4,500	12,500	154	541	430 & 663,744	465 & 217,064	1,749	600	86	25.0%
R25,1.2,SQ-10	2025	1.2%	Intercon.	5,000	13,000	45	639	210 & 310,246	250 & 120,257	1,165	800	203	40.0%
R25,1.2,ISO-10	2025	1.2%	Isolated	5,000	13,000	161	639	466 & 724,116	553 & 260,128	1,872	600	0	30.0%

Baseline scenarios for 2021 and 2025 are selected as follows:

- 2021-Baseline Scenario (RES capacity that Ukrenergo expects to be connected by the year-end):
    - Installed Capacity of WPP: 2,585 MW, Installed Capacity of SPP: 6,241 MW
    - Yearly Load Growth Rate: 0.5%
    - Mode of Operation: Interconnected
- 2025-Baseline Scenario-1 (Base scenario in Ukrenergo's Generation Adequacy Study):
    - Installed Capacity of WPP: 3,000 MW, Installed Capacity of SPP: 9,500 MW
    - Yearly Load Growth Rate: 1.2%
    - Mode of Operation: Interconnected
- 2025-Baseline Scenario-2 (Base scenario in Ukrenergo's Generation Adequacy Study):
    - Installed Capacity of WPP: 3,000 MW, Installed Capacity of SPP: 9,500 MW
    - Yearly Load Growth Rate: 1.2%
    - Mode of Operation: Isolated mode of operation

Key conclusions and findings of the flexibility assessment are summarized as follows:

- RES penetration levels above 4,300MW installed capacity creates a ramping deficit in IPS of Ukraine with the existing load levels. At this level of RES capacity, our flexibility assessment model has resulted a deficit of in need of RES curtailment of 30GWh (35 hours)[1] in the last 12 months, till May 2020. This curtailment might have been prevented via an additional flexibility resource of 230MW (that would work with a 1.5% yearly capacity factor, if this gap would have been filled with new generation capacities)
- In order to have a decreased level of flexibility inadequacy in the system, our model has resulted with a 5-15% (depends on RES penetration levels) reduction of nuclear generation in 2021. (For baseline scenario, 5% nuclear generation reduction has been required. For higher level of RES penetration levels, higher reduction in the must-run power plants' generation is implemented in 2025).
- Considering the interconnections with neighbor countries as a flexibility resource is an important contributor to reduce the flexibility inadequacy of the system[2]
- Necessity for RES Curtailment and new flexibility resources are inevitable for all scenarios that has been studied for 2021 and 2025.
- For all scenarios in 2021 and 2025; in case the required additional flexibility resource (Upward Ramping Deficit) is met with construction of new power plants, their capacity factor within the year will be lower than 2-3%.

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[1] RES curtailment requirement that our model has resulted has been compared with Ukrenergo's announced RES curtailment levels. As declared in Ukrenergo's weekly operational reports of past 12 months, curtailed RES energy was around 23GWh (totally 23 hours in different months) in last 12 months. Comparison of these figures is used for validation of the developed model.

[2] Cross-border energy exchanges per hour have been restrained to figures between +400MW and -100MW (Per histogram analysis, 80% of all hours) for hours of future years. (In isolated mode of operation scenarios, cross-border exchanges have been assumed to be zero for all hours).

- For the Baseline Scenario of 2021 (8,826MW[3] RES installed capacity, 0.5% load growth),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 149GWh, which is 1.03% of yearly RES generation (number of hours that system will be forced to RES restriction: 104 hours)
    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 10.5 GWh (in 10 hours)
    - Maximum Additional Maneuvering Capacity Required: 491 MW (capacity factor: 0.25% for upward ramping requirements)
- For the Baseline Scenario-1 of 2025 (12,500MW RES installed capacity, 1.2% annual load growth, interconnected mode of operation),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 196GWh, which is 1.02% of yearly RES generation (number of hours that system will be forced to RES restriction: 124 hours)
    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 26.3 GWh (in 53 hours)
    - Maximum Additional Maneuvering Capacity Required: 727 MW (capacity factor: 0.41% for upward ramping requirements)
- For the Baseline Scenario-2 of 2025 (12,500 MW RES installed capacity, 1.2% annual load growth, isolated mode of operation),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 380 GWh, which is 1.98% of yearly RES generation (number of hours that system will be forced to RES restriction: 250 hours)
    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 95.7 GWh (in 198 hours)
    - Maximum Additional Maneuvering Capacity Required: 1351 MW (capacity factor: 0.81% for upward ramping requirements)
- In comparison with Ukrenergo's Generation Adequacy study results that state that;
    - in 2021, 2000 MW of highly maneuverable thermal power plants and 2000 MW of Power Storage capacity,
    - and in 2025, 2000 MW of highly maneuverable thermal power plants and 2550 MW of Power Storage capacity

  will be required; our results in baseline and interconnected mode of operations showed that,

    - in 2021, the maximum upward ramping deficit might be experienced for just 10 hours within the year and the maximum capacity of this deficit is 491MW,
    - and in 2025, the maximum upward ramping deficit might be experienced for 53 hours within the year and the maximum capacity of this deficit is 727MW,
- For selection of flexibility resources required, there are variety of options including,

[3] Level of RES to be energized as foreseen by Ukrenergo for the end of October 2021.

- RES curtailment for downward ramping requirements and pro-active RES curtailment for upward ramping,
  - power storage,
  - internal combustion engines,
  - additions of new pump storage hydro power plants,
  - demand response,
  - and modernization of existing thermal power plants to provide more available and flexible capacities

  The decision should be made on economic studies in terms of cost/benefit ratios and the time required for implementation. Per our calculations, if the flexibility deficit is met with construction of new power plants, the capacity factors of these new plants will be lower than 1% in 2021 and lower than ~3% in 2025.

- As the basic economic assessment of the costs of the four flexibility options (RES curtailment for downward ramping requirements and pro-active RES curtailment for upward ramping, power storage, internal combustion engines, additions of new pump storage hydro power plants) show that the most feasible options is considering RES curtailment as a source flexibility is the economically most viable option for 2025 of Ukraine PS. Our study concludes that implementing RES curtailment during infrequent extreme ramping rate events can potentially be a least cost option as compared to investment in low capacity factor generation flexibility. Accurate short-term load, generation and weather forecasting and curtailment automation are however required for effective implementation of this option (which are also considered as costs items in the basic economic assessment of this study).
- Existing installed capacities of WPPs and SPPs indicate that solar generation investment tend to be higher in Ukraine. Wind/solar ratio in RES generation mix is an important factor for the flexibility adequacy of the power system. In this context, scenarios with same installed capacity of wind and solar are less likely to occur. We estimate that solar/wind ratio will be around 3 (solar generation installed capacity will be 3 times of wind installed capacity)
- As higher wind ratio in wind/solar mix brings in more challenges to adequate ramp adjustments in comparison with solar; wind power plants should be more carefully assessed.

1.2. REVIEW OF RECENT FLEXIBILITY ASSESSMENT STUDIES FOR UKRAINE PS

As part of this study, comparative review of recent flexibility assessment studies for IPS of Ukraine has also been developed. Our review has included the comparison of the following studies[4]:

- USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020
- Approved Generation Adequacy Study of Ukrenergo – 2019

[4] ESP team welcomes comments and improvement suggestions on this comparative review as not all details for reflected in the available documents.

- Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)
- Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)

Results of the studies have been reviewed, as well methodologies, scenarios and assumptions implemented for the assessments. The items for comparison includes the following items:

- Main Results
    - RES Penetration Level (MW) @which RES Curtailment is Expected to Start According to the Model Developed
    - Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2020
    - Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2021 (Baseline or Target Scenario)
    - Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2025 (Baseline or Target Scenario)
    - RES Curtailment Proposed (GWh, % of RES generation) for 2020 (for 6 months)
    - RES Curtailment Proposed (GWh, % of RES generation) for 2021 (Baseline or Target Scenario)
    - RES Curtailment Proposed (GWh, % of RES generation) for 2025 (Baseline or Target Scenario)
- Methodology & Scenarios
    - Time Horizon Covered
    - Software Tool Used
    - Granularity of Inputs (Time Perspective)
    - Granularity of Flexibility Assessment (Time Perspective)
    - Granularity of Methodology (Generation Modelling)
    - Economic Optimization (Optimal Dispatch) Used?
    - Objective Function of New Dispatch Calculation
    - Fuel Availability/Constraints Considered?
    - Definition of Flexibility Adequacy
    - Fast/Slow Flexibility Considered?
    - RES and Load Forecast Errors Incorporated?
    - Thermal Power Plant Technical Constraints/Characteristics Implemented?
    - Water Usage Constraints for HPPs Implemented?
    - Regimes of Pump-Storage HPPs Considered?
    - Availability Parameters of Power Plants Considered?
    - Allocated Reserves in the Analysis
    - Results of Ancillary Services Performance Tests Incorporated?
    - Mode of Operation (Isolated vs. Existing Interconnections)

- Cross-Border Interconnections Considered as a Source of Flexibility?
- RES Curtailment as a Source of Flexibility?
- Load Shedding as a Source of Flexibility?
- NPPs Considered as a Source of Flexibility?
- Reduction of Must-Run Generation (Nuclear) in Base Scenarios
- Part-Loading of Flexible Generation Units
- Decommissioning Status of Thermal Power Plants (2025) (Baseline or Target Scenario)
- Decommissioning Status of Nuclear Power Plants (2025) (Baseline or Target Scenario)
- New Investments for Conventional Power Plants (till 2025)
- Baseline or Target Scenario Definition (2025)
- RES Generation Installed Capacity (2025) (Baseline or Target scenario)
- Yearly Load Growth Assumption (%)
- Additional Maneuvering Capacity Incorporated in Base Scenario (MW) (2025)

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
M1	Methodology & Scenarios	Date of the Study	2020	2019	2018, Updated in 2020	2018
M2	Methodology & Scenarios	Time Horizon Covered	2021 and 2025	2021, 2025 and 2030	2020 and 2050	2035
M3	Methodology & Scenarios	Software Tool Used	Spreadsheet Models	BACS-RVE (+PLEXOS and ANTARES)	PLEXOS	Optimal Dispatch Model (ODM)
M4	Methodology & Scenarios	Granularity of Inputs (Time Perspective)	Hourly	Hourly	Hourly	Hourly
M5	Methodology & Scenarios	Granularity of Flexibility Assessment (Time Perspective)	Hourly	Hourly (for characteristic days)	Aggregated hourly and for defined scenarios	Aggregated energy
M6	Methodology & Scenarios	Granularity of Methodology (Generation Modelling)	Unit Based, for TPPs and HPPs	Unit Based, for TPPs and HPPs	Unit Based, for TPPs and HPPs	Aggregated Power Plants Based on Technology.
M7	Methodology & Scenarios	Economic Optimization (Optimal Dispatch) Used?	No	Yes	Yes	Yes
M8	Methodology & Scenarios	Objective Function of New Dispatch Calculation	Maximize Flexibility	Economic Optimization	Economic Optimization	Economic Optimization
M9	Methodology & Scenarios	Fuel Availability/Constraints Considered?	No	Yes, economically	Yes	No
M10	Methodology & Scenarios	Definition of Flexibility Adequacy	4 different criteria have been considered for all 8760 hours of a year. 1. Non-zero Residual Load 2. RES Ramps in % of System Load 3. Downward Ramping Adequacy 4. Upward Ramping Adequacy	Residual load imbalance analysis (based on the results of statistical analysis data on the error of consumption/generation forecasts and their fluctuations)	1.Maximum ramp up rate 2.Maximum ramp down rate	Hourly variability of Load and RES has been cross-checked against flexibility resources in the system
M11	Methodology & Scenarios	Fast/Slow Flexibility Considered?	Only slow flexibility has been assessed (hourly)	Both fast and slow.	Both fast and slow.	Slow

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
M12	Methodology & Scenarios	RES and Load Forecast Errors Incorporated?	Yes, 2% error for RES forecasting and 1% error for load forecasting.	Yes (minimum 20% of RES generation (MW)).[5]	Yes (20% of RES generation (MW) is reserved all the time).	No
M13	Methodology & Scenarios	Thermal Power Plant Technical Constraints/Characteristics Implemented?	Yes	Yes	Yes	Aggregated form.
M14	Methodology & Scenarios	Water Usage Constraints for HPPs Implemented?	Yes (Empiric methodologies implemented rather than complicated hydrology models due to unavailability of data)	Yes	Yes (Details unspecified)	Aggregated form.
M15	Methodology & Scenarios	Regimes of Pump-Storage HPPs Considered?	Yes	Yes	Yes	Aggregated form.
M16	Methodology & Scenarios	Availability Parameters of Power Plants Considered?	Yes	Yes	Yes	No
M17	Methodology & Scenarios	Allocated Reserves in the Analysis	- For 2021: 1000 MW for Base Scenarios (at least for 95% of all hours) - For 2025: 800 MW for Base Scenarios (at least for 95% of all hours)	1000 MW	Primary Reserve= 4% of system load (all the time) + Secondary Reserve= 9% of system load (all the time)	Not specified.

[5] Per the regulatory change, RES power plants will be also included in the balancing responsibilities by the beginning of 2021.

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
M18	Methodology & Scenarios	Results of Ancillary Services Performance Tests Incorporated?	Yes, incorporated as additional constraint of power plants for which the AnS Performance Tests are completed.	Not applicable.	Not applicable.	Not applicable.
M19	Methodology & Scenarios	Mode of Operation (Isolated vs. Existing Interconnections)	Base Scenarios: Interconnected Also, isolated mode of operation has been assessed for all RES penetration scenarios for 2025.	Interconnected	Isolated	Interconnected
M20	Methodology & Scenarios	Cross-Border Interconnections Considered as a Source of Flexibility?	Yes, within technical limits[6].	Yes. Physical restrictions on the possibility of import-export of electricity by interstate interconnections considered.	No	No
M21	Methodology & Scenarios	RES Curtailment as a Source of Flexibility?	No (It is a result of downward ramping capability deficit)	Yes	Yes	Yes
M22	Methodology & Scenarios	Load Shedding as a Source of Flexibility?	No	No	No	No
M23	Methodology & Scenarios	NPPs Considered as a Source of Flexibility?	No	No	No	Yes

[6] Cross-border energy exchanges per hour have been restrained to figures between +400MW and -100MW (Per histogram analysis, 80% of all hours) for hours of future years. (In isolated mode of operation scenarios, cross-border exchanges have been assumed to be zero for all hours).

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
M24	Methodology & Scenarios	Reduction of Must-Run Generation (Nuclear) in Base Scenarios	For 2021 baseline scenario, 5% nuclear reduction has been proposed. For 2025 baseline scenario, 10% nuclear reduction has been proposed.	Yes (Dispatching limitations of NPP capacity were associated, in particular, with abnormally high air temperatures in the autumn-winter period, and the associated decline in electricity consumption.)	Yes, Nuclear Generation is reduced down to 70TWh in 2025	Not specified
M25	Methodology & Scenarios	Part-Loading of Flexible Generation Units	Yes	Yes	No, considered to be inefficient	Yes
M26	Methodology & Scenarios	Decommissioning Status of Thermal Power Plants (2025) (Baseline or Target Scenario)	It has been assumed that no TPP unit will be shut down till 2025 (technically available capacities are assumed to remain same as it is today)	In the TSO scenario, 14GW of available capacity is assumed (very little reduction)	Slight Reduction till 2025 (Cost Optimized Scenario)	No, same capacity is kept.
M27	Methodology & Scenarios	Decommissioning Status of Nuclear Power Plants (2025) (Baseline or Target Scenario)	Same capacity is kept.	In the TSO scenario, same capacity is kept.	No, same capacity is kept.	No, same capacity is kept.
M28	Methodology & Scenarios	New Investments for Conventional Power Plants (till 2025)	As Ukrenergo provided, only 3 units added to existing conventional generation till 2025. - Dnistrovska PSHPP - Tashlytska PSHPP - Kakhovska HPP	PSHPP Investment have been incorporated TPP rehabilitation projects as well to keep the available in the same levels.	Not specified.	No new capacity investments on conventional power plants.
M29	Methodology & Scenarios	Baseline or Target Scenario Definition (2025)	Based on specified RES level and load growth ratios	Formation of the target scenario (TSO scenario) on the development of generation was carried out taking into account the results of conformity assessment (sufficiency) of generating capacities for the baseline scenario and the results of forming long-term supply and demand scenarios	Cost Optimized Scenario	Cost Optimized Scenario

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
M30	Methodology & Scenarios	RES Generation Installed Capacity (2025) (Baseline or Target scenario)	2021 Baseline Scenario: WPP: 2,585 MW, SPP: 6,241 MW 2025 Baseline Scenario: WPP: 3,000 MW, SPP: 9,500 MW	2021 TSO Scenario: WPP: 2,200 MW, SPP: 5,600 MW 2025 TSO Scenario: WPP: 3,200 MW, SPP: 6,350 MW	-Solar Installed Capacity Assumed to Remain Almost Unchanged between 2021-2025: 4900 MW (for 2025) (major solar build-out is assumed after 2030, - Wind Installed Capacity: 2600MW (for 2025)	15,000 MW
M31	Methodology & Scenarios	Yearly Load Growth Assumption (%)	Base Scenario: 1.2% (CAGR till 2025) Other load growth scenarios have also been calculated (0% load growth, etc.)	Maximum demand scenario, yearly increase of ~1%.	~1.5% till 2025	Not specified.
M32	Methodology & Scenarios	Additional Maneuvering Capacity Incorporated in Base Scenario (MW) (2025)	Not Applicable (It is not considered as given input for generation dispatch calculation; it is a result based on Expected Unserved Ramping Downward/Upward)	2000 MW of highly maneuverable thermal power plants. 2550 MW of Power Storage Capacity.	2-3 GW of flexible engine	0 MW
R1	Results	RES Penetration Level (MW) @which RES Curtailment is Expected to Start According to the Model Developed	4300 MW	Not specified.	Not specified.	10,000 MW
R2	Results	Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2020	230MW (that would work with a 1.5% yearly capacity factor)	Not specified.	500 MW of internal combustion engines	Not specified.

#	Category	Review Item	USAID ESP - Flexibility Assessment Study for Different RES Penetration Scenarios (This Study) – 2020	Approved Generation Adequacy Study of Ukrenergo – 2019	Flexibility to Future-Proof the Ukraine Power System – 2018 (Wartsila)	Balancing of Fluctuating Renewable Power Sources – 2018 (Berlin Economics)
R3	Results	Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2021 (Baseline or Target Scenario)	479 MW (CF: 0.24%)	2000 MW of highly maneuverable thermal power plants. 2000 MW of Power Storage Capacity.	800 MW of internal combustion engines	0 MW
R4	Results	Recommended New Maneuvering Capacity (MW) and Capacity Factors for 2025 (Baseline or Target Scenario)	727 MW (CF: 0.41%) for interconnected scenario. 1,351 MW (CF: 0.82%) for isolated mode of operation	2000 MW of highly maneuverable thermal power plants. 2550 MW of Power Storage Capacity.	2000 MW of internal combustion engines (low capacity factors)	0 MW
R5	Results	RES Curtailment Proposed (GWh, % of RES generation) for 2019-2020 6 months	30GWh (35 hours)	Not specified. (As declared in Ukrenergo's weekly operational reports of past, curtailed RES energy was around 23GWh (totally 23 hours in different months) in last 12 months.)	Not specified.	Not specified.
R6	Results	RES Curtailment Proposed (GWh, % of RES generation) for 2021 (Baseline or Target Scenario)	149GWh (104 hours) (1.02% of RES generation)	RES restrictions are reduced to zero in TSO-target scenario.	In 7.5GW RES case, the RES curtailment is reduced from 30% to around 5% by adding 2GW of flexible engine capacity.	Not specified.
R7	Results	RES Curtailment Proposed (GWh, % of RES generation) for 2025 (Baseline or Target Scenario)	197GWh (124 hours) (1.05% of RES generation)	RES restrictions are reduced to zero in TSO-target scenario.	In 13.5GW RES case, the RES curtailment is in the level of 20% even though 3-4 GW of flexible engine capacity is added.	For 10 GW RES installed capacity, 300GWh. For 15 GW RES installed capacity, 1,500GWh.

2. INTRODUCTION

2.1. BACKGROUND

Similar to other countries, renewable energy sources (RES) are expected to play a major role in the generation capacity additions to Ukraine power system in the future. This brings in the need to carefully assess system requirements to match the challenges with increasing wind and solar generation.

Deployment of intermittent renewable energy power plants (i.e. wind and photovoltaic solar power plants) bring in challenges in terms of matching the variations in the load/generation patterns. Higher ramping and flexibility capabilities play key roles in sustaining secure operation of power networks.

Power system flexibility is the ability to adapt to dynamic and changing grid conditions by effective balancing supply and demand by the hour (or minute) or deploying new generation and transmission resources over a period of years[7]. Flexible resources include RES curtailment, conventional generators (TPPs, HPPs, PSHPPs, NGPPs), interconnections, demand response (DR) and battery storage, which can change their output sufficiently quickly in response to a changing residual load (net demand).

Inadequate system flexibility may require numerous planning decisions including understanding of risks to address potential deficits. Some potential risks:

- Difficulties meeting the RE policy targets
- Network security and reliability problems
- Increased stress on power system equipment

The inclusion of flexibility assessment for the long-term system planning studies help to understand the adequacy of generation mix in the power system.

2.2. OBJECTIVES OF THE STUDY

Ukrenergo has performed studies to evaluate the maximum variable RES generation that Ukraine power system could connect with the existing flexibility resources and has requested an independent consultant's assessment on the subject.

Objectives of this study can be summarized as follows:

- Bringing in a practical, black-box systematic approach for evaluation of flexibility for IPS of Ukraine
- Assessing residual load hourly (8760 hours) characteristics of Ukraine power system in different RES penetration and load growth scenarios

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[7] EPRI, Electric Power System Flexibility, Challenges and Opportunities

- Analysis of hourly (8760 hours) ramping adequacy of Ukraine power system in different RES penetration and load growth scenarios
- Provision of insights about the overall system characteristics in the process of decision making about maximum RES capacity to be allowed in Ukraine power system under availability of different flexibility options.

2.3. OVERVIEW OF THE TASKS

The project was completed through several iterations of "development of results ↔ incorporation of Ukrenergo's feedbacks" with the following high-level activities:

- Data/information gathering, online interactive sessions with Ukrenergo,
- Data verification and cleansing,
- Conducting flexibility adequacy assessment studies and consolidation of the preliminary results,
    - Incorporation of results of Ancillary Services Performance tests regarding ramping/flexibility capability of TPPs, CHPPs, HPPs etc.;
    - Modelling forced outage/availability parameters and maintenance plans for NPP, TPP, CHP, HPPs;
    - investigation of precipitation and flow regimes and water usage constraints of Dnipro and Dniester rivers;
    - assessment of future cross-border energy exchanges;
    - basic economic assessment of different flexibility resources that will provide the maneuvering capacity for alternative RES penetration scenarios.
- Presentation of the preliminary results to all stakeholders,
- Finalization of results and preparation of final draft of the deliverable.

2.4. ABOUT THE CONTENT OF THE REPORT

Chapter 3, following next chapter of the Introduction part present the methodologies implemented in this study, including problem formulation, approach, scenarios, assumptions and formulas used for technical calculations.

Chapter 4 is composed of three components. In the first sub-chapter, a brief discussion on the validation of the flexibility adequacy assessment model developed for this study is presented. In the following sub-chapter, a comparative review of recent flexibility assessment studies for IPS of Ukraine is shown. In the last sub-chapter, detailed results for all the evaluated scenarios have been presented.

Chapter 5 has been dedicated to o basic economic assessment of different flexibility resources that will provide the maneuvering capacity for baseline RES penetration scenario in 2025.

Chapter 6 presents the conclusion and discussion about the outcomes of this study. Furthermore, specific sub-chapter has been presented for "Pro-Active RES Curtailment" as a source of flexibility to further discuss the economically most viable solution per economic calculations.

The appendix part of the report presents the illustrations for the results of the analysis which include

- Detailed Results of Load and Residual Load Duration Curves

- Detailed Results of Probabilistic Distribution of (1-RL%) in % of Load
- Detailed Results of Probabilistic Distribution of RES Ramp Ratio in % of Load
- Detailed Results of Chromatic Illustration of RL in % of Load
- Daily Profiles - As-Is and Selected Scenarios for 2021 and 2025

3. METHODOLOGY AND TECHNICAL STUDIES

3.1. PROBLEM STATEMENT AND APPROACH

Challenges to be addressed in this study have been identified as follows:

- √ Excessive hourly deviations that cannot be balanced sufficiently quickly
- √ Excess power in cases of low consumption and high RES
- √ Lack of power in cases of high consumption and low RES

The assessment try to answer following question: **Does the current generation mix (power plant fleet) allow for the integration of a higher share of fluctuating renewable power sources in Ukraine and which balancing options are appropriate?**

Different approaches are mentioned in the literature for flexibility adequacy studies[8].

- √ Tier 1: Tools with light data requirements, e. g., no time series. These can be based on data about the generation portfolio, interconnections and other potential sources of flexibility and usually require expert judgement.
- √ **Tier 2: Tools that calculate sufficiency of flexibility based on time series and more detailed generation data or based on a non-optimal dispatch, typically with calculations performed on a spreadsheet without full optimization.**
- √ Tier 3: Tools based on optimal dispatch and unit commitment models, combined with generation planning models. Generally, complex solvers are used, and comprehensive economic modelling is required.

Since Tier-3 studies -which require a well-developed economic database/model of the power system- are planned to be performed as part of "Network Development Plan" project that ESP will develop together with Ukrenergo, a more simplistic approach has been selected (Tier-2) for this specific assignment.

In this context, "Flexibility Assessment" in time series (8760 hours) have been decided to be executed in the scope of the project.

[8] *IRENA, 2017, Power System Flexibility for The Energy Transition*

3.2. FLEXIBILITY ASSESSMENT METHODOLOGY

Integrating increasing wind and solar generation in Ukraine power system can lead to a strong increase of flexibility requirements for other generation elements which are expected to balance the fluctuations of variable generation. As increasing level of RES penetration puts pressure on the system flexibility challenges, variation driven by RES power plants should be assessed, at least using a time resolution of an hour.

In this context, the methodology used in this study assignment has been developed based on two main pillars:

- **Residual Load Analyses (per ENTSO-E parameters):** The main objective is to identify potential lack of flexible generation in future power system operations of Ukraine. It mainly considers the hourly time-series calculation of residual load and RES ramps and check the system behavior for all hours against the ENTSO-E recommended threshold values.
- **Assessment of Ramping Needs and Sources for Ukraine (Calculating selected EPRI Flexibility Metrics):** As the hourly changes must be met by the dispatchable generations; hourly comparison of flexibility requirements and flexibility resources (hydro, pump-storage, thermal) have been applied for both directions; namely downward and upward ramps. Metrics including EUR (Expected Unserved Ramping) and PFD (Period of Flexibility Deficit) have been calculated and heuristic limits considering the power system, available reserve capacities and interconnections have been applied.

The study does not include any economic optimization and purely focuses on technical assessment; with basic assumptions to estimate hourly dispatch of future generation. Calculations performed on a spreadsheet model without power system optimization. Developed spreadsheet model calculates generation dispatch rules based that maximize flexibility. Residual Load (System Load - RES - Must-run Generation) has been calculated and required upward and downward ramping capabilities and resources for each hour have been evaluated.

Time series (e.g., demand and variable generation, which should be synchronous with each other) are attained from historical data (last 24 months, as May 10th, 2020 is the last day of the time series) and are converted for possible future situations. The tool developed has mainly been used for screening potential issues (e. g., curtailments and high ramp requirements) as the share of variable generation increases.

In this context, flexibility resources are limited by the constraints of hydro, thermal and pump storage power plants, for each hour;

- Generation level (MW)
- Ramp rate (MW/hour)
- Maximum available capacity of the (MW) power plant
- Minimum generation (technical minimum) level (MW)
- Water usage constraints for HPPs and operational regime limitations of PSHPPs
- Allocated system reserves per grid code
- Retained % of must-run generation (as the RES penetration level increases certain reductions in the generation of must-run-units (e.g. nuclear power plants) have been applied to reach a technically feasible solution

Four criteria have been applied to assess system flexibility adequacy for all scenarios:

- Criteria 1.1: Residual load to be non-negative for all hours of the year
- Criteria 1.2: RES ramps not to exceed ±10% of the load for all hours of the year

- Criteria 2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours
- Criteria 2.2: Downward ramping deficit should be lower than 1% of the load for 99% of the hours

The set of parameters and the calculation methods used:

- "Must Run" generation is considered as the sum of nuclear generation and generation from CHPPs for all hours.
    - Formula: Must Run (t) = NPP (t) + CHP (t); (0<t<8,760h)
- "RES Generation" includes wind and solar generation, as well as run-of-river hydro power plants.
    - Formula: RES (t) = WPP (t) + SPP (t) + Run of River HPP (t); (0<t<8,760h)
- "Residual Load" is the load that should be supplied by dispatchable generation. Absolute value of RL, RL ratio in comparison with load, the hourly change (ramp) need of RL and rate of RL ramp are calculated.
    - Formula: Residual Load Absolute Value (t) = Load (t) - WPP (t) - SPP (t) - Run of River HPP (t) - Must Run (t); (0<t<8,760h)
    - Formula: Residual Load Ratio (%) (t) = Residual Load Absolute Value (t) / Load (t); (0<t<8,760h)
    - Formula: Residual Load Ramp = ΔRL (t)= (RL(t) - RL(t-1)); (0<t<8,760h)
    - Formula: Residual Load Ramp Rate (%)= %ΔRL= ΔRL(t)/ RL(t-1); (0<t<8,760h)
- "RES Ramp" is the hourly change of generation from RES; and calculated both in absolute figures (MW) and as percentage in comparison with the load.
    - Formula: RES Generation Ramp (t) = ΔRES (t)= (RES(t) - RES(t-1)); (0<t<8,760h)
    - Formula: RES Generation Ramp Rate in Percentage of Load (%)= %ΔRES (t)= ΔRES/ Load (t); (0<t<8,760h)
- "RLPI - RES Load Penetration Index" is defined as maximum hourly coverage of load by RES
    - Formula: RLPI = max (WPP(t) + SPP(t)) / L(t))
- "REPI - RES Energy Penetration Index" is defined as the share of RES generation in the annual total demand
    - Formula: REPI = (WPP(annual) + SPP (annual)) / E (annual)
- "Violation of RL Constraint in MWh)" is the total net load (residual load) for the negative hours
    - Formula: RLV= (number of hours with RL<0) / 8,760h
    - Formula: RLV in MWh= abs (sum of hourly RL values if RL<0)
    - Formula: RLV in % of annual RES generation= (RLV in MWh) / (Annual RES generation)
- "Flexibility Requirement" of the system is defined as the hourly change in residual load (RL), separately calculated for both directions (upward and downward)
    - Formula: Flexibility Requirement (t) Up = Residual Load Hourly Change= ΔRL (MW)
    - Formula: Flexibility Requirement (t) Down =Abs (Residual Load Hourly Change= ΔRL (MW))

- "Upward Flexibility Source" is defined as the sum of the hourly upward ramp that can be provided by hydro, pump-storage and thermal power plants.
  - Formula: Flexibility Source (t) Up = TPP_flexibility_up(t) + HPP_flexibility_up (t) + PSHPP_flexibility_generation_up (t) + PSHPP_flexibility_pumping_up (t)
    - For TPP (unit based)>>> if unit generation (t)≠0, TPP_flexibility_up(t)=max_available_capacity - unit generation (t)
    - For HPP (PP based)>>> HPP_flexibility_up(t)=max_daily_HPP_generation (t) - HPP generation (t)
    - For PSHPP >>>

      PSHPP_flexibility_generation_up (t) =

        if PSHPP generation(t)=0>>>0

        if PSHPP generation(t)≠0>>>max_daily_PSHPP_generation - PSHPP generation (t) *(Flexibility figures are limited with generation mode durability of Kiev and Dnistrovska PSHPP)*

      PSHPP_flexibility_pumping_up (t) =

        if PSHPP pumping(t)=0>>>0

        if PSHPP pumping(t)≠0>>>abs(PSHPP consumption (t))

- "Downward Flexibility Source" is defined as the sum of the downward ramp that can be provided by hydro, pump-storage and thermal power plants.
  - Formula: Flexibility Source (t) down = TPP_flexibility_down(t) + HPP_flexibility_down (t) + PSHPP_flexibility_generation_down (t) + PSHPP_flexibility_pumping_down (t)
    - For TPP (unit based)>>> if unit generation (t)≠0, TPP_flexibility_down(t)=unit generation (t) - technical_minimum_of unit
    - For HPP (PP based)>>>

      if non-flood times>>> HPP_flexibility_down(t)=HPP_generation (t) – HPP Minimum(t)

      if flood times (March, April, May, mid-June)>>> HPP_flexibility_down(t)=HPP_generation (t) – minimum_daily_HPP_generation
    - For PSHPP >>>

      PSHPP_flexibility_generation_down (t) =

        if PSHPP generation(t)=0>>>0

        if PSHPP generation(t)≠0>>>PSHPP generation (t))

      PSHPP_flexibility_pumping_down (t) =

        if PSHPP consumption(t)=0>>>0

        if PSHPP consumption(t)≠0>>>max_daily_PSHPP_consumption-abs(PSHPP consumption (t))

(Flexibility figures are limited with generation mode durability of Kiev and Dnistrovska PSHPP)

- PFD - Period of Flexibility Deficit: Number of periods when the system has insufficient ramping capability to manage the expected ramping of the system's net load
- EUR - Expected Unserved Ramping: Total shortage of flexibility when the system has insufficient ramping capability to manage the expected ramping of the system's residual load measured in MW= ΔRL (t) - Flexibility Resources (t) (Note that both PFD and EUR are calculated separately for upward and downward directions.)

3.3. SCENARIOS

For the flexibility assessment, scenarios have been developed for;

- Years of 2021 and 2025
- Different levels of WPP & SPP penetration (installed capacity)
  - For 2021 Scenarios: WPP: 1,500MW – 2,600MW, SPP: 5,000MW – 8,000MW
  - For 2025 Scenarios: WPP: 2,500MW – 5,000MW, SPP: 5,000MW – 13,000MW

Year for Analysis	# of RES Penetration Scenarios	# of Load Growth Scenarios	# of Operational Mode Scenarios	Total Number of Scenarios
2021	10	3	2	60
2025	10	2	2	40

- Annual load growth rates: No growth, 0.5% and 1.2% annual increase of demand
- Mode of operation of the power system
  - Existence of as-is interconnections
  - Isolated mode of operation

For the evaluation against all aforementioned criteria, following scenarios have been developed and used:

Table 2: RES Penetration Level Scenarios Analyzed in This Study

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.0,0.SQ.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,585	6,241
R21.0,0.SQ.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.0%	15.0%	0.0%	Existing Interconn.	2,585	6,241
R21.0,0.SQ.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,000	7,000
R21.0,0.SQ.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.0%	15.0%	0.0%	Existing Interconn.	2,000	7,000
R21.0,0.SQ.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	1,500	5,000
R21.0,0.SQ.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	1,500	6,000
R21.0,0.SQ.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,000	6,000
R21.0,0.SQ.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	1,500	7,000
R21.0,0.SQ.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,500	6,000
R21.0,0.SQ.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,500	7,000
R21.0,0.SQ.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	0.0%	10.0%	0.0%	Existing Interconn.	2,000	7,500
R21.0,0.SQ.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	0.0%	15.0%	0.0%	Existing Interconn.	2,500	7,500
R21.0,0.SQ.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	0.0%	15.0%	0.0%	Existing Interconn.	2,000	8,000
R21.0,5.SQ.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,585	6,241

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.0,5.SQ.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.5%	12.5%	0.0%	Existing Interconn.	2,585	6,241
R21.0,5.SQ.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,000	7,000
R21.0,5.SQ.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.5%	12.5%	0.0%	Existing Interconn.	2,000	7,000
R21.0,5.SQ.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	1,500	5,000
R21.0,5.SQ.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	1,500	6,000
R21.0,5.SQ.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,000	6,000
R21.0,5.SQ.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	1,500	7,000
R21.0,5.SQ.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,500	6,000
R21.0,5.SQ.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,500	7,000
R21.0,5.SQ.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,000	7,500
R21.0,5.SQ.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	0.5%	12.5%	0.0%	Existing Interconn.	2,500	7,500
R21.0,5.SQ.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	0.5%	12.5%	0.0%	Existing Interconn.	2,000	8,000
R21.0,5.SQ.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.5%	7.5%	0.0%	Existing Interconn.	2,585	6,241
R21.1,0.SQ.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,585	6,241

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.1,0.SQ.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	1.0%	10.0%	0.0%	Existing Interconn.	2,585	6,241
R21.1,0.SQ.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,000	7,000
R21.1,0.SQ.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	1.0%	10.0%	0.0%	Existing Interconn.	2,000	7,000
R21.1,0.SQ.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	1,500	5,000
R21.1,0.SQ.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	1,500	6,000
R21.1,0.SQ.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,000	6,000
R21.1,0.SQ.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	1,500	7,000
R21.1,0.SQ.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,500	6,000
R21.1,0.SQ.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,500	7,000
R21.1,0.SQ.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	1.0%	5.0%	0.0%	Existing Interconn.	2,000	7,500
R21.1,0.SQ.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	1.0%	10.0%	0.0%	Existing Interconn.	2,500	7,500
R21.1,0.SQ.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	1.0%	10.0%	0.0%	Existing Interconn.	2,000	8,000
R21.0,0.ISO.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.0%	10.0%	0.0%	Isolated	2,585	6,241
R21.0,0.ISO.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.0%	15.0%	0.0%	Isolated	2,585	6,241

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.0,0.ISO.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.0%	10.0%	0.0%	Isolated	2,000	7,000
R21.0,0.ISO.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.0%	15.0%	0.0%	Isolated	2,000	7,000
R21.0,0.ISO.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	0.0%	10.0%	0.0%	Isolated	1,500	5,000
R21.0,0.ISO.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Isolated	1,500	6,000
R21.0,0.ISO.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Isolated	2,000	6,000
R21.0,0.ISO.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	0.0%	10.0%	0.0%	Isolated	1,500	7,000
R21.0,0.ISO.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	0.0%	10.0%	0.0%	Isolated	2,500	6,000
R21.0,0.ISO.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	0.0%	10.0%	0.0%	Isolated	2,500	7,000
R21.0,0.ISO.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	0.0%	10.0%	0.0%	Isolated	2,000	7,500
R21.0,0.ISO.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	0.0%	15.0%	0.0%	Isolated	2,500	7,500
R21.0,0.ISO.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	0.0%	15.0%	0.0%	Isolated	2,000	8,000
R21.0,5.ISO.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.5%	7.5%	0.0%	Isolated	2,585	6,241
R21.0,5.ISO.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	0.5%	12.5%	0.0%	Isolated	2,585	6,241
R21.0,5.ISO.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.5%	7.5%	0.0%	Isolated	2,000	7,000

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.0,5.ISO.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	0.5%	12.5%	0.0%	Isolated	2,000	7,000
R21.0,5.ISO.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	0.5%	7.5%	0.0%	Isolated	1,500	5,000
R21.0,5.ISO.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Isolated	1,500	6,000
R21.0,5.ISO.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Isolated	2,000	6,000
R21.0,5.ISO.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	0.5%	7.5%	0.0%	Isolated	1,500	7,000
R21.0,5.ISO.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	0.5%	7.5%	0.0%	Isolated	2,500	6,000
R21.0,5.ISO.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	0.5%	7.5%	0.0%	Isolated	2,500	7,000
R21.0,5.ISO.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	0.5%	7.5%	0.0%	Isolated	2,000	7,500
R21.0,5.ISO.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	0.5%	12.5%	0.0%	Isolated	2,500	7,500
R21.0,5.ISO.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	0.5%	12.5%	0.0%	Isolated	2,000	8,000
R21.1,0.ISO.1a	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	1.0%	5.0%	0.0%	Isolated	2,585	6,241
R21.1,0.ISO.1b	2021 Mainland with WPP Installed Capacity: 2585 MW and SPP Installed Capacity: 6241 MW (RES Connection Forecast of Ukrenergo for end of 2021)	2021	1.0%	10.0%	0.0%	Isolated	2,585	6,241
R21.1,0.ISO.2a	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	1.0%	5.0%	0.0%	Isolated	2,000	7,000
R21.1,0.ISO.2b	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2021	1.0%	10.0%	0.0%	Isolated	2,000	7,000
R21.1,0.ISO.3	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 5000 MW	2021	1.0%	5.0%	0.0%	Isolated	1,500	5,000

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R21.1,0.ISO.4	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Isolated	1,500	6,000
R21.1,0.ISO.5	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Isolated	2,000	6,000
R21.1,0.ISO.6	2021 Mainland with WPP Installed Capacity: 1500 MW and SPP Installed Capacity: 7000 MW	2021	1.0%	5.0%	0.0%	Isolated	1,500	7,000
R21.1,0.ISO.7	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 6000 MW	2021	1.0%	5.0%	0.0%	Isolated	2,500	6,000
R21.1,0.ISO.8	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7000 MW	2021	1.0%	5.0%	0.0%	Isolated	2,500	7,000
R21.1,0.ISO.9	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 7500 MW	2021	1.0%	5.0%	0.0%	Isolated	2,000	7,500
R21.1,0.ISO.10	2021 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW	2021	1.0%	10.0%	0.0%	Isolated	2,500	7,500
R21.1,0.ISO.11	2021 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2021	1.0%	10.0%	0.0%	Isolated	2,000	8,000
R25.0,5.SQ.1	2025 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	10.0%	0.0%	Existing Interconn.	2,500	7,500
R25.0,5.SQ.2	2025 Mainland with WPP Installed Capacity: 3000 MW and SPP Installed Capacity: 9500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	10.0%	10.0%	Existing Interconn.	3,000	9,500
R25.0,5.SQ.3	2025 Mainland with WPP Installed Capacity: 7500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	40.0%	20.0%	Existing Interconn.	7,500	12,000
R25.0,5.SQ.4	2025 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2025	0.5%	10.0%	0.0%	Existing Interconn.	2,000	8,000
R25.0,5.SQ.5	2025 Mainland with WPP Installed Capacity: 3500 MW and SPP Installed Capacity: 9000 MW	2025	0.5%	10.0%	0.0%	Existing Interconn.	3,500	9,000
R25.0,5.SQ.6	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 10000 MW	2025	0.5%	15.0%	10.0%	Existing Interconn.	4,000	10,000

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R25.0,5.SQ.7	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 10000 MW	2025	0.5%	20.0%	20.0%	Existing Interconn.	5,000	10,000
R25.0,5.SQ.8	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 12000 MW	2025	0.5%	20.0%	20.0%	Existing Interconn.	4,000	12,000
R25.0,5.SQ.9	2025 Mainland with WPP Installed Capacity: 4500 MW and SPP Installed Capacity: 12500 MW	2025	0.5%	30.0%	20.0%	Existing Interconn.	4,500	12,500
R25.0,5.SQ.10	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 13000 MW	2025	0.5%	35.0%	20.0%	Existing Interconn.	5,000	13,000
R25.1,2.SQ.1	2025 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	10.0%	0.0%	Existing Interconn.	2,500	7,500
R25.1,2.SQ.2	2025 Mainland with WPP Installed Capacity: 3000 MW and SPP Installed Capacity: 9500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	10.0%	10.0%	Existing Interconn.	3,000	9,500
R25.1,2.SQ.3	2025 Mainland with WPP Installed Capacity: 7500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	50.0%	20.0%	Existing Interconn.	7,500	12,000
R25.1,2.SQ.4	2025 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2025	1.2%	10.0%	0.0%	Existing Interconn.	2,000	8,000
R25.1,2.SQ.5	2025 Mainland with WPP Installed Capacity: 3500 MW and SPP Installed Capacity: 9000 MW	2025	1.2%	10.0%	0.0%	Existing Interconn.	3,500	9,000
R25.1,2.SQ.6	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 10000 MW	2025	1.2%	20.0%	10.0%	Existing Interconn.	4,000	10,000
R25.1,2.SQ.7	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 10000 MW	2025	1.2%	25.0%	10.0%	Existing Interconn.	5,000	10,000
R25.1,2.SQ.8	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 12000 MW	2025	1.2%	30.0%	10.0%	Existing Interconn.	4,000	12,000
R25.1,2.SQ.9	2026 Mainland with WPP Installed Capacity: 4500 MW and SPP Installed Capacity: 12500 MW	2025	1.2%	30.0%	20.0%	Existing Interconn.	4,500	12,500
R25.1,2.SQ.10	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 13000 MW	2025	1.2%	40.0%	20.0%	Existing Interconn.	5,000	13,000

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R25.0,5.ISO.1	2025 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	10.0%	0.0%	Isolated	2,500	7,500
R25.0,5.ISO.2	2025 Mainland with WPP Installed Capacity: 3000 MW and SPP Installed Capacity: 9500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	10.0%	10.0%	Isolated	3,000	9,500
R25.0,5.ISO.3	2025 Mainland with WPP Installed Capacity: 7500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	0.5%	40.0%	20.0%	Isolated	7,500	12,000
R25.0,5.ISO.4	2025 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2025	0.5%	10.0%	0.0%	Isolated	2,000	8,000
R25.0,5.ISO.5	2025 Mainland with WPP Installed Capacity: 3500 MW and SPP Installed Capacity: 9000 MW	2025	0.5%	10.0%	0.0%	Isolated	3,500	9,000
R25.0,5.ISO.6	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 10000 MW	2025	0.5%	15.0%	10.0%	Isolated	4,000	10,000
R25.0,5.ISO.7	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 10000 MW	2025	0.5%	20.0%	20.0%	Isolated	5,000	10,000
R25.0,5.ISO.8	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 12000 MW	2025	0.5%	25.0%	20.0%	Isolated	4,000	12,000
R25.0,5.ISO.9	2025 Mainland with WPP Installed Capacity: 4500 MW and SPP Installed Capacity: 12500 MW	2025	0.5%	30.0%	20.0%	Isolated	4,500	12,500
R25.0,5.ISO.10	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 13000 MW	2025	0.5%	30.0%	20.0%	Isolated	5,000	13,000
R25.1,2.ISO.1	2025 Mainland with WPP Installed Capacity: 2500 MW and SPP Installed Capacity: 7500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	10.0%	0.0%	Isolated	2,500	7,500
R25.1,2.ISO.2	2025 Mainland with WPP Installed Capacity: 3000 MW and SPP Installed Capacity: 9500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	10.0%	10.0%	Isolated	3,000	9,500

Sc. No	Scenario Name	Year of Calculation	Yearly Load Growth	Reduction of Yearly Nuclear Generation (MWh)	Reduction of Yearly CHPP Generation (MWh)	Mode of Operation	RES Installed Capacity	
							WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)
R25.1,2.ISO.3	2025 Mainland with WPP Installed Capacity: 7500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*	2025	1.2%	40.0%	20.0%	Isolated	7,500	12,000
R25.1,2.ISO.4	2025 Mainland with WPP Installed Capacity: 2000 MW and SPP Installed Capacity: 8000 MW	2025	1.2%	10.0%	0.0%	Isolated	2,000	8,000
R25.1,2.ISO.5	2025 Mainland with WPP Installed Capacity: 3500 MW and SPP Installed Capacity: 9000 MW	2025	1.2%	10.0%	0.0%	Isolated	3,500	9,000
R25.1,2.ISO.6	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 10000 MW	2025	1.2%	15.0%	10.0%	Isolated	4,000	10,000
R25.1,2.ISO.7	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 10000 MW	2025	1.2%	15.0%	10.0%	Isolated	5,000	10,000
R25.1,2.ISO.8	2025 Mainland with WPP Installed Capacity: 4000 MW and SPP Installed Capacity: 12000 MW	2025	1.2%	20.0%	15.0%	Isolated	4,000	12,000
R25.1,2.ISO.9	2026 Mainland with WPP Installed Capacity: 4500 MW and SPP Installed Capacity: 12500 MW	2025	1.2%	25.0%	15.0%	Isolated	4,500	12,500
R25.1,2.ISO.10	2025 Mainland with WPP Installed Capacity: 5000 MW and SPP Installed Capacity: 13000 MW	2025	1.2%	30.0%	20.0%	Isolated	5,000	13,000

3.4. ASSUMPTIONS

Simulation results were impacted by three assumptions groupings:

- Future uncertainty
- Data quality
- The need for simplification

The following table summarizes the assumptions that have been used for calculations. Main reason for assumptions and impact of the assumptions have also been presented in the table.

Scale of impact score is categorized as follows: 1: Negligible, 2: Minor, 3: Moderate, 4: High, 5: Very high

Table 3: Set of Assumptions for Flexibility Assessment

No	Assumption	Main Reason for Assumption	Impact of the Assumption	Impact Score (1-5)
1	**Scope of Power System:** Burshtyn Island has been excluded from all calculations and the calculations have been performed for the rest of IPS of Ukraine.	Need for simplification. Burshtyn Island cannot exchange energy with IPS of Ukraine since it is interconnected with ENTSO-E network.	RES potential of Burshtyn Island RES is not considered in the results.	2
2	**Time Series Used:** We've used last 2x8760 hours of generation mix and load data between 12.05.2018 and 11.05.2020.	Data quality for previous year (2016, 2017) is relatively worse than last 24 months.	Load and RES characteristics include only the behavior in last 24 months, which is decent enough for the assessment.	1
3	**Load Growth:** We have assumed 0%, 0.5%, 1.2% annual growth rate for 2021 and 2025 scenarios.	Future uncertainty.	Load growth is an important parameter that affects the system ramping requirements. It has direct impact on residual load.	4
4	**Load Pattern:** "Per unit load profile" has been accepted to remain unchanged throughout the years.	Future uncertainty. It is less likely to change in 2-5-year horizon.	Change in customer behavior in terms of hourly load characteristics and minimum/maximum consumption have impact on hourly calculations.	2
5	**Load-Temperature Variation:** Potential change in the load pattern (per unit load profile) due to temperature forecast for the next years have been ignored in this study. Furthermore, temperature information has not been used to reflect market minimum conditions of Thermal Power Plants. (for the sake of simplicity).	Future uncertainty.	Forecasts for long-term temperature and weather would affect load patterns.	2

No	Assumption	Main Reason for Assumption	Impact of the Assumption	Impact Score (1-5)
6	**Treatment of HPP Constraints:** - Results of Ans Performance for 8 HPPs (RR) has been implemented as a constraint to flexibility capability - Indicative water usage constraints have been implemented for different seasons (winter, summer, flooding) Flexibility capability of the HPPs for the hours of the day will be limited to monthly max generation for each and every day	Unavailability of detailed data	The actual water usage constraints might be stricter/looser than the engineering assumptions.	4

7	**Treatment of PSHPP Constraints:**
	
	- Pumping>generating cycle has been taken care of.
	- Dnistrovska PSHPP – Storage Capacity
	  ○ 11,300MWh (generating mode) (addition of a new unit has been also considered in 2025 scenarios)
	  ○ 14,700MWh (pumping mode)
	- Kyivska PSHPP – Storage Capacity
	  ○ 530MWh (generating mode)
	  ○ 810MWh (pumping mode)
	- Tashlyk PSHPP – Storage Capacity (Not considered as a source of flexibility, since it has been stated that Tashlyk PSHPP by Energoatom to regulate NPP)
		Assumption about the water usage constraint and operation regimes: Unavailability of detailed data of PPs and water usage requirements.	The constraints might be stricter/looser than the engineering assumptions.	4

8	**Interconnection:** Moldova, Belarus and Russia interconnections are considered as resource flexibility and the exchanges per hour have been restrained to figures between +400MW and -100MW (Per histogram analysis, 80% of all hours) for each hours of future years[9] (In isolated mode of operation scenarios, cross-border exchanges have been assumed to be zero for all hours)	Future uncertainty. There is no robust future projection about the hourly energy exchanges at the interconnections, challenging an accurate assessment of impact on flexibility.	Changes with the limits may impact availability of the cross-border exchanges.	3

[9] Calculated impact in total is relatively low, between 6% to 14% of the existing yearly total net cross-border exchanges with Russia system, depending on the scenario.

No	Assumption	Main Reason for Assumption	Impact of the Assumption	Impact Score (1-5)
9	**New Conventional Power Plants:** We've assumed that no new unit/power plant will be added to NPP, CHPP, TPP, HPPs will be implemented for 2021 and 2025. (PSHPP investments planned till 2025 has been considered in the model)	Future uncertainty.	New investments (or disassembly) for the power plants with conventional resources (hydro, thermal, CHPP, NPP) would affect the system flexibility balance.	3
10	**TPP Dispatch Inconsistencies:** For certain hours, total generation of TPPs are smaller than total technical minimum of dispatched (active) TPP units (For some of the individual TPP units this duration even goes beyond 1000 hours). We assume technical minimum of each unit in the flexibility assessment.	Data quality.	As online flexibility concept is introduced, the inconsistencies have little impact on the ramp source calculations.	2
11	**ENTSO-E Interconnection, Zamość Link:** The "ENTSO-E Export" data for Burshtyn Island does not include "Dobrotvirska TPP - Zamość" link to ENTSO-E. We assume that certain units of Dobrotvirska TPP is directed to ENTSO-E interconnected network for certain hours and have been isolated from IPS of Ukraine. We also assume that while exporting to Zamość line, those units of Dobrotvirska TPP do not supply any loads in IPS of Ukraine.	The need for simplification.	As we assume that, the coverage of ENTSO-E interconnected network changes according to the energy trade plans to ENTSO-E network from Dobrotvirska TPP – Zamość; assuming same trading regime will have impact on the RL calculations for IPS of Ukraine.	2
12	**RES Hourly Generation Patterns:** Potential RES ramp changes with the geo-spatial diversification of new WPP and SPPs have been ignored in the study.	Future uncertainty about future RES generation profiles. It should be noted that existing data (per-unit profile) lacks measurement of RES power plants in distribution level and even some of the RES in transmission level.	As geo-spatial diversification of the RES may increase, the ramp requirements may be decreased. Individual ramps occur in different times of the day, resulting in less fluctuation in the overall system flexibility balance.	4

4. RESULTS OF THE ANALYSES

4.1. VALIDATION OF THE MODEL DEVELOPED FOR THIS STUDY

For the sake of assessing the accuracy of the technical model that has been developed for Flexibility Assessment, we have analyzed the last 12 months (12 May 2019 – 11 May 2020) as well.

- Final Installed Capacity of SPPs (as of May 2020) = 4231MW
- Final Installed Capacity of WPPs (as of May 2020) = 1030MW
- Load and generation dispatches of must-run units are assumed to be as given in the data.
- Hours with RES curtailment has been identified from Ukrenergo's declaration and the restrictions have been reverted (i.e. assumed that RES units have produced in their normal pattern. The objective is to test the model's accuracy for identification of RES curtailment needs)

Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.	
Number of hours in violation	% of hours in violation
0	0.00%

Criteria-1.2: RES ramps should be below ±10% of the load for all hours	
Number of hours in violation	% of hours in violation
0	0.00%

Criteria#2.1: Downward ramping deficit should be lower than 2.5% of the load for 99% of the hours			
Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation
35	0.40%	34,066	0.56%

~34GWh of RES curtailment need is identified (35 hours)

Criteria#2.2: Upward ramping deficit should be lower than 2.5% of the load for 99% of the hours			
Number of hours in violation	% of hours in violation	Upward Downward Ramping Deficit (MWh)	Upward Ramping Deficit in % of annual RES generation
4	0.05%	4,022	0.07%

231 MW of additional maneuvering capacity required to avoid RES restrictions (1.8% capacity factor)

Figure 1: Result for May 2019 – May 2020 in the Model

Analyzing to last 12 months, the model has resulted in downward ramping deficit in 35 hours, which would require ~34GWh hours of RES curtailment in the power system of Ukraine. This curtailment might have been prevented with an additional ~230MW of flexibility resources.

Date	Time	Power
5 November 2019	41 min	395 MW
22 December 2019	60 min	350 MW
7 January 2020	70 min	929 MW
14 March 2020	20 min	282.5 MW
15 March 2020	80 min	460 MW
26 March 2020	120-170 min	407 MW
28 March 2020	60 min	409 MW
2 April 2020	48 min	390.4 MW
3 April 2020	180 min	597.6 MW
4 April 2020	>6 hour	1363,4 MW
5 April 2020	>5 hour	1656,7 MW

~22,6 GWh of RES curtailment need is identified (23 hours)

Figure 2: RES Restriction in IPS of Ukraine between May 2019-May 2020[10]

RES curtailment requirement that our model has resulted has been compared with Ukrenergo's announced RES curtailment levels. As declared in Ukrenergo's weekly operational reports of past 12 months, curtailed RES energy was around 23GWh (totally 23 hours in different months) in last 12 months. Comparison of these figures is used for validation of the developed model; which we think we have concluded a reasonably accurate results which ensure that results for 2021 and 2025 have decent accuracy.

[10] https://ua.energy/media/pres-tsentr/pres-relizy/do-kintsya-2020-roku-vyrobnytstvo-elektroenergiyi-z-vde-dorivnyuvatyme-13-generatsiyi-aes-ta-24-tes/

4.2. DETAILED RESULTS FOR EVALUATED SCENARIOS

The results are presented in the upcoming page in a tabular form. The tables include the following information about the results:

- Information About Main Assumption for This Scenario
    - Sc. No
    - Year of Calculation
    - Yearly Load Growth
    - Mode of Operation
    - WPP Inst. Cap. (MW)
    - SPP Inst. Cap. (MW)
    - RLPI: RES Load Penetration Index
    - REPI: RES Energy Penetration Index
    - Tertiary System Reserves (MW) 95% of all hours
    - Tertiary System Reserves (MW)
- New Calculated Dispatch (Energy Balance) for Selected Scenario
    - Load (TWh)
    - Gen (TWh)
    - Wind (TWh)
    - Solar (TWh)
    - TPP (TWh)
    - CHPP (TWh)
    - Nuclear (TWh)
    - HPP (TWh)
    - Run-of River
    - PSP_Gen (TWh)
    - PSP_Cons (TWh)
- Detailed Results for This Scenario
    - Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours
        - Number of hours in violation
        - % of hours in violation
    - Criteria-1.2: RES ramps should be below ±10% of the load for all hours
        - Number of hours in violation
        - % of hours in violation
    - Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours
        - Number of hours in violation
        - % of hours in violation

        - Annual Downward Ramping Deficit (MWh)
        - Downward Ramping Deficit in % of annual RES generation
    - Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours
        - Number of hours in violation
        - % of hours in violation
        - Annual Upward Ramping Deficit (MWh)
    - New Maneuvering Source Requirement
        - Additional Maneuvering Capacity Required (MW) (Max)
        - Additional Maneuvering Energy Required Yearly (MWh)
        - Capacity Factor for New Capacity

The following items should be considered for the interpretation of the results.

- Each row of the table corresponds to a RES penetration level scenario.
- For each of the four criteria, if the results are within the acceptable ranges, that cell has been highlighted in green. If the results are violating the limits, they are highlighted in yellow. Limit violations should be interpreted as an indication of the inadequacy of the flexibility for the selected RES penetration level and for certain hours and the power system will be unable to accommodate it without making some adjustments.
- The violations are presented both in number of hours in violation, as well energy (MWh) in the hours of violation.

Table 4: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.1a	2021	0.0%	Intercon.	2,585	6,241	42.73%	10.83%	1,000	735

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.8	7.5	6.9	37.0	6.6	72.9	5.7	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
1	0.01%	5	0.06%	208	2.37%	280,439	1.94%	27	0.31%	9,514	468	9,514	0.23%

Table 5: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.1b	2021	0.0%	Intercon.	2,585	6,241	42.73%	10.83%	1,000	749

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.2	7.5	6.9	38.9	6.6	68.8	7.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	5	0.06%	76	0.87%	120,466	0.84%	30	0.34%	10,149	480	10,149	0.24%

Table 6: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.2a	2021	0.0%	Intercon.	2,000	7,000	43.05%	10.20%	1,000	734

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.5	5.8	7.7	37.0	6.6	72.9	6.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
1	0.01%	8	0.09%	104	1.19%	168,720	1.24%	33	0.38%	10,614	490	10,614	0.25%

Table 7: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.2b	2021	0.0%	Intercon.	2,000	7,000	43.05%	10.20%	1,000	753

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.0	5.8	7.7	39.3	6.6	68.8	7.6	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	8	0.09%	52	0.59%	88,372	0.65%	36	0.41%	11,520	509	11,520	0.26%

Table 8: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 5,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.3	2021	0.0%	Intercon.	1,500	5,000	31.19%	7.51%	1,000	990

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.1	4.4	5.5	38.7	6.6	72.9	7.9	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	22	0.25%	38,396	0.39%	18	0.21%	7,309	401	7,309	0.21%

Table 9: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.4	2021	0.0%	Intercon.	1,500	6,000	35.77%	8.32%	1,000	886

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.2	4.4	6.6	38.2	6.6	72.9	7.4	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	40	0.46%	66,336	0.60%	27	0.31%	8,700	443	8,700	0.22%

Table 10: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.5	2021	0.0%	Intercon.	2,000	6,000	38.47%	9.39%	1,000	820

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.4	5.8	6.6	37.7	6.6	72.9	6.7	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	1	0.01%	78	0.89%	129,609	1.04%	30	0.34%	8,881	448	8,881	0.23%

Table 11: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.6	2021	0.0%	Intercon.	1,500	7,000	40.35%	9.13%	1,000	787

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.3	4.4	7.7	37.6	6.6	72.9	7.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	5	0.06%	62	0.71%	102,689	0.85%	30	0.34%	10,539	485	10,539	0.25%

Table 12: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.7	2021	0.0%	Intercon.	2,500	6,000	41.16%	10.46%	1,000	763

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.7	7.3	6.6	37.3	6.6	72.9	5.9	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	2	0.02%	182	2.08%	252,091	1.81%	27	0.31%	9,157	456	9,157	0.23%

Table 13: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.8	2021	0.0%	Intercon.	2,500	7,000	45.75%	11.27%	1,000	688

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.8	7.3	7.7	36.5	6.6	72.9	5.6	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
12	0.14%	16	0.18%	218	2.49%	290,891	1.94%	33	0.38%	10,843	498	10,843	0.25%

Table 14: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.9	2021	0.0%	Intercon.	2,000	7,500	45.34%	10.57%	1,000	698

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.5	5.8	8.3	36.5	6.6	72.9	6.3	0.3	2.9	-3.1

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
9	0.10%	14	0.16%	132	1.51%	196,665	1.40%	39	0.45%	11,713	509	11,713	0.26%

Table 15: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.10	2021	0.0%	Intercon.	2,500	7,500	48.04%	11.68%	1,000	656

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.2	7.3	8.3	38.1	6.6	68.8	7.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	21	0.24%	114	1.30%	163,237	1.05%	39	0.45%	12,854	533	12,854	0.28%

Table 16: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,0.SQ.11	2021	0.0%	Intercon.	2,000	8,000	47.63%	11.01%	1,000	665

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
136.1	139.1	5.8	8.9	38.6	6.6	68.8	7.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	26	0.30%	94	1.07%	139,509	0.95%	39	0.45%	14,176	551	14,176	0.29%

Table 17: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.1a	2021	0.5%	Intercon.	2,585	6,241	42.30%	10.73%	1,000	695

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	141.2	7.5	6.9	36.8	6.6	74.9	5.4	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
2	0.02%	5	0.06%	240	2.74%	326,606	2.26%	27	0.31%	9,881	479	9,881	0.24%

Table 18: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.1b	2021	0.5%	Intercon.	2,585	6,241	42.30%	10.73%	1,000	712

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.6	7.5	6.9	38.5	6.6	70.9	7.1	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	5	0.06%	104	1.19%	149,009	1.03%	30	0.34%	10,555	491	10,555	0.25%

Table 19: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.2a	2021	0.5%	Intercon.	2,000	7,000	42.62%	10.10%	1,000	694

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	141.0	5.8	7.7	36.7	6.6	74.9	6.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
1	0.01%	7	0.08%	144	1.64%	205,151	1.51%	33	0.38%	11,063	501	11,063	0.25%

Table 20: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.2b	2021	0.5%	Intercon.	2,000	7,000	42.62%	10.10%	1,000	723

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.4	5.8	7.7	38.8	6.6	70.9	7.5	0.3	2.9	-3.1

Detailed Results for This Scenario														
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	7	0.08%	56	0.64%	98,528	0.73%	36	0.41%	11,912	518	11,912	0.26%

Table 21: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 5,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.3	2021	0.5%	Intercon.	1,500	5,000	30.88%	7.43%	1,000	959

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.5	4.4	5.5	38.3	6.6	74.9	7.7	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	32	0.37%	49,846	0.50%	21	0.24%	7,607	411	7,607	0.21%

Table 22: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.4	2021	0.5%	Intercon.	1,500	6,000	35.42%	8.24%	1,000	838

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.6	4.4	6.6	37.8	6.6	74.9	7.1	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	52	0.59%	78,076	0.71%	27	0.31%	9,015	453	9,015	0.23%

Table 23: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.5	2021	0.5%	Intercon.	2,000	6,000	38.09%	9.30%	1,000	775

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.9	5.8	6.6	37.4	6.6	74.9	6.4	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	1	0.01%	110	1.26%	166,384	1.34%	30	0.34%	9,268	460	9,268	0.23%

Table 24: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.6	2021	0.5%	Intercon.	1,500	7,000	39.95%	9.04%	1,000	744

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.7	4.4	7.7	37.2	6.6	74.9	6.8	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	5	0.06%	74	0.84%	116,717	0.96%	30	0.34%	10,904	495	10,904	0.25%

Table 25: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.7	2021	0.5%	Intercon.	2,500	6,000	40.76%	10.35%	1,000	721

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	141.2	7.3	6.6	37.0	6.6	74.9	5.6	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	1	0.01%	216	2.47%	299,994	2.16%	27	0.31%	9,500	467	9,500	0.23%

Table 26: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.8	2021	0.5%	Intercon.	2,500	7,000	45.29%	11.16%	1,000	651

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	141.2	7.3	7.7	36.3	6.6	74.9	5.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
15	0.17%	15	0.17%	254	2.90%	340,164	2.27%	33	0.38%	11,207	510	11,207	0.25%

Table 27: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.9	2021	0.5%	Intercon.	2,000	7,500	44.89%	10.46%	1,000	660

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	141.0	5.8	8.3	36.2	6.6	74.9	6.1	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
15	0.17%	13	0.15%	170	1.94%	233,520	1.66%	39	0.45%	12,162	520	12,162	0.27%

Table 28: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.10	2021	0.5%	Intercon.	2,500	7,500	47.56%	11.56%	1,000	620

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.7	7.3	8.3	37.8	6.6	70.9	6.8	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
9	0.10%	21	0.24%	130	1.48%	189,212	1.22%	39	0.45%	13,302	544	13,302	0.28%

Table 29: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.0,5.SQ.11	2021	0.5%	Intercon.	2,000	8,000	47.16%	10.91%	1,000	628

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
137.5	140.5	5.8	8.9	38.1	6.6	70.9	7.1	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
7	0.08%	25	0.29%	100	1.14%	151,534	1.03%	39	0.45%	14,558	560	14,558	0.30%

Table 30: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.1a	2021	1.0%	Intercon.	2,585	6,241	41.89%	10.62%	1,000	655

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.7	7.5	6.9	36.6	6.6	76.9	5.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
2	0.02%	5	0.06%	268	3.06%	373,485	2.59%	27	0.31%	10,241	490	10,241	0.24%

Table 31: 2021 Mainland with WPP Installed Capacity: 2,585 MW and SPP Installed Capacity: 6,241 MW (RES Connection Forecast of Ukrenergo for end of 2021)

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.1b	2021	1.0%	Intercon.	2,585	6,241	41.89%	10.62%	1,000	679

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.1	7.5	6.9	38.2	6.6	72.9	6.8	0.3	2.9	-3.1

Detailed Results for This Scenario														
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	5	0.06%	132	1.51%	184,390	1.28%	30	0.34%	10,978	502	10,978	0.25%

Table 32: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.2a	2021	1.0%	Intercon.	2,000	7,000	42.20%	10.00%	1,000	654

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.4	5.8	7.7	36.5	6.6	76.9	5.7	0.3	2.9	-3.1

Detailed Results for This Scenario															
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
3	0.03%	7	0.08%	178	2.03%	257,143	1.90%	36	0.41%	11,534	513	11,534	0.26%

Table 33: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,000 MW (RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.2b	2021	1.0%	Intercon.	2,000	7,000	42.20%	10.00%	1,000	682

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	141.9	5.8	7.7	38.4	6.6	72.9	7.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	7	0.08%	66	0.75%	112,717	0.83%	36	0.41%	12,328	528	12,328	0.27%

Table 34: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 5,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.3	2021	1.0%	Intercon.	1,500	5,000	30.57%	7.36%	1,000	904

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.0	4.4	5.5	38.1	6.6	76.9	7.3	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	38	0.43%	71,488	0.72%	21	0.24%	7,941	422	7,941	0.21%

Table 35: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.4	2021	1.0%	Intercon.	1,500	6,000	35.07%	8.16%	1,000	790

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.1	4.4	6.6	37.6	6.6	76.9	6.8	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	0	0.00%	56	0.64%	100,032	0.91%	27	0.31%	9,375	464	9,375	0.23%

Table 36: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.5	2021	1.0%	Intercon.	2,000	6,000	37.71%	9.20%	1,000	731

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.3	5.8	6.6	37.2	6.6	76.9	6.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	1	0.01%	144	1.64%	217,916	1.75%	30	0.34%	9,677	472	9,677	0.23%

Table 37: 2021 Mainland with WPP Installed Capacity: 1,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.6	2021	1.0%	Intercon.	1,500	7,000	39.56%	8.95%	1,000	701

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.2	4.4	7.7	36.9	6.6	76.9	6.5	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	3	0.03%	84	0.96%	141,216	1.17%	36	0.41%	11,296	505	11,296	0.26%

Table 38: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 6,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.7	2021	1.0%	Intercon.	2,500	6,000	40.35%	10.25%	1,000	680

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.6	7.3	6.6	36.8	6.6	76.9	5.2	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	1	0.01%	250	2.85%	346,262	2.49%	27	0.31%	9,861	479	9,861	0.24%

Table 39: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.8	2021	1.0%	Intercon.	2,500	7,000	44.84%	11.05%	1,000	613

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.7	7.3	7.7	36.0	6.6	76.9	5.0	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
19	0.22%	12	0.14%	292	3.33%	386,610	2.57%	36	0.41%	11,587	520	11,587	0.25%

Table 40: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.9	2021	1.0%	Intercon.	2,000	7,500	44.45%	10.36%	1,000	622

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.5	5.8	8.3	36.0	6.6	76.9	5.7	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
18	0.21%	13	0.15%	208	2.37%	286,483	2.04%	39	0.45%	12,634	532	12,634	0.27%

Table 41: 2021 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.10	2021	1.0%	Intercon.	2,500	7,500	47.09%	11.45%	1,000	585

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	142.1	7.3	8.3	37.4	6.6	72.9	6.5	0.3	2.9	-3.1

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
12	0.14%	19	0.22%	162	1.85%	220,620	1.42%	39	0.45%	13,783	555	13,783	0.28%

Table 42: 2021 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R21.1,0.SQ.11	2021	1.0%	Intercon.	2,000	8,000	46.69%	10.80%	1,000	592

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
138.8	141.9	5.8	8.9	37.7	6.6	72.9	7.0	0.3	2.9	-3.1

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
9	0.10%	23	0.26%	110	1.26%	165,764	1.13%	39	0.45%	14,966	569	14,966	0.30%

Table 43: 2025 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.1	2025	0.5%	Intercon.	2,500	7,500	46.62%	11.33%	800	576

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.9	7.3	8.3	38.0	6.6	72.9	6.9	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	18	0.21%	96	1.10%	147,839	0.95%	30	0.34%	12,816	531	12,816	0.28%

Table 44: 2025 Mainland with WPP Installed Capacity: 3,000 MW and SPP Installed Capacity: 9,500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.2	2025	0.5%	Intercon.	3,000	9,500	58.13%	13.95%	800	462

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.3	8.7	10.5	36.1	5.9	72.9	6.1	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
114	1.30%	139	1.59%	212	2.42%	299,837	1.56%	43	0.49%	19,980	645	19,980	0.35%

Table 45: 2025 Mainland with WPP Installed Capacity: 7,500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.3	2025	0.5%	Intercon.	7,500	12,000	93.12%	25.25%	800	285

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.8	21.8	13.3	43.8	5.2	48.6	7.0	0.3	3.7	-4.0

Detailed Results for This Scenario														
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
231	2.64%	697	7.96%	500	5.71%	749,097	2.13%	168	1.92%	75,902	1,063	75,902	0.81%

Table 46: 2025 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.4	2025	0.5%	Intercon.	2,000	8,000	46.23%	10.69%	800	584

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.7	5.8	8.9	38.3	6.6	72.9	7.2	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	21	0.24%	74	0.84%	110,465	0.75%	30	0.34%	13,902	556	13,902	0.29%

Table 47: 2025 Mainland with WPP Installed Capacity: 3,500 MW and SPP Installed Capacity: 9,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.5	2025	0.5%	Intercon.	3,500	9,000	58.53%	14.59%	800	457

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.7	10.2	10.0	35.7	6.6	72.9	5.4	0.3	3.7	-4.0

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
118	1.35%	102	1.16%	292	3.33%	400,163	1.99%	38	0.43%	18,118	626	18,118	0.33%

Table 48: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.6	2025	0.5%	Intercon.	4,000	10,000	65.59%	16.42%	800	408

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.3	11.6	11.1	36.8	5.9	68.8	6.1	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
156	1.78%	225	2.57%	304	3.47%	407,419	1.79%	53	0.61%	24,920	708	24,920	0.40%

Table 49: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.7	2025	0.5%	Intercon.	5,000	10,000	70.82%	18.49%	800	376

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.2	14.5	11.1	38.3	5.2	64.8	6.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
150	1.71%	270	3.08%	336	3.84%	477,841	1.87%	60	0.68%	29,745	755	29,745	0.45%

Table 50: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 12,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.8	2025	0.5%	Intercon.	4,000	12,000	74.48%	17.92%	800	360

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.8	11.5	13.3	38.0	5.2	64.8	6.9	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
239	2.73%	528	6.03%	320	3.65%	447,884	1.81%	85	0.97%	41,979	840	41,979	0.57%

Table 51: 2025 Mainland with WPP Installed Capacity: 4,500 MW and SPP Installed Capacity: 12,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.9	2025	0.5%	Intercon.	4,500	12,500	79.32%	19.43%	800	338

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.4	13.1	13.8	43.0	5.2	56.7	7.5	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
177	2.02%	631	7.20%	300	3.42%	428,928	1.59%	125	1.43%	58,349	931	58,349	0.72%

Table 52: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 13,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.SQ.10	2025	0.5%	Intercon.	5,000	13,000	84.16%	20.86%	800	318

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.3	14.5	14.4	44.9	5.2	52.6	7.6	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
187	2.13%	722	8.24%	348	3.97%	486,485	1.68%	158	1.80%	72,380	1,002	72,380	0.82%

Table 53: 2025 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.1	2025	1.2%	Intercon.	2,500	7,500	44.72%	10.87%	800	368

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.1	7.3	8.3	41.8	6.6	72.9	8.2	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	11	0.13%	46	0.53%	82,024	0.53%	35	0.40%	17,478	622	17,478	0.32%

Table 54: 2025 Mainland with WPP Installed Capacity: 3,000 MW and SPP Installed Capacity: 9,500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.2	2025	1.2%	Intercon.	3,000	9,500	55.76%	13.38%	800	295

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.4	8.7	10.5	40.0	5.9	72.9	7.4	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
40	0.46%	105	1.20%	124	1.42%	196,248	1.02%	53	0.61%	26,306	727	26,306	0.41%

Table 55: 2025 Mainland with WPP Installed Capacity: 7,500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.3	2025	1.2%	Intercon.	7,500	12,000	89.32%	24.22%	800	182

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	148.9	21.8	13.3	55.6	5.2	40.5	8.5	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
78	0.89%	598	6.83%	278	3.17%	445,365	1.27%	260	2.97%	120,687	1,204	120,687	1.14%

Table 56: 2025 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.4	2025	1.2%	Intercon.	2,000	8,000	44.34%	10.25%	800	373

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.0	5.8	8.9	42.6	6.6	72.9	8.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	13	0.15%	48	0.55%	84,612	0.58%	38	0.43%	19,523	652	19,523	0.34%

Table 57: 2025 Mainland with WPP Installed Capacity: 3,500 MW and SPP Installed Capacity: 9,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.5	2025	1.2%	Intercon.	3,500	9,000	56.14%	14.00%	800	292

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.7	10.2	10.0	39.1	6.6	72.9	7.0	0.3	3.7	-4.0

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
45	0.51%	70	0.80%	192	2.19%	257,236	1.28%	50	0.57%	24,035	698	24,035	0.39%

Table 58: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.6	2025	1.2%	Intercon.	4,000	10,000	62.91%	15.75%	800	260

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.1	11.6	11.1	43.9	5.9	64.8	7.9	0.3	3.7	-4.0

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
43	0.49%	172	1.96%	140	1.60%	212,712	0.94%	68	0.78%	36,449	811	36,449	0.51%

Table 59: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.7	2025	1.2%	Intercon.	5,000	10,000	67.94%	17.74%	800	240

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.2	14.5	11.1	45.0	5.9	60.7	7.9	0.3	3.7	-4.0

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
54	0.62%	213	2.43%	174	1.99%	269,079	1.05%	85	0.97%	42,116	846	42,116	0.57%

Table 60: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 12,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.8	2025	1.2%	Intercon.	4,000	12,000	71.44%	17.19%	800	230

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.0	11.5	13.3	49.3	5.9	56.7	8.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
54	0.62%	427	4.87%	190	2.17%	283,366	1.14%	133	1.52%	68,221	985	68,221	0.79%

Table 61: 2025 Mainland with WPP Installed Capacity: 4,500 MW and SPP Installed Capacity: 12,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.9	2025	1.2%	Intercon.	4,500	12,500	76.09%	18.63%	800	216

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	148.8	13.1	13.8	55.5	5.2	48.6	8.5	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
38	0.43%	541	6.18%	176	2.01%	266,070	0.99%	208	2.37%	98,435	1,092	98,435	1.03%

Table 62: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 13,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.SQ.10	2025	1.2%	Intercon.	5,000	1,3000	80.73%	20.01%	800	203

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	148.8	14.5	14.4	57.5	5.2	44.5	8.6	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
45	0.51%	639	7.29%	210	2.40%	310,246	1.07%	250	2.85%	120,257	1,165	120,257	1.18%

Table 63: 2025 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.1	2025	0.5%	Isolated	2,500	7,500	46.62%	11.33%	600	248

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.0	7.3	8.3	38.2	6.6	72.9	6.9	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	18	0.21%	232	2.65%	330,675	2.12%	110	1.26%	50,419	1,086	50,419	0.53%

Table 64: 2025 Mainland with WPP Installed Capacity: 3,000 MW and SPP Installed Capacity: 9,500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.2	2025	0.5%	Isolated	3,000	9,500	58.13%	13.95%	600	199

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.4	8.7	10.5	36.3	5.9	72.9	6.1	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
114	1.30%	139	1.59%	414	4.73%	573,344	2.98%	163	1.86%	73,210	1,258	73,210	0.66%

Table 65: 2025 Mainland with WPP Installed Capacity: 7,500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.3	2025	0.5%	Isolated	7,500	12,000	93.12%	25.25%	600	123

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.9	21.8	13.3	44.0	5.2	48.6	7.0	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
231	2.64%	697	7.96%	728	8.31%	1,108,235	3.16%	508	5.80%	234,188	1,850	234,188	1.45%

Table 66: 2025 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.4	2025	0.5%	Isolated	2,000	8,000	46.23%	10.69%	600	251

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.8	5.8	8.9	38.5	6.6	72.9	7.2	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
4	0.05%	21	0.24%	160	1.83%	250,706	1.71%	108	1.23%	54,676	1,112	54,676	0.56%

Table 67: 2025 Mainland with WPP Installed Capacity: 3,500 MW and SPP Installed Capacity: 9,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.5	2025	0.5%	Isolated	3,500	9,000	58.53%	14.59%	600	197

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.8	10.2	10.0	35.7	6.6	72.9	5.4	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
118	1.35%	102	1.16%	520	5.94%	708,222	3.52%	148	1.69%	66,238	1,232	66,238	0.61%

Table 68: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.6	2025	0.5%	Isolated	4,000	10,000	65.59%	16.42%	600	176

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.4	11.6	11.1	36.9	5.9	68.8	6.1	0.3	3.7	-4.0

Detailed Results for This Scenario												
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
156	1.78%	225	2.57%	506	5.78%	708,559	3.12%	190	2.17%	90,400	1,350	90,400	0.76%

Table 69: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.7	2025	0.5%	Isolated	5,000	10,000	70.82%	18.49%	600	162

New Calculated Dispatch (Energy Balance) for Selected Scenario										
Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	144.3	14.5	11.1	38.4	5.2	64.8	6.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
150	1.71%	270	3.08%	570	6.51%	787,416	3.07%	225	2.57%	105,592	1,427	105,592	0.84%

Table 70: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 12,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.8	2025	0.5%	Isolated	4,000	12,000	74.48%	17.99%	600	155

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.6	11.6	13.3	41.3	5.2	60.7	7.4	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
166	1.89%	534	6.10%	434	4.95%	612,313	2.46%	338	3.86%	159,938	1,516	159,938	1.20%

Table 71: 2025 Mainland with WPP Installed Capacity: 4,500 MW and SPP Installed Capacity: 12,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.9	2025	0.5%	Isolated	4,500	12,500	79.32%	19.43%	600	145

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.5	13.1	13.8	43.1	5.2	56.7	7.5	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
177	2.02%	631	7.20%	468	5.34%	674,387	2.51%	420	4.79%	192,013	1,658	192,013	1.32%

Table 72: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 13,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.0,5.ISO.10	2025	0.5%	Isolated	5,000	13,000	84.16%	20.76%	600	137

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
140.2	143.7	14.4	14.4	41.6	5.2	56.7	7.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
247	2.82%	715	8.16%	576	6.58%	855,484	2.97%	448	5.11%	205,069	1,769	205,069	1.32%

Table 73: 2025 Mainland with WPP Installed Capacity: 2,500 MW and SPP Installed Capacity: 7,500 MW (Min RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.1	2025	1.2%	Isolated	2,500	7,500	44.72%	10.87%	600	146

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.2	7.3	8.3	42.0	6.6	72.9	8.2	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	11	0.13%	106	1.21%	193,784	1.24%	125	1.43%	66,882	1,191	66,882	0.64%

Table 74: 2025 Mainland with WPP Installed Capacity: 3,000 MW and SPP Installed Capacity: 9,500 MW (Medium RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.2	2025	1.2%	Isolated	3,000	9,500	55.76%	13.38%	600	117

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.6	8.7	10.5	40.1	5.9	72.9	7.4	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
40	0.46%	105	1.20%	250	2.85%	380,343	1.98%	198	2.26%	95,718	1,351	95,718	0.81%

Table 75: 2025 Mainland with WPP Installed Capacity: 7,500 MW and SPP Installed Capacity: 12,000 MW (High RES Penetration Scenario in Ukrenergo's Generation Adequacy Report)*

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.3	2025	1.2%	Isolated	7,500	12,000	89.32%	24.22%	600	0

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.4	21.8	13.3	48.7	5.2	48.6	7.7	0.3	3.7	-4.0

Detailed Results for This Scenario														
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
141	1.61%	598	6.83%	574	6.55%	902,952	2.57%	613	7.00%	288,100	1,969	288,100	1.67%

Table 76: 2025 Mainland with WPP Installed Capacity: 2,000 MW and SPP Installed Capacity: 8,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.4	2025	1.2%	Isolated	2,000	8,000	44.34%	10.25%	600	148

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.2	5.8	8.9	42.8	6.6	72.9	8.2	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
0	0.00%	13	0.15%	118	1.35%	191,249	1.30%	133	1.52%	74,130	1,218	74,130	0.69%

Table 77: 2025 Mainland with WPP Installed Capacity: 3,500 MW and SPP Installed Capacity: 9,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.5	2025	1.2%	Isolated	3,500	9,000	56.14%	14.00%	600	116

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.8	10.2	10.0	39.2	6.6	72.9	7.0	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
45	0.51%	70	0.80%	328	3.74%	490,116	2.43%	170	1.94%	87,336	1,327	87,336	0.75%

Table 78: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.6	2025	1.2%	Isolated	4,000	10,000	62.91%	15.75%	600	103

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.6	11.6	11.1	40.9	5.9	68.8	7.3	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
69	0.79%	172	1.96%	346	3.95%	514,868	2.27%	240	2.74%	117,590	1,453	117,590	0.92%

Table 79: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 10,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.7	2025	1.2%	Isolated	5,000	10,000	67.94%	17.65%	600	95

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	150.1	14.4	11.1	39.2	5.9	68.8	6.7	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
129	1.47%	208	2.37%	550	6.28%	792,909	3.11%	248	2.83%	119,071	1,494	119,071	0.91%

Table 80: 2025 Mainland with WPP Installed Capacity: 4,000 MW and SPP Installed Capacity: 12,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.8	2025	1.2%	Isolated	4,000	12,000	71.44%	17.26%	600	91

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.4	11.6	13.3	42.6	5.6	64.8	7.5	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
148	1.69%	434	4.95%	400	4.57%	602,984	2.42%	363	4.14%	182,415	1,594	182,415	1.31%

Table 81: 2025 Mainland with WPP Installed Capacity: 4,500 MW and SPP Installed Capacity: 12,500 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.9	2025	1.2%	Isolated	4,500	12,500	76.09%	18.63%	600	86

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.4	13.1	13.8	44.5	5.6	60.7	7.7	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
154	1.76%	541	6.18%	430	4.91%	663,744	2.47%	465	5.31%	217,064	1,749	217,064	1.42%

Table 82: 2025 Mainland with WPP Installed Capacity: 5,000 MW and SPP Installed Capacity: 13,000 MW

Information About Main Assumption for This Scenario									
Sc. No	Year of Calculation	Yearly Load Growth	Mode of Operation	WPP Inst. Cap. (MW)	SPP Inst. Cap. (MW)	RLPI: RES Load Penetration Index	REPI: RES Energy Penetration Index	Tertiary System Reserves (MW) 95% of all hours	Tertiary System Reserves (MW) Minimum of all hours
R25.1,2.ISO.10	2025	1.2%	Isolated	5,000	13,000	80.73%	20.01%	600	0

Load (TWh)	Gen (TWh)	Wind (TWh)	Solar (TWh)	TPP (TWh)	CHPP (TWh)	Nuclear (TWh)	HPP (TWh)	Run-of River	PSP_Gen (TWh)	PSP_Cons (TWh)
146.2	149.3	14.5	14.4	46.6	5.2	56.7	7.8	0.3	3.7	-4.0

Detailed Results for This Scenario													
Criteria 1.1: RL (Residual Load) magnitude should be non-negative for all hours.		Criteria-1.2: RES ramps should be below ±10% of the load for all hours		Criteria#2.1: Downward ramping deficit should be lower than 1% of the load for 99% of the hours				Criteria#2.2: Upward ramping deficit should be lower than 1% of the load for 99% of the hours			New Maneuvering Source Requirement		
Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Number of hours in violation	% of hours in violation	Annual Downward Ramping Deficit (MWh)	Downward Ramping Deficit in % of annual RES generation	Number of hours in violation	% of hours in violation	Annual Upward Ramping Deficit (MWh)	Additional Maneuvering Capacity Required (MW) (Max)	Additional Maneuvering Energy Required Yearly (MWh)	Capacity Factor for New Capacity
161	1.84%	639	7.29%	466	5.32%	724,116	2.50%	553	6.31%	260,128	1,872	260,128	1.59%

5. ECONOMIC ASSESSMENT OF FLEXIBILITY OPTIONS

In this part of the study, four different flexibility options has been compared from cost perspective to the power sector of Ukraine. The assessed flexibility options include the following alternatives:

- RES Curtailment for Downward Ramping + Pro-Active RES Curtailment for Upward Ramping
- Gas Engines
- Battery Storage
- Pump Storage

2025, Baseline Scenario: 12.5GW RES, 1.2% Annual Demand Growth Interconnected Mode of Operation
Downward Ramping Deficit (RES Energy to be Curtailed, if that is the option): 196GWh, which is 1.02% of yearly RES generation (number of hours that system will be forced to RES restriction: 124 hours)
Upward Ramping Deficit (Energy Required from New Flexible Capacity): 26.3 GWh (in 53 hours)
Maximum Additional Maneuvering Capacity Required: 727 MW (capacity factor: 0.41% for upward ramping)

For the economic assessment, 2025 baseline scenario has been considered with 12.5GW RES (3000MW WPP and 9500 MW SPP) with 1.2% of annual demand increase and interconnected mode of operation. This scenario has resulted in need;

- Downward Ramping Deficit (RES Energy to be Curtailed, if that is the option): 196GWh, which is 1.02% of yearly RES generation (number of hours that system will be forced to RES restriction: 124 hours)
- Upward Ramping Deficit (Energy Required from New Flexible Capacity): 26.3 GWh (in 53 hours)
- Maximum Additional Maneuvering Capacity Required: 727 MW (capacity factor: 0.41% for upward ramping)

The economic assessment has been developed for three cost items, which include;

- CAPEX
- OPEX
- Cost of Energy Restrictions.

The following table presents the outcome of the economic assessment which include;

- Pre-requisites for Implementation
- Time Required for Implementation

- CAPEX Assumptions[11]
- CAPEX Amount
- OPEX Assumptions[12]
- Annual OPEX Amount
- Assumptions About Cost of Energy Restrictions
- Deemed Energy Cost of RES (Cost of RES Restrictions)

[11] Most up-to-date version of Lazard's key assumptions have been used for new construction and OPEX items of power storage, gas engines power plants and PSHPPs.
[12] Most up-to-date version of Lazard's key assumptions have been used for new construction and OPEX items of power storage, gas engines power plants and PSHPPs.

Cost Items	RES Curtailment for Downward Ramping + Pro-Active RES Curtailment for Upward Ramping	Gas Engines	Battery Storage	Pump Storage
Pre-requisites for Implementation	- RES Curtailment Management System (RES-CMS) - Short Term Load Forecast System (STLFS) -already available - Short Term RES Forecasting System (STRESFS) – already available at TSO and ESP project for the Guaranteed Buyer and TSO underway - Direct Integration of WPP & SPP Controllers to Dispatch Centre (for directly sending set points to PPs)	- Identification of best sites and capacities for optimal flexibility to be provided.	- Identification of best sites and capacities for optimal flexibility to be provided.	- Identification of best sites and capacities for optimal flexibility to be provided (Limited available sites (i.e., water availability required). - Incorporation of water usage constraint is key for best design schemes.
Time Required for Implementation	- 6 months for implementation of analytical forecasting and management systems. - 6 to 9 months for direct integration of RES PPs to Ukrenergo Dispatch Center (optional)	- 12 months of construction time	- 18 -24 months of construction time	- 3-5 years of construction time
CAPEX Assumptions	- Cost of Implementation of RES-CMS, STLFS and STRESFS: 10M USD - Cost of RES Connection to Control Center - Number of WPPs in 2025: 100 (in average 30 MW capacity) - Number of SPPs in 2025: 1250 (in average 7.5 MW capacity) - RTU panel with all SCADA engineering for each WPP: 100k USD - RTU panel with all SCADA engineering for each WPP: 20k USD	- Build Cost: 700$/kW - Installed Capacity of 727 MW	- Assumed that each unit will be 10MW/40MWh - Initial Capital Cost-AC: 70$/kW - Initial Capital Cost-DC: 228$/kWh - Total Installed Capacity of 727 MW/2908MWh	- Assumed that each unit will be 100MW/800MWh - Installed Capacity of 727MW/5,816MWh - Build Cost: 238$/kWh
CAPEX (Million USD)	**45.0**	**508.9**	**713.9**	**1384.2**
OPEX Assumptions	- Annual OPEX of Automation System: 10% of CAPEX - Annual OPEX of Analytical IT System: 10% of CAPEX	- Fixed O&M: 7$/kW-yr - Variable O&M: 4.7$/MWh - Heat Rate: 8000 Btu/kWh - Capacity Factor (for upward ramping): 0.41% - Fuel Price: 3$/MBtu	- O&M: 0.8$/kWh - Warranty Expenses in % of CAPEX: 3% - Loss of Energy due to Efficiency of Storage: 10% - Average MWh Energy price: 30$/MWh - For upward ramping deficit: 26.3GWh - For downward ramping deficit: 196GWh	- Fixed O&M: 1% of OPEX annual. - Variable O&M: 4$/MWh - Loss of Energy due to Efficiency of PSHPP: 20% - Average MWh Energy price: 30$/MWh - For upward ramping deficit: 26.3GWh - For downward ramping deficit: 196GWh
Fixed O&M (Annual, Million USD)	4.5	5.09	21.42	13.84
Variable O&M (Annual, Million USD)	-	0.12	0.18	0.89

Cost Items	RES Curtailment for Downward Ramping + Pro-Active RES Curtailment for Upward Ramping	Gas Engines	Battery Storage	Pump Storage
Fuel Cost (or Losses for Storage) (Annual, Million USD)	-	0.42	0.67	1.33
Annual OPEX (Million USD)	**4.5**	**5.6**	**22.26**	**16.1**
Assumptions About Cost of Energy Restrictions	- For downward ramping, the system will have 196GWh of deficit, that will be curtailed from RES generation. - For provision of upward ramping of 26.3 GWh (53 hours) required from RES via pro-active curtailment, we assume that despite the fact that analytical tools will be used, due to certain error margin of forecasting, more RES will be curtailed then the actual system requirement, which also have been incorporated in the cost calculation. Furthermore, additional incentives for RES power plants to support this upward ramping needs is also estimated. - Assumed unit price for curtailed RES generation: 57$/MWh (price in day-ahead market is assumed, since the cost difference between curtailing and not curtailing of RES can be compensated from DAM prices.) - Assumed unit price for upward regulation in balancing market: 62$/MWh	Assumed as zero.	Assumed as zero.	Assumed as zero.
Deemed Energy Cost of RES (Cost of RES Restrictions)	**12.8**	**0**	**0**	**0**
Total Cost (1st Year of Operation) (Million USD)	**62.3**	**514.5**	**736.2**	**1400.3**
Total Cost (5 years) (Million USD)	**131.5**	**537.0**	**825.2**	**1464.5**
Total Cost (20 years) (Million USD)	**391.1**	**621.5**	**1159.2**	**1705.5**

6. CONCLUSION AND DISCUSSIONS

6.1. CONCLUSION

Key conclusions and findings of the flexibility assessment are summarized as follows:

- RES penetration levels above 4,300MW installed capacity creates a ramping deficit in IPS of Ukraine with the existing load levels. At this level of RES capacity, our flexibility assessment model has resulted a deficit of in need of RES curtailment of 30GWh (35 hours)[13] in the last 12 months, till May 2020. This curtailment might have been prevented via an additional flexibility resource of 230MW (that would work with a 1.5% yearly capacity factor, if this gap would have been filled with new generation capacities)
- In order to have a decreased level of flexibility inadequacy in the system, our model has resulted with a 5-15% (depends on RES penetration levels) reduction of nuclear generation in 2021. (For baseline scenario, 5% nuclear generation reduction has been required. For higher level of RES penetration levels, higher reduction in the must-run power plants' generation is implemented in 2025).
- Considering the interconnections with neighbor countries as a flexibility resource is an important contributor to reduce the flexibility inadequacy of the system[14]
- Necessity for RES Curtailment and new flexibility resources are inevitable for all scenarios that has been studied for 2021 and 2025.
- For all scenarios in 2021 and 2025; in case the required additional flexibility resource (Upward Ramping Deficit) is met with construction of new power plants, their capacity factor within the year will be lower than 2-3%.
- For the Baseline Scenario of 2021 (8,826MW RES installed capacity, 0.5% load growth),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 149GWh, which is 1.03% of yearly RES generation (number of hours that system will be forced to RES restriction: 104 hours)
    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 10.5 GWh (in 10 hours)
    - Maximum Additional Maneuvering Capacity Required: 491 MW (capacity factor: 0.25% for upward ramping requirements)
- For the Baseline Scenario-1 of 2025 (8,826MW RES installed capacity, 1.2% annual load growth, interconnected mode of operation),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 196GWh, which is 1.02% of yearly RES generation (number of hours that system will be forced to RES restriction: 124 hours)

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[13] RES curtailment requirement that our model has resulted has been compared with Ukrenergo's announced RES curtailment levels. As declared in Ukrenergo's weekly operational reports of past 12 months, curtailed RES energy was around 23GWh (totally 23 hours in different months) in last 12 months. Comparison of these figures is used for validation of the developed model.

[14] Cross-border energy exchanges per hour have been restrained to figures between +400MW and -100MW (Per histogram analysis, 80% of all hours) for each hours of future years. (In isolated mode of operation scenarios, cross-border exchanges have been assumed to be zero for all hours)

    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 26.3 GWh (in 53 hours)
    - Maximum Additional Maneuvering Capacity Required: 727 MW (capacity factor: 0.41% for upward ramping requirements)
- For the Baseline Scenario-2 of 2025 (8,826MW RES installed capacity, 1.2% annual load growth, isolated mode of operation),
    - Downward Ramping Deficit (RES Energy to be Curtailed): 380 GWh, which is 1.98% of yearly RES generation (number of hours that system will be forced to RES restriction: 250 hours)
    - Upward Ramping Deficit (Energy Required from New Flexible Capacity): 95.7 GWh (in 198 hours)
    - Maximum Additional Maneuvering Capacity Required: 1351 MW (capacity factor: 0.81% for upward ramping requirements)
- In comparison with Ukrenergo's Generation Adequacy study results that state that;
    - in 2021, 2000 MW of highly maneuverable thermal power plants and 2000 MW of Power Storage capacity,
    - and in 2025, 2000 MW of highly maneuverable thermal power plants and 2550 MW of Power Storage capacity

  will be required; our results in baseline and interconnected mode of operations showed that,

    - in 2021, the maximum upward ramping deficit might be experienced for just 10 hours within the year and the maximum capacity of this deficit is 491MW,
    - and in 2025, the maximum upward ramping deficit might be experienced for 53 hours within the year and the maximum capacity of this deficit is 727MW,
- For selection of flexibility resources required, there are variety of options including,
    - RES curtailment for downward ramping requirements and pro-active RES curtailment for upward ramping,
    - power storage,
    - internal combustion engines,
    - additions of new pump storage hydro power plants,
    - demand response,
    - and modernization of existing thermal power plants to provide more available and flexible capacities

    The decision should be made on economic studies in terms of cost/benefit ratios and the time required for implementation. Per our calculations, if the flexibility deficit is met with construction of new power plants, the capacity factors of these new plants will be lower than 1% in 2021 and lower than ~3% in 2025.

- As the basic economic assessment of the costs of the four flexibility options (RES curtailment for downward ramping requirements and pro-active RES curtailment for upward ramping, power storage, internal combustion engines, additions of new pump storage hydro power plants) show that the most feasible options is considering RES curtailment as a source flexibility is the economically most viable option for 2025 of Ukraine PS. Our study concludes that implementing RES curtailment during infrequent extreme ramping rate events can potentially be a least cost option as compared to investment in low capacity factor generation flexibility. Accurate short-term load, generation and weather forecasting and curtailment automation are however required for effective implementation of this option (which are also considered as costs items in the basic economic assessment of this study).

- Existing installed capacities of WPPs and SPPs indicate that solar generation investment tend to be higher in Ukraine. Wind/solar ratio in RES generation mix is an important factor for the flexibility adequacy of the power system. In this context, scenarios with same installed capacity of wind and solar are less likely to occur. We estimate that solar/wind ratio will be around 3 (solar generation installed capacity will be 3 times of wind installed capacity)
- As higher wind ratio in wind/solar mix brings in more challenges to adequate ramp adjustments in comparison with solar; wind power plants should be more carefully assessed.

6.2. PRO-ACTIVE RES CURTAILMENT FOR UPWARD RAMPING

Renewable generation from wind and solar power plants are expected to play an important role in the future of Ukraine Power System. On the other hand, varying outputs of WPPs and SPPs bring in additional challenges to the system operator (Ukrenergo) to meet the flexibility requirements of the network.

If IPS of Ukraine does not have enough operational flexibility— particularly upward ramping capability—this might result in security and reliability deficits such as need for load shedding. Overgeneration, generally is experienced when the production of must-run unit, including RES, nuclear generation, minimum hydro, and CHPP generation, is larger than the system load plus the system's capability to export.

While investment in power system flexibility solutions such as flexible gas generation or energy storage could help mitigate overgeneration, eliminating all overgeneration may not be cost-effective. As the share of wind and PV generation increases, so does the need to invest in generation flexibility. However, if the grid becomes over-invested in generation flexibility, some capacity will only be needed for a few hours annually, which is not cost efficient.

In this context, we, in this study, suggest that RES curtailment as a flexibility source, to eliminate both downward and upward ramping deficits, should be considered as a least cost option as compared to investment in low capacity factor generation flexibility.

RES curtailment has been used by TSOs in various countries during the periods when there were network constraints, security constraints and excess generation relative to the system load. RES curtailment can form part of normal system operation during long-term capacity expansion modelling as a method to reduce the number of future units required for generation flexibility (especially from a ramping rate perspective).

Managed curtailment of renewable energy generation may be needed to avoid curtailment of system load due to lack of power system flexibility, for example, by helping to meet sharp upward or downward ramps or making room for additional operating reserves. RES curtailment enables RES to provide ramping services, allowing dispatchable resources to continue to operate at their minimum generating levels rather than shutting down and better positioning the system to meet upward ramps.

The loss from curtailing generation based on renewable energy sources is generally seen as an unacceptable solution by the public. The main argument is that it is a loss of green energy and an economic loss to curtail generation with near zero marginal costs. However, this approach could lead to overinvestment in grid infrastructure or new flexible capacities and underinvestment in renewable energy sources.

Dynamic/Pro-Active RES curtailment can provide a least cost flexibility option when compared to traditional generators operating at low capacity factors. However, while the idea of curtailment is conceptually easy, the implementation has several operational challenges that need to be considered.

Operational Considerations:

Currently, the system operation focuses on continuously matching supply with varying demand as economically as possible, while maintaining acceptable system reliability. This is achieved by a sequence of temporally separated control actions (both centralized and decentralized), based on the natural temporal decomposition of the load demand.

To enable the pro-active RES curtailment for upward ramping, TSO must be prepared to curtail renewable energy output at any time in order to prevent potential upward ramping shortages. This finding may be intuitive; however, it is not clear that most TSOs are prepared for widespread use of RES curtailment for this purpose.

Operators should develop a formalized process for determining RES curtailment, which might consist of the following steps:

- Continually monitor actual and forecast RES generation and develop confidence intervals around renewable energy forecasts over several hours in order to ensure that unit commitment decisions are made with the best available RES forecast data.
- Continually monitor available upward ramping capability, whether from hydro resources (HPP, PSHPP) and thermal resources (TPPs)
- Develop and implement rules for when to dispatch prospective curtailment of RES output. These rules would likely entail comparing forecast RES generation, along with confidence bands, over various timesteps (1 hour, 4 hours, etc.) with available upward ramping capability. If the expected upward ramping need caused by RES output fluctuations exceeds the upward capability subject to a given confidence interval (e.g., 99%), the rule would call for RES curtailment to avoid a forecasted potential upward ramping shortfall.

These operational procedures should definitely be supported by implementation of central analytical tools and advanced automation in RES sites:

- Short-Term Weather Forecast System,
- Short-Term Load Forecast System,
- Short-Term RES Forecast System
- Direct Integration of Wind and Solar Power Plant Controllers to Ukrenergo Dispatch Center (for directly sending set points to PPs)

Other Technical Challenges

- Measuring Restricted Generation: While it is conceptually simple to issue dispatch instructions to RES to operate at or below a given set point on an emergency basis, additional information is required in order to provide accurate compensation. TSO could calculate the lost production using real-time data on insolation, wind speed, and air density, along with technology-specific power curves. This method is data-intensive but is required to eliminate any potential conflicts with RES owners.
- System Modelling: Assessing the economic tradeoff between RES curtailment and investment in power system flexibility will require the development and deployment of new modeling techniques. Conventional generation reliability modeling has evaluated the likelihood that load would exceed available generation capacity.

In summary, we think that RES curtailment may serve as a “default” or “backstop” grid flexibility solution against which to measure the cost-effectiveness of investments in power system flexibility. Investment in power system flexibility is indicated when the benefits from investment, in the form of reduced curtailment, outweigh the costs of new flexible power plant investments. Very accurate short-term forecasting and data-intensive curtailment automation are however required for effective implementation of this flexibility option.

6.3. LIMITATIONS OF THE STUDY

The following facts should be considered to understand the limitations of the results:

- The study has not been built on a well-developed demand forecast and a least-cost generation planning:
    - As the assumptions for the future demand are based on the existing per-unit load profile, change in the load characteristics are not considered.
    - Load growth introduced is the result of basic assumptions (0.0%, 0.5%, 1.0% and 1,2% annual load growth, for all hours of the calculation year)
    - A long-term least-cost generation has not been developed for this study
- The study has been performed in hourly time resolution. 5 to 15 min assessment could give more accurate results:
    - Especially for wind power plants, better time resolutions (if measurements are available) should be incorporated to better capture ramping requirements.
- Decreasing RES ramps with the geo-spatial diversification of new WPP and SPPs have been ignored in the study.
    - Existing per-unit profiles have been used for RES generation.
    - It should be noted that existing data (per-unit profile) lacks measurement of RES power plants in distribution level and even some of the RES in transmission level.
    - As geo-spatial diversification of the RES may increase, the ramp requirements may be decreased. Individual ramps occur in different times of the day, resulting in less fluctuation in the overall system flexibility balance.
- Potential new capacity investments for conventional generation have been ignored.
    - New investments for the power plants with conventional resources (hydro, thermal, CHPP, NPP) would affect the system flexibility balance. (Only new capacity investments for PSHPP have been considered for 2025 studies)
- NPP maintenance plans for next years have been ignored.
    - The hourly generation profile for NPPs have assumed to remain unchanged. Maintenance/outage plans for the NPP units may affect the residual load related calculations.
- Degradation of old generation equipment has been ignored and assumed to work in the given regime and performance for 2021and 2025.
    - Power plant units are assumed to sustain their existing performance characteristics in terms of ramping in the following years.

6.4. OTHER OBSERVATIONS

- **RES Forecasting:**
    - As observed in the data provided by Ukrenergo that shows the difference between the forecasted wind/solar hourly generation and realization; there is not a reliable forecasting process for RES. The difference between forecast values and realization are dramatically high. This may impact a proper daily planning for the dispatchable generation.

- It should be noted that, forecast accuracy has major impact on grid integration of renewable energy sources. The effectiveness of RES integration and the control reserves necessary for accommodating stochastic generation profiles is a function of RES forecast accuracy.
- Also, a lack of RES curtailment management system is noted for Ukrenergo's operation, for which there is on-going work within the TSO to initiate the system.

- **Hourly Telemetry:** The following are the observations about remote measurement of load and generation:
  - Wind and solar power plants that are connected to distribution level are not remotely monitored for their hourly measurements.
  - There are problems with the hourly measurements of some of the RES power plants that are connected to the transmission network as well.
  - The hourly load data is not the result of measurement, rather it is the difference between the measured generation and the cross-border exchanges. This creates a gap between the real load and estimated load.
  - Increasing situational awareness with implementation of telemetry in the substations of Ukrenergo (and other load substations) will help better RES forecasting and proper management of flexibility in the system.

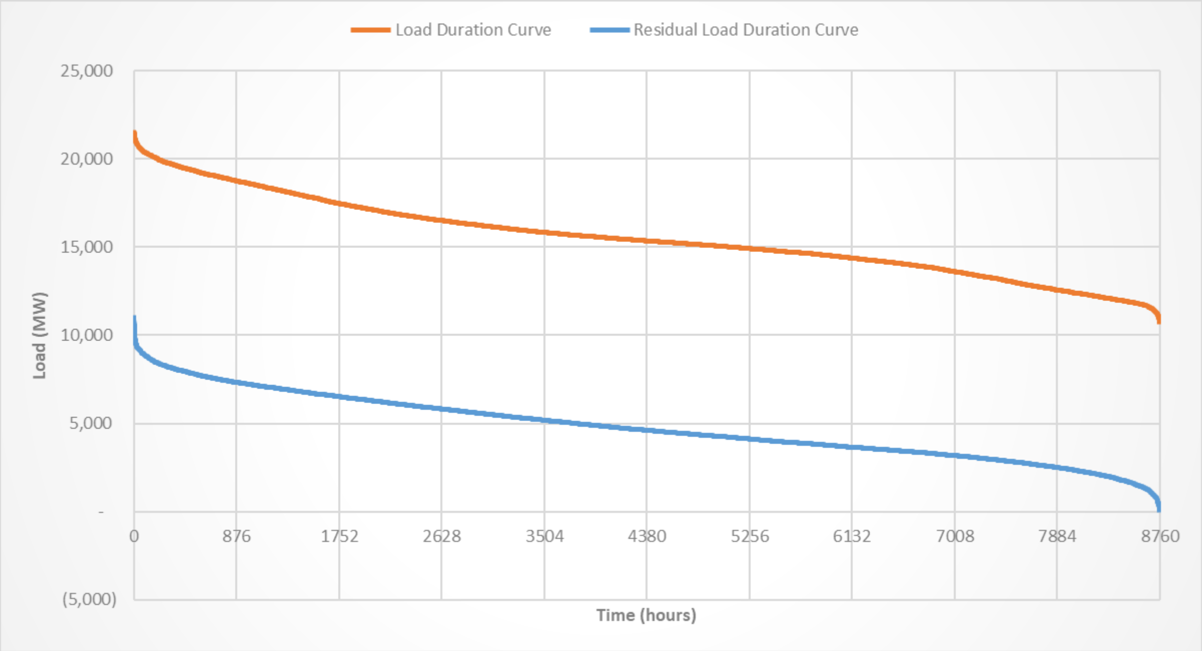
7. APPENDIX – ILLUSTRATIONS FOR ANALYSES RESULTS

In this part, the following illustrations are presented for all scenarios.

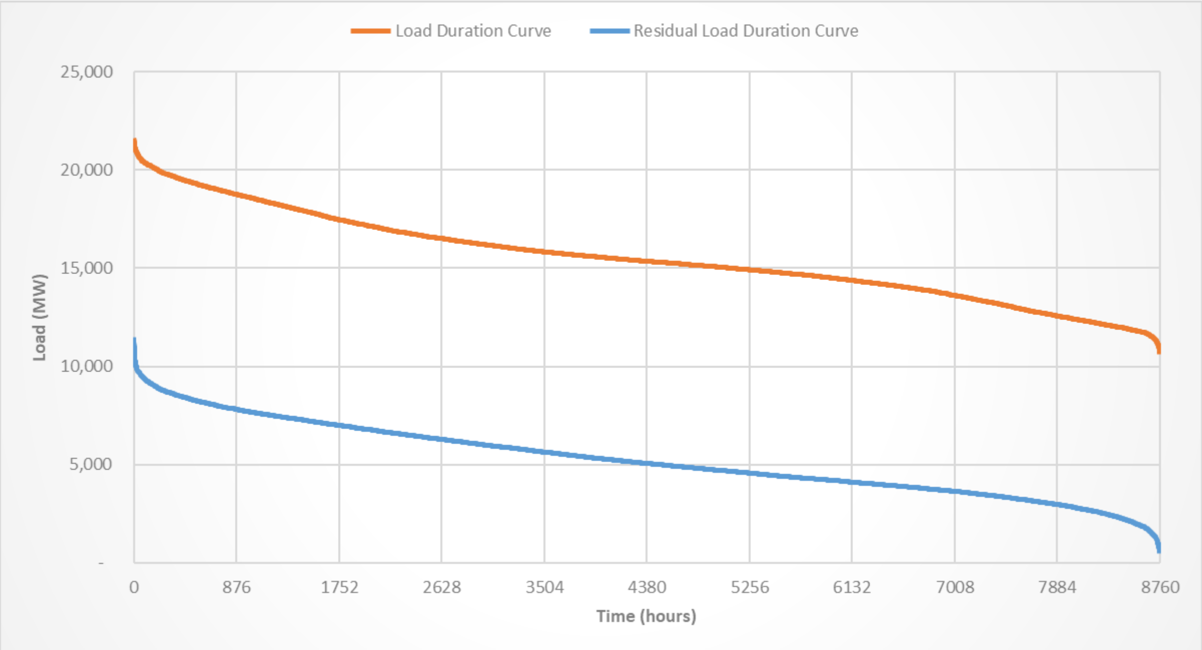
- Load and Residual Load Duration Curves
- Probabilistic Distribution of (1-RL%) in % of Load
- Probabilistic Distribution of RES Ramp Ratio in % of Load
- Chromatic Illustration of RL in % of Load
- Daily Profiles - As-Is and Selected Scenarios for 2021 and 2025

7.1. DETAILED RESULTS OF LOAD AND RESIDUAL LOAD DURATION CURVES

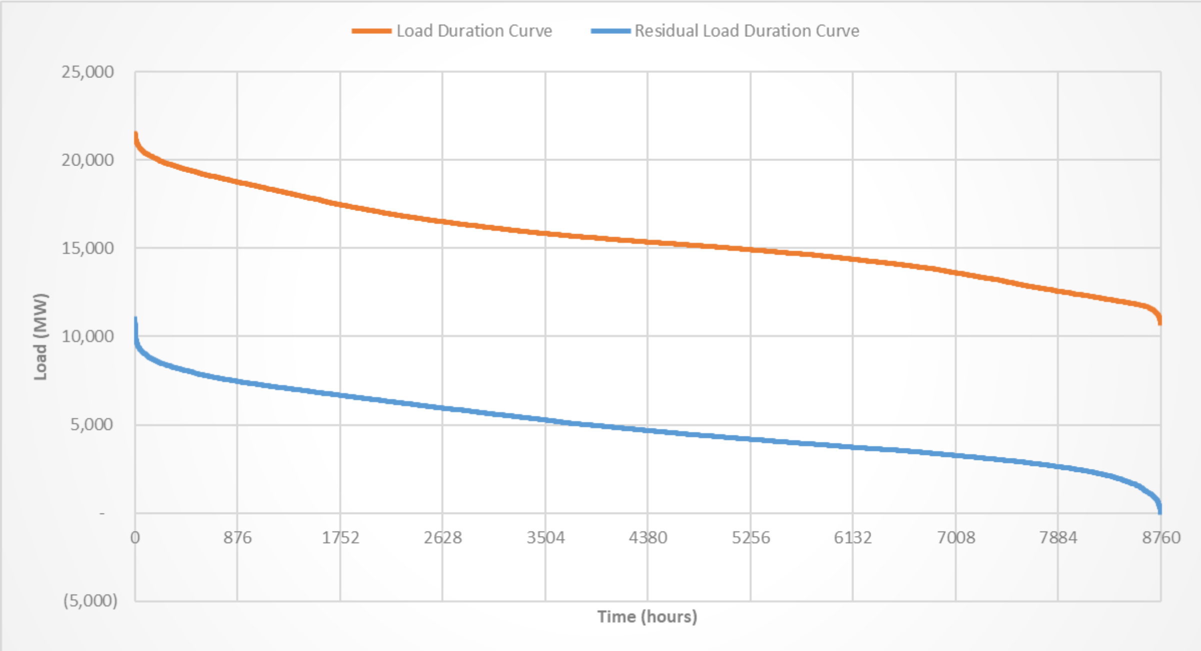
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



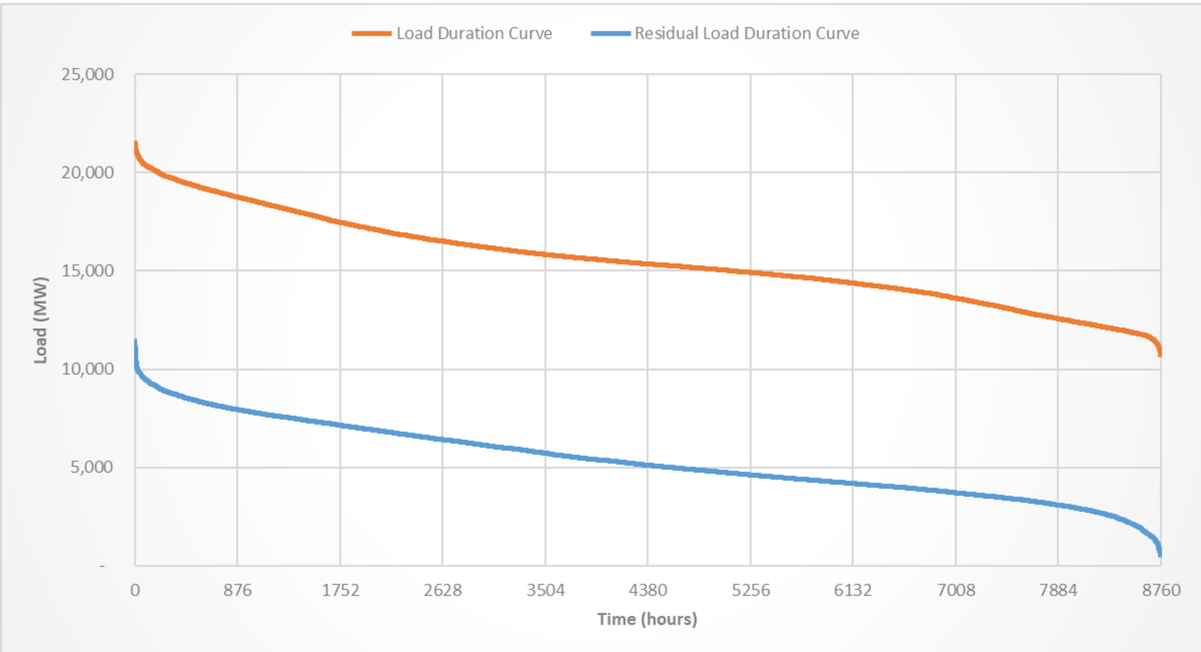
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=15% Reduction Interconnected



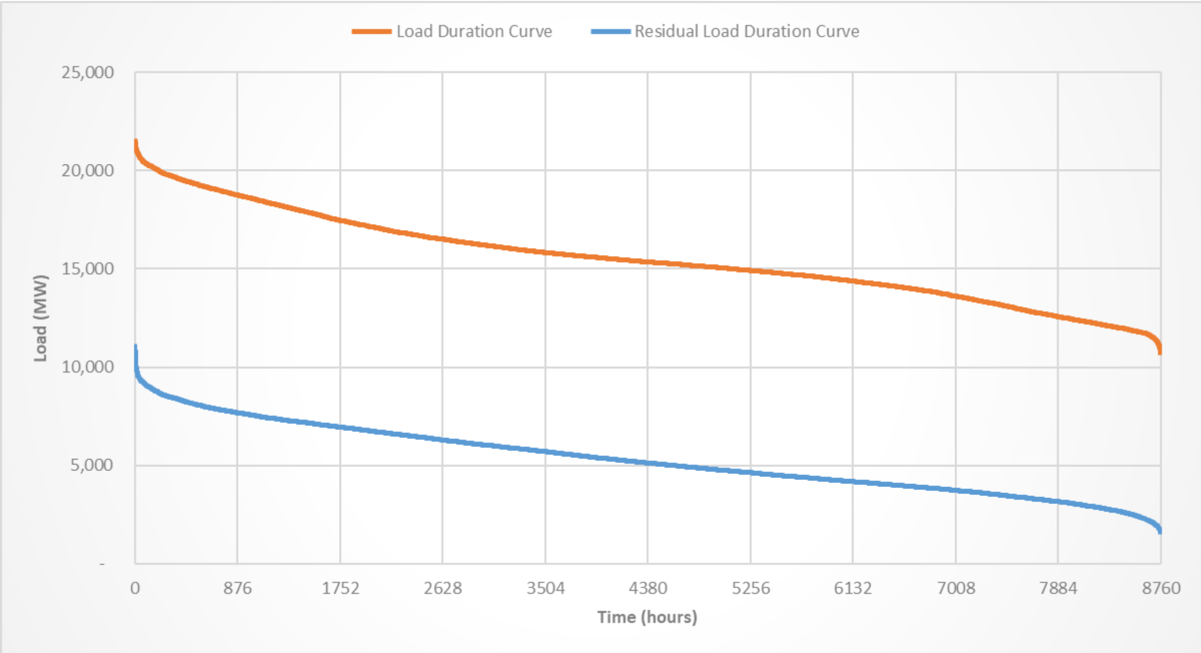
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



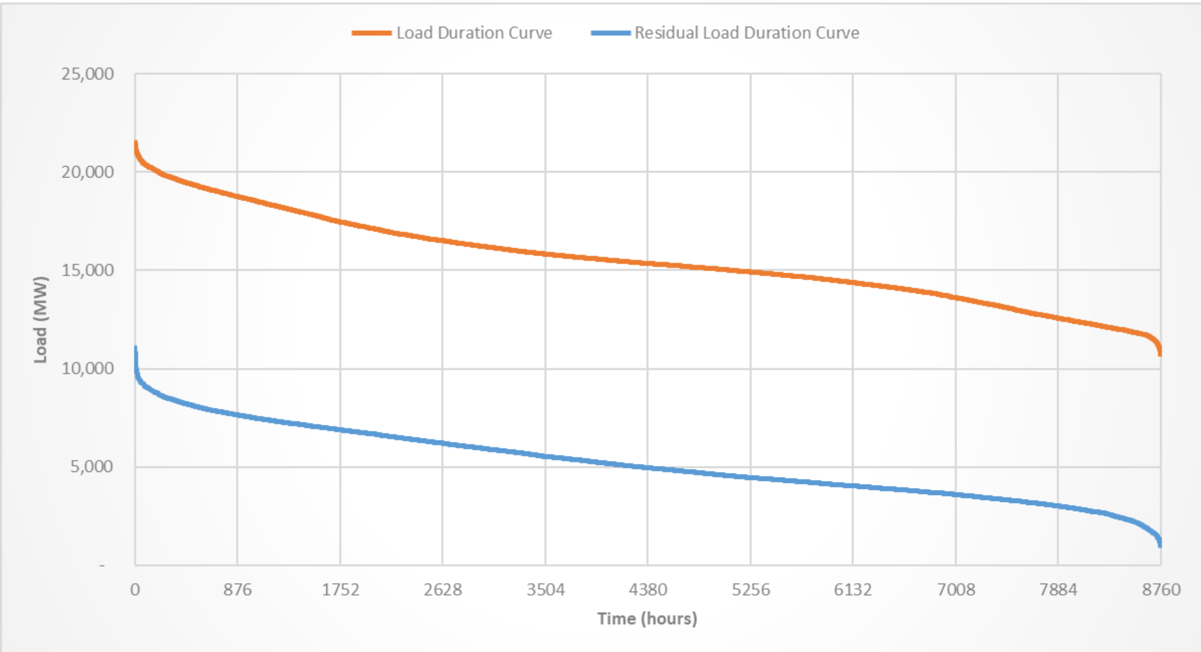
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=15% Reduction Interconnected



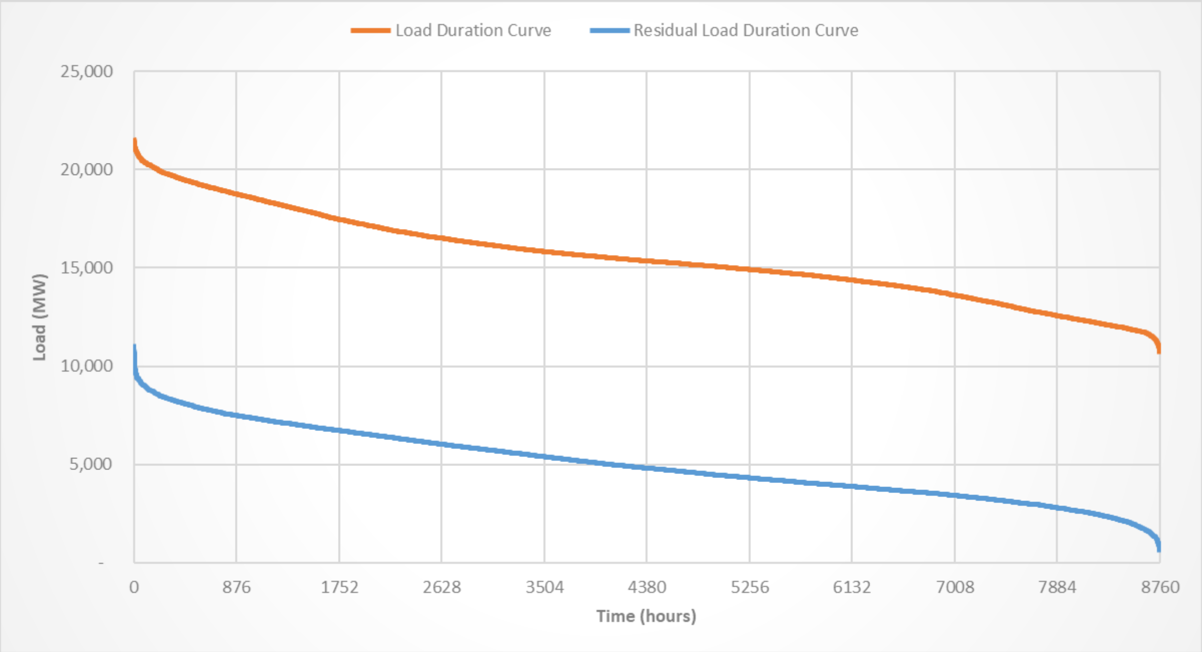
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=5,000MW Interconnected



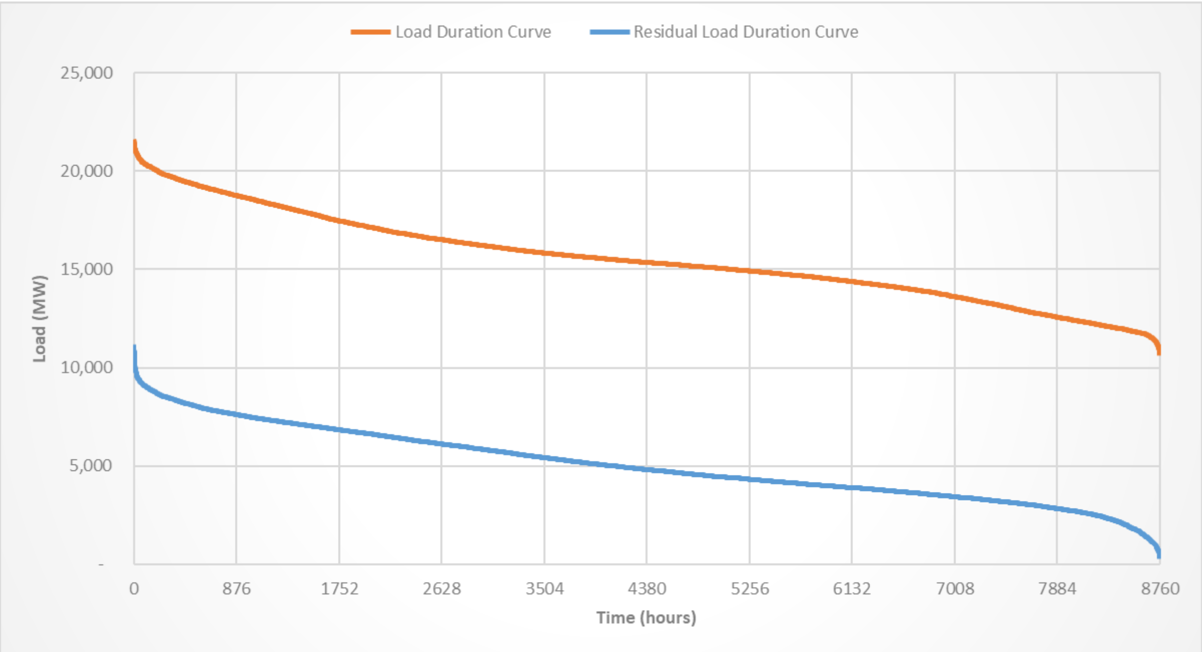
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=6,000MW Interconnected



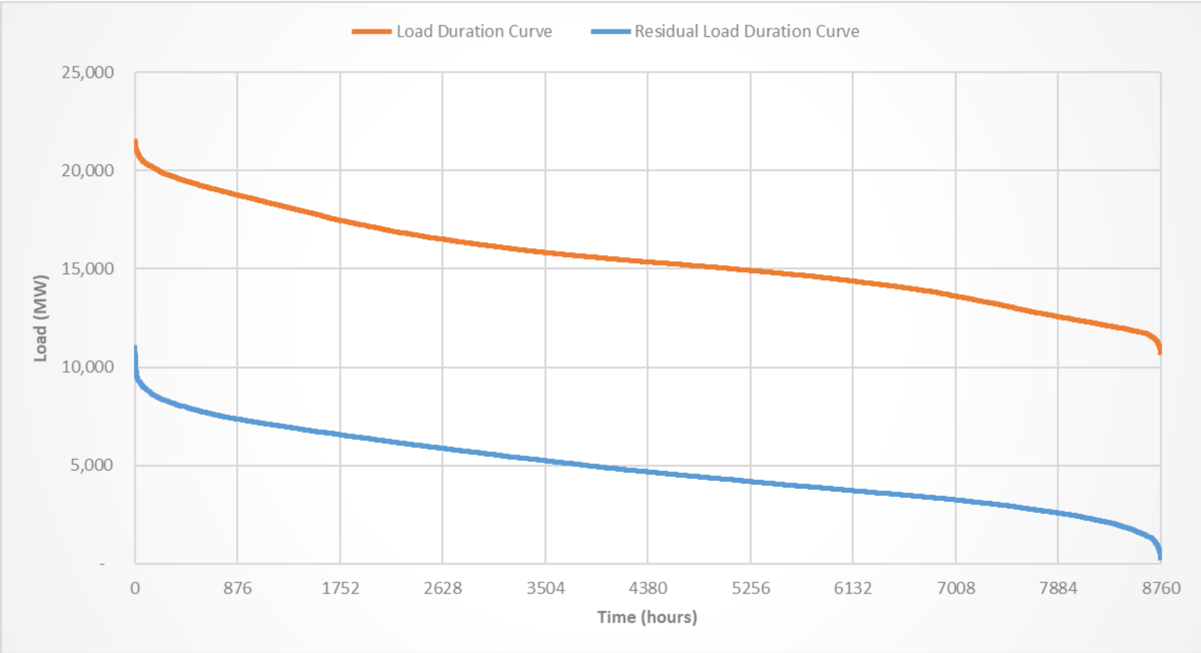
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=6,000MW Interconnected



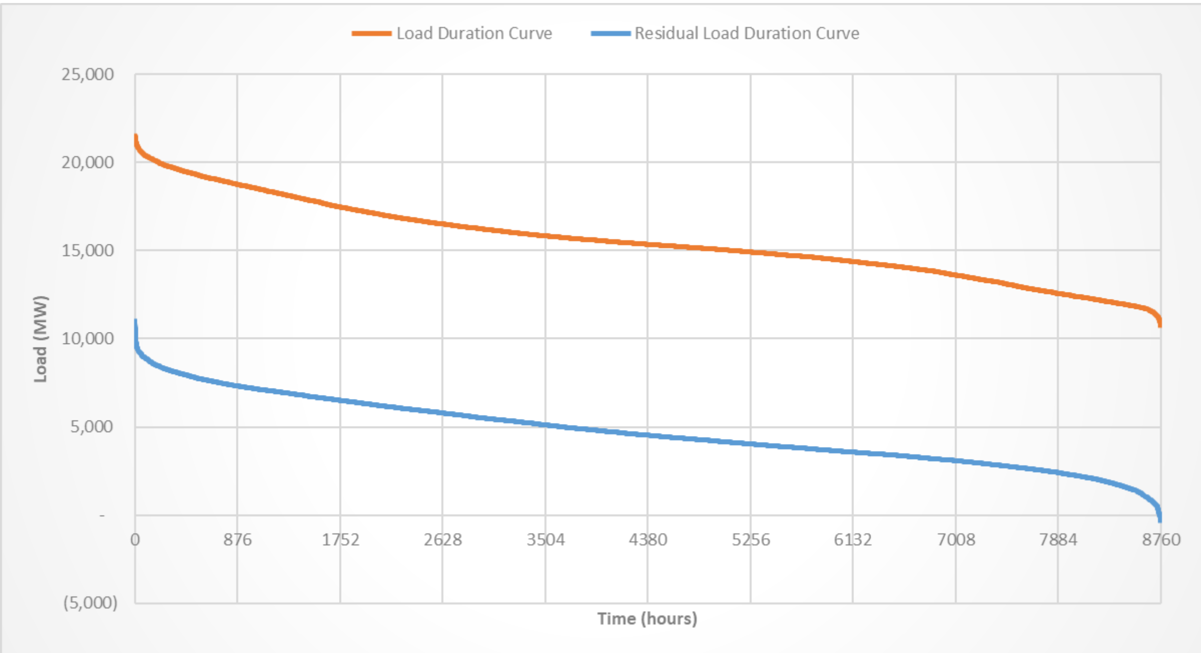
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=7,000MW Interconnected



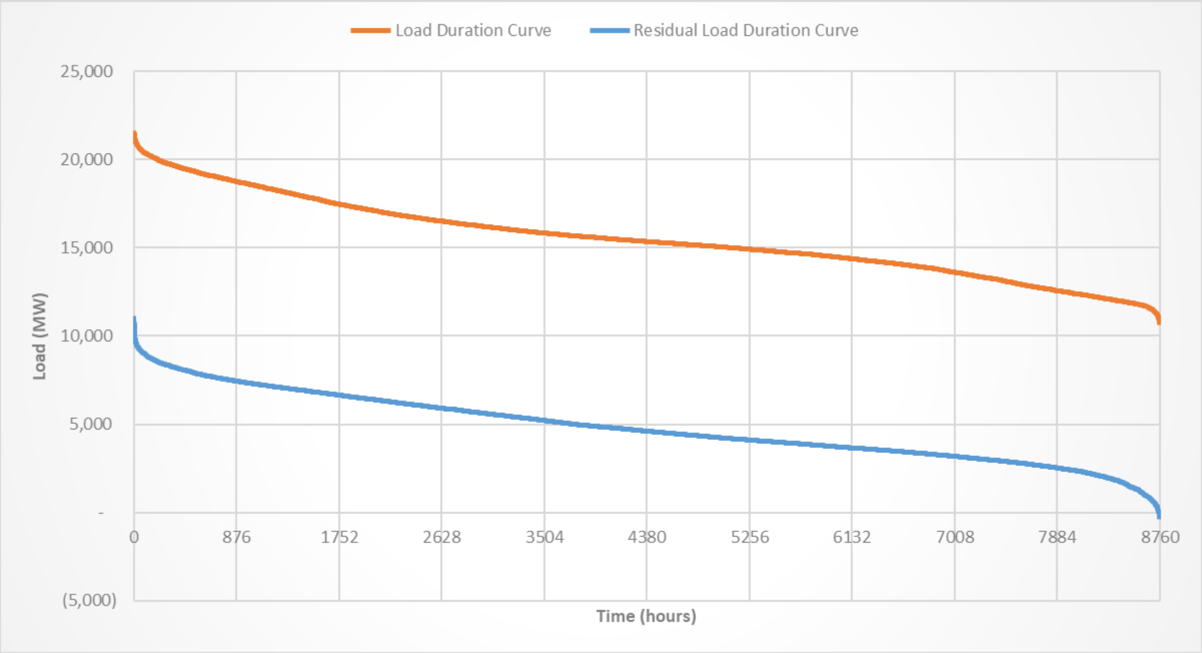
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=6,000MW Interconnected



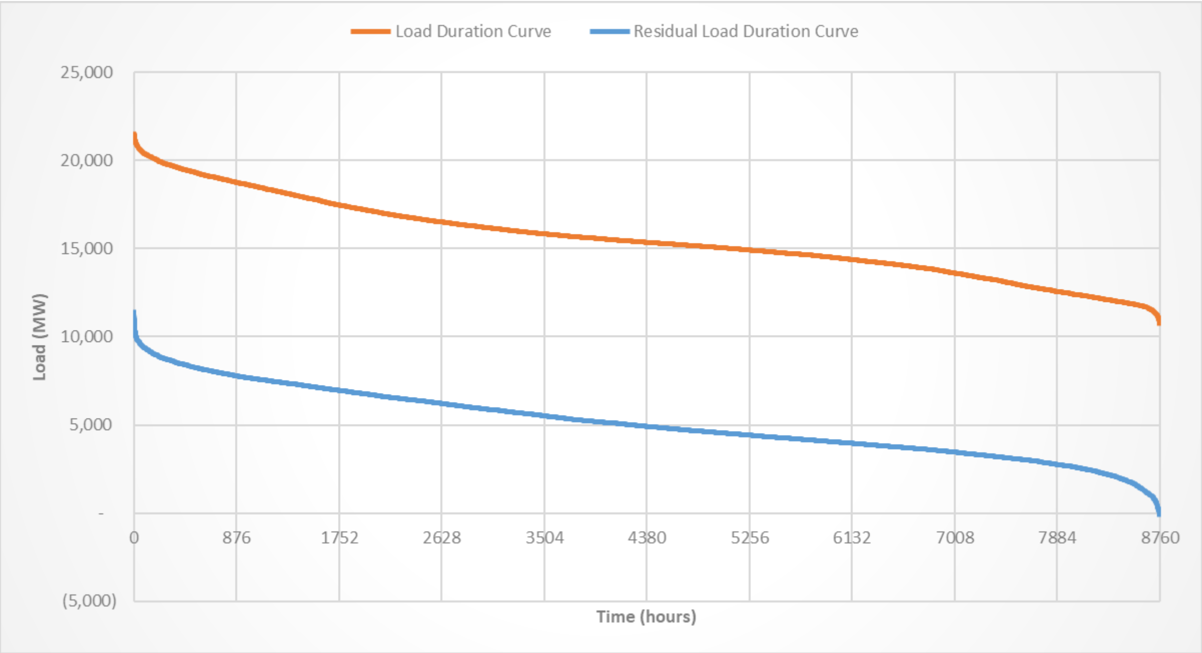
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,000MW Interconnected



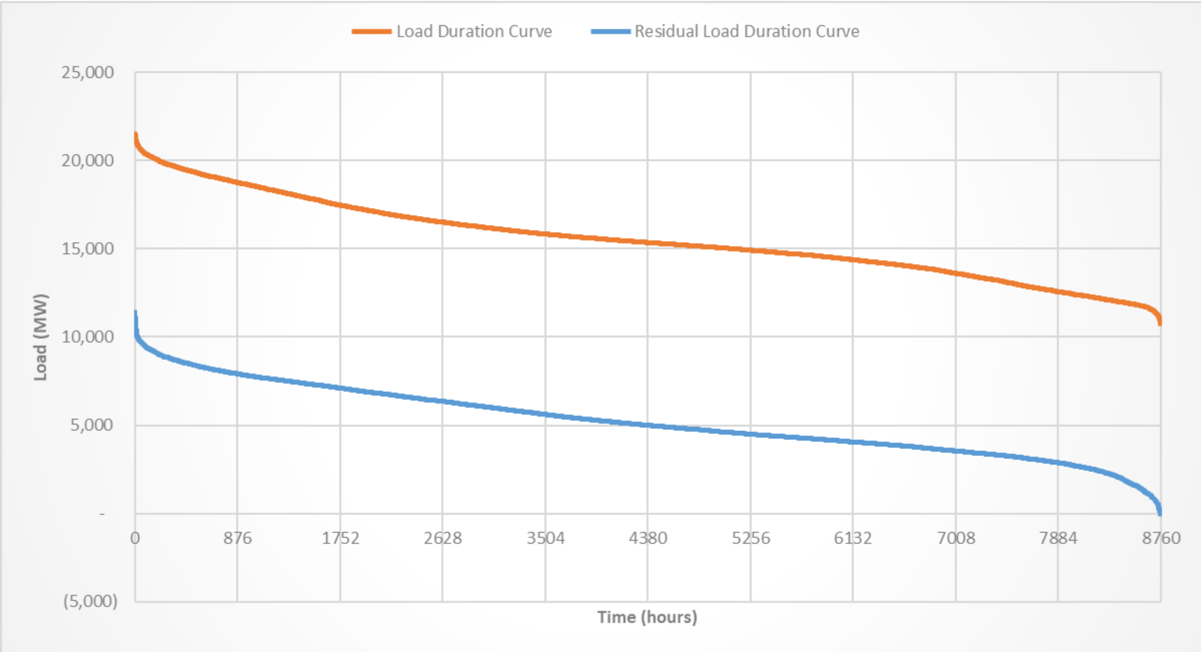
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,500MW Interconnected



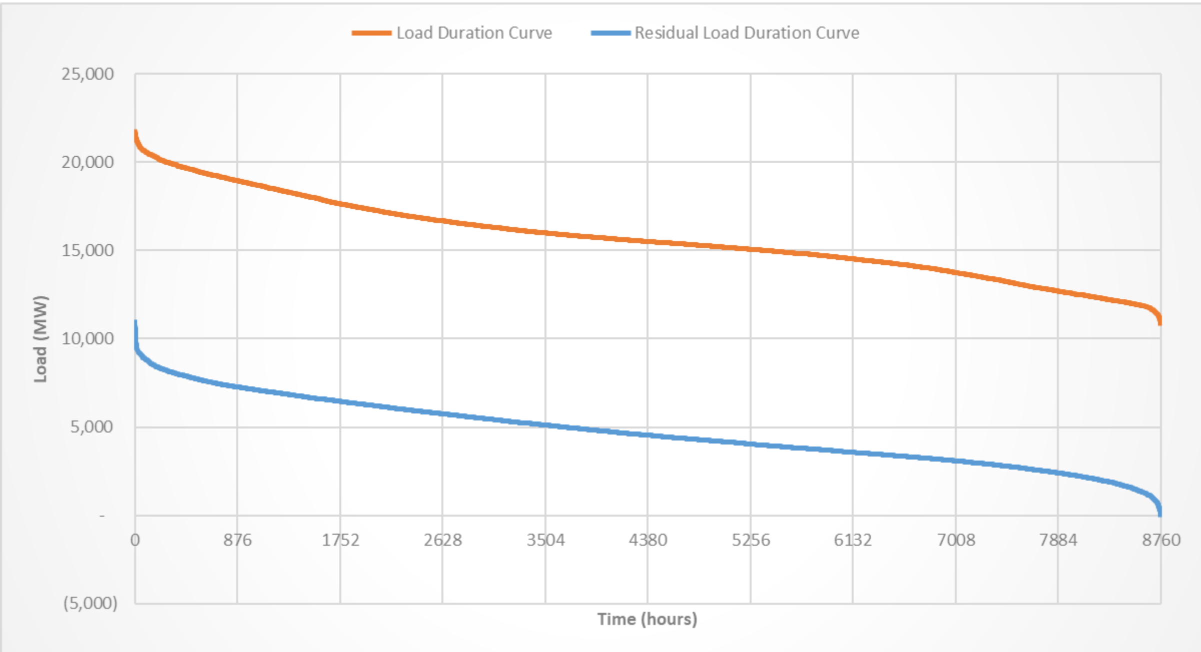
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,500MW Interconnected



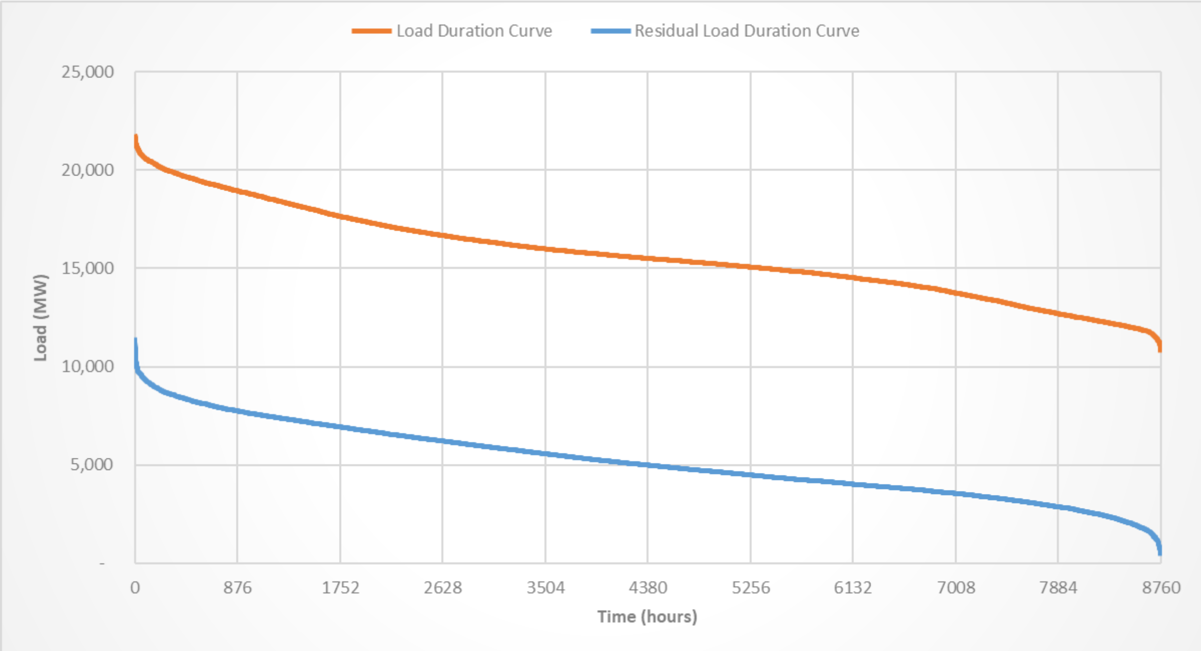
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=8,000MW Interconnected



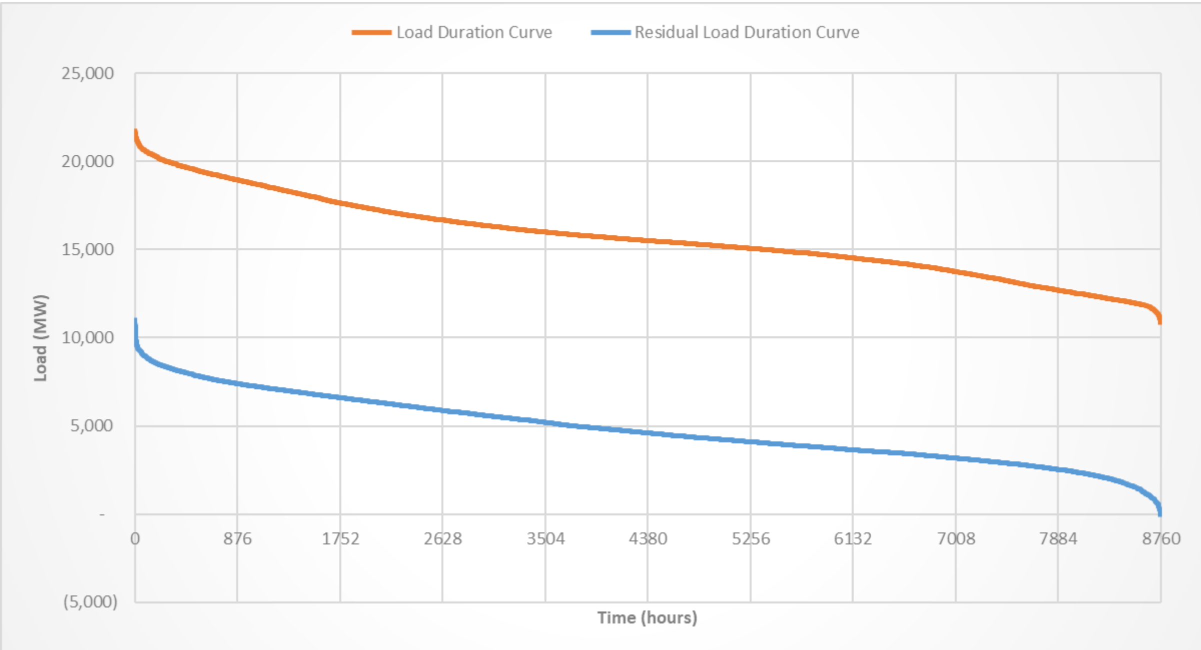
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=7.5% Reduction Interconnected



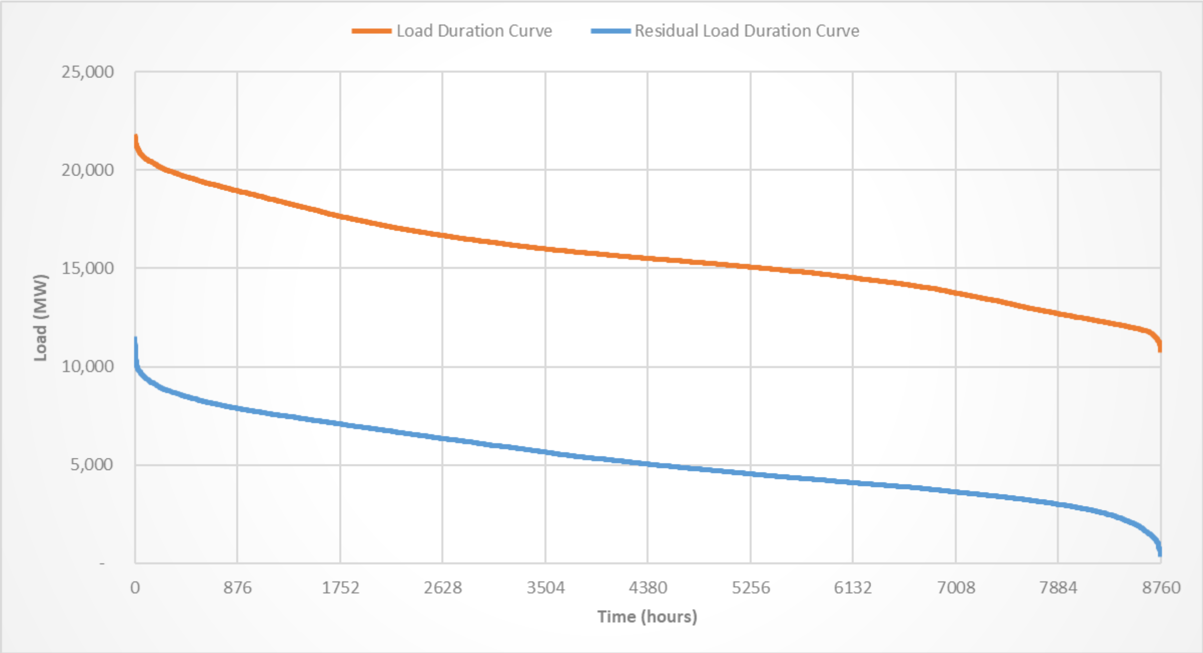
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=12.5% Reduction Interconnected



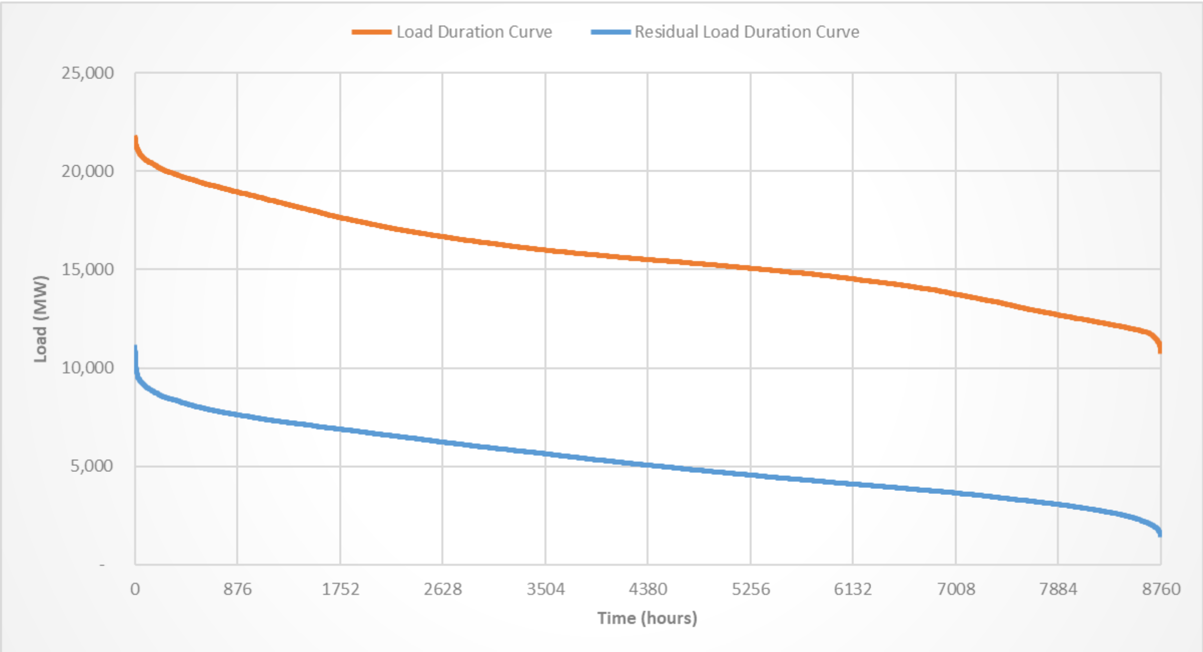
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=7.5% Reduction Interconnected



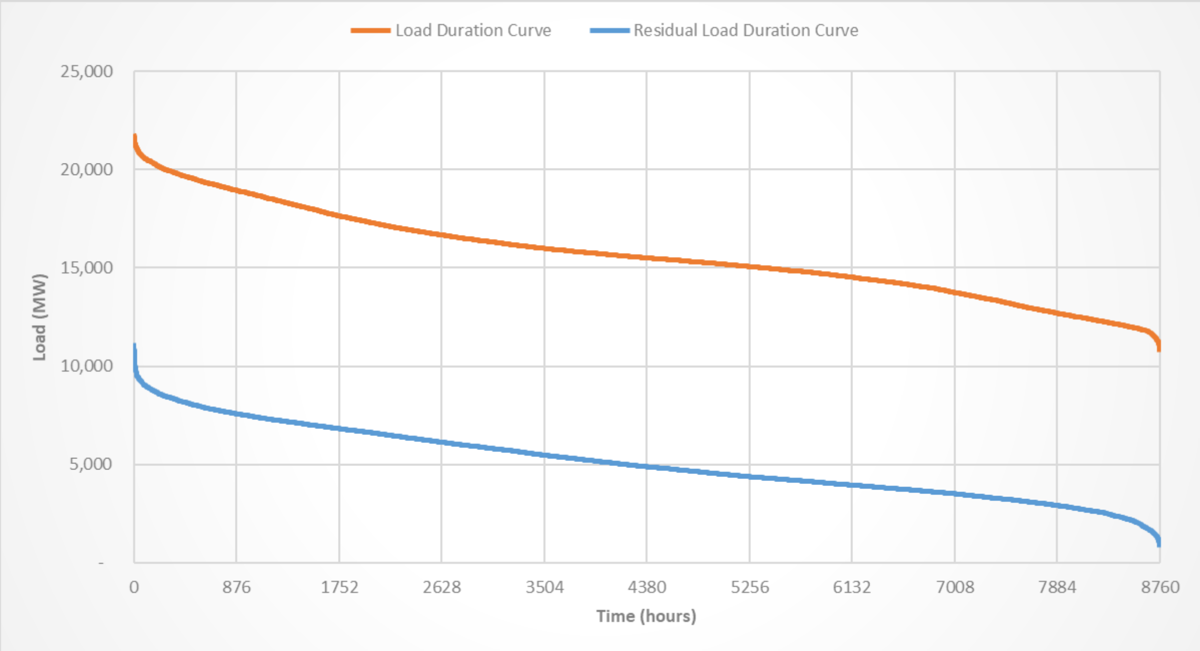
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=12.5% Reduction Interconnected



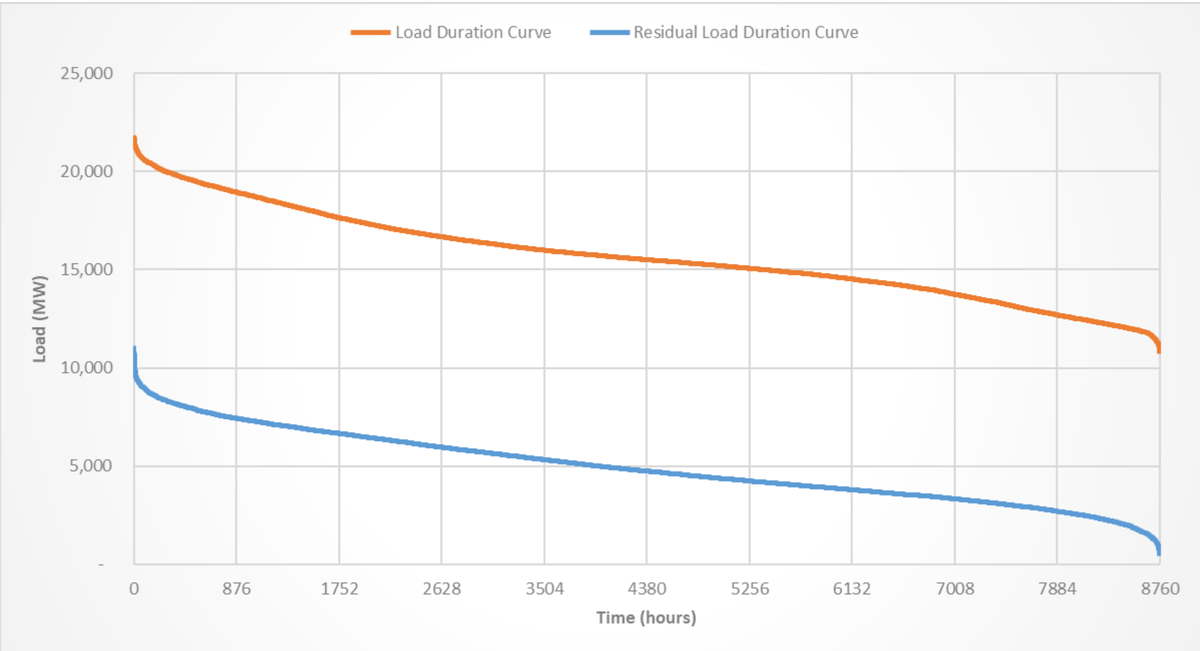
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=5,000MW Interconnected



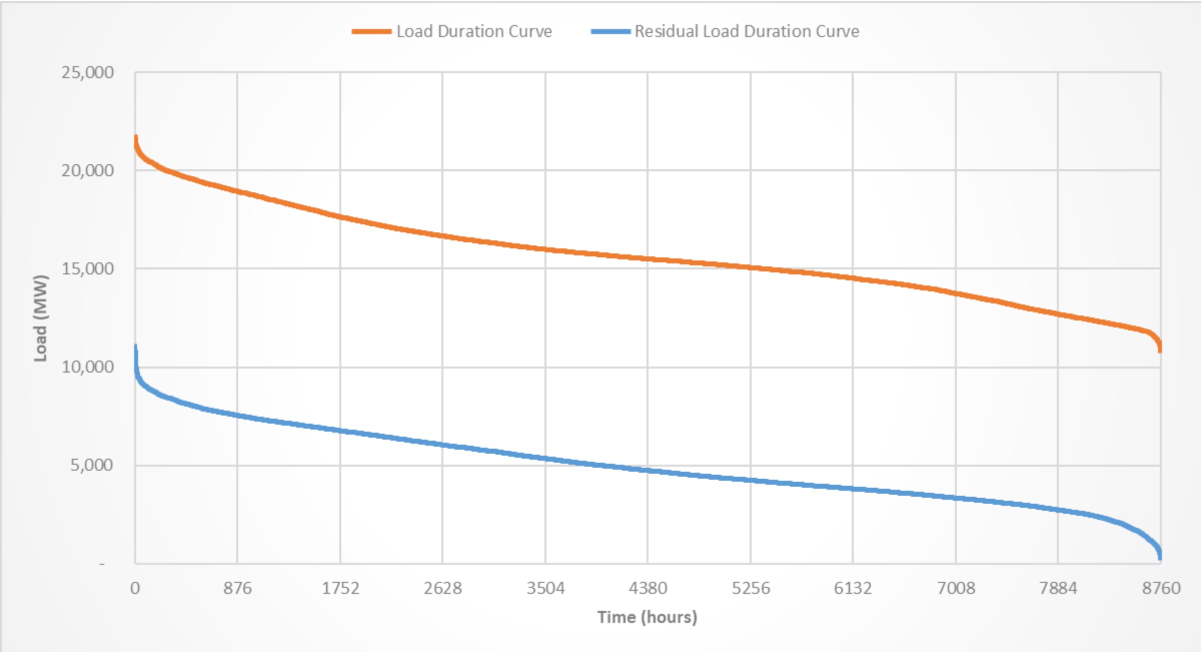
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=6,000MW Interconnected



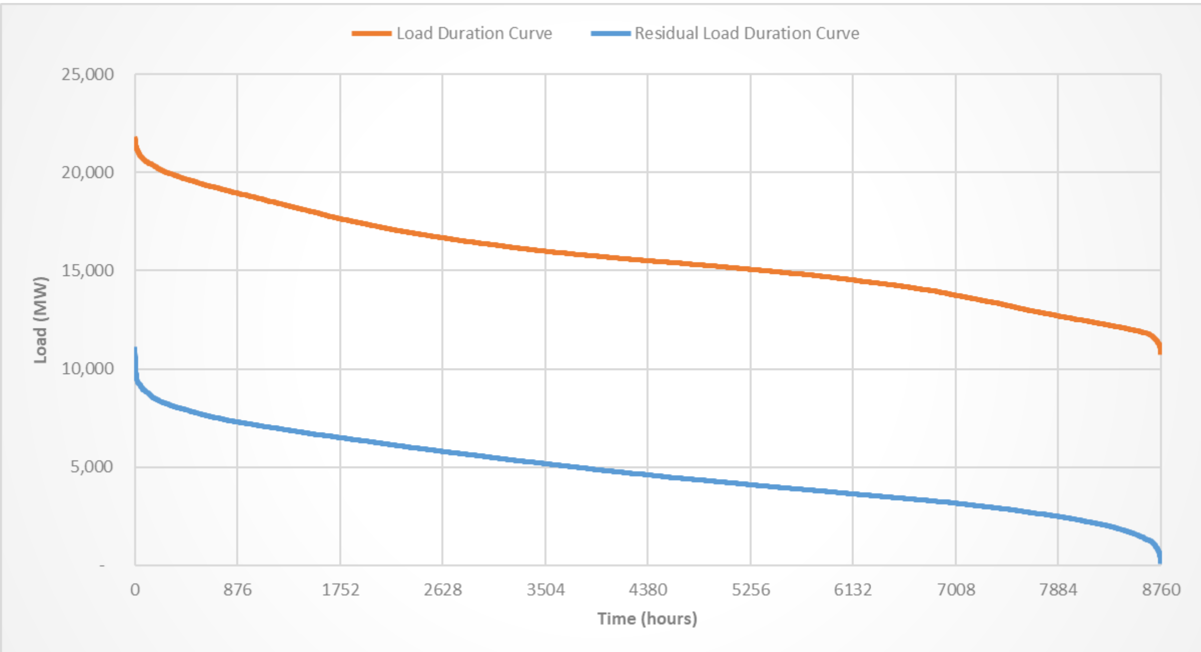
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=6,000MW Interconnected



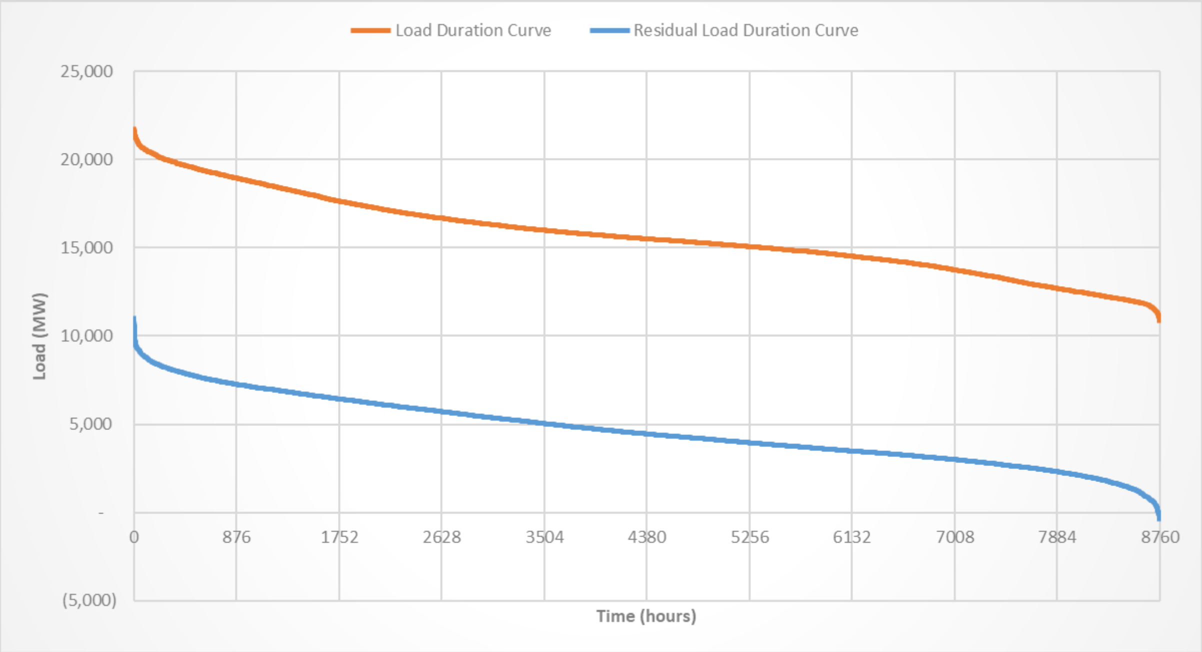
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=7,000MW Interconnected



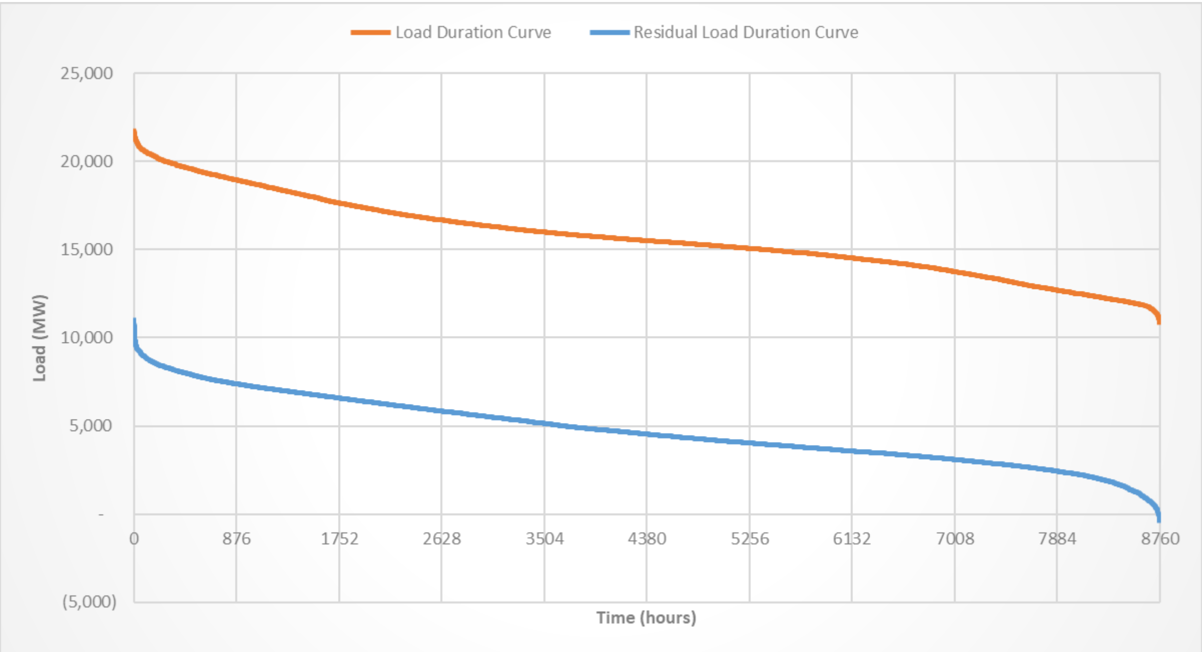
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=6,000MW Interconnected



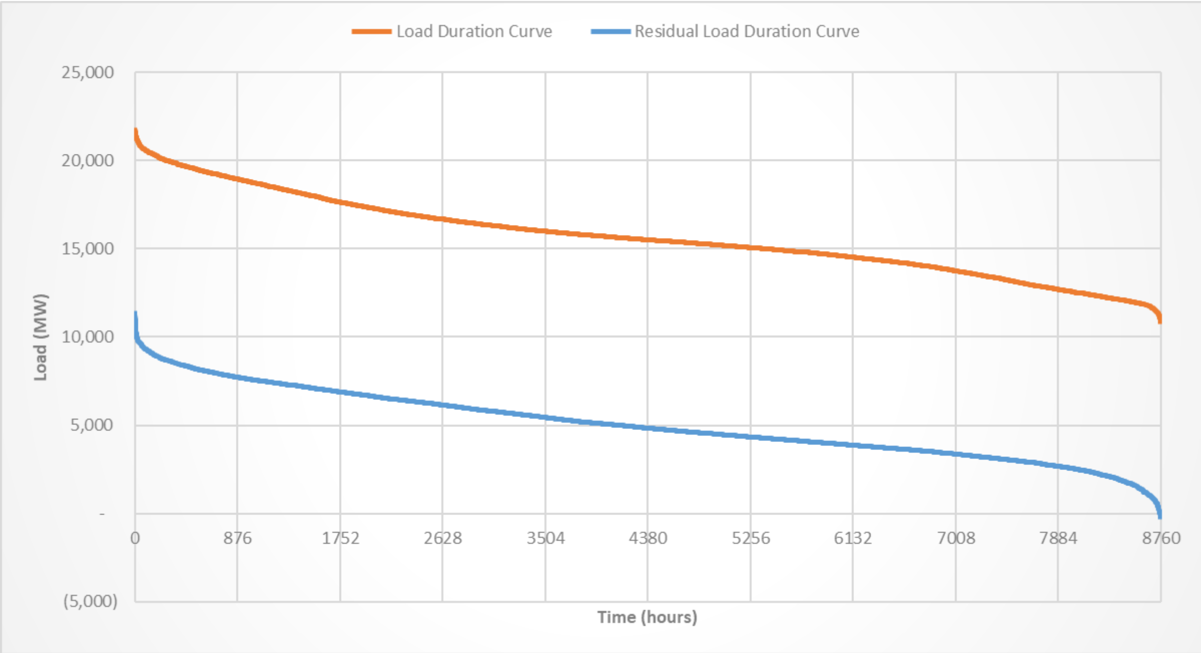
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,000MW Interconnected



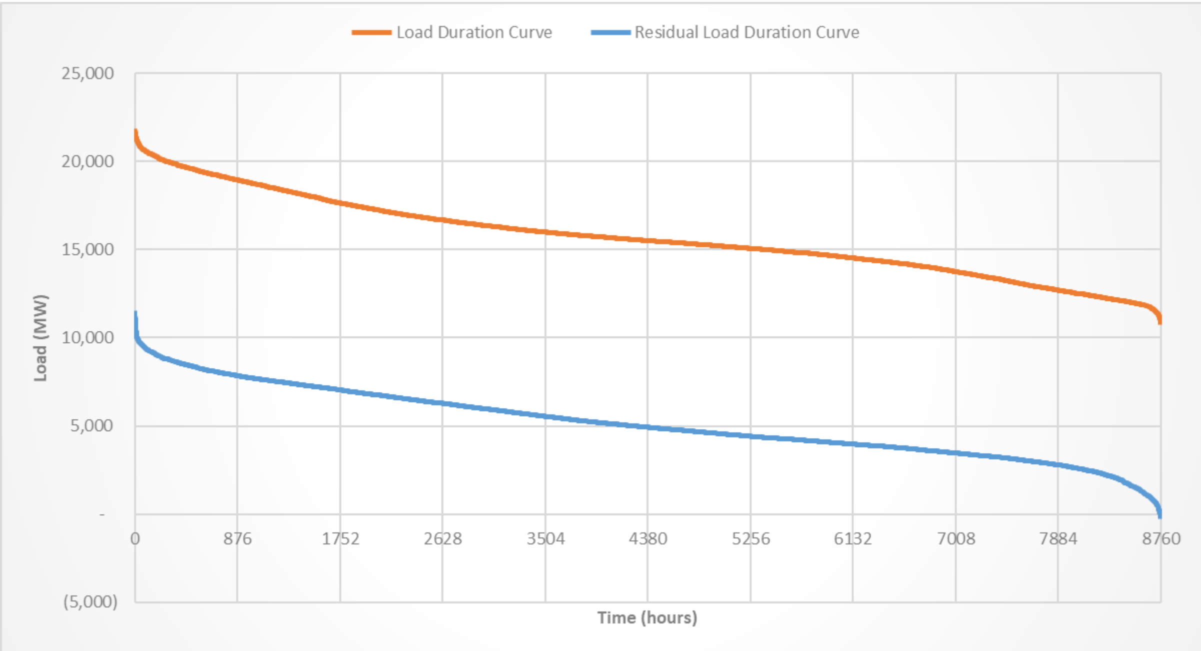
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,500MW Interconnected



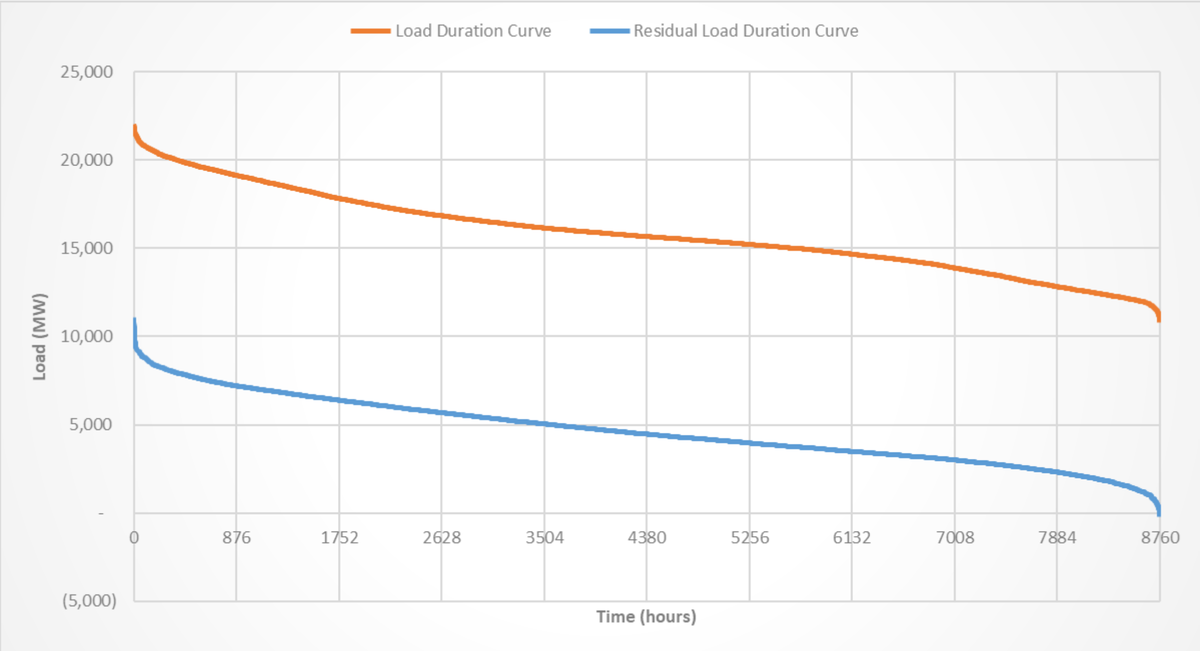
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,500MW Interconnected



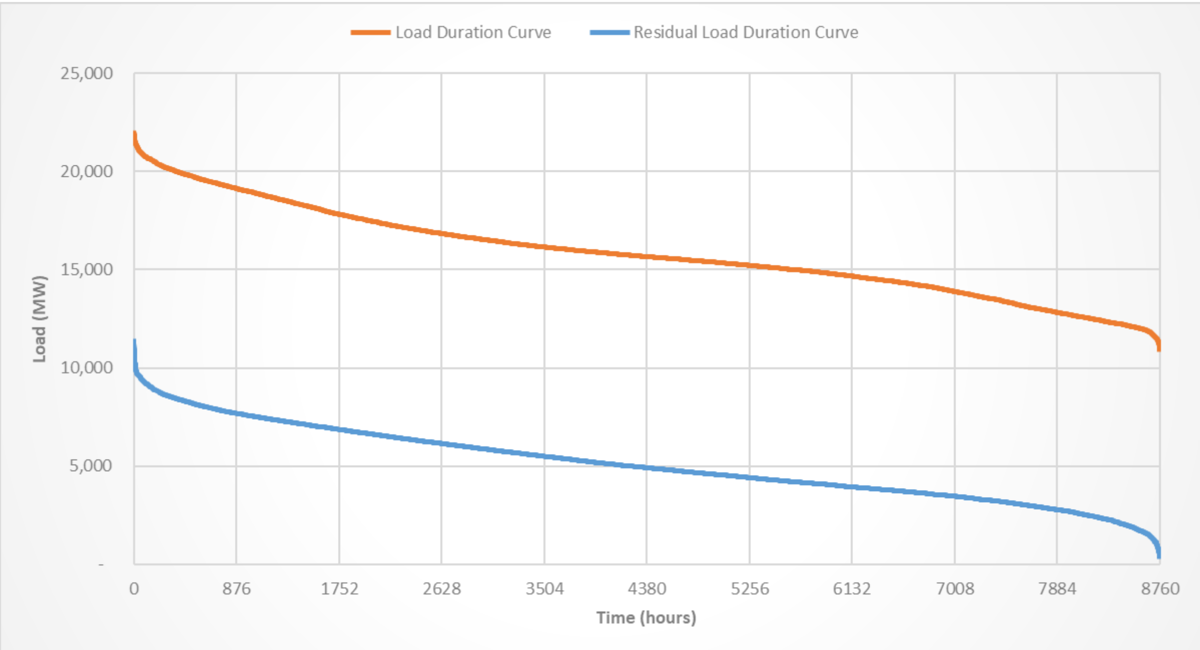
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=8,000MW Interconnected



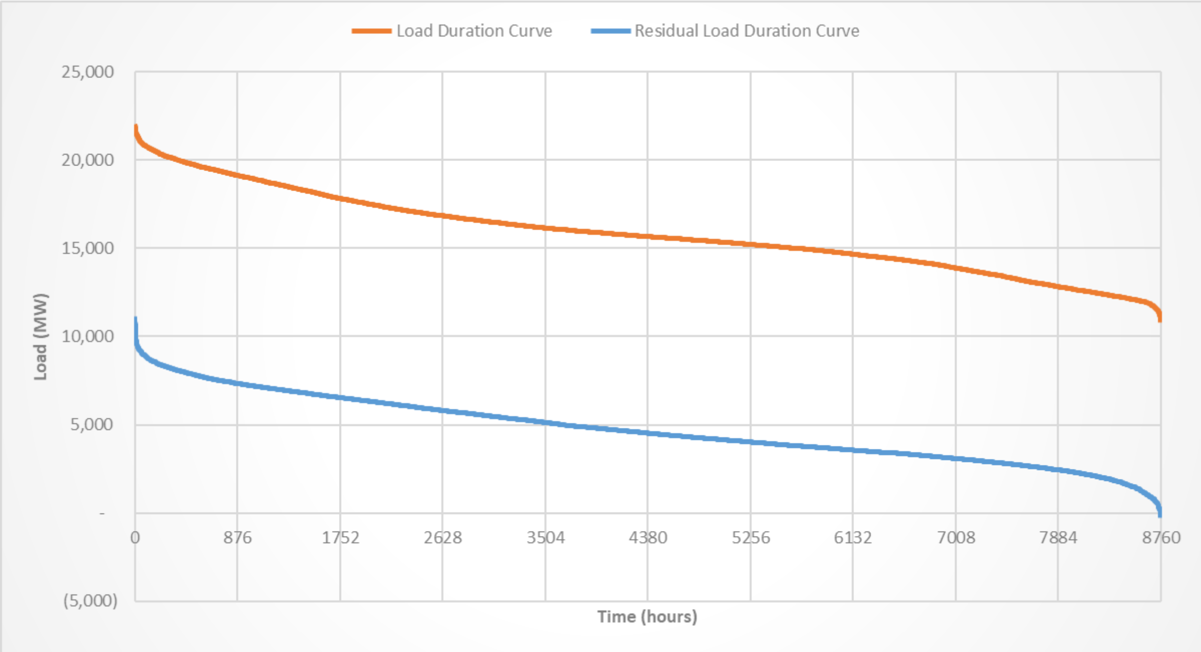
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=5% Reduction Interconnected



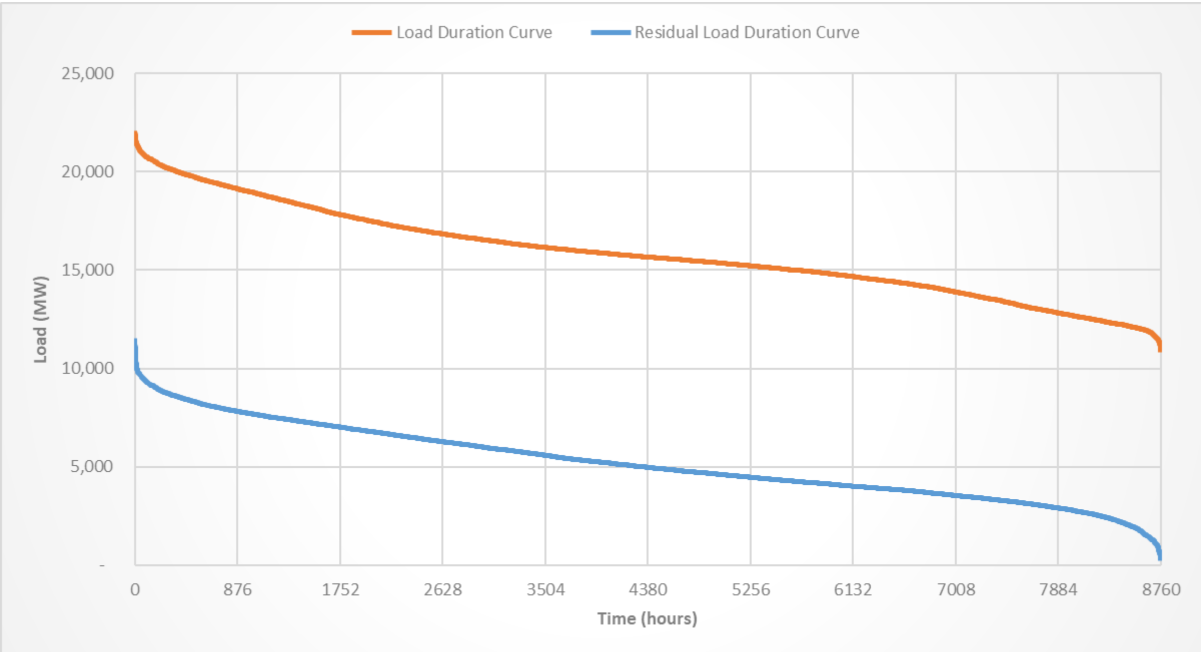
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



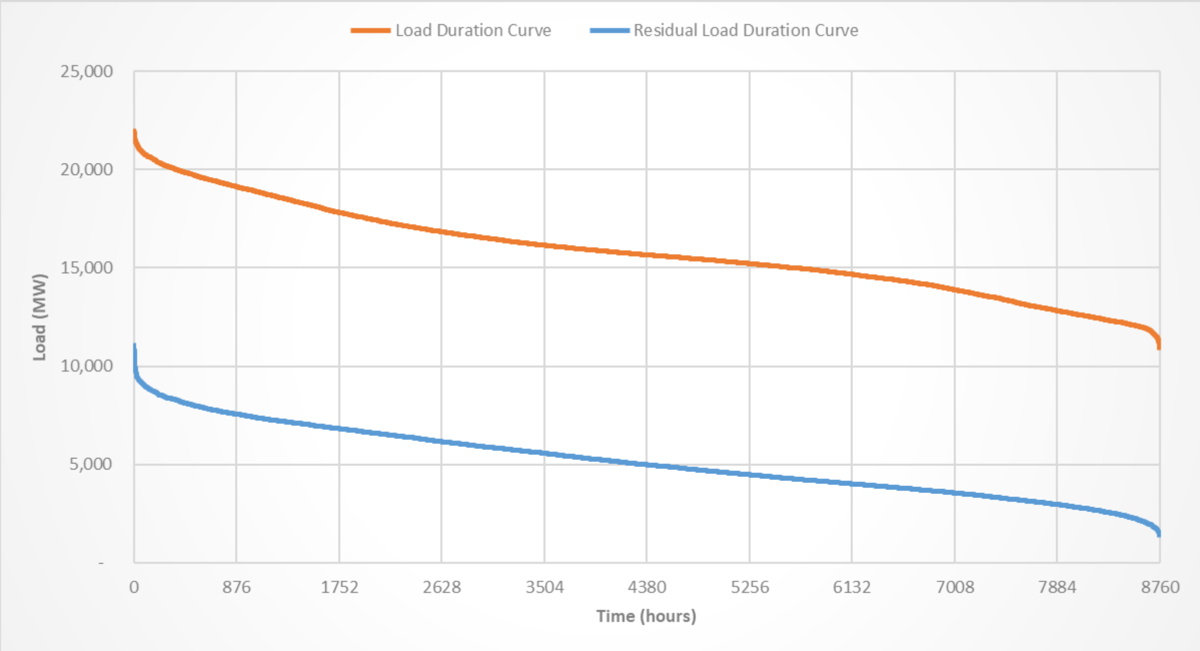
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=5% Reduction Interconnected



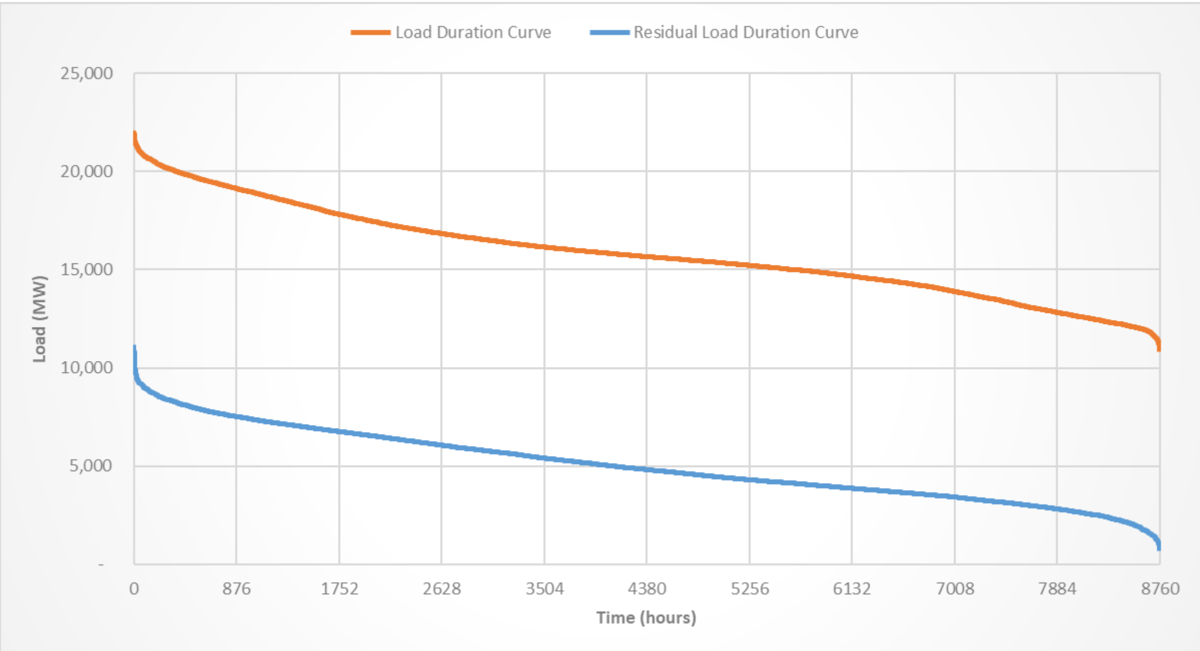
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



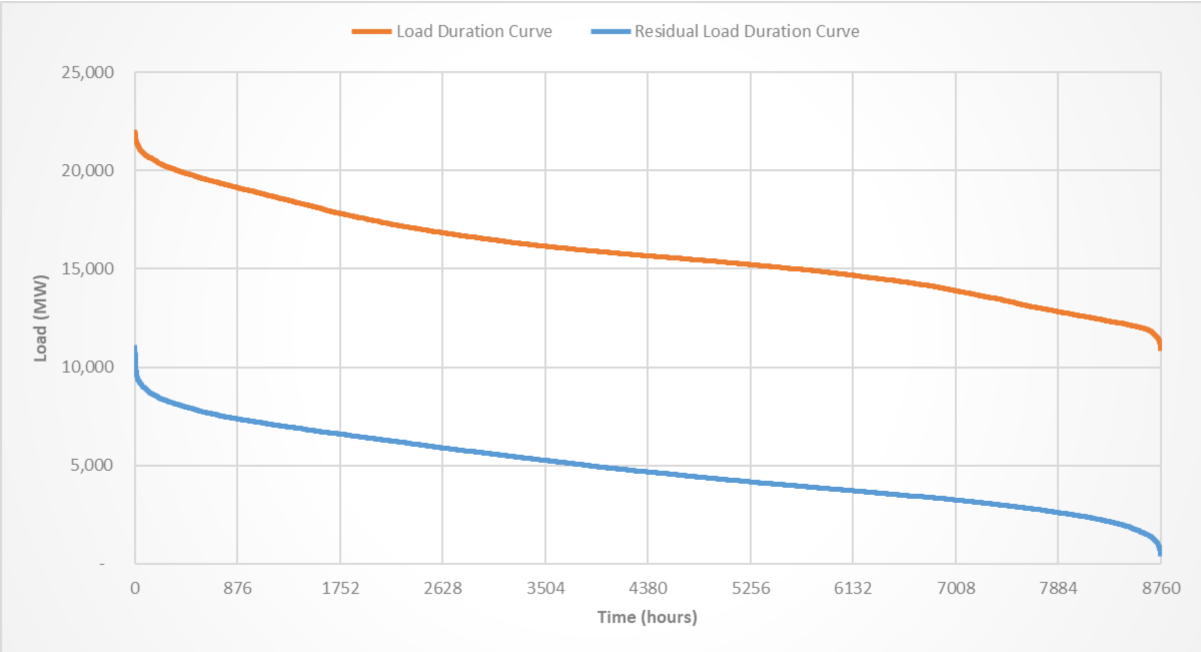
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=5,000MW Interconnected



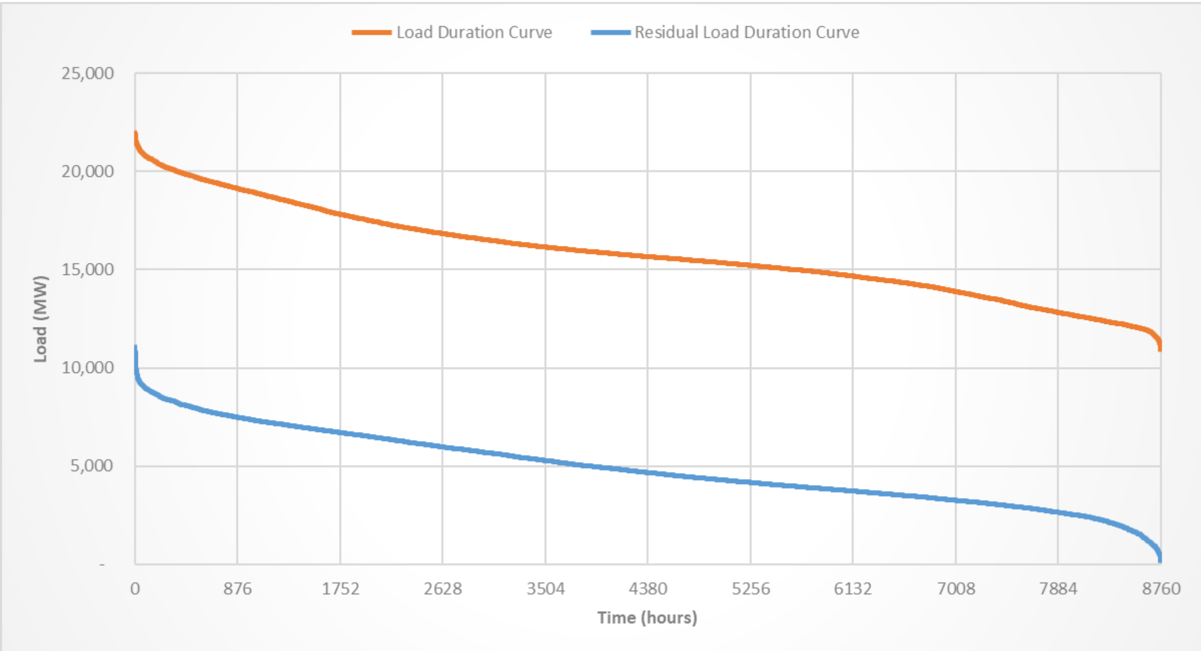
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=6,000MW Interconnected



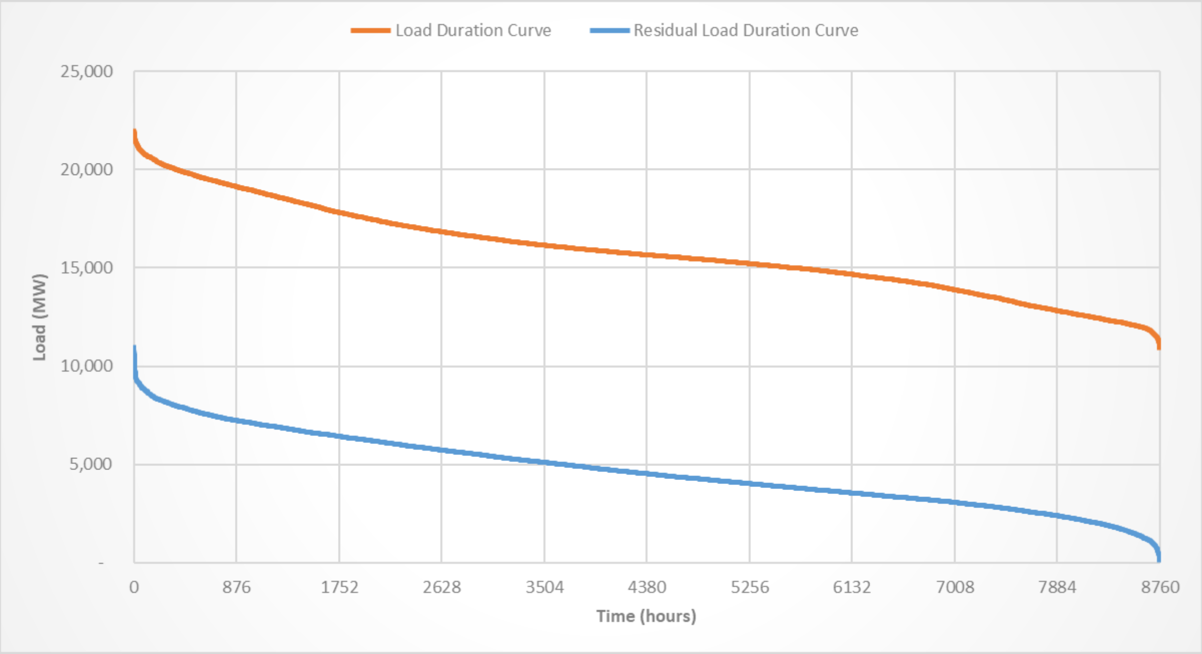
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=6,000MW Interconnected



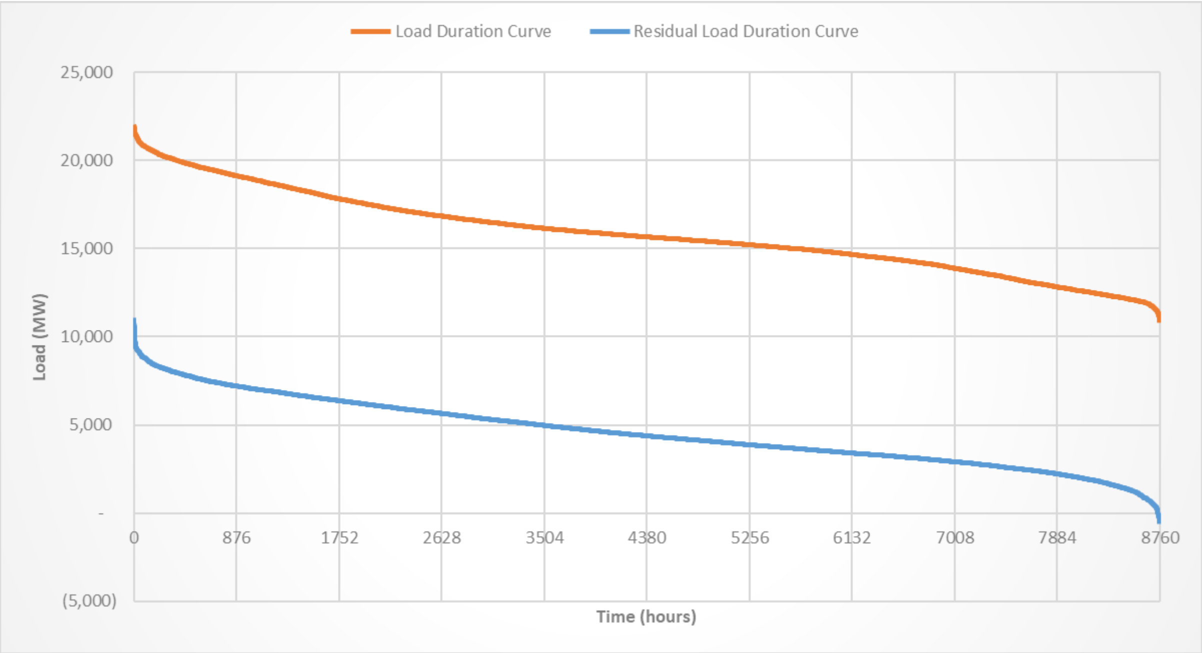
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=7,000MW Interconnected



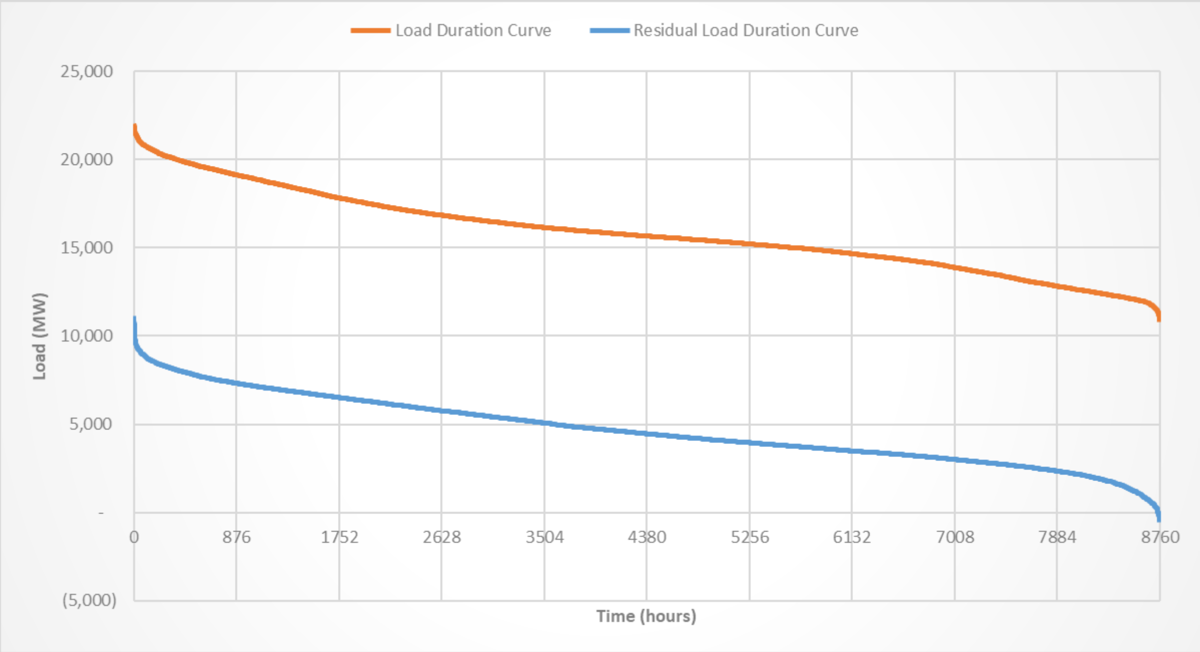
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=6,000MW Interconnected



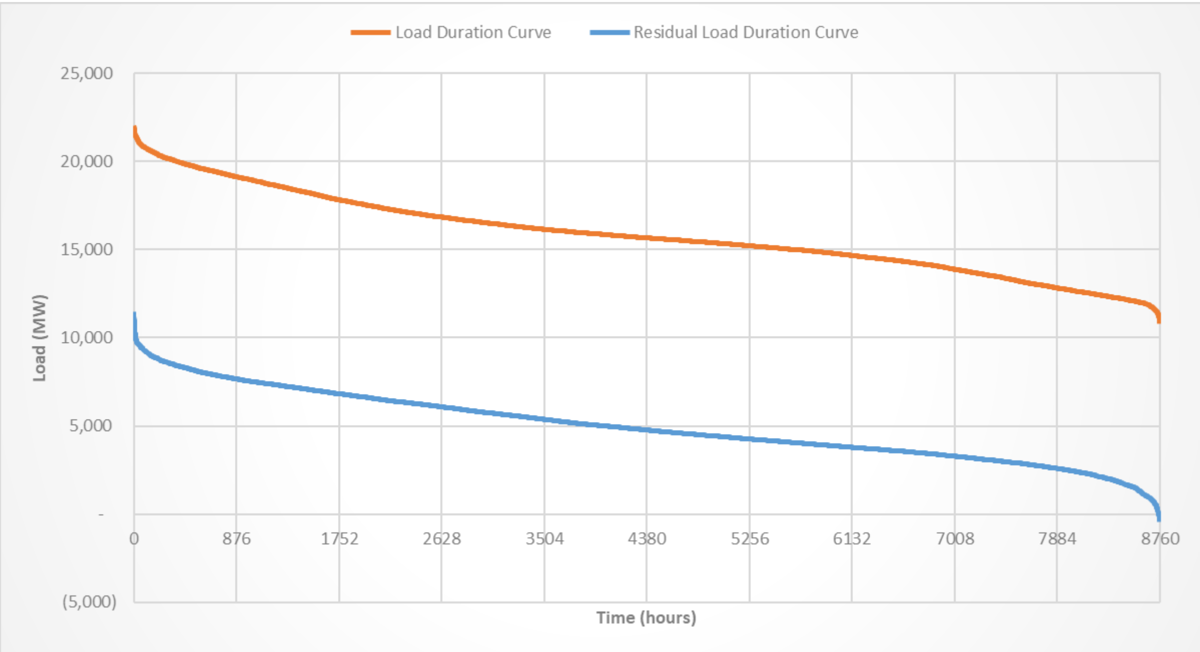
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,000MW Interconnected



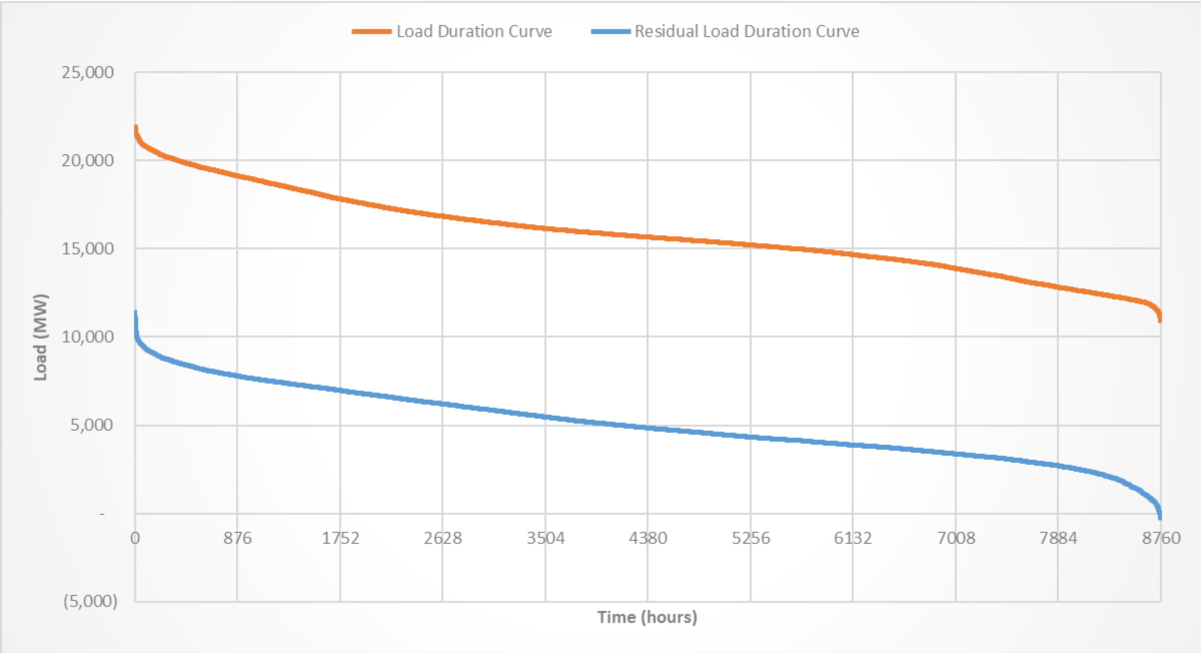
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,500MW Interconnected



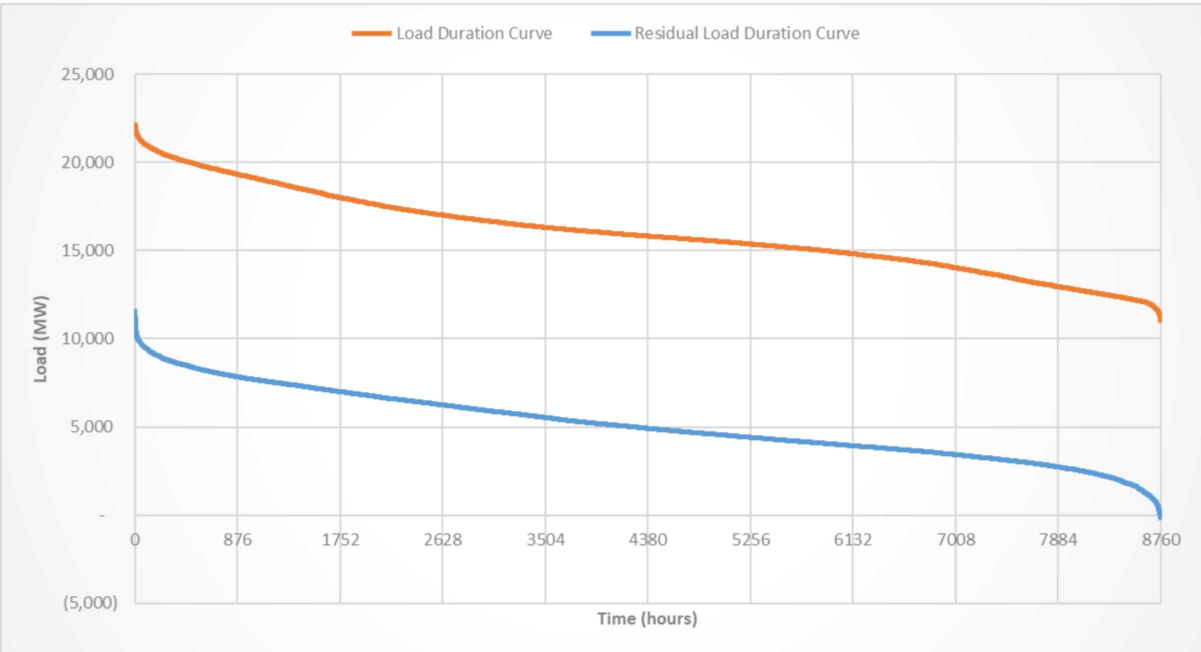
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,500MW Interconnected



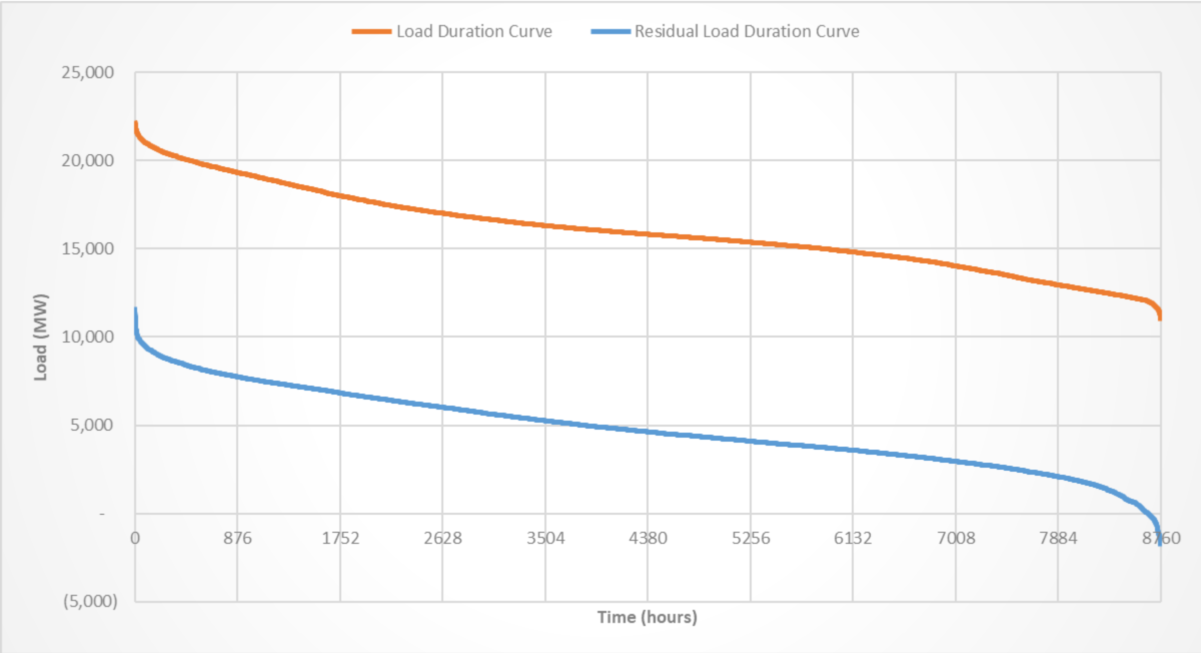
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=8,000MW Interconnected



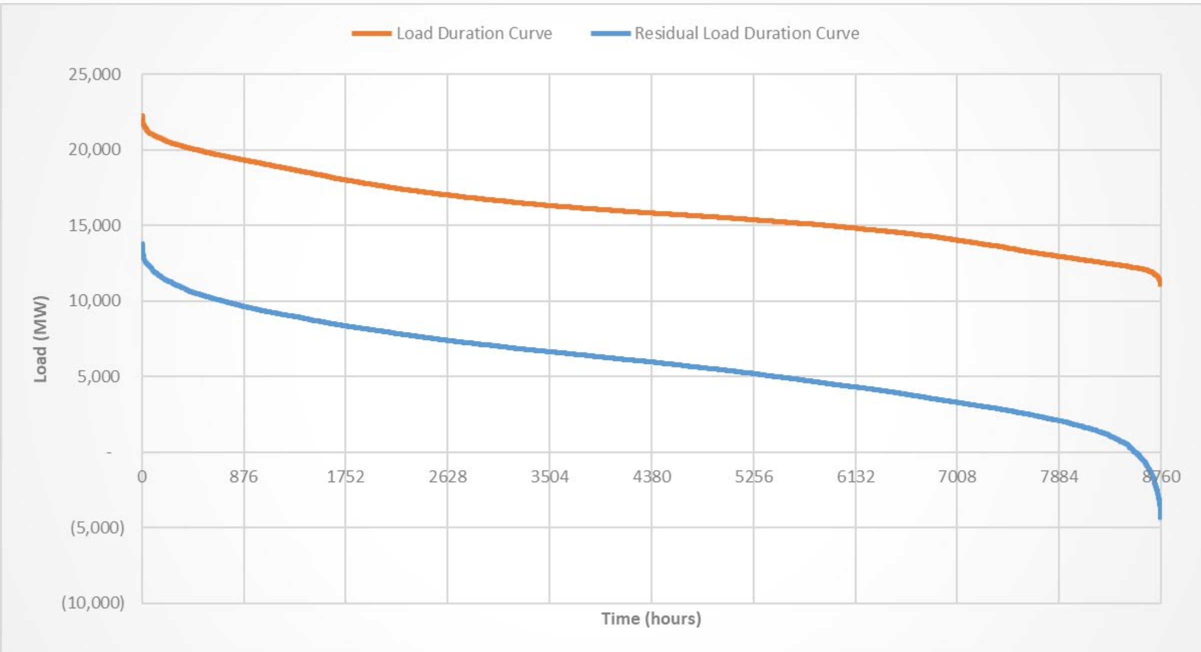
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Interconnected



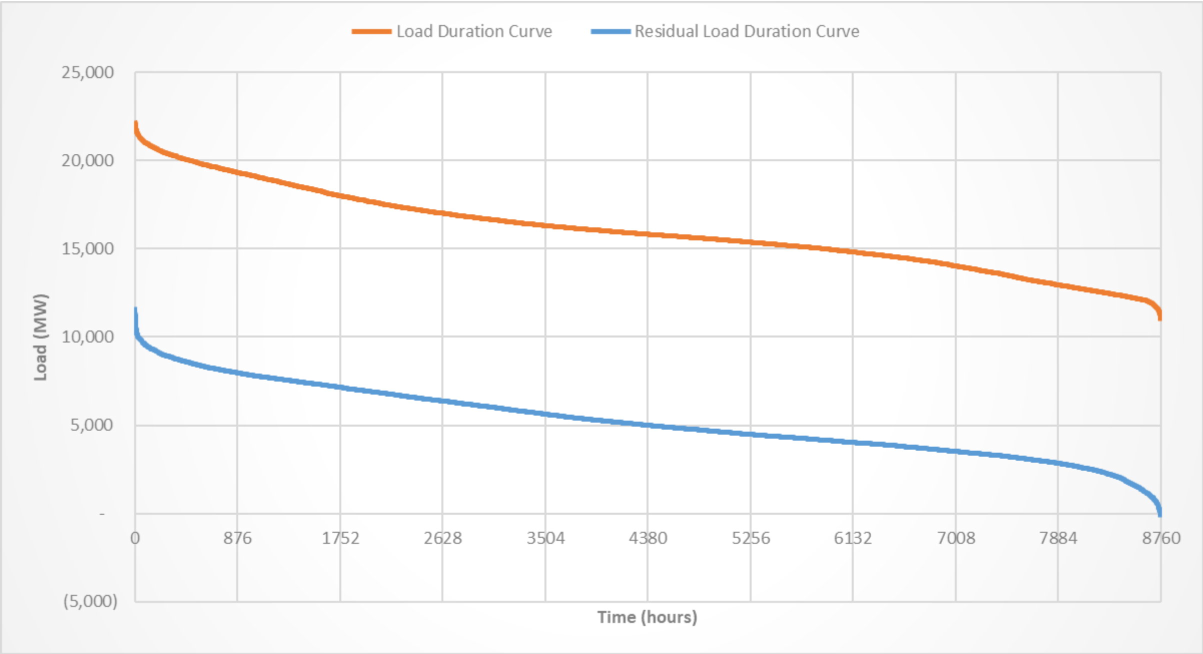
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Interconnected



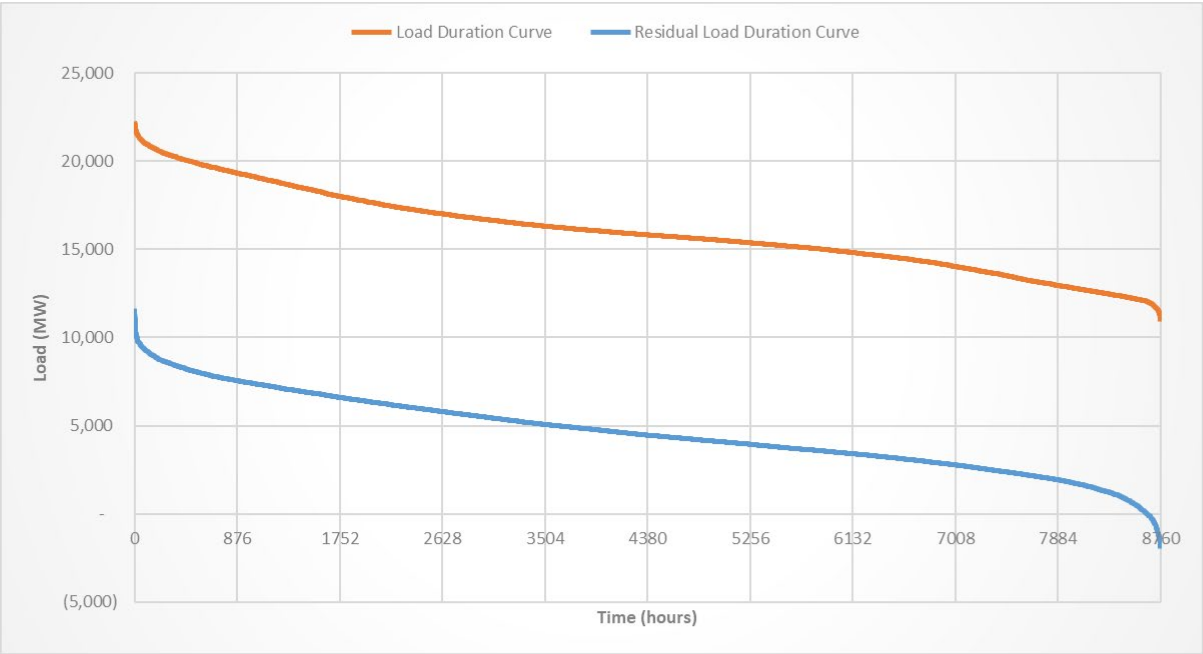
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Interconnected



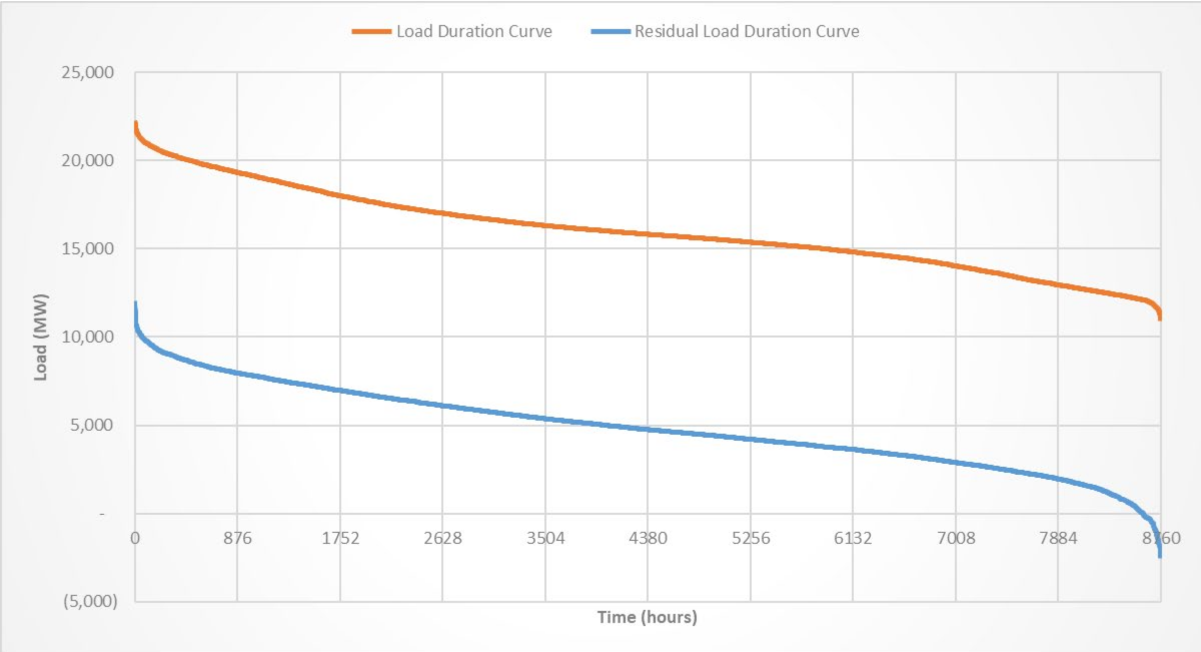
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Interconnected



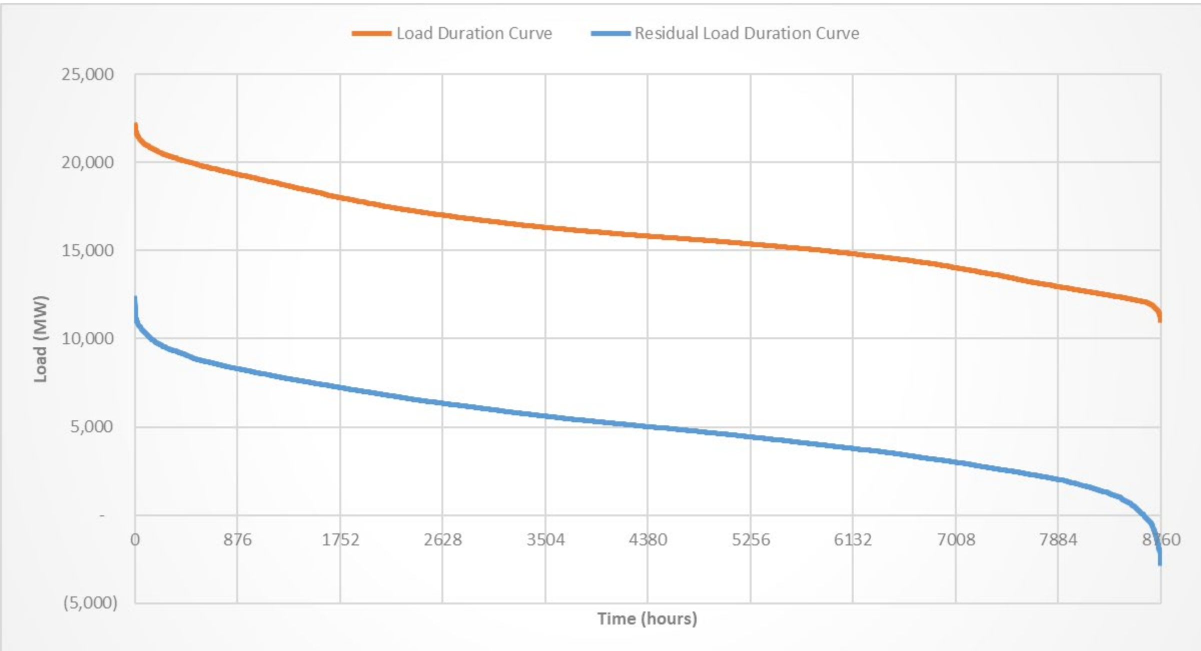
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Interconnected



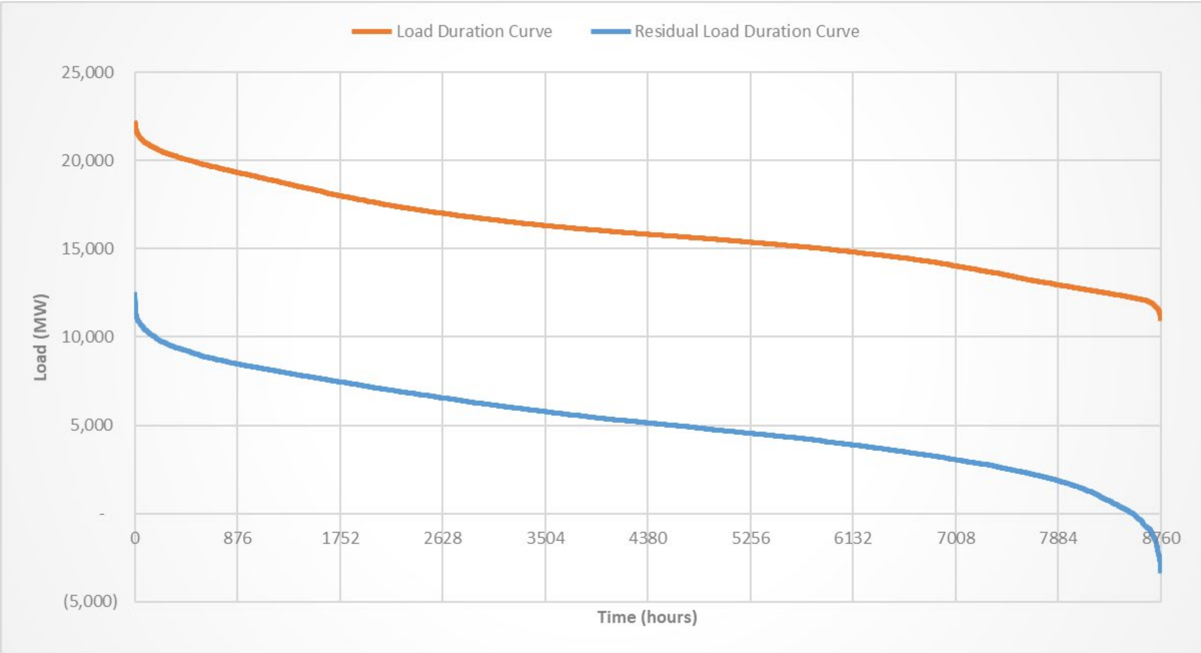
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Interconnected



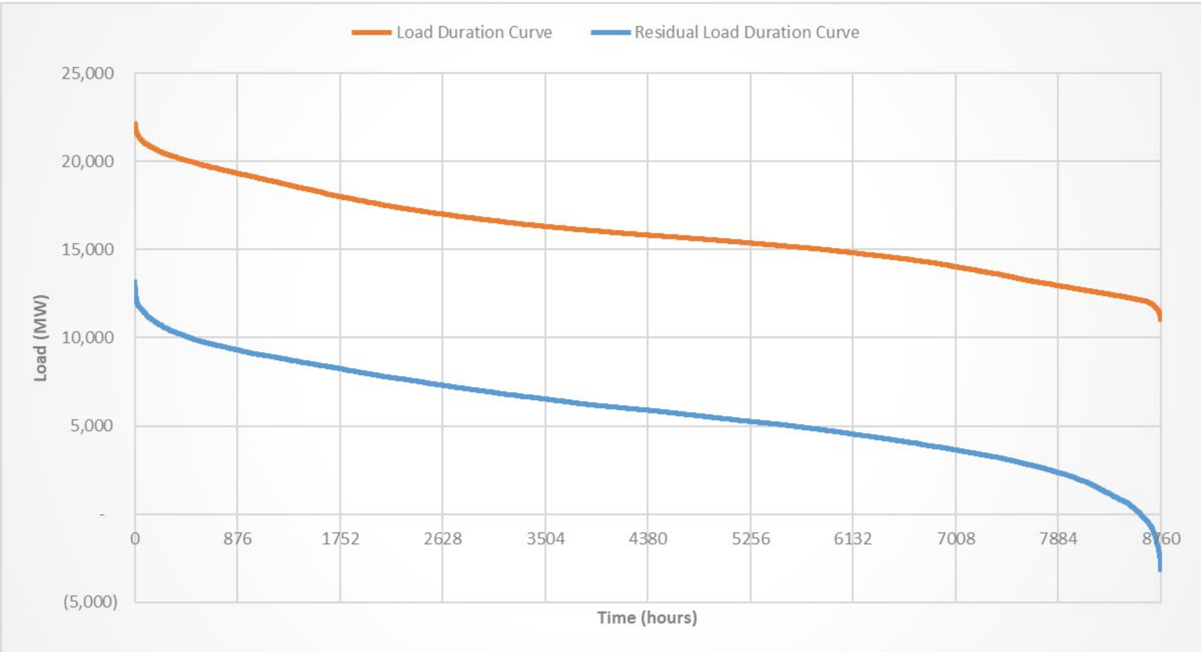
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Interconnected



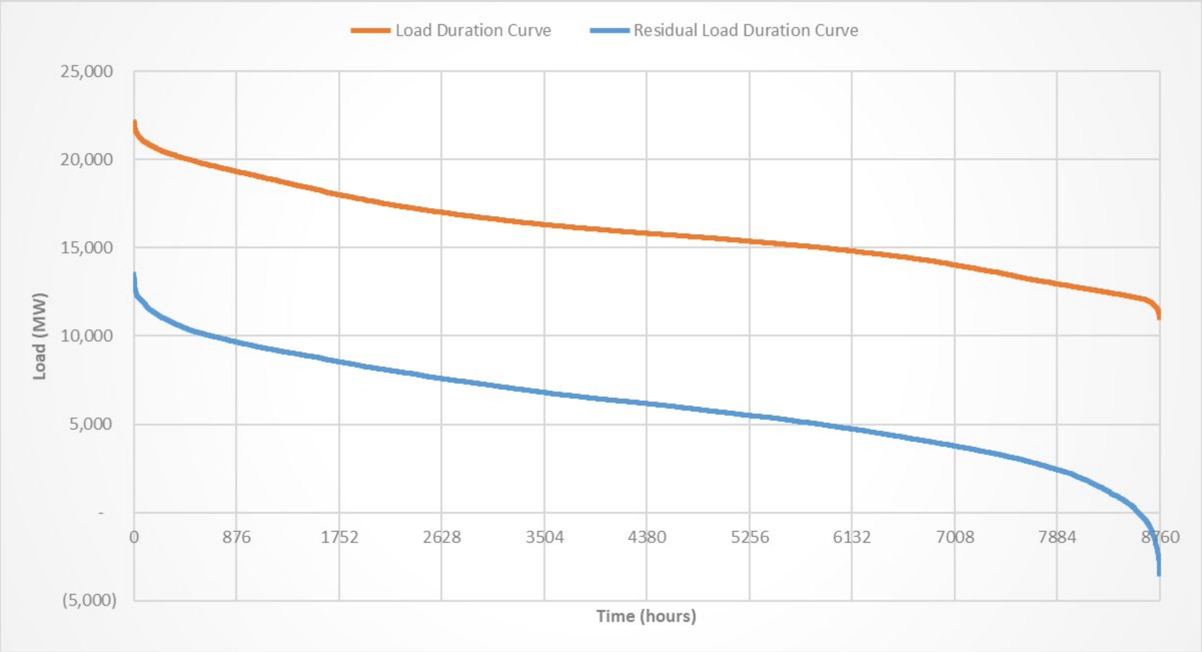
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Interconnected



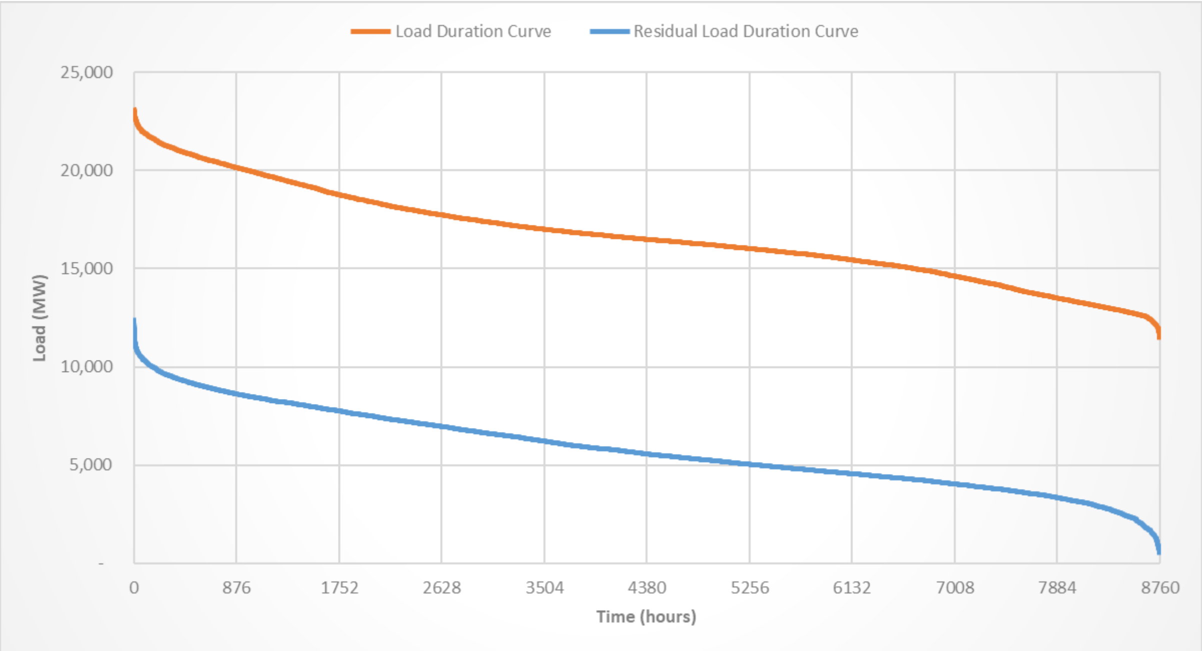
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Interconnected



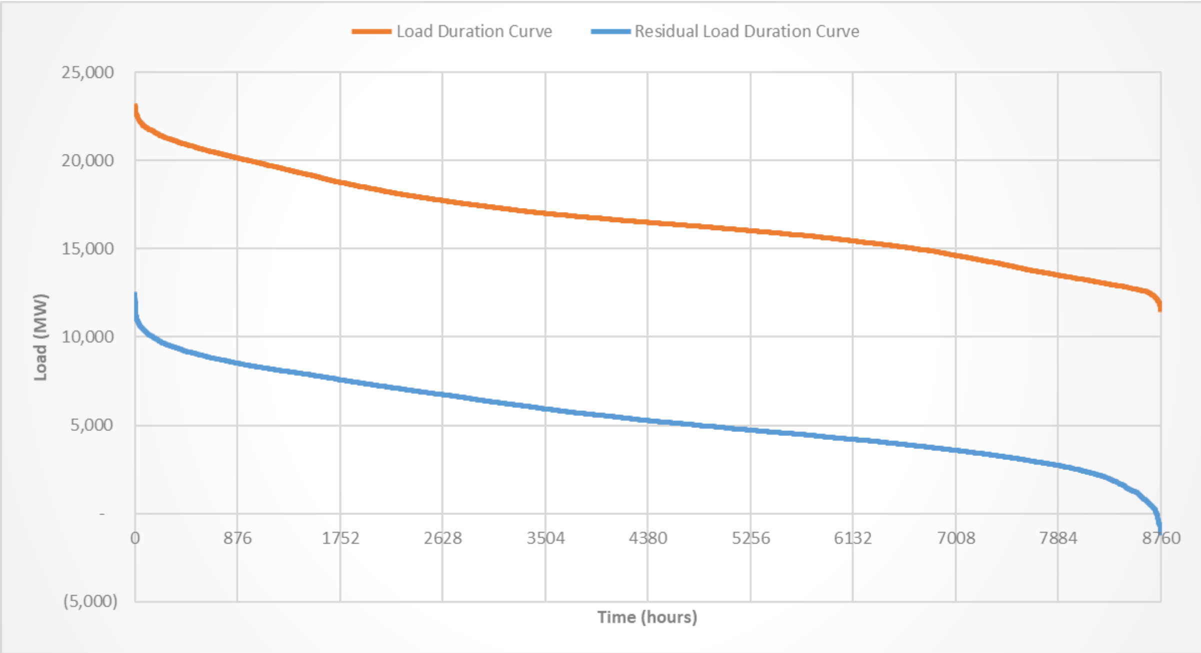
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Interconnected



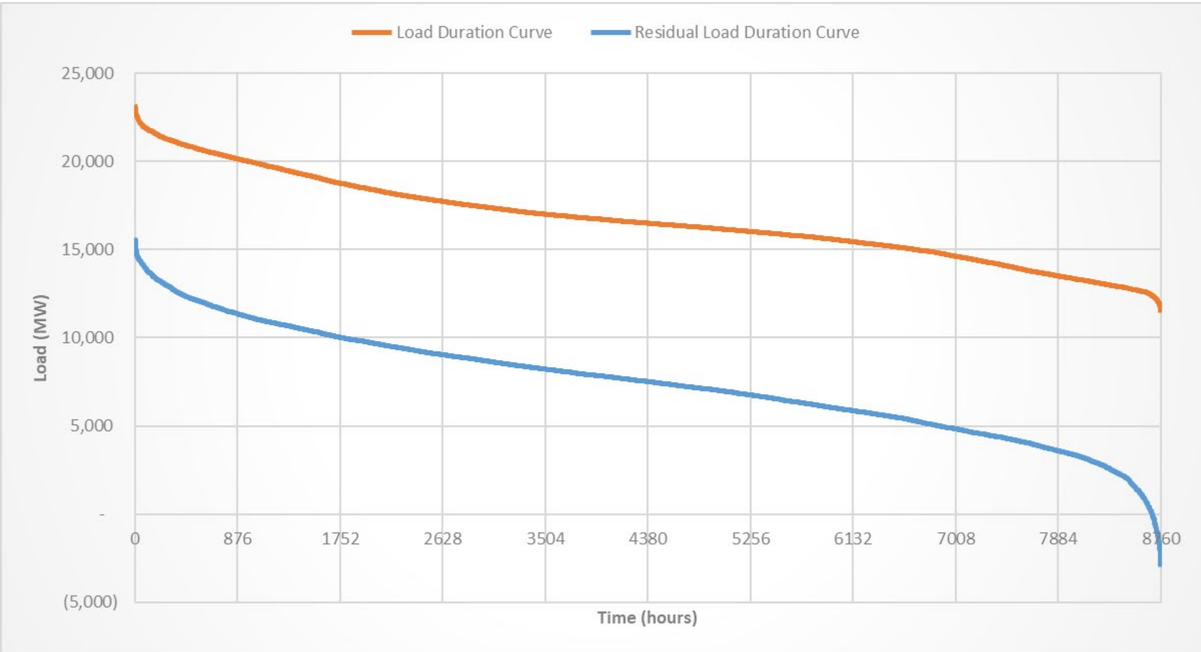
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Interconnected



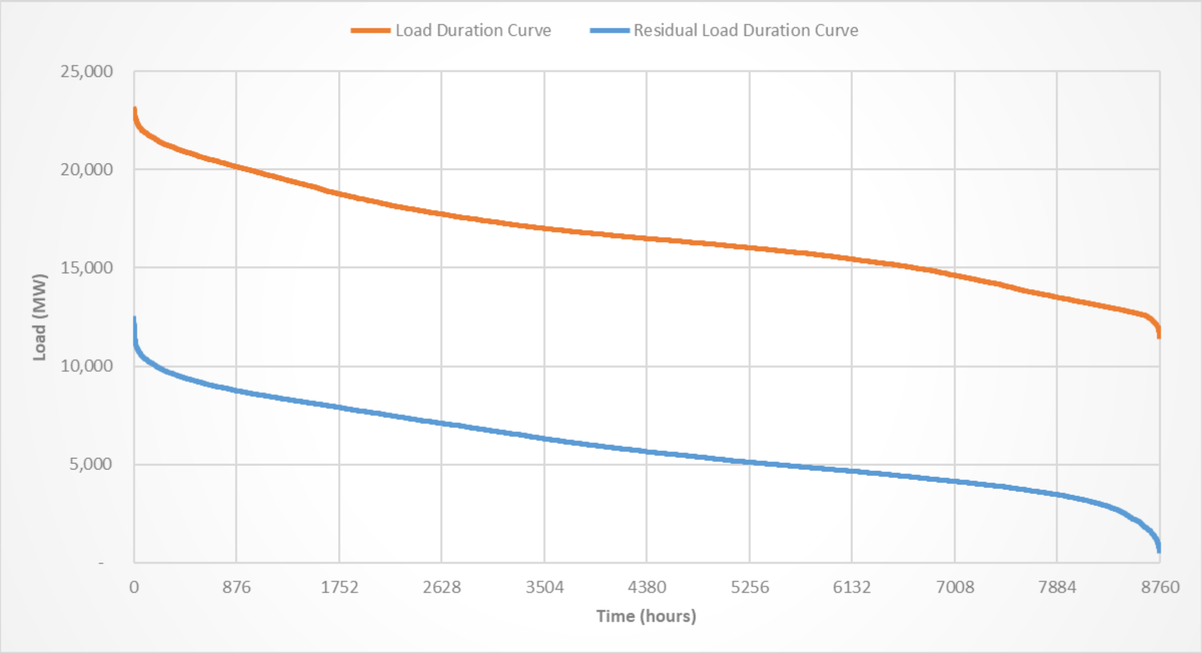
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Interconnected



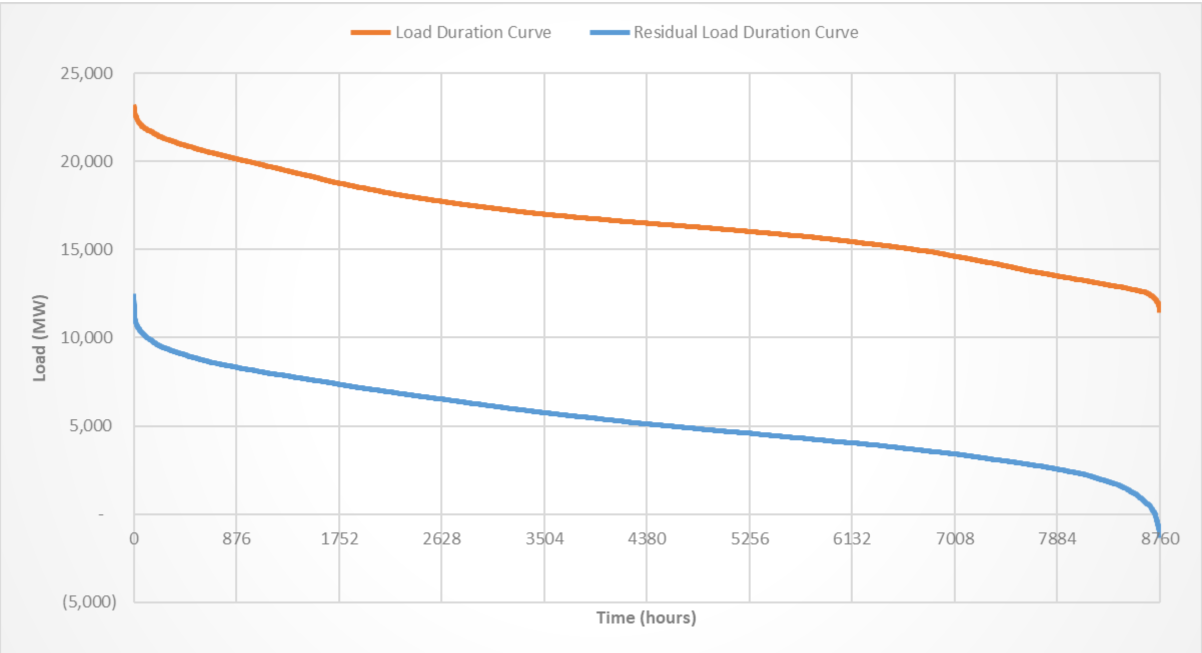
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Interconnected



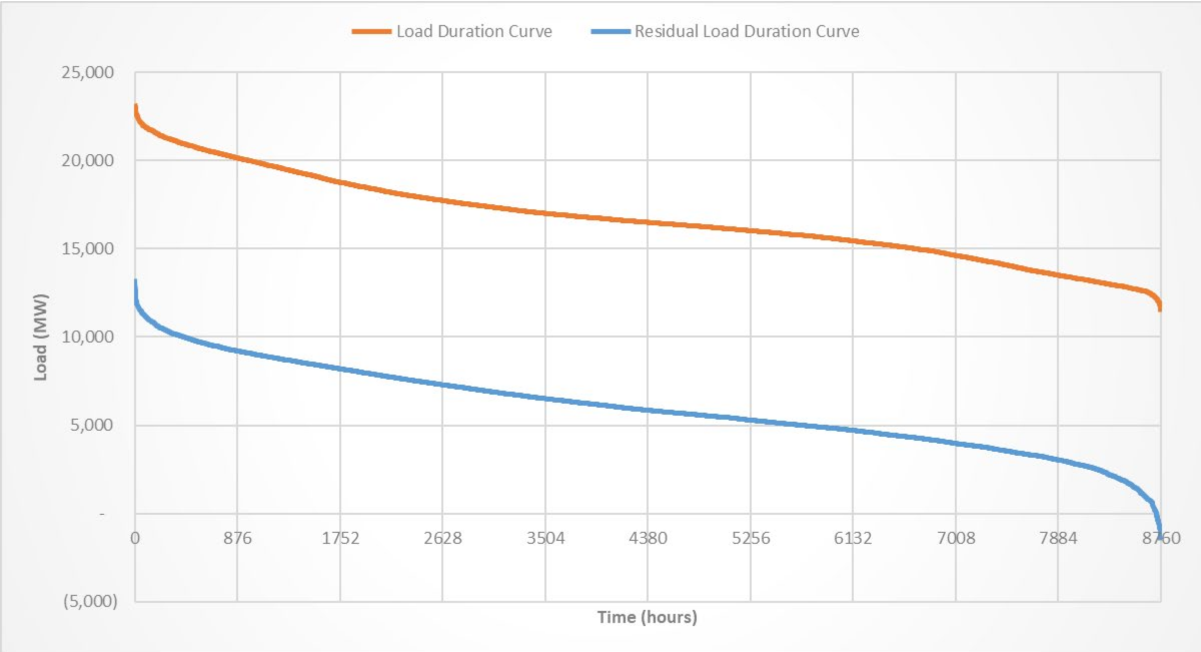
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Interconnected



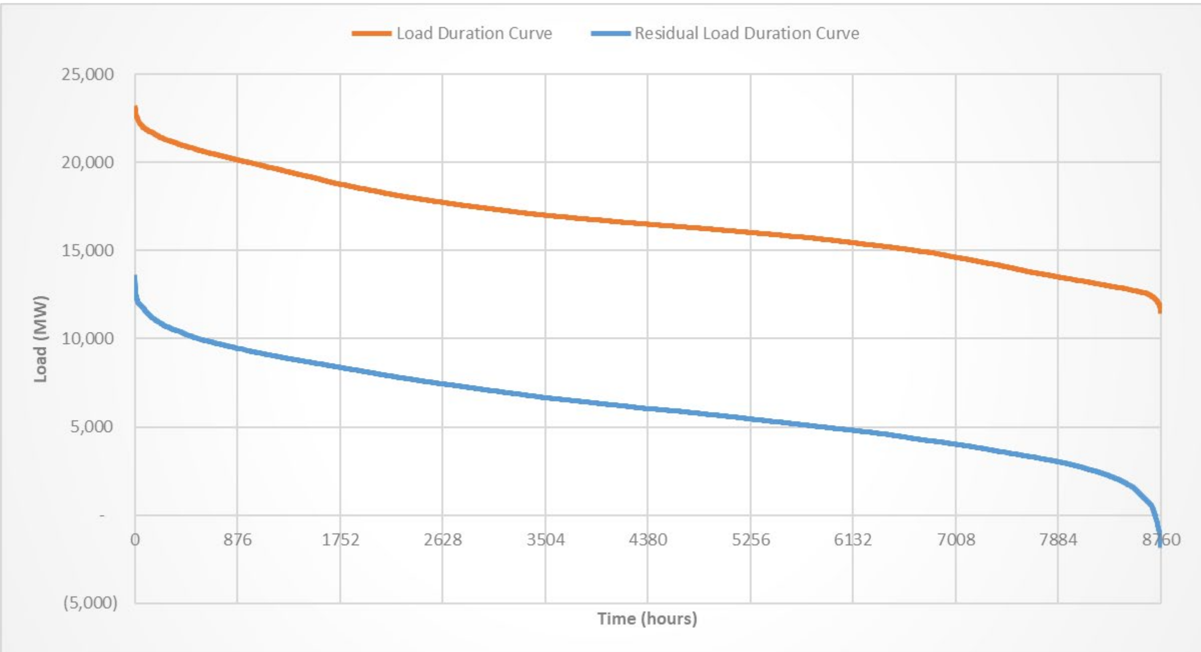
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Interconnected



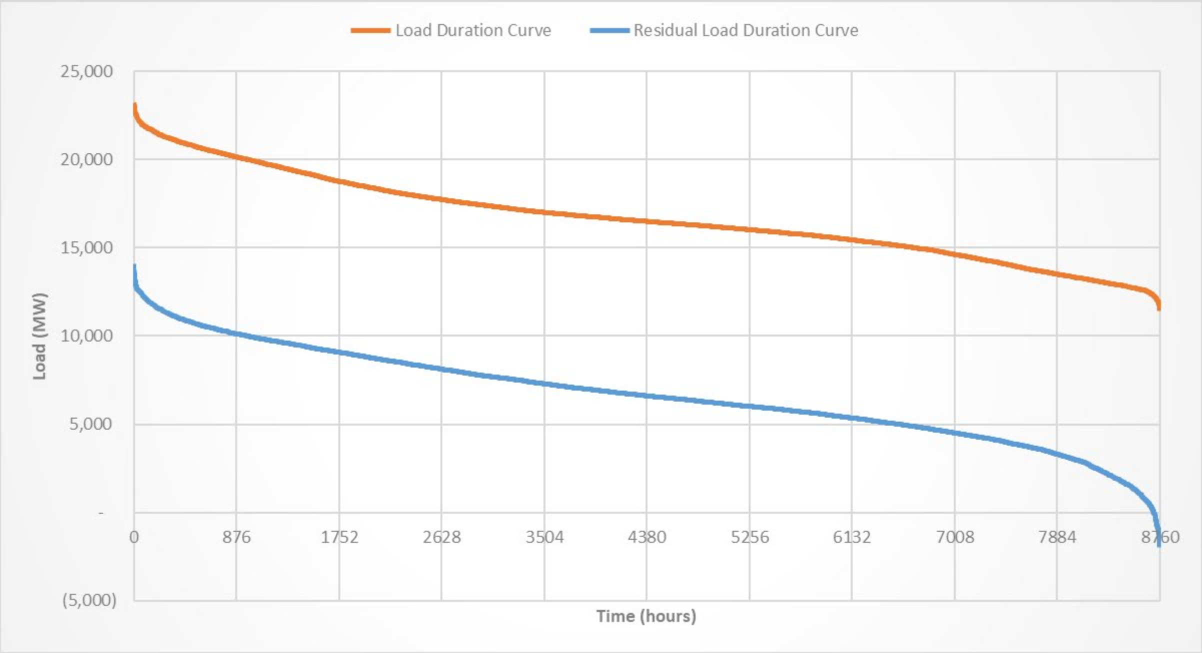
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Interconnected



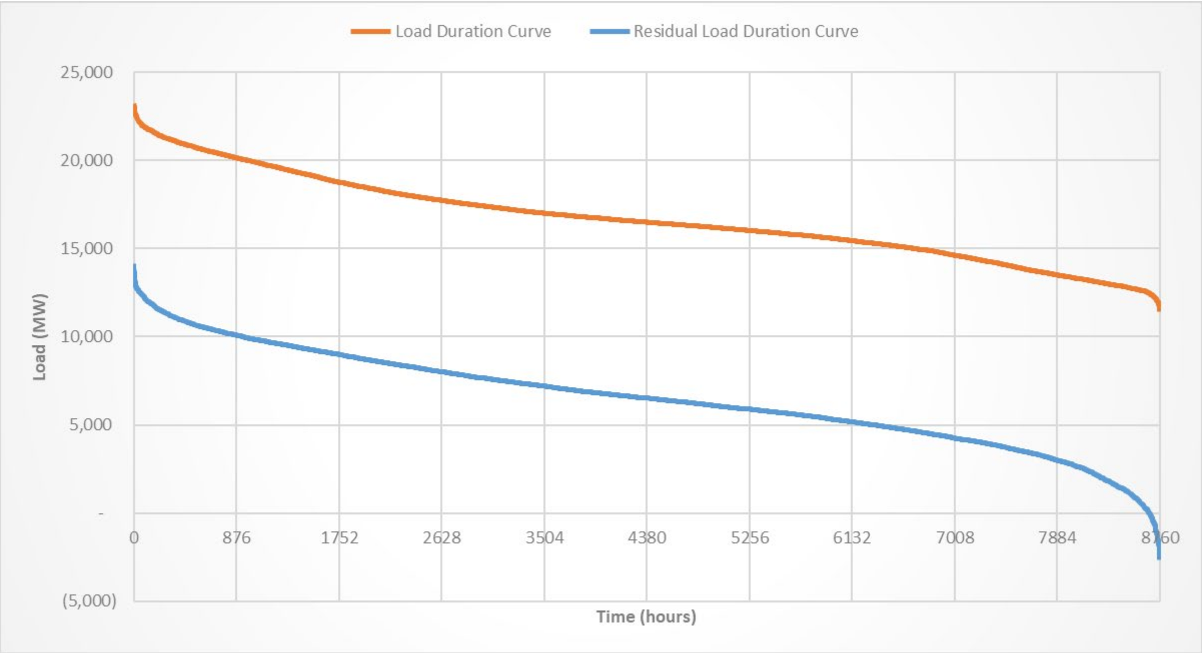
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Interconnected



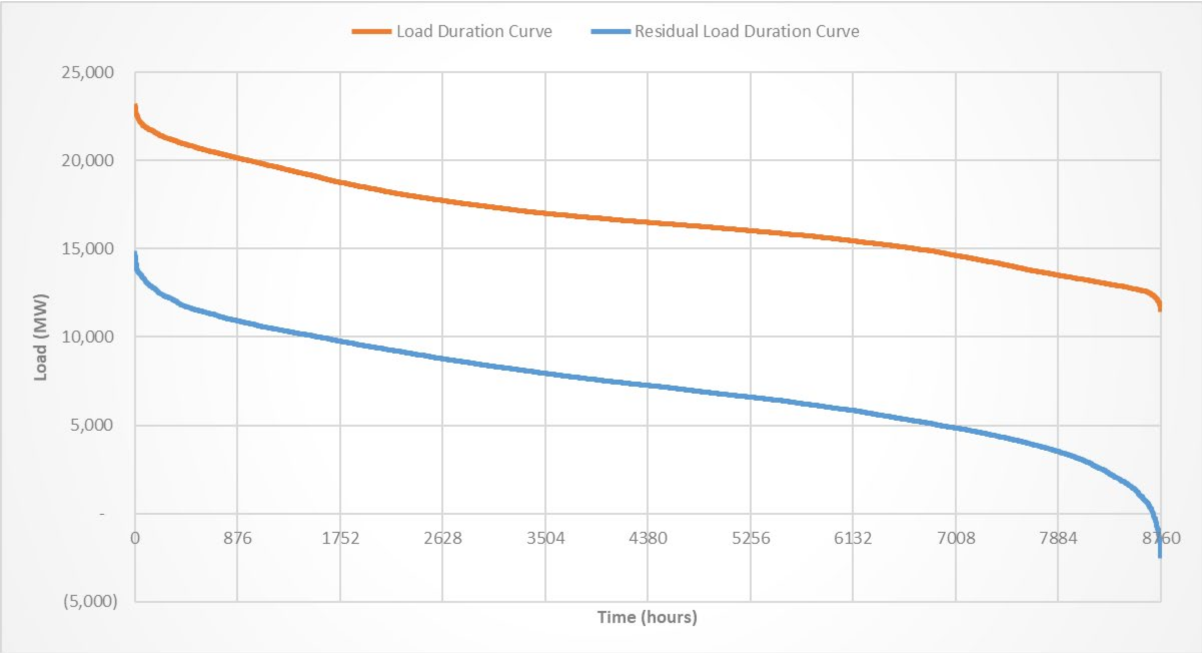
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Interconnected



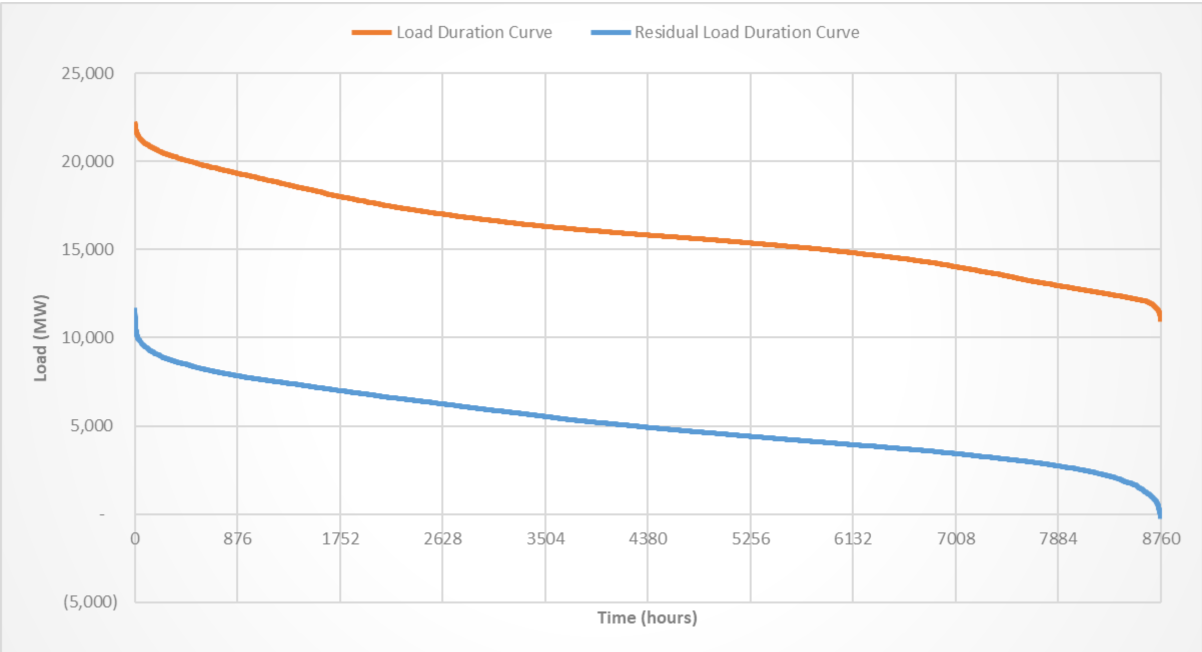
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Interconnected



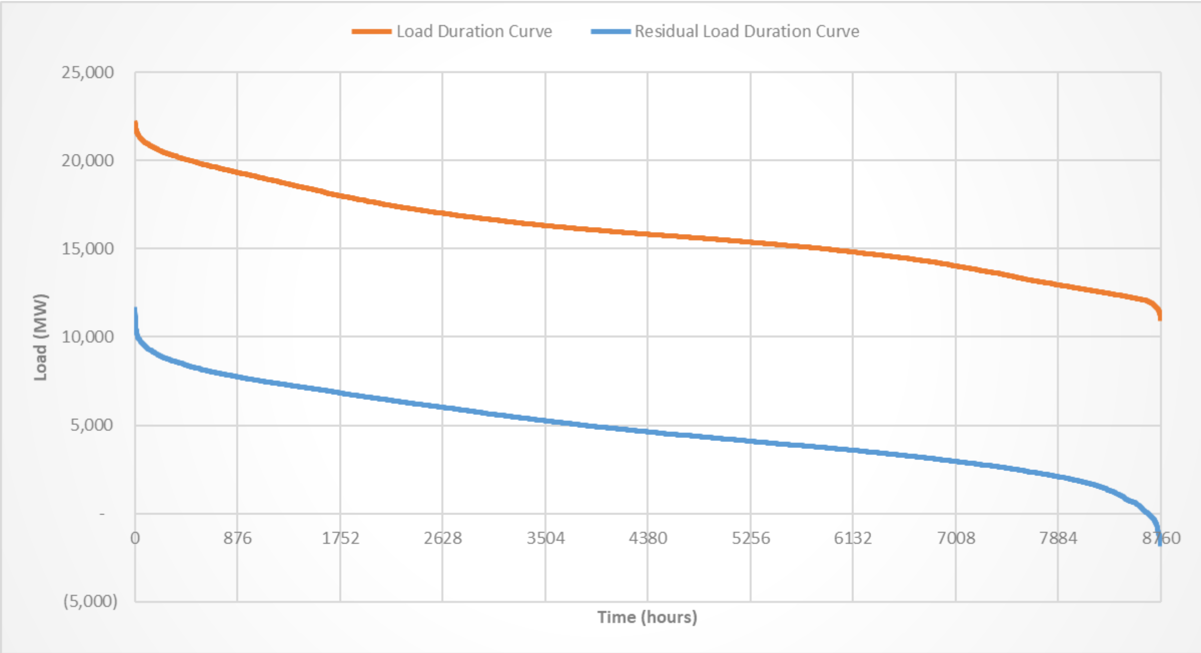
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Interconnected



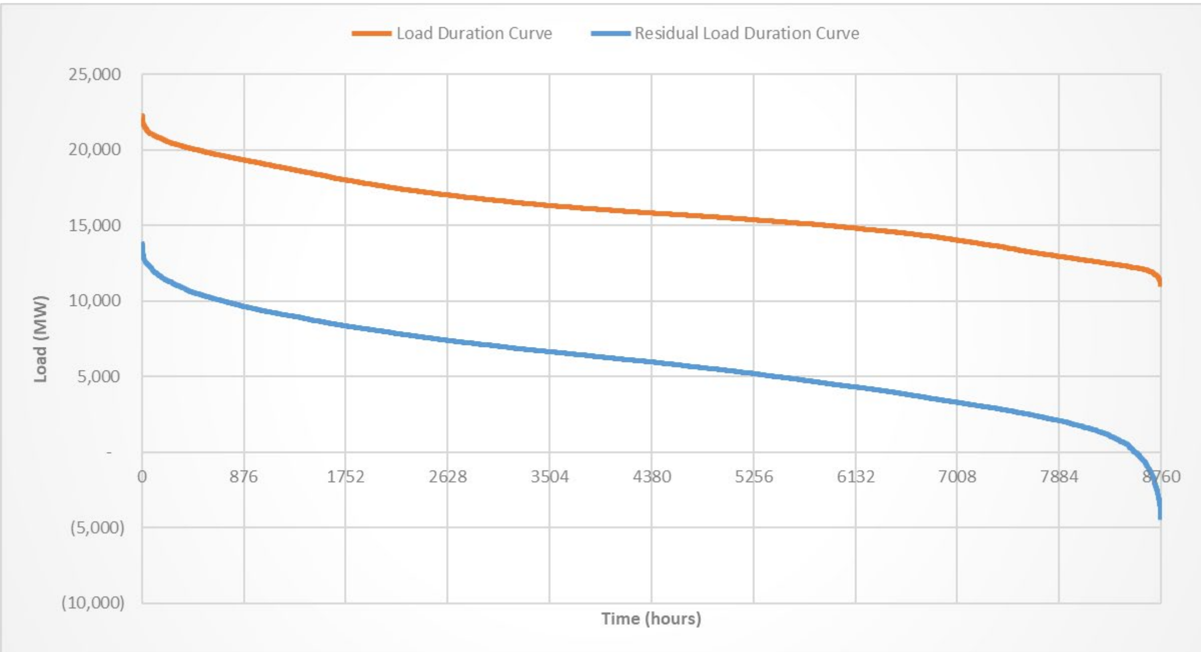
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Isolated



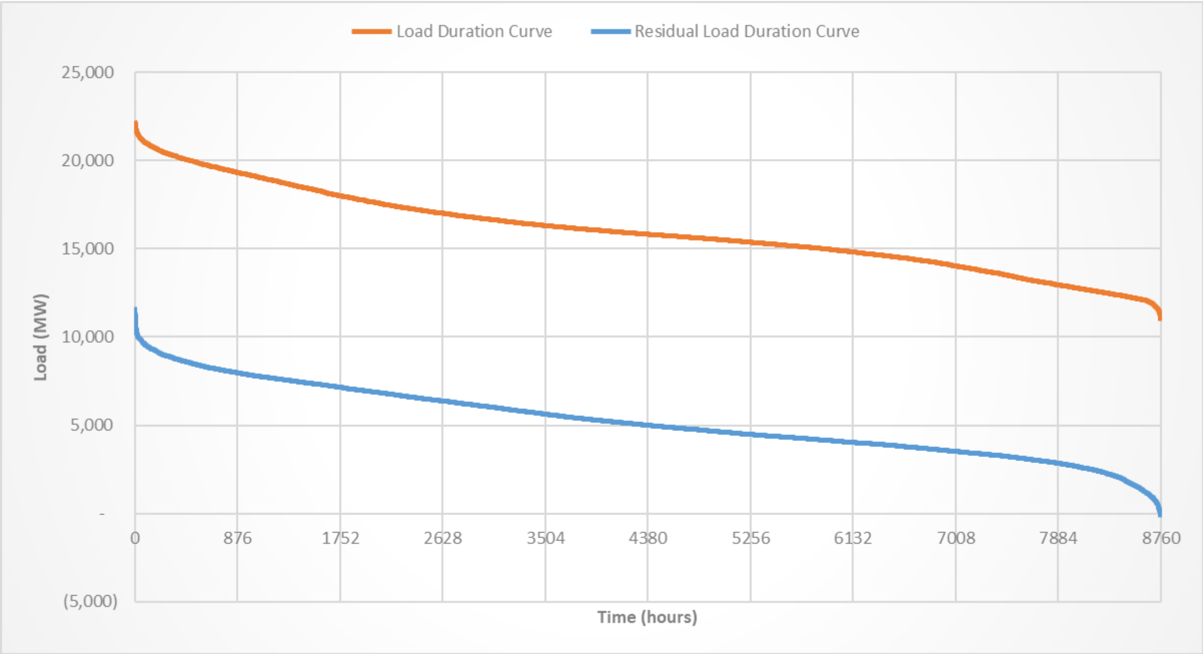
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Isolated



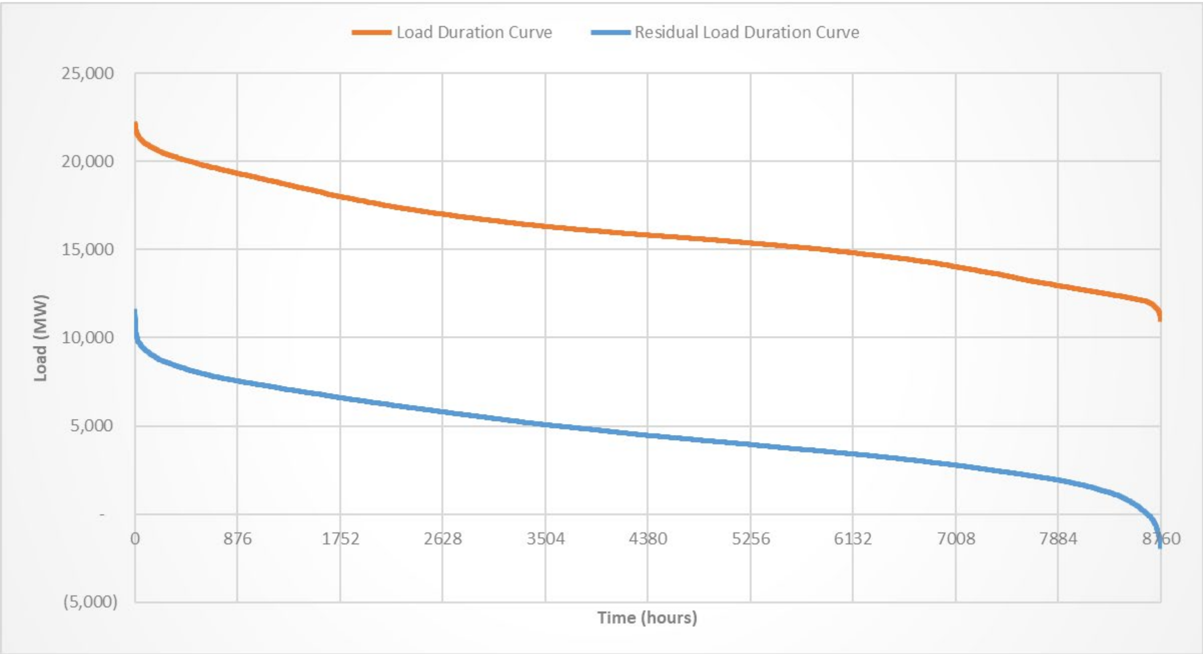
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Isolated



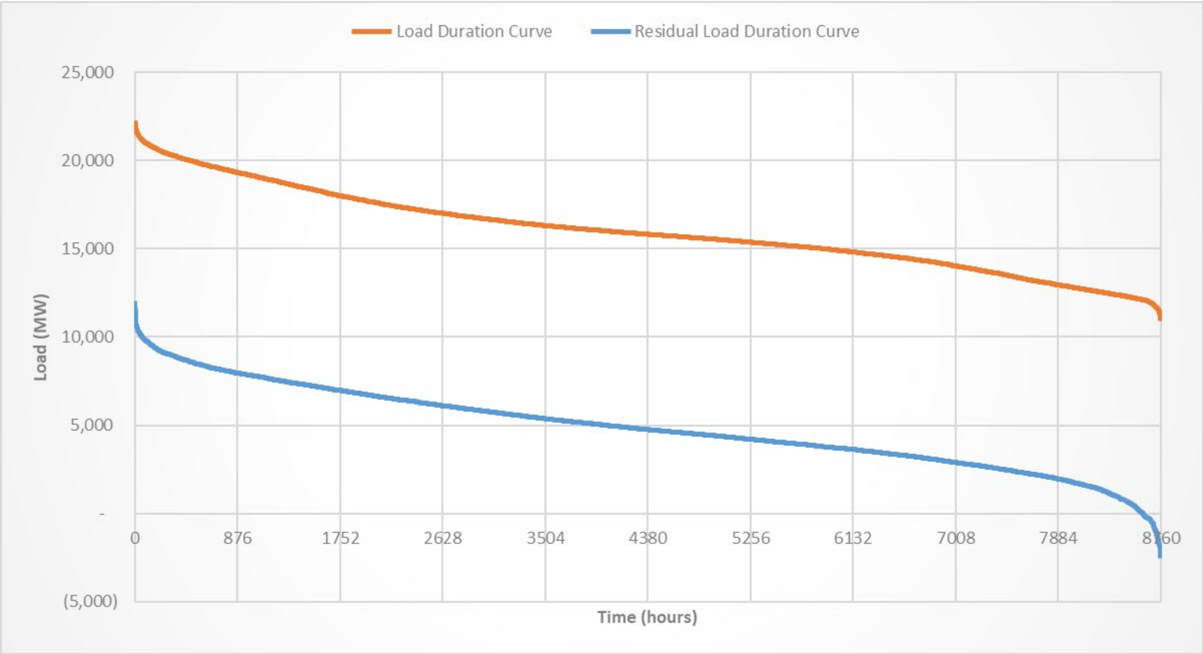
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Isolated



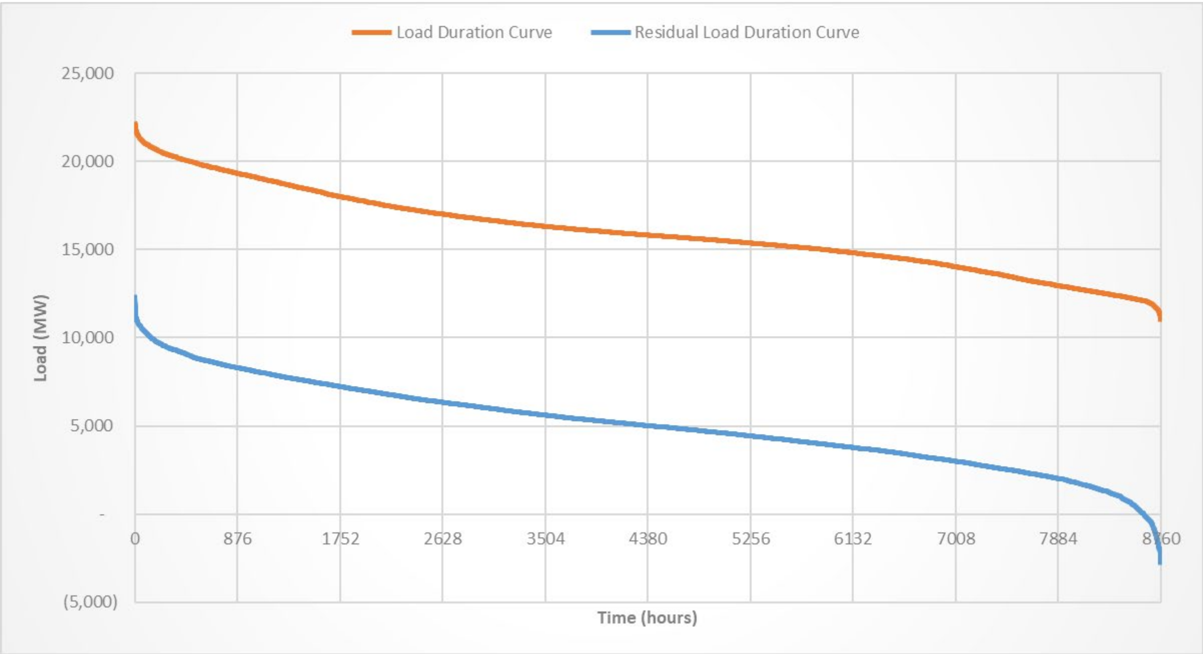
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Isolated



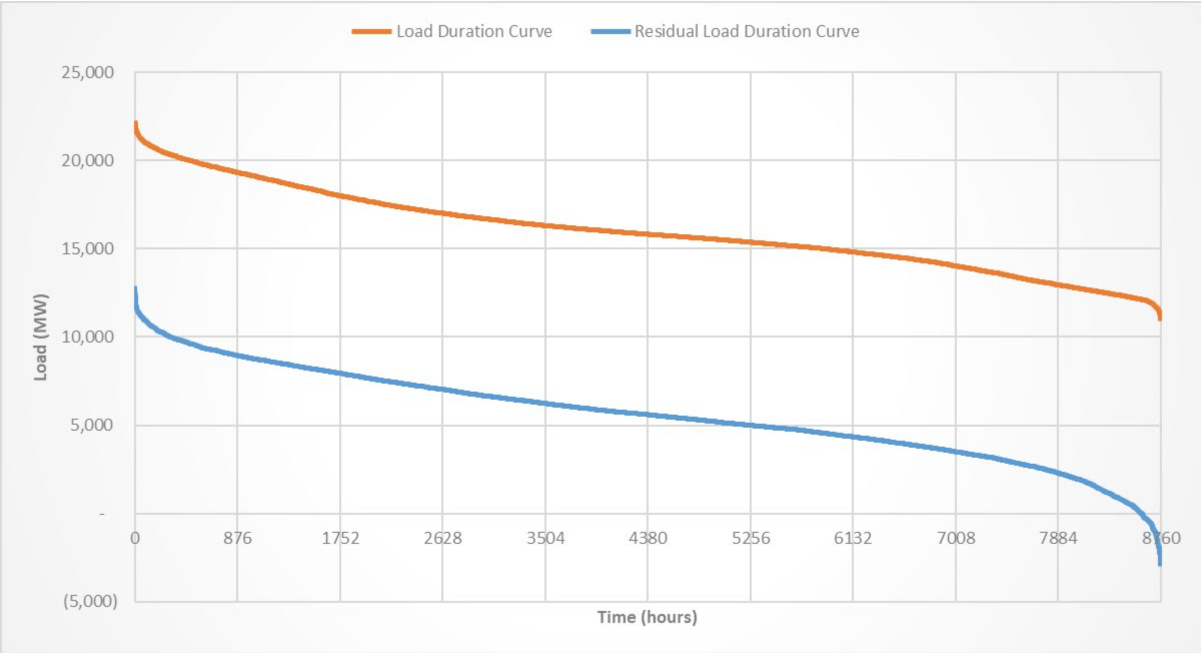
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Isolated



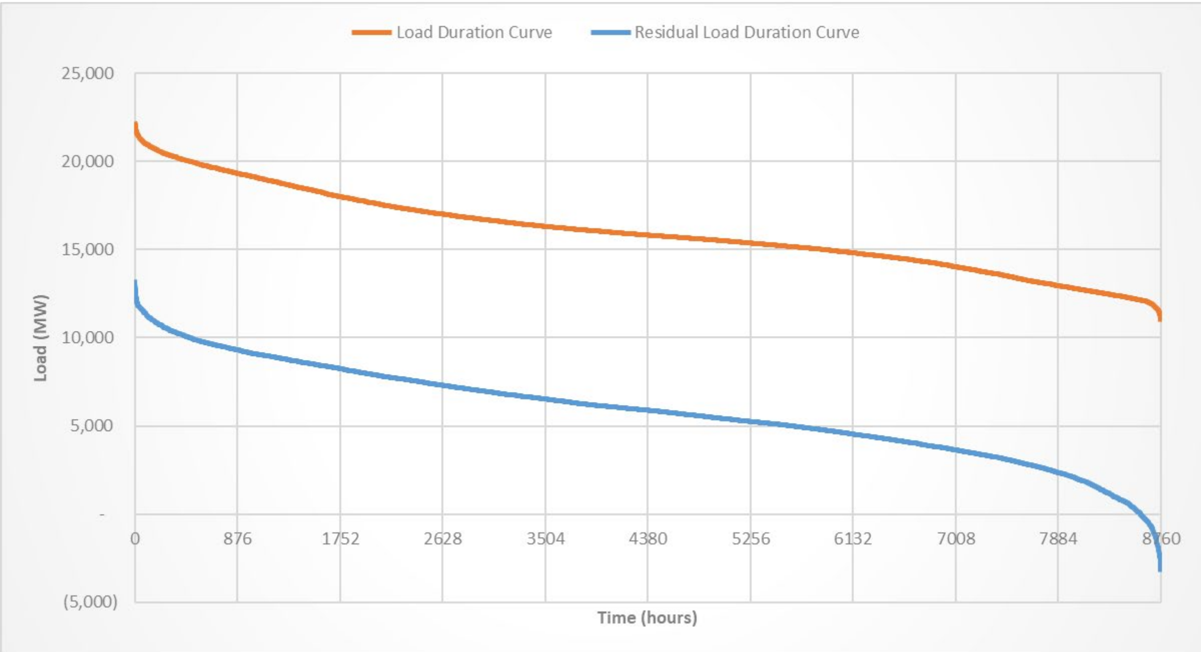
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Isolated



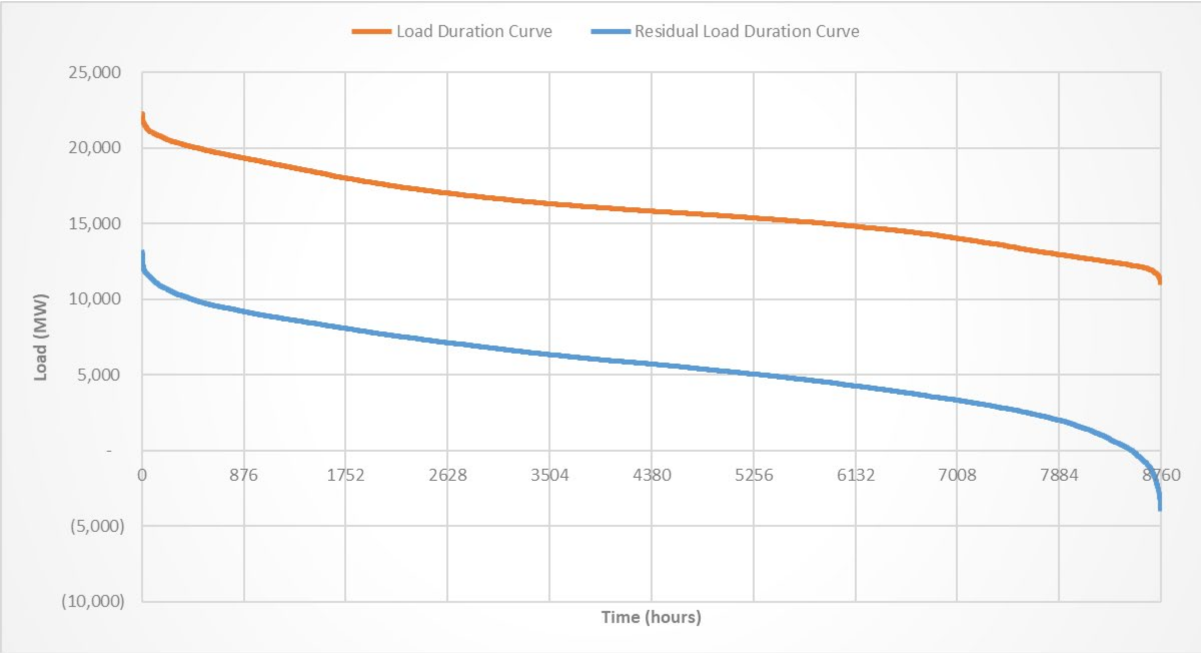
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Isolated



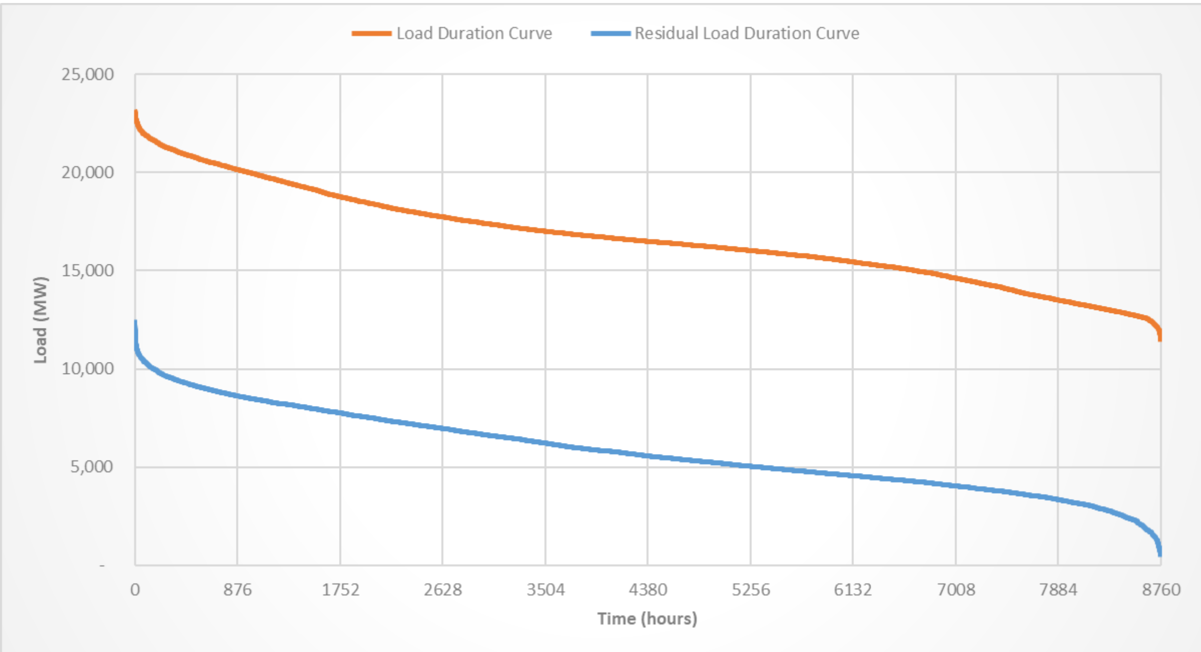
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Isolated



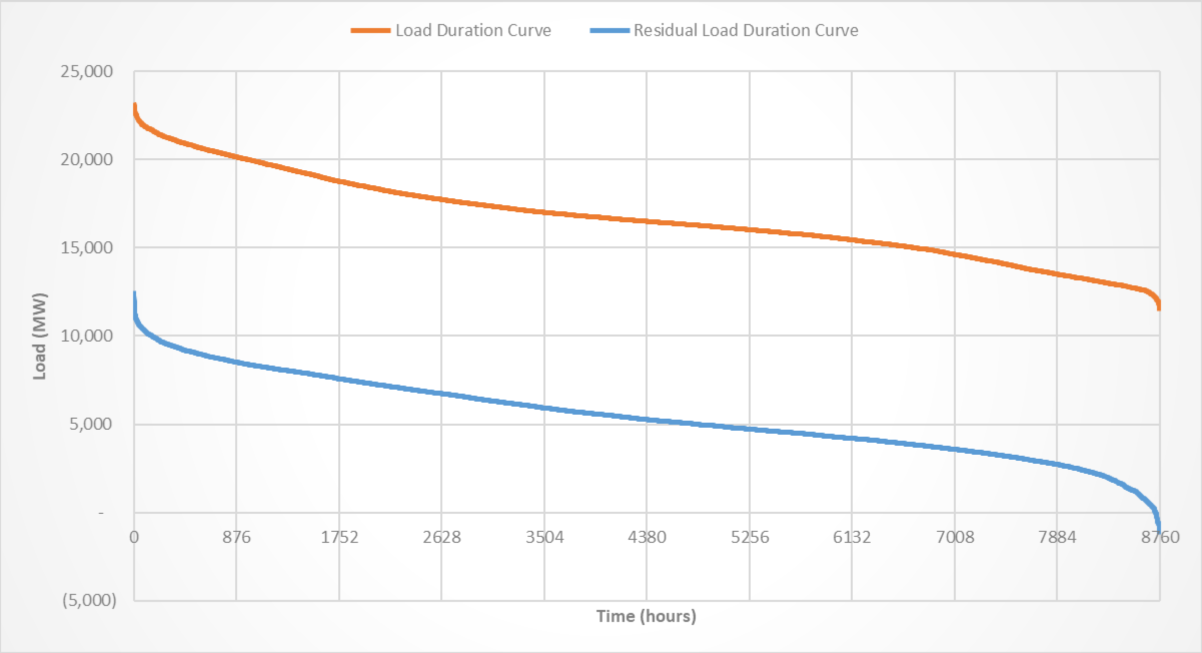
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Isolated



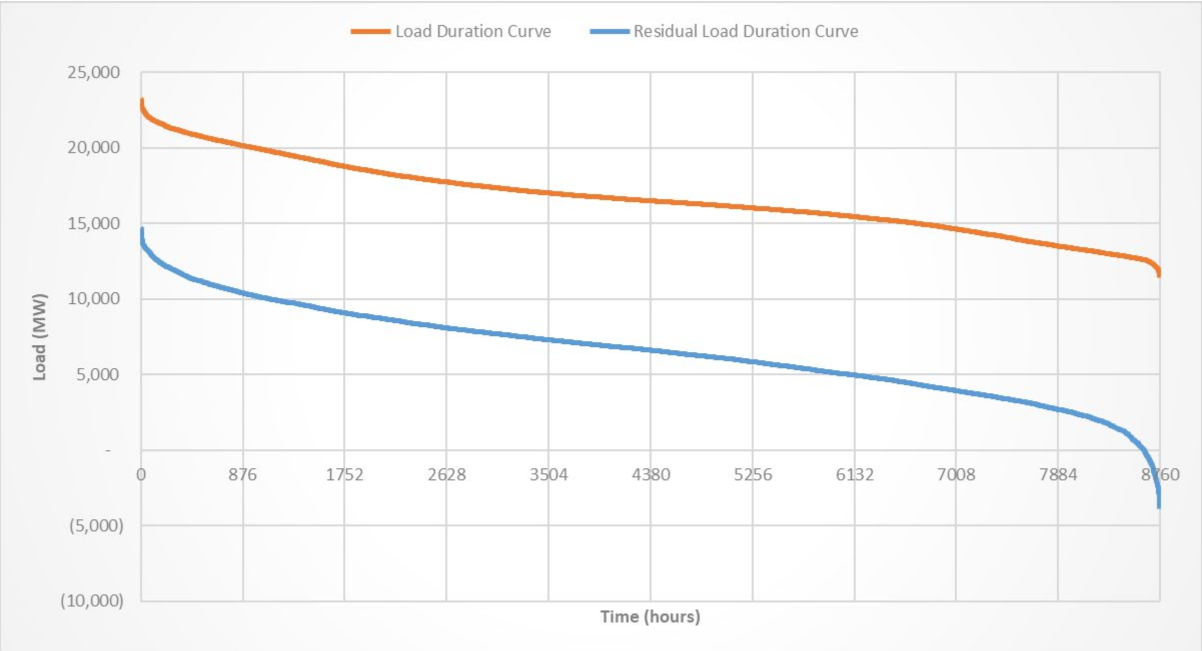
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Isolated



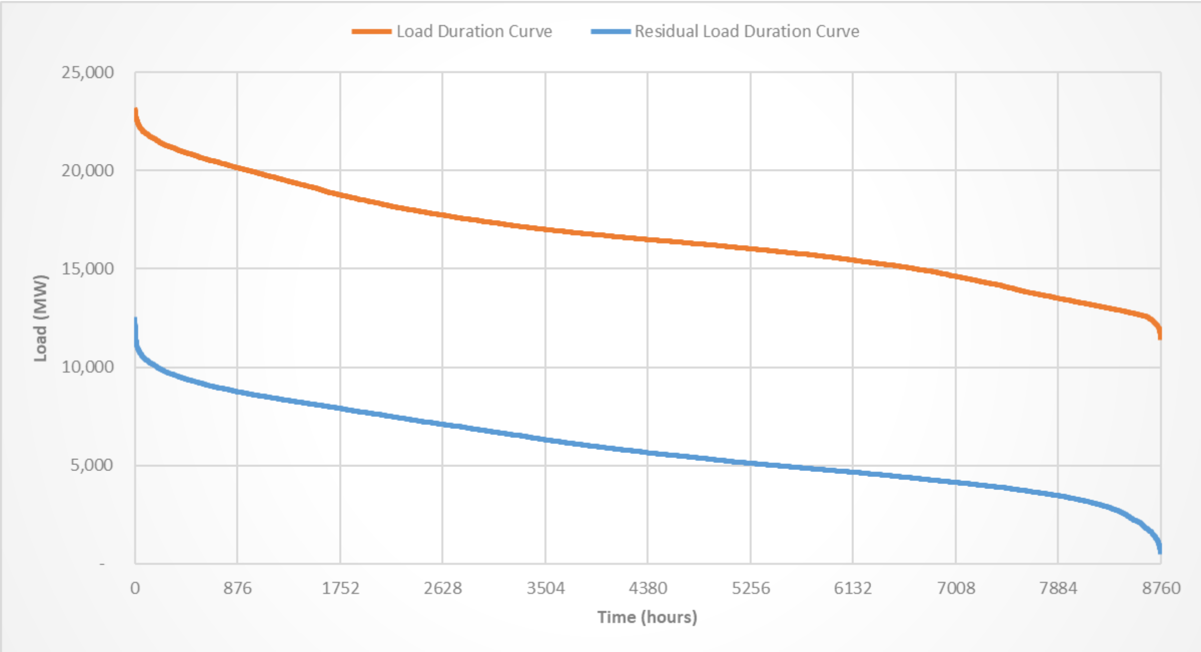
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Isolated



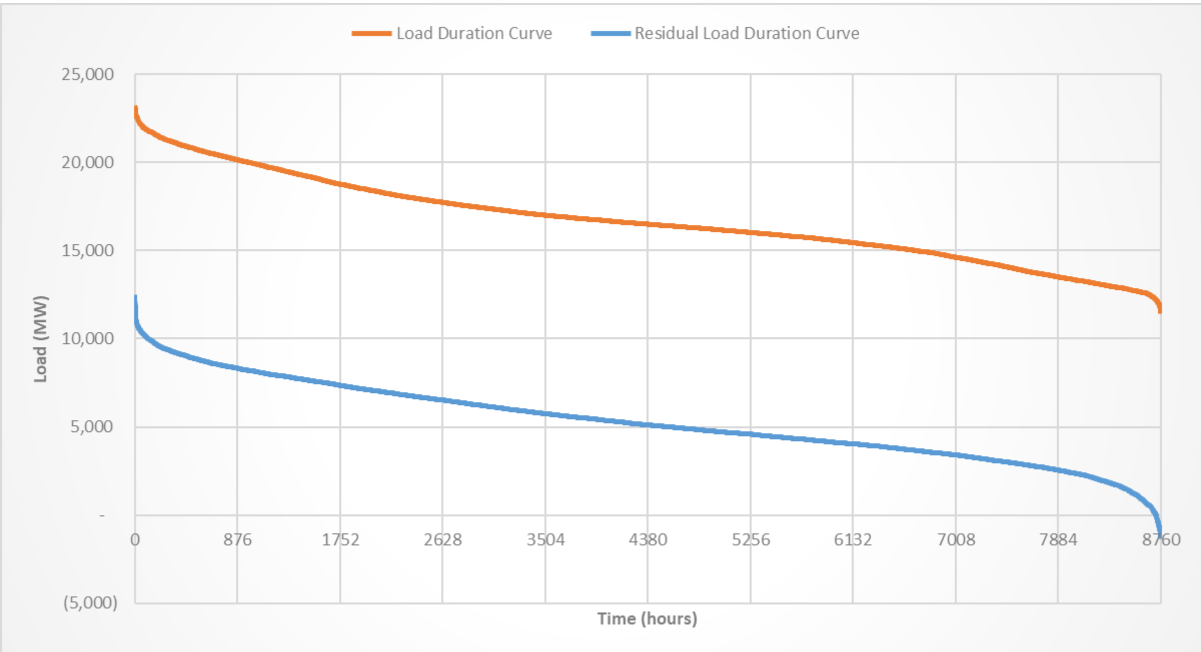
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Isolated



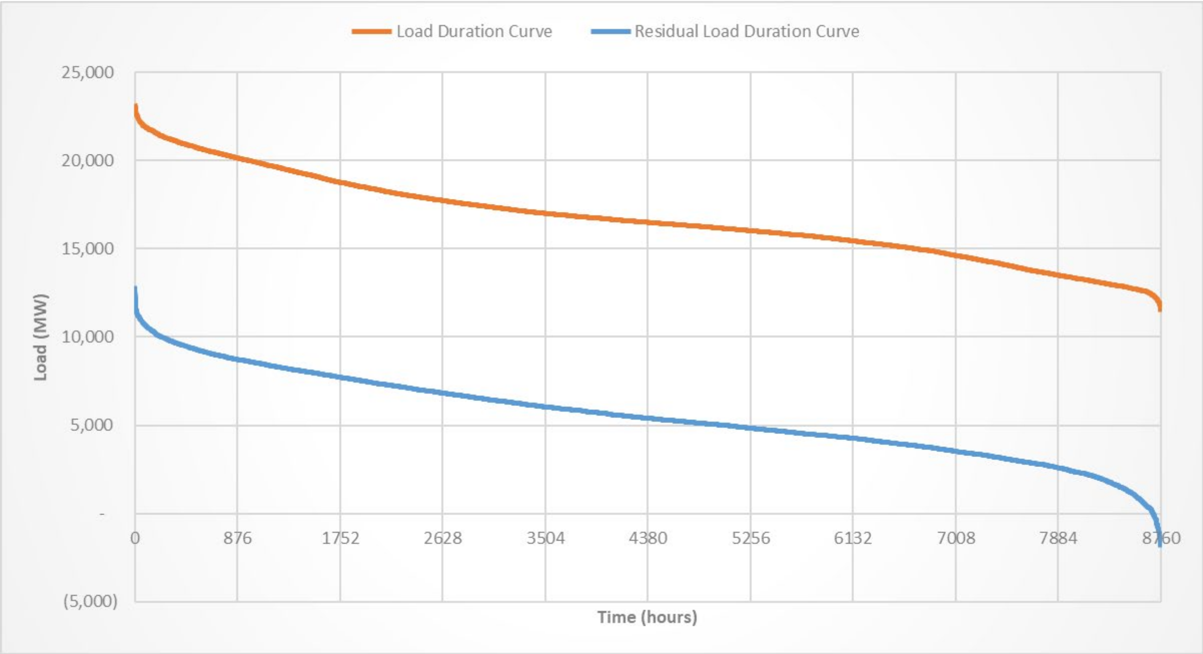
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Isolated



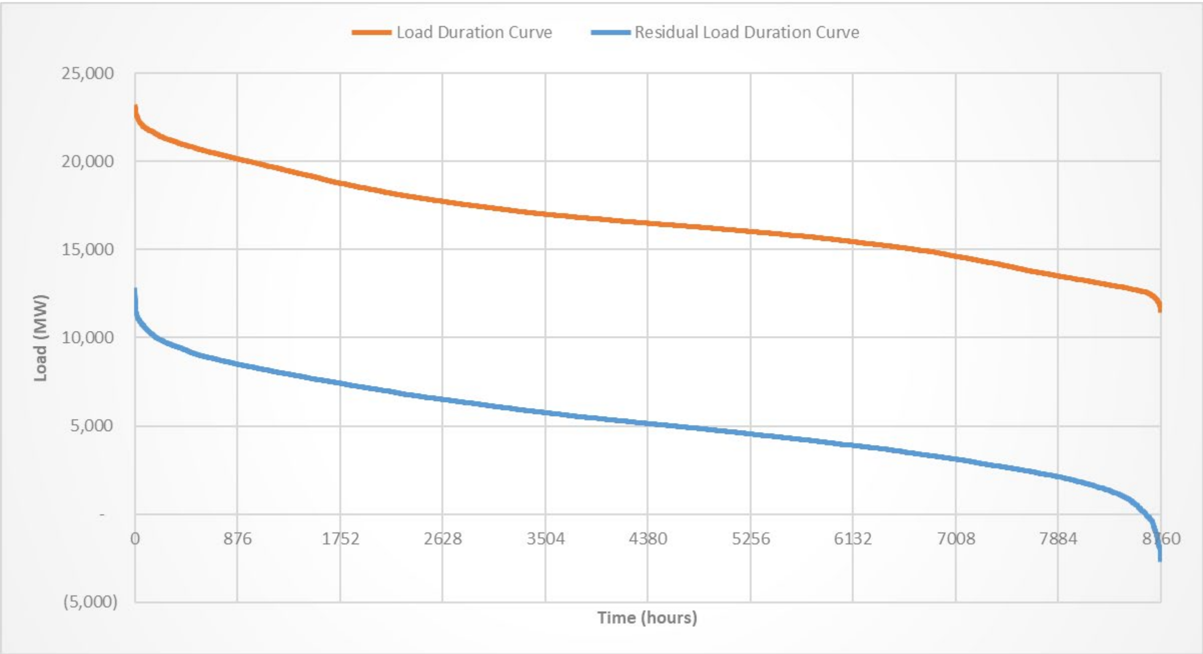
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Isolated



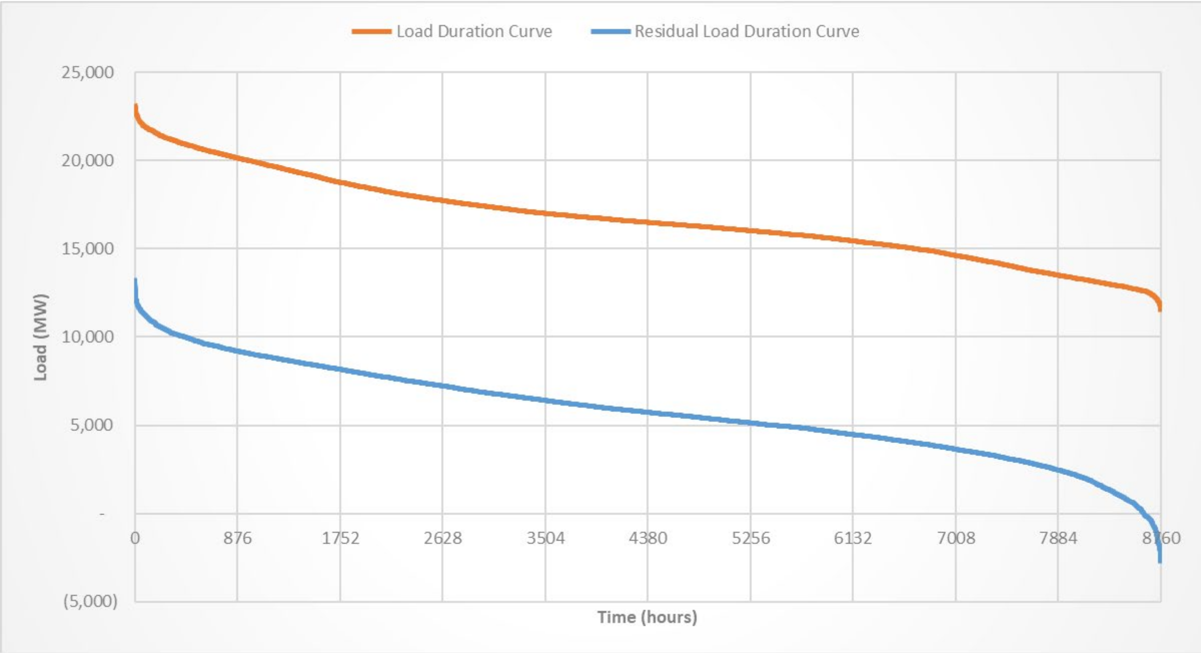
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Isolated



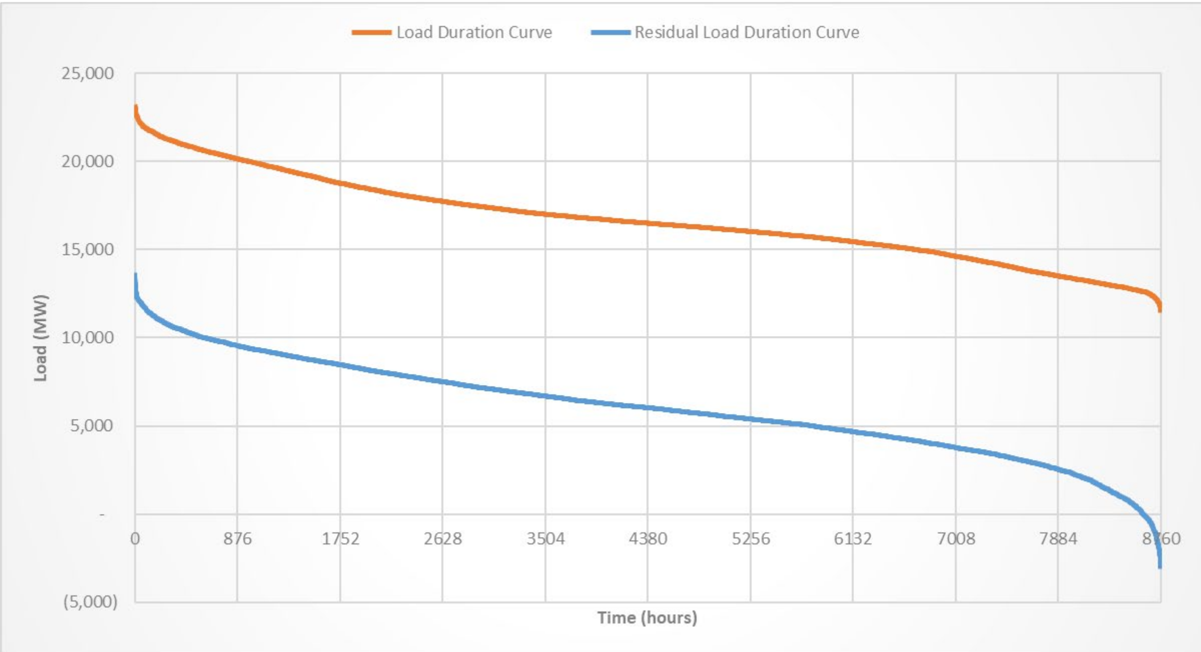
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Isolated



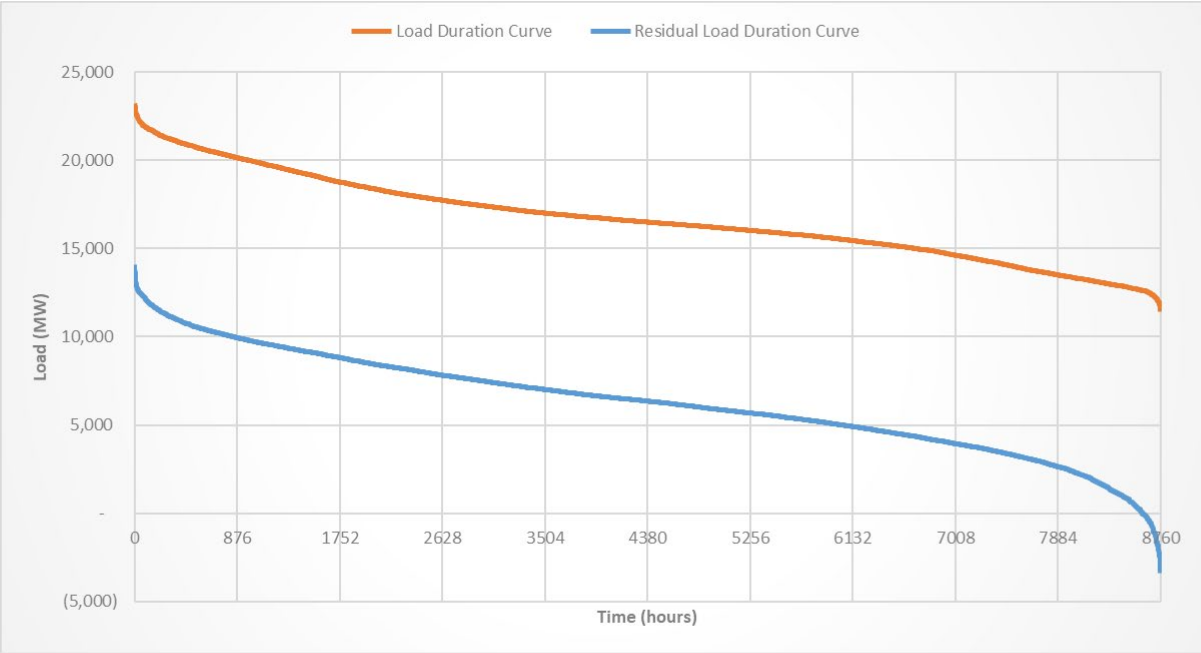
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Isolated



Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Isolated

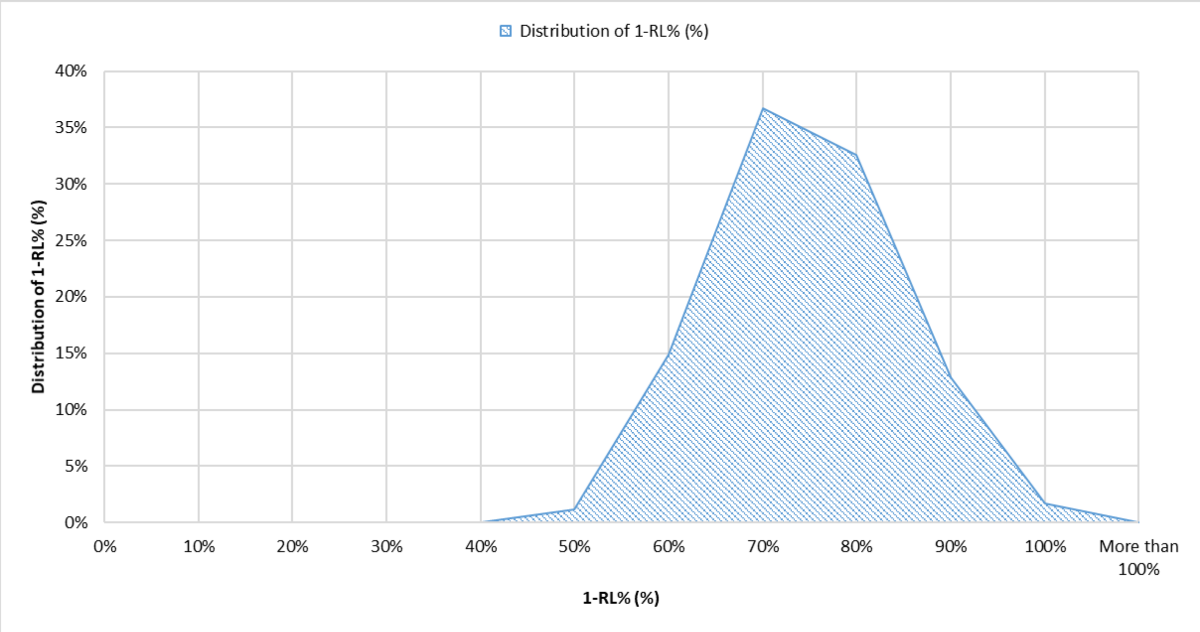


Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Isolated

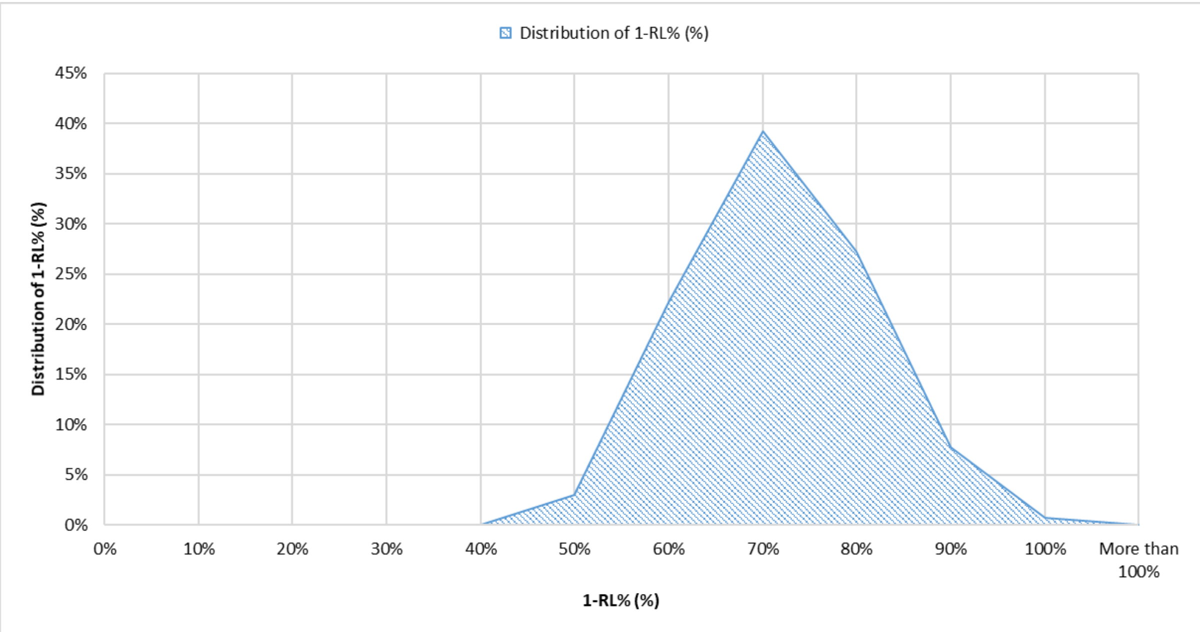


7.2. DETAILED RESULTS OF PROBABILISTIC DISTRIBUTION OF (1-RL%) IN % OF LOAD

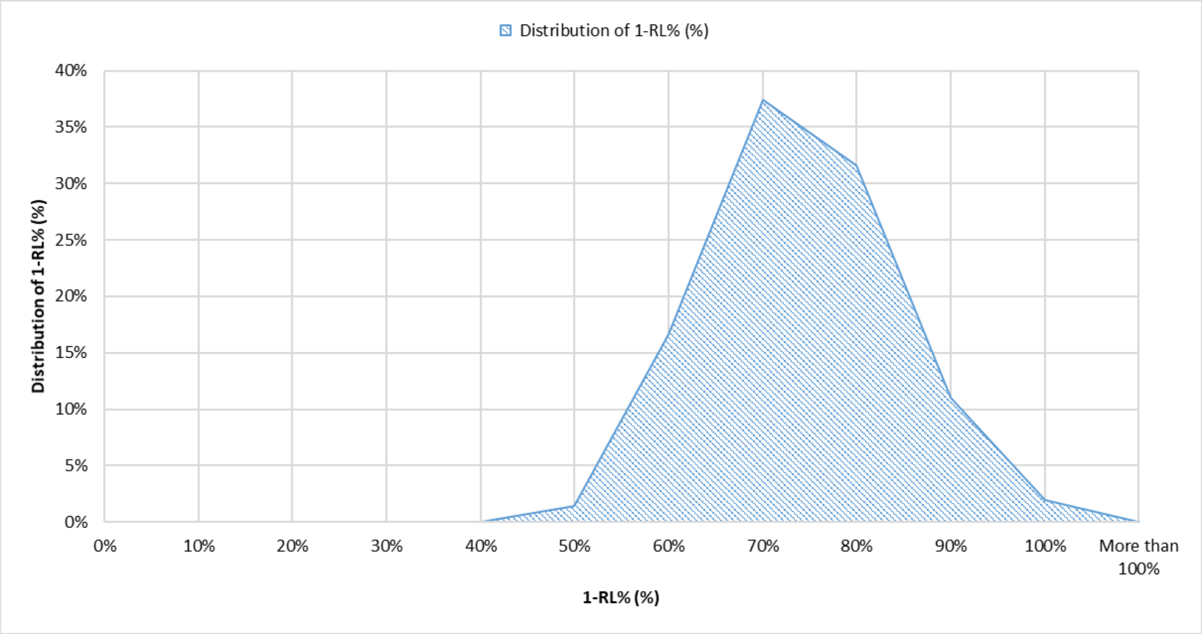
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



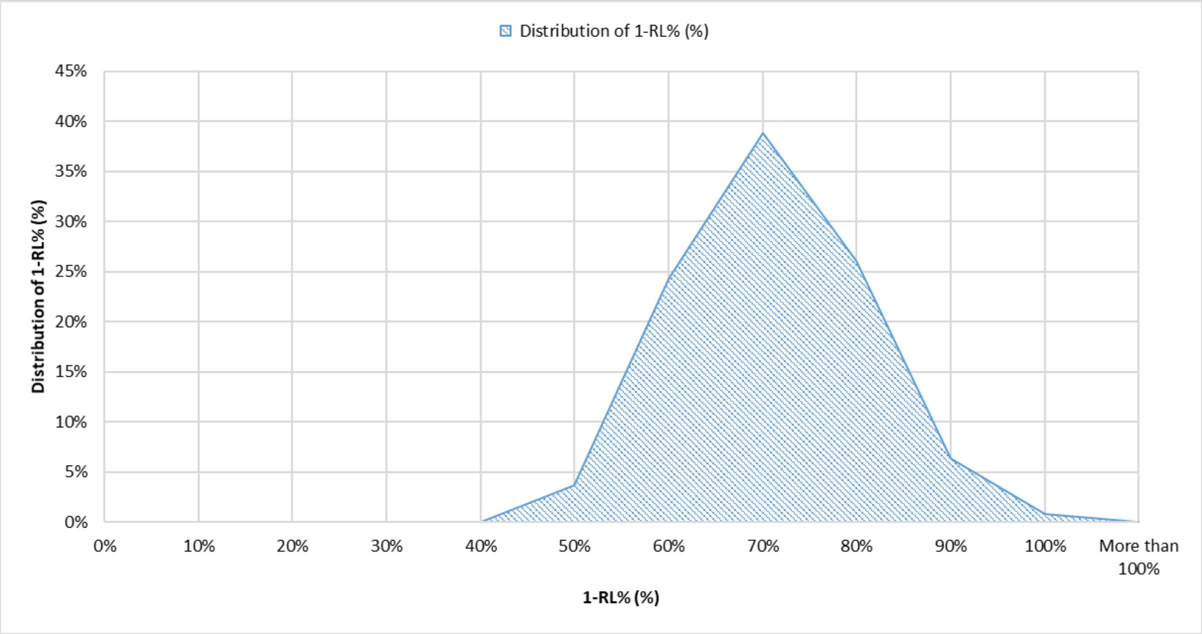
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=15% Reduction Interconnected



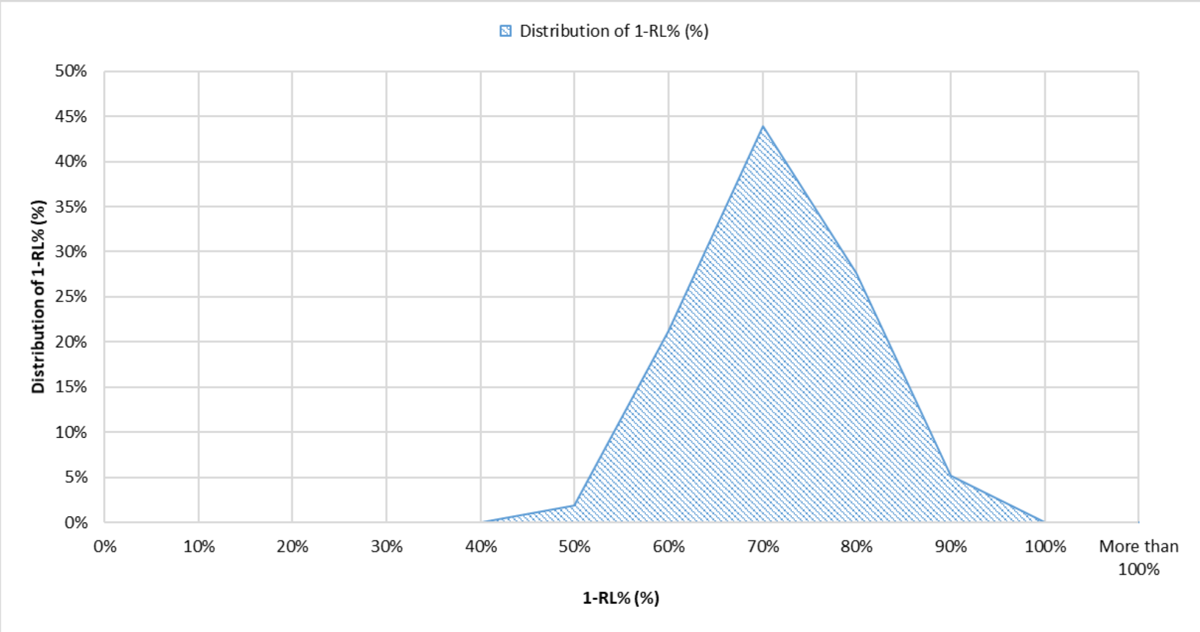
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



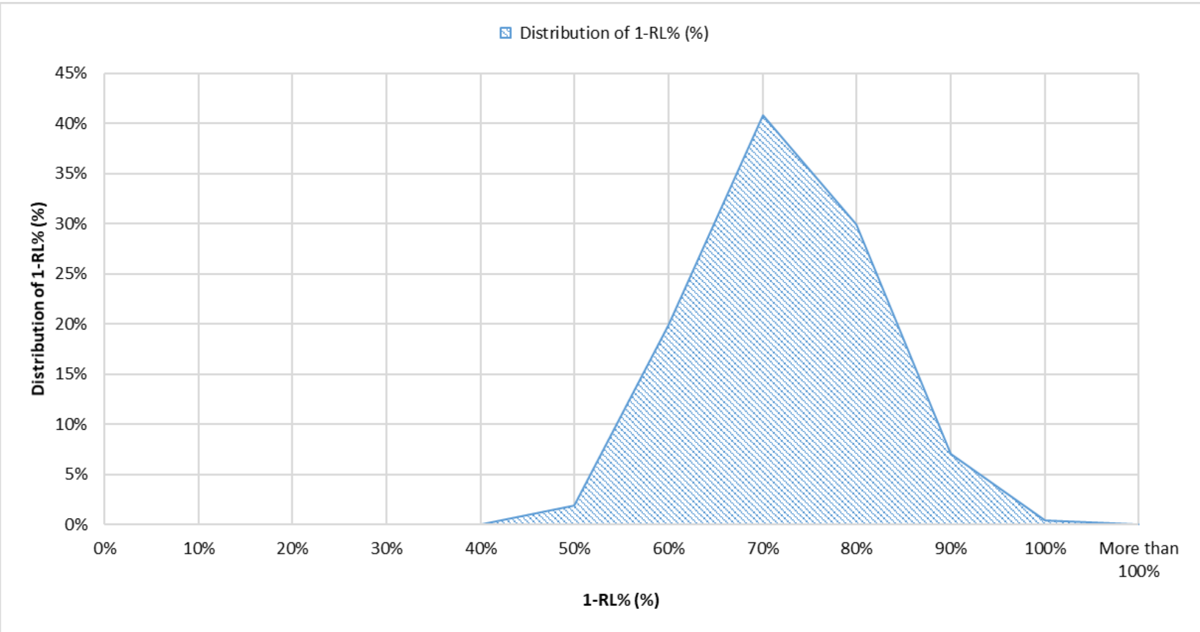
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=15% Reduction Interconnected



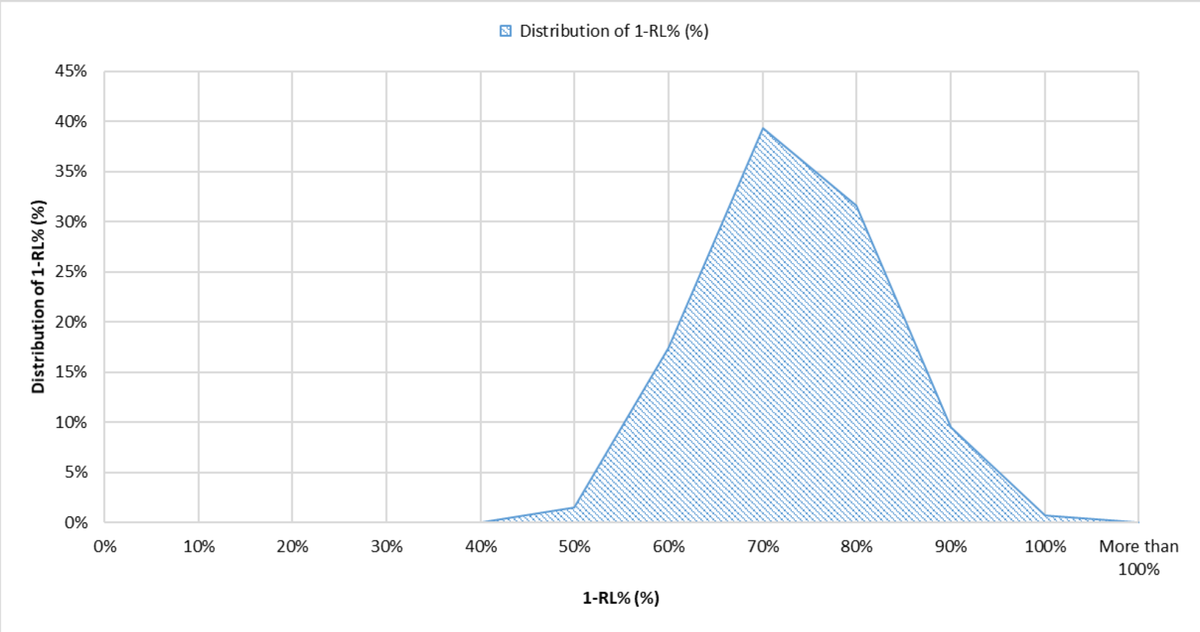
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=5,000MW Interconnected



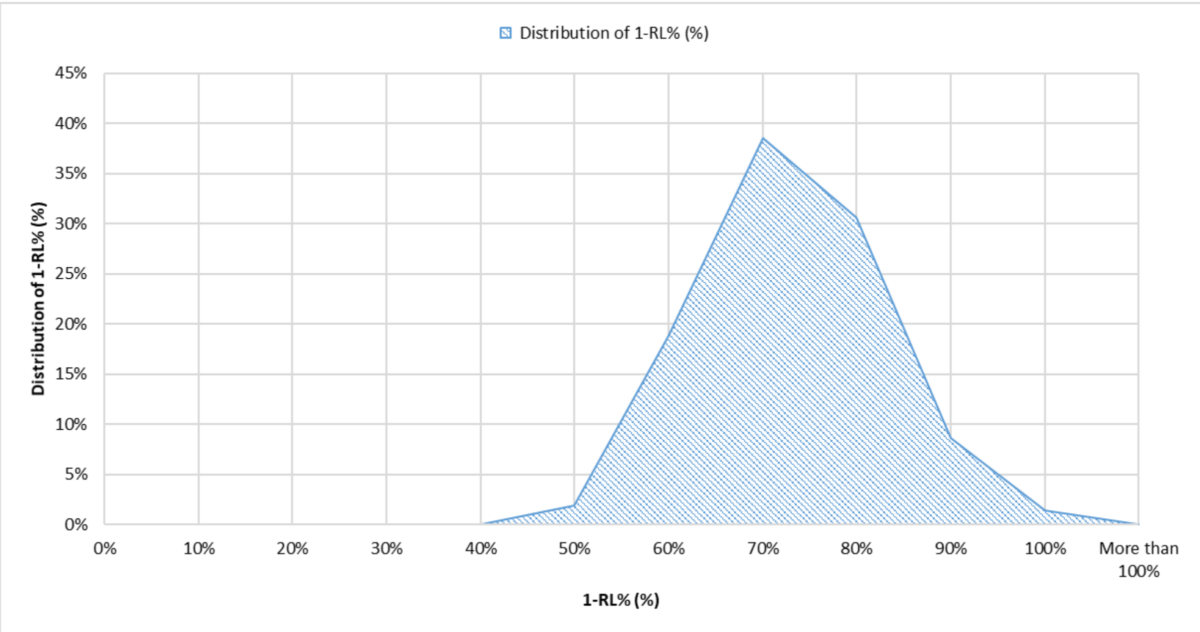
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=6,000MW Interconnected



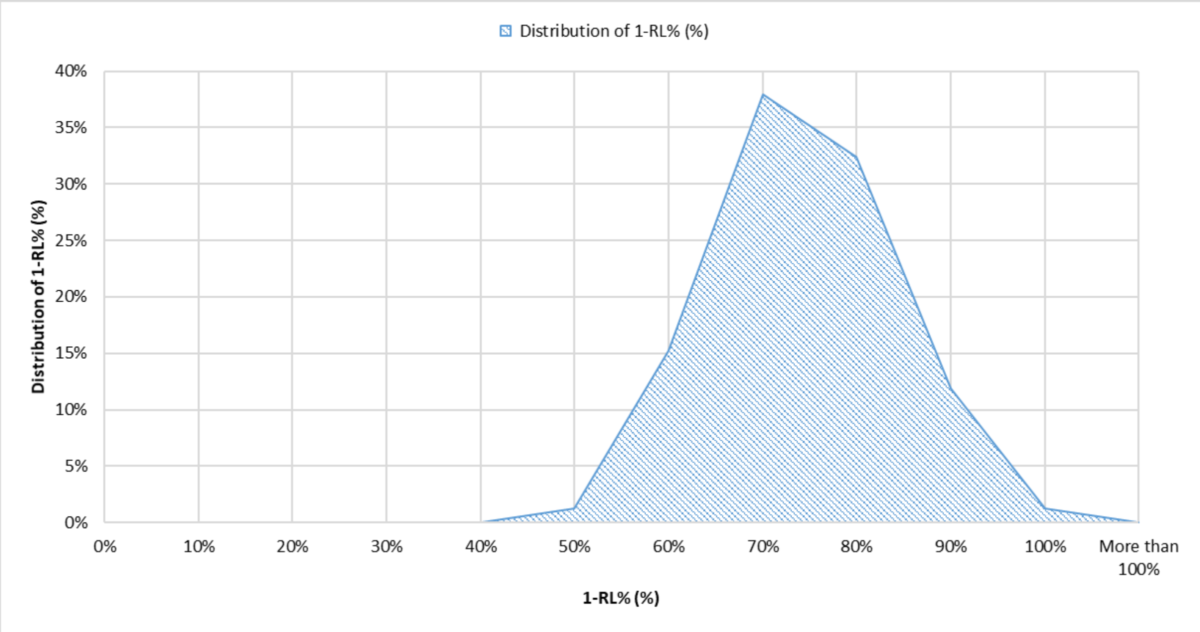
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=6,000MW Interconnected



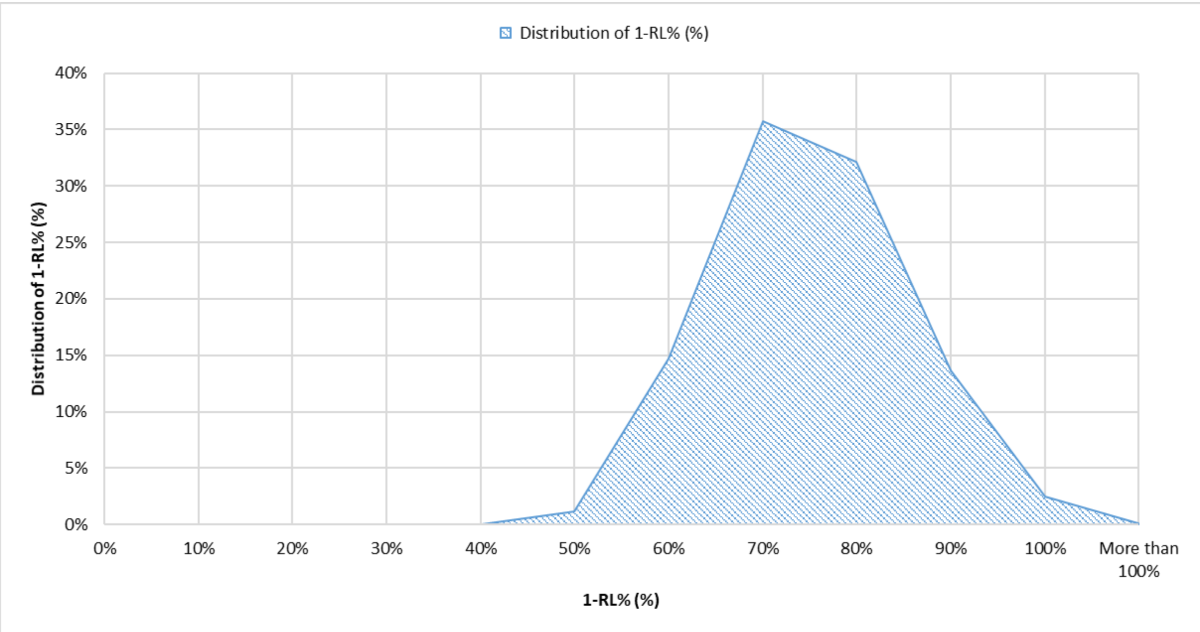
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=7,000MW Interconnected



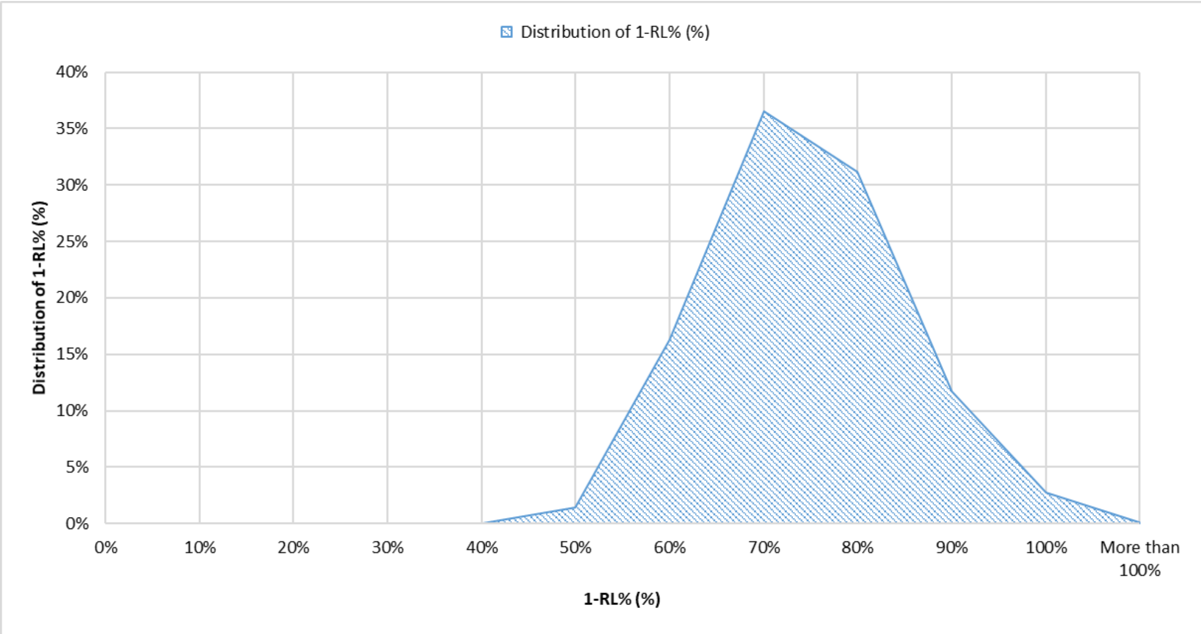
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=6,000MW Interconnected



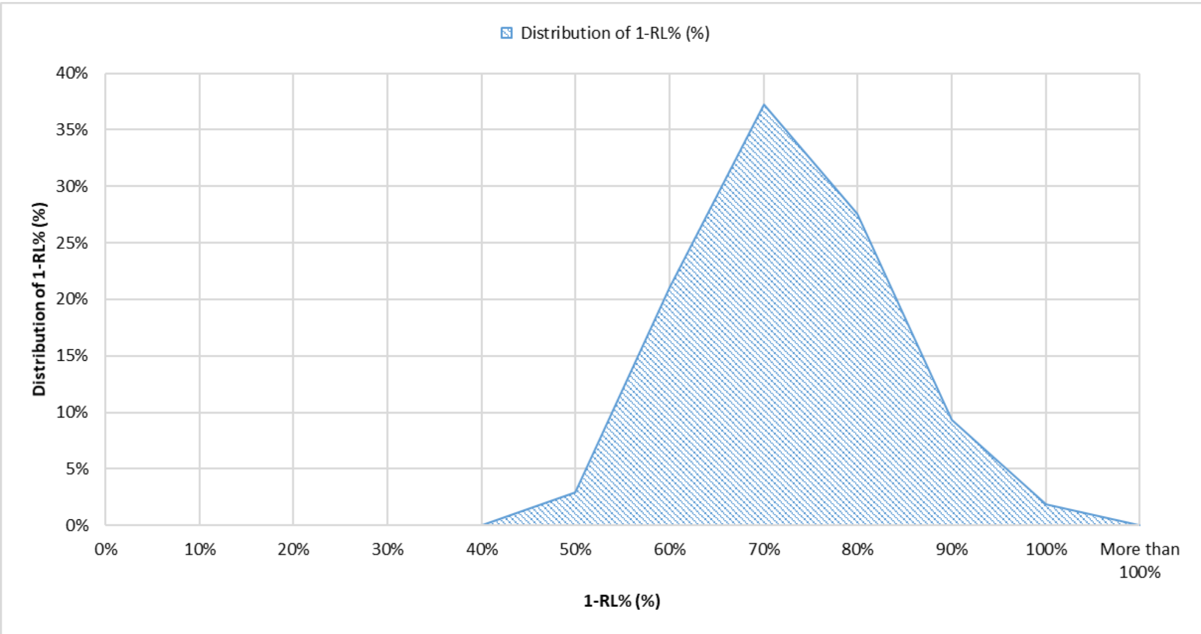
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,000MW Interconnected



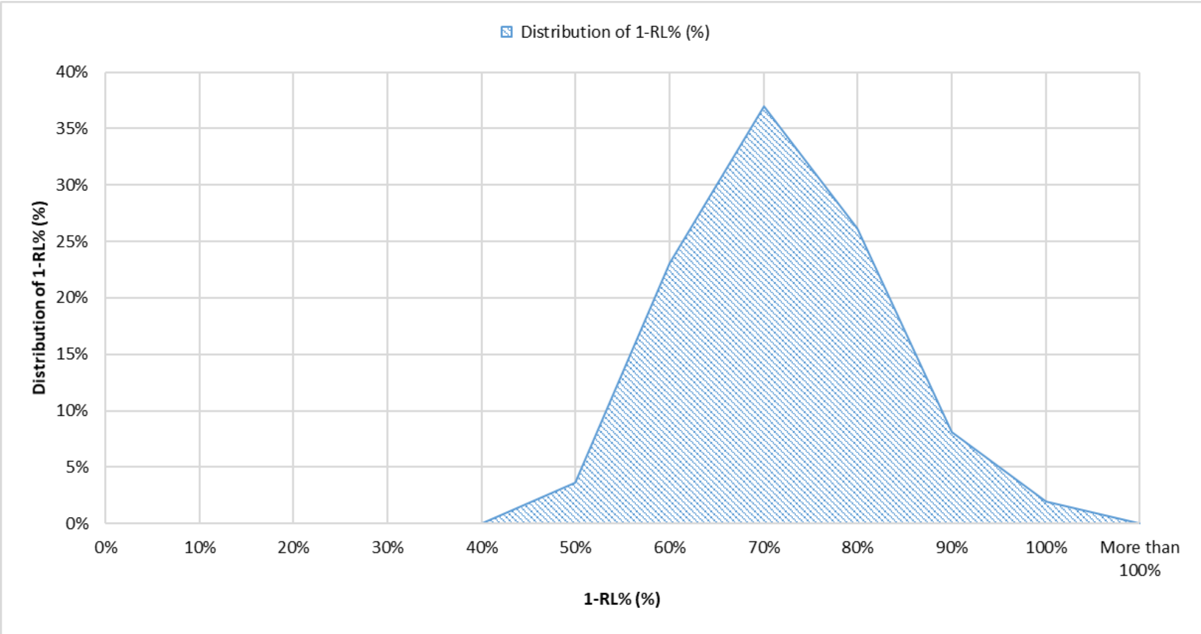
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,500MW Interconnected



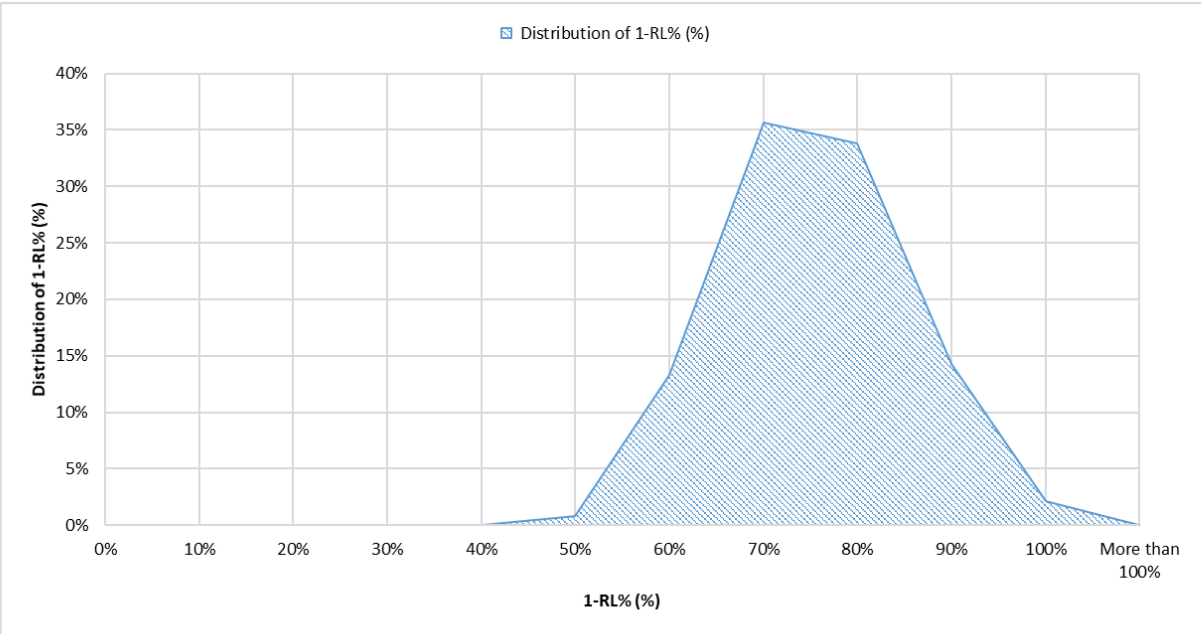
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,500MW Interconnected



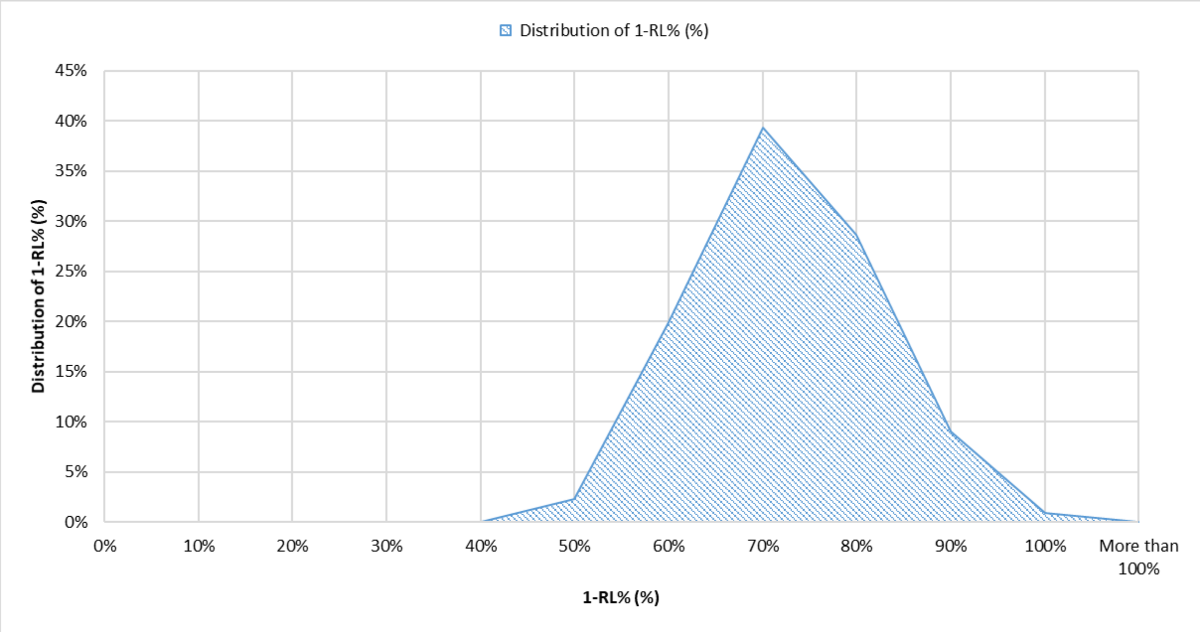
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=8,000MW Interconnected



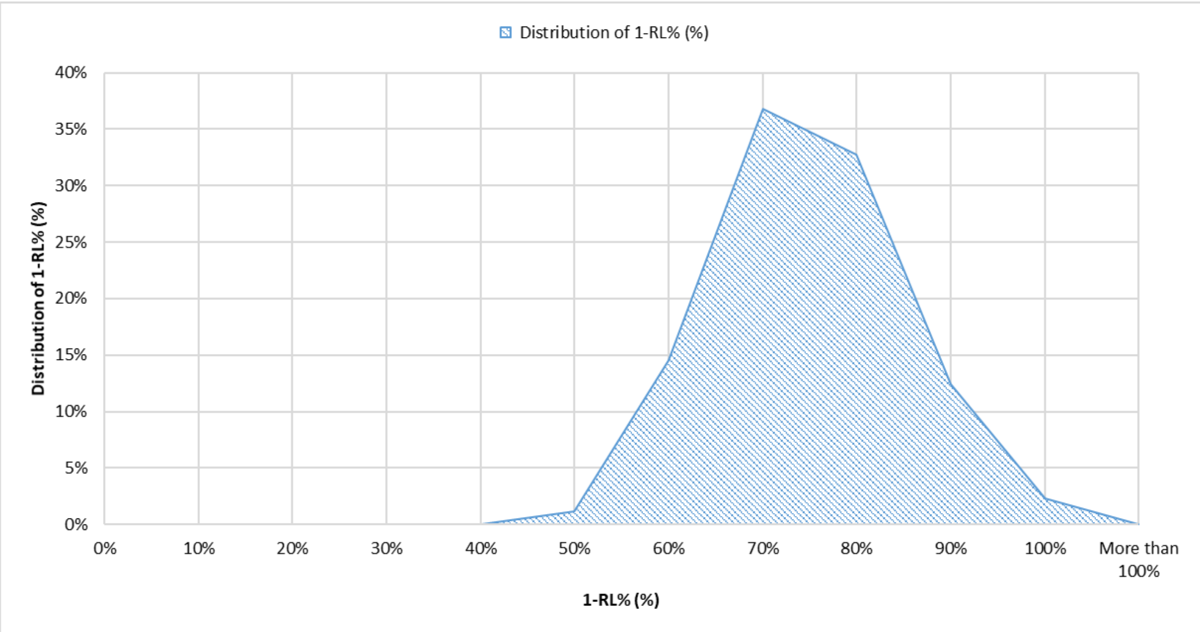
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=7.5% Reduction Interconnected



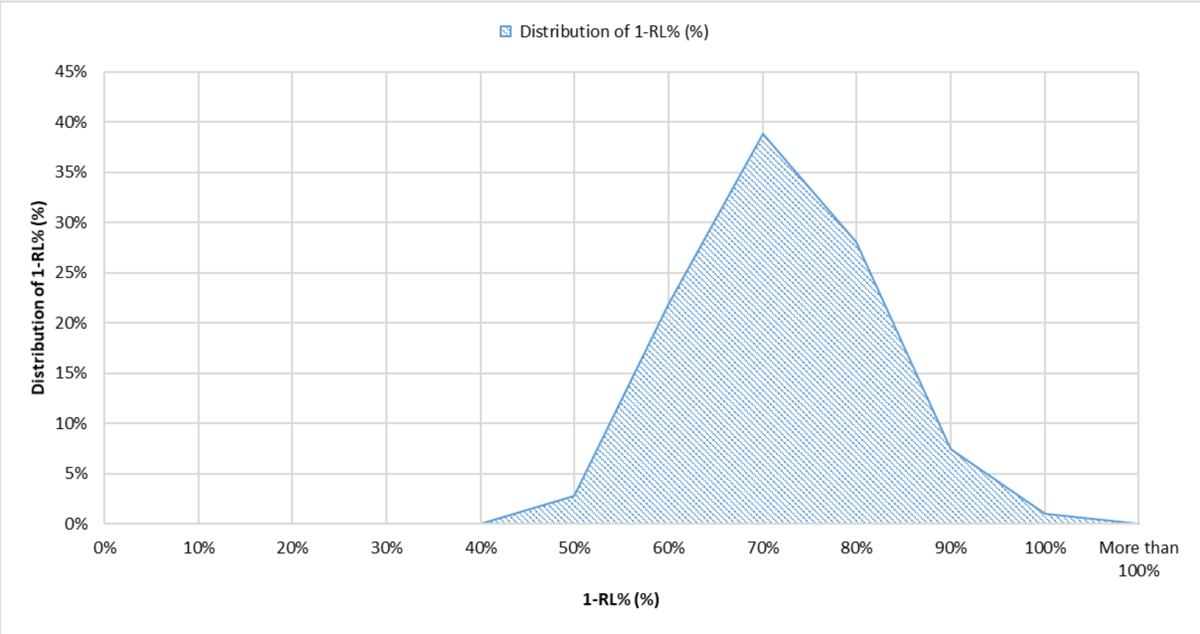
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=12.5% Reduction Interconnected



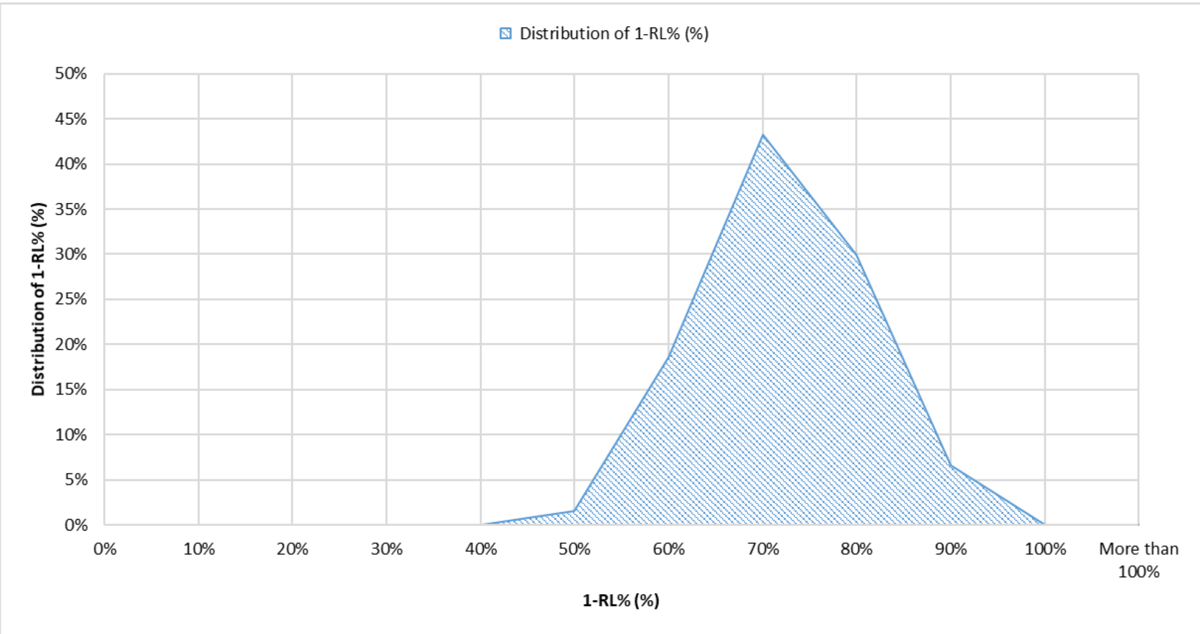
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=7.5% Reduction Interconnected



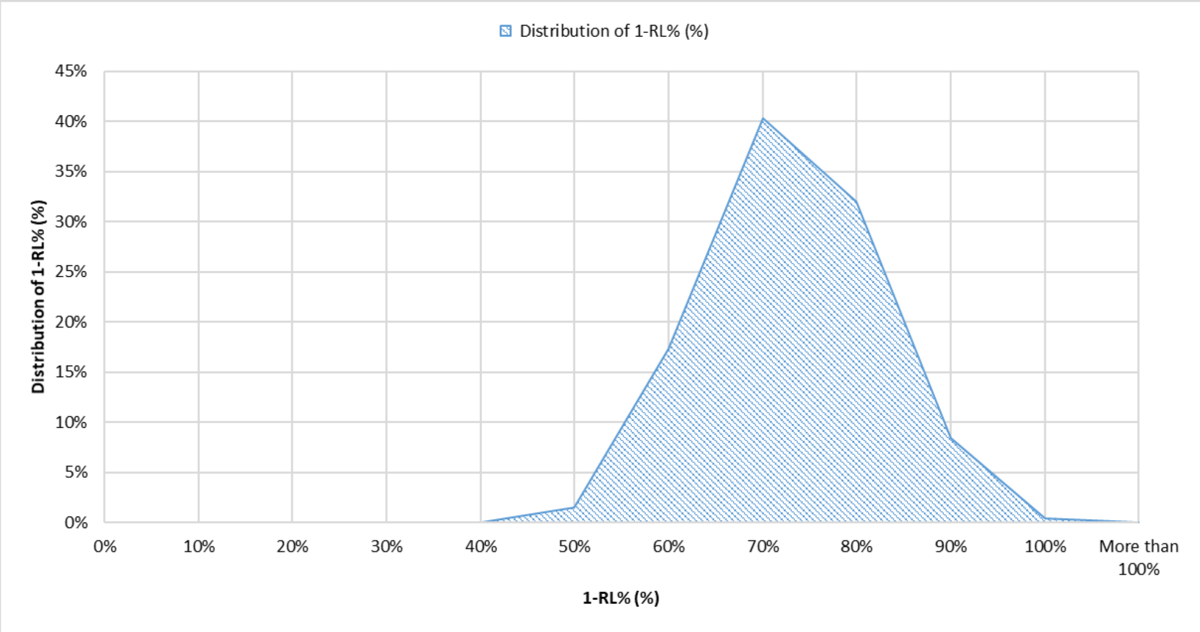
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=12.5% Reduction Interconnected



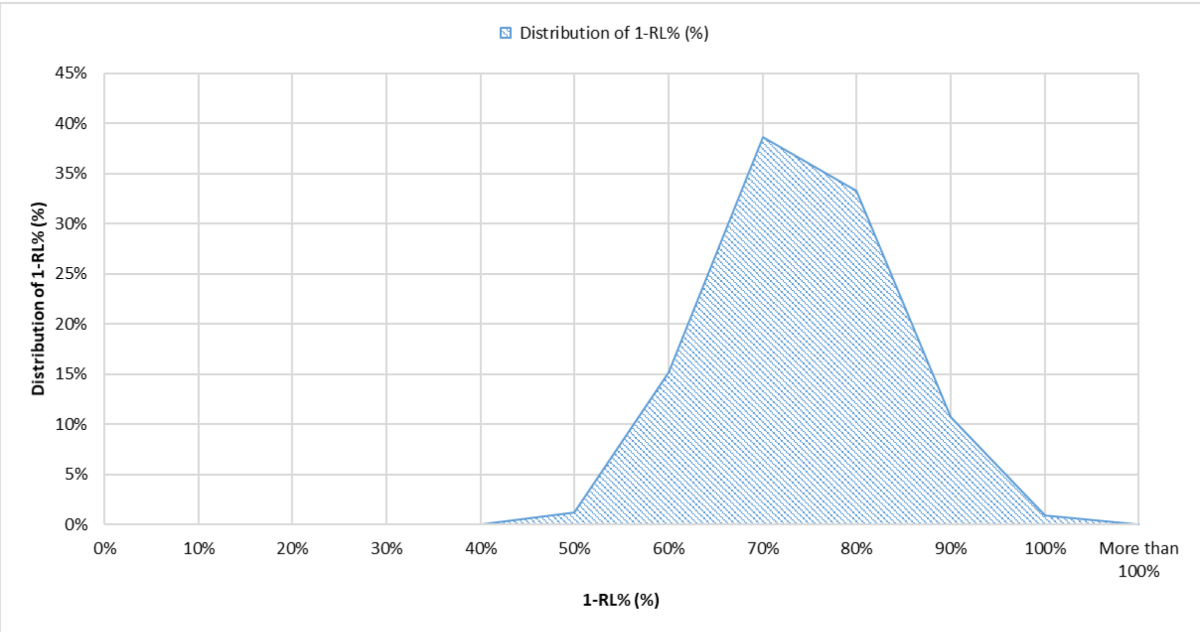
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=5,000MW Interconnected



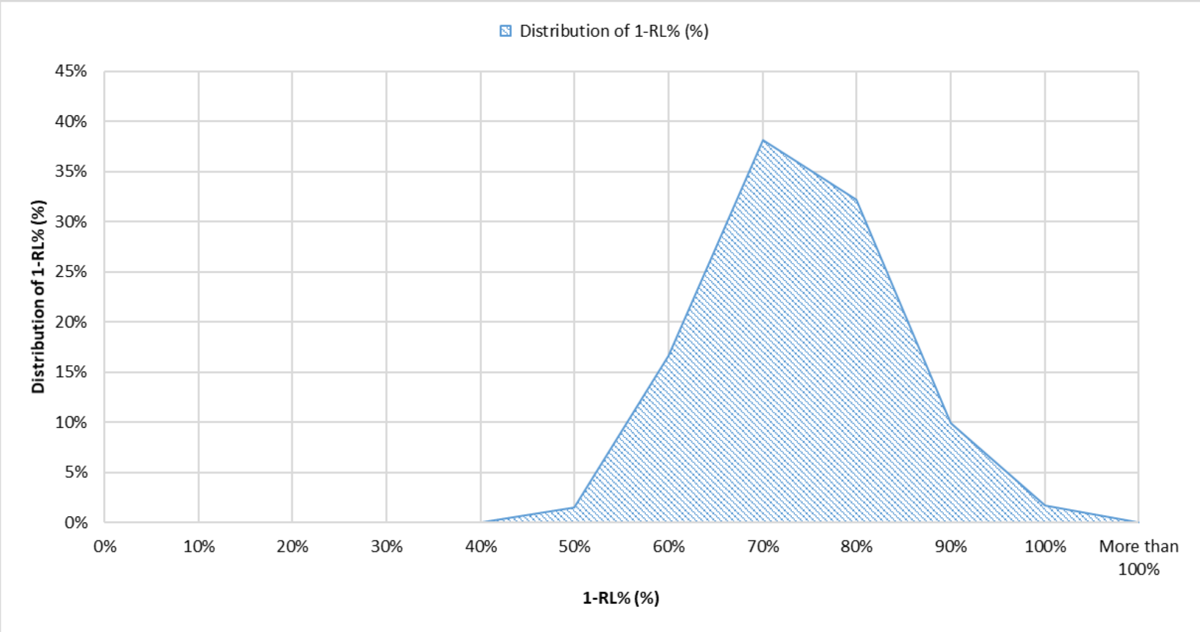
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=6,000MW Interconnected



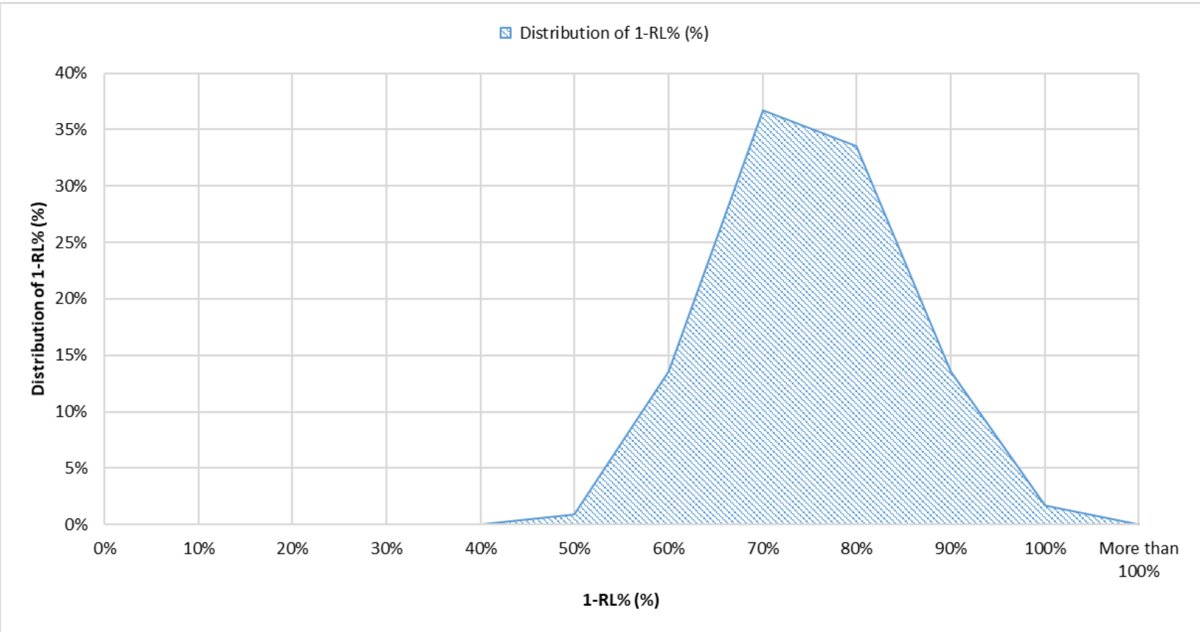
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=6,000MW Interconnected



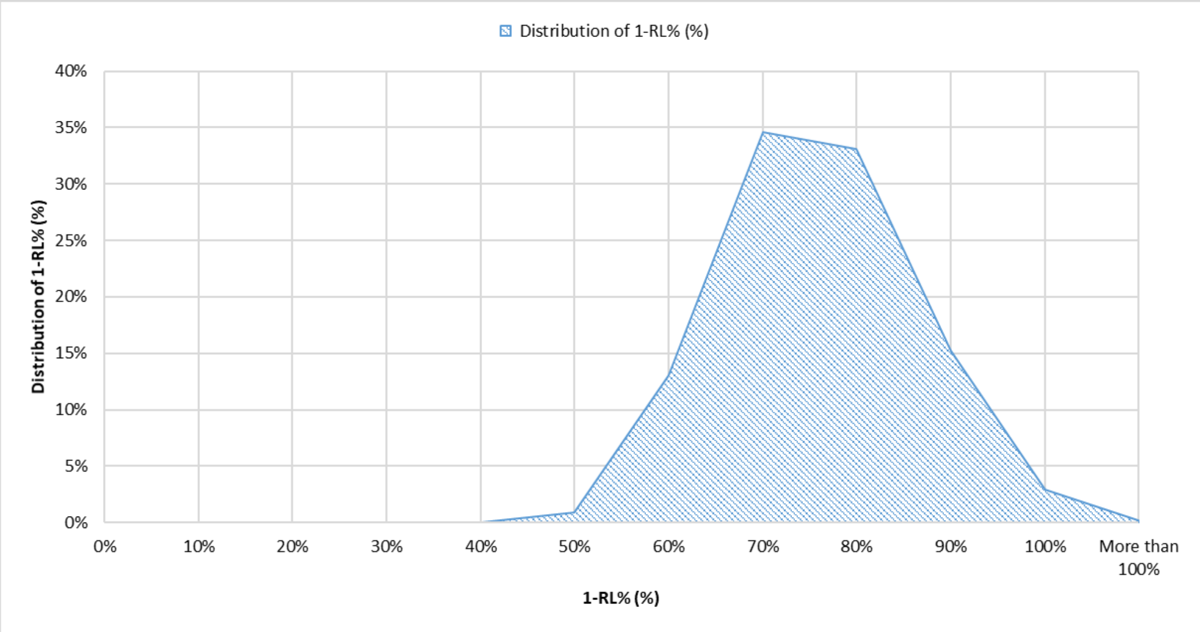
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=7,000MW Interconnected



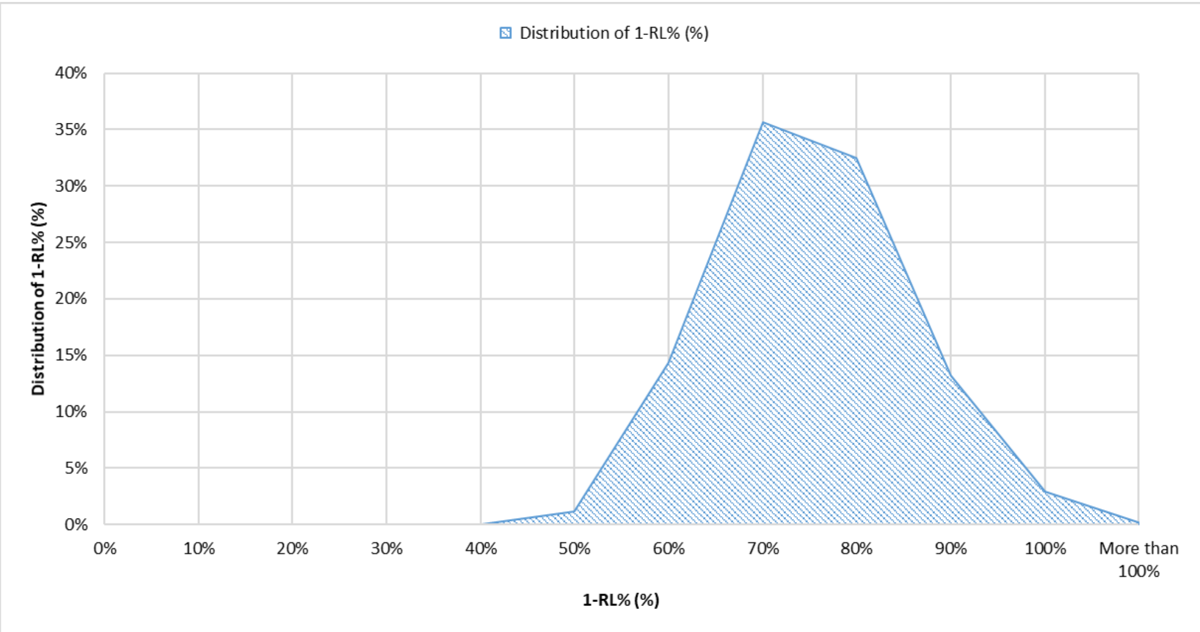
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=6,000MW Interconnected



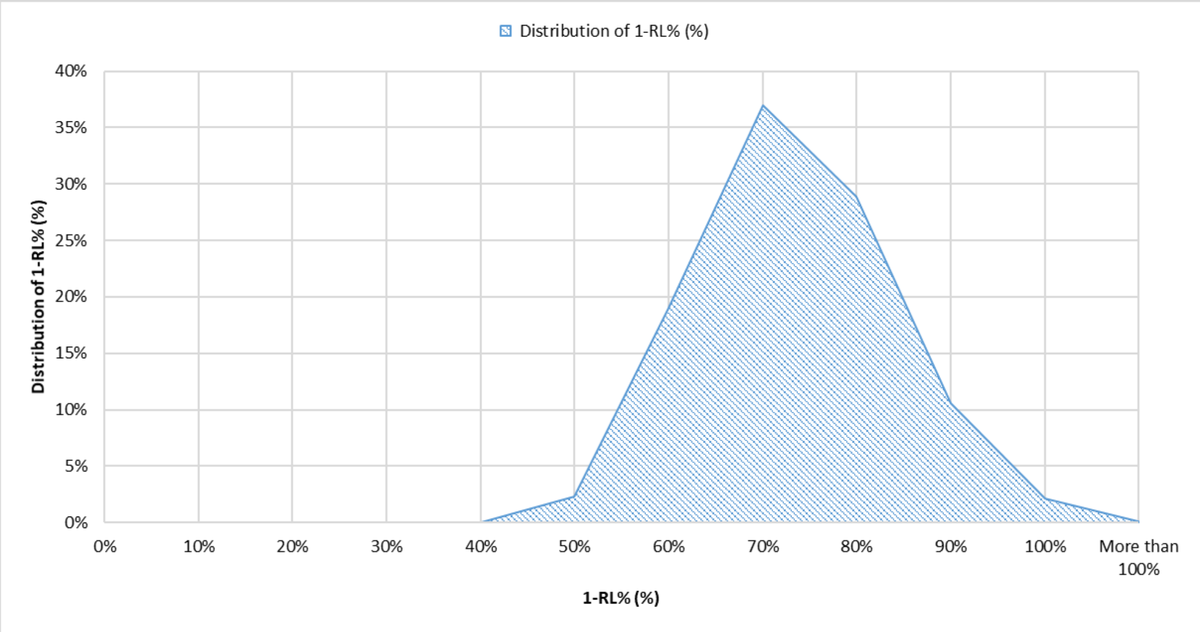
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,000MW Interconnected



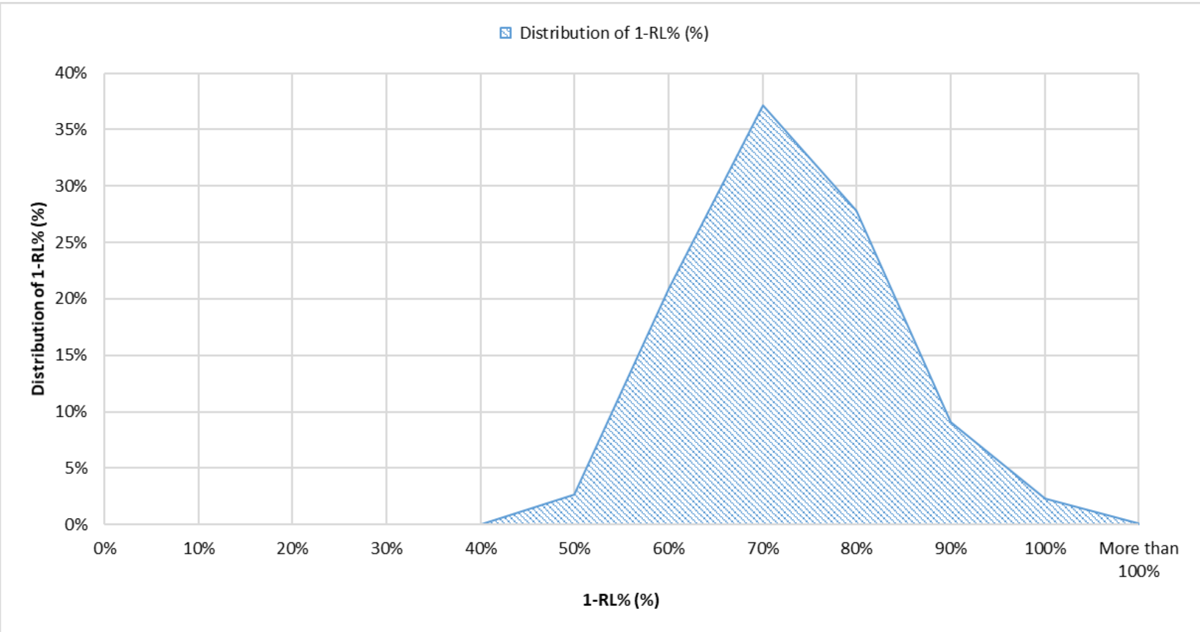
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,500MW Interconnected



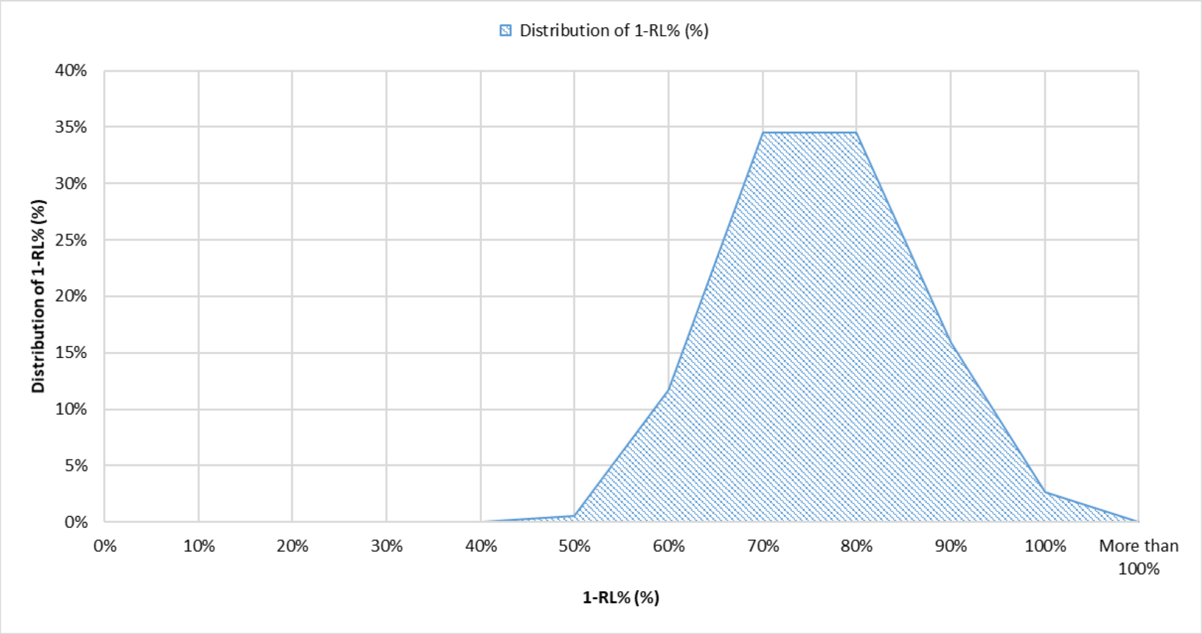
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,500MW Interconnected



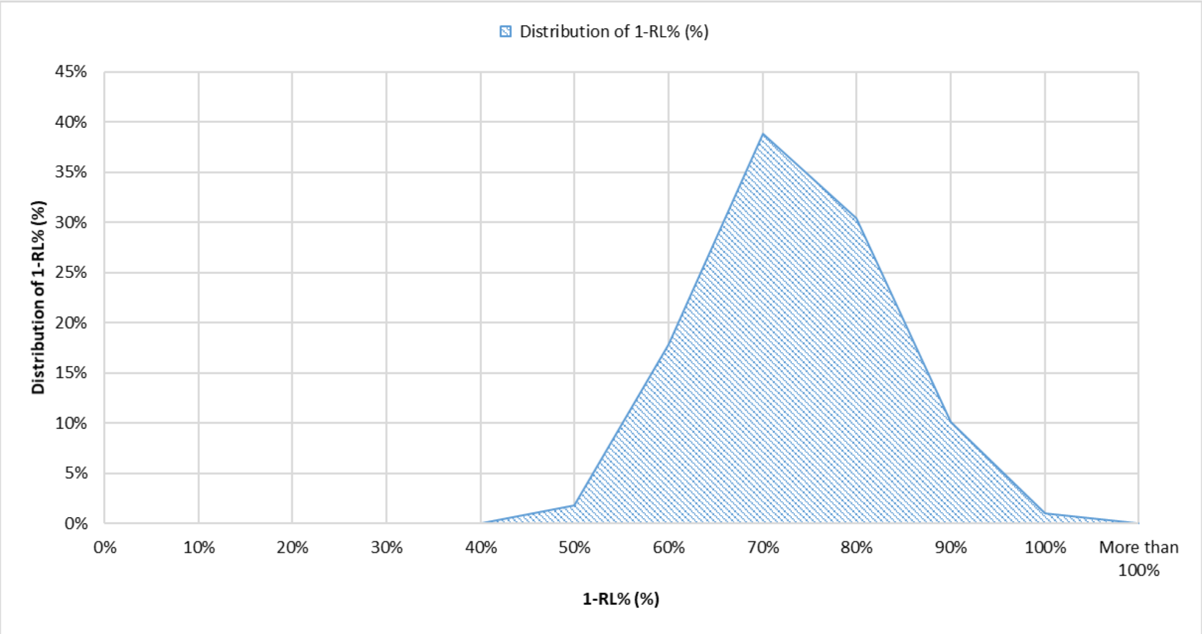
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=8,000MW Interconnected



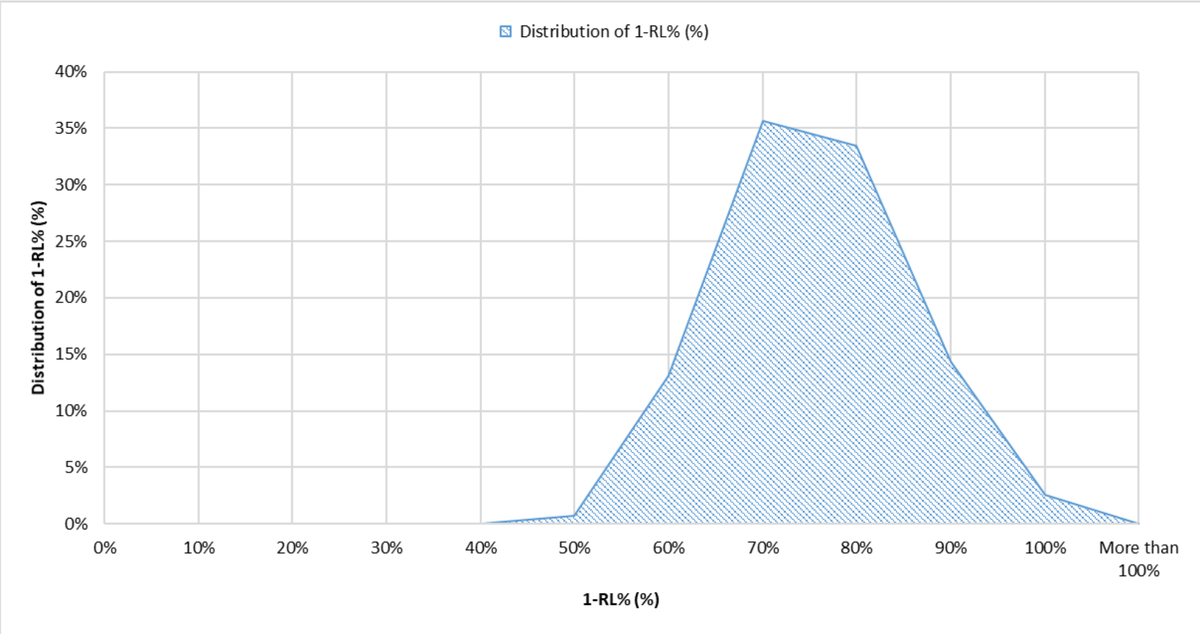
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=5% Reduction Interconnected



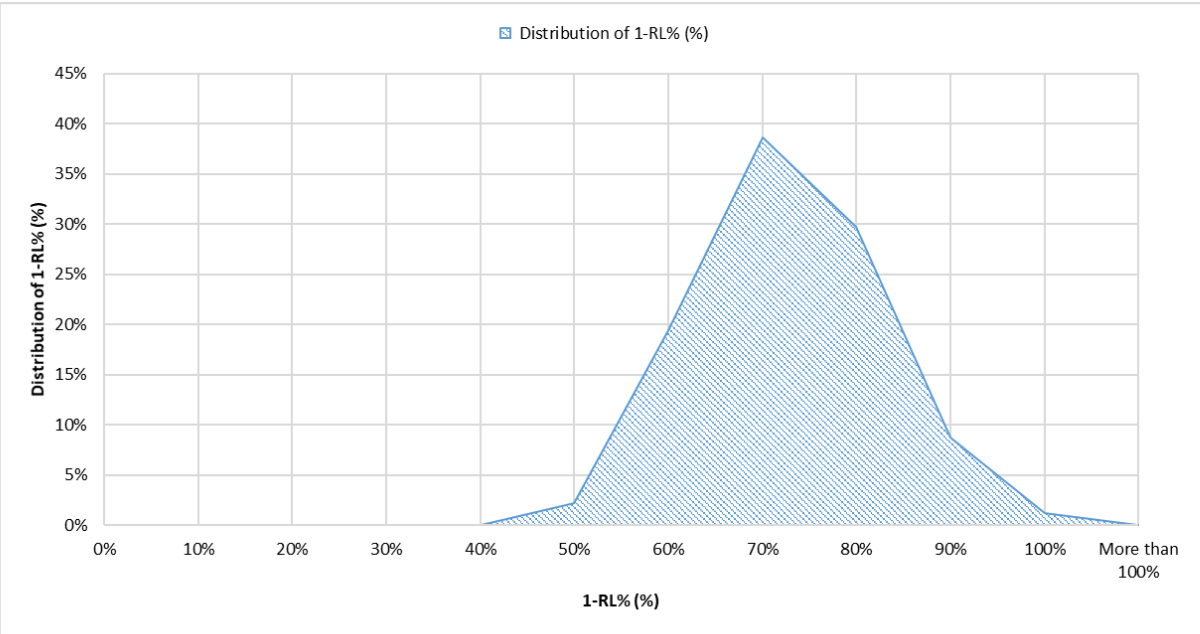
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



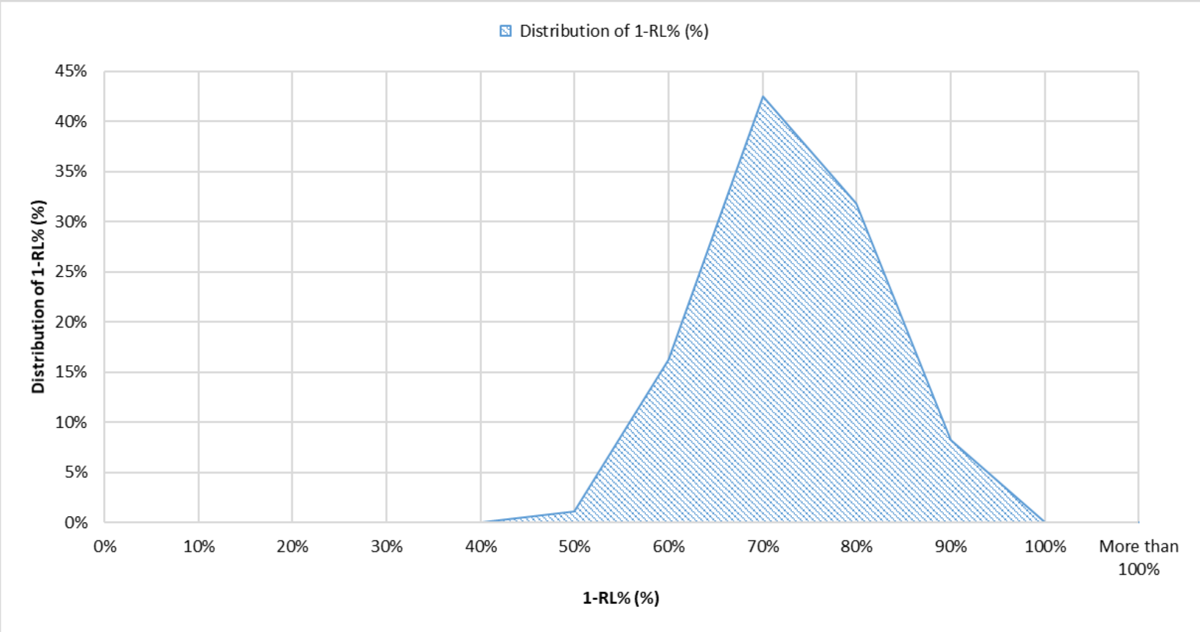
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=5% Reduction Interconnected



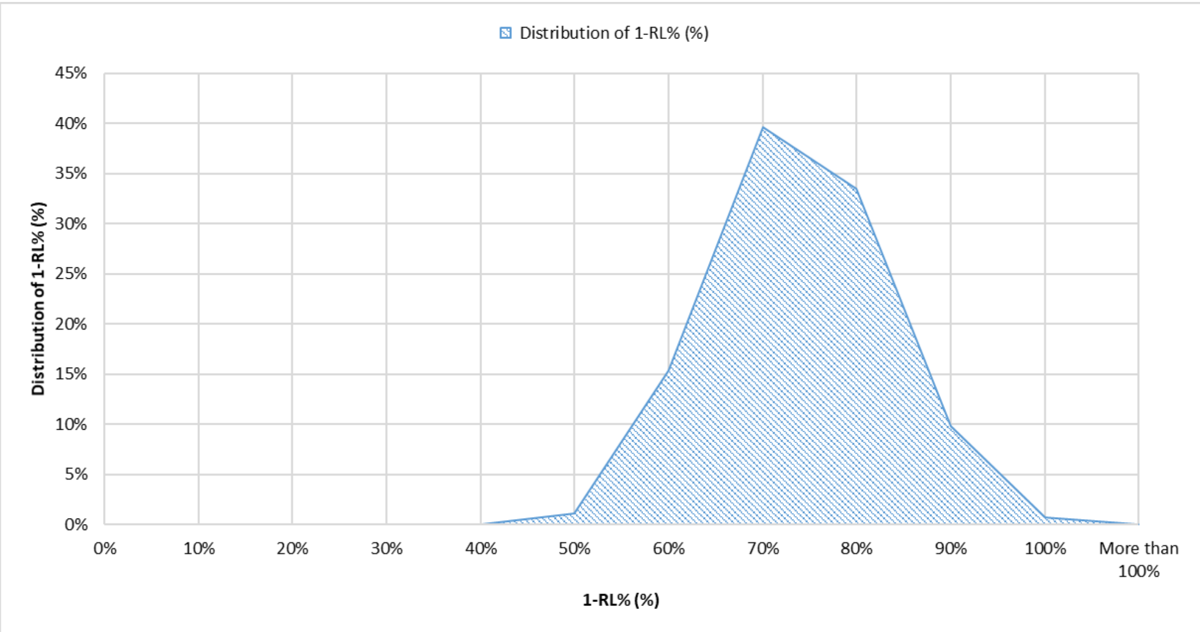
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



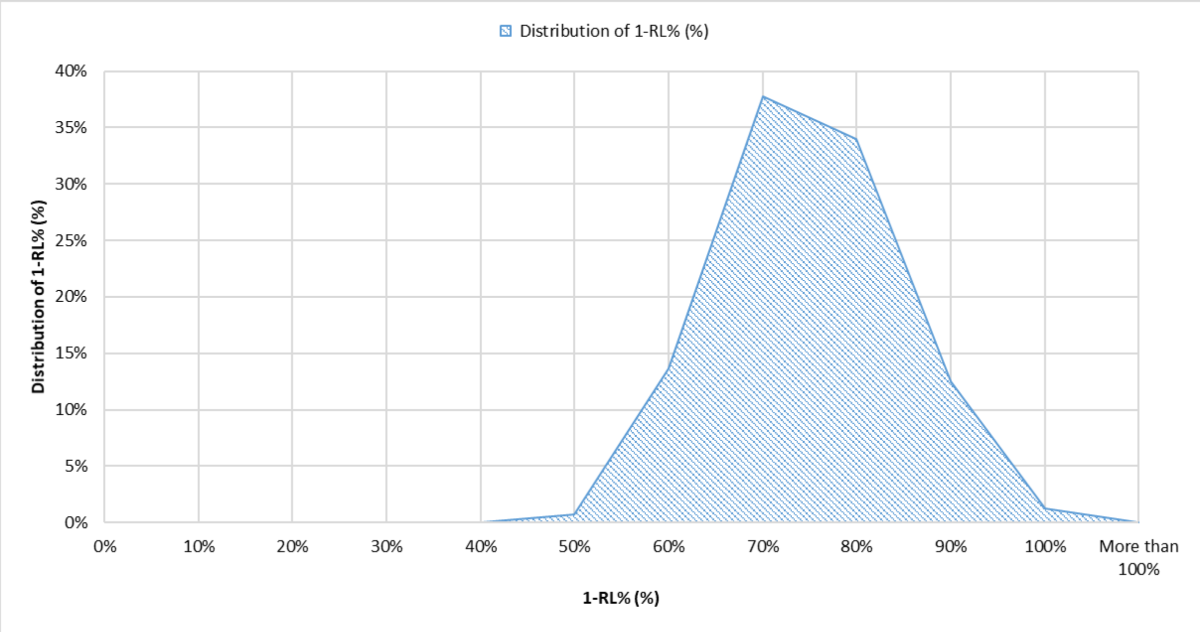
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=5,000MW Interconnected



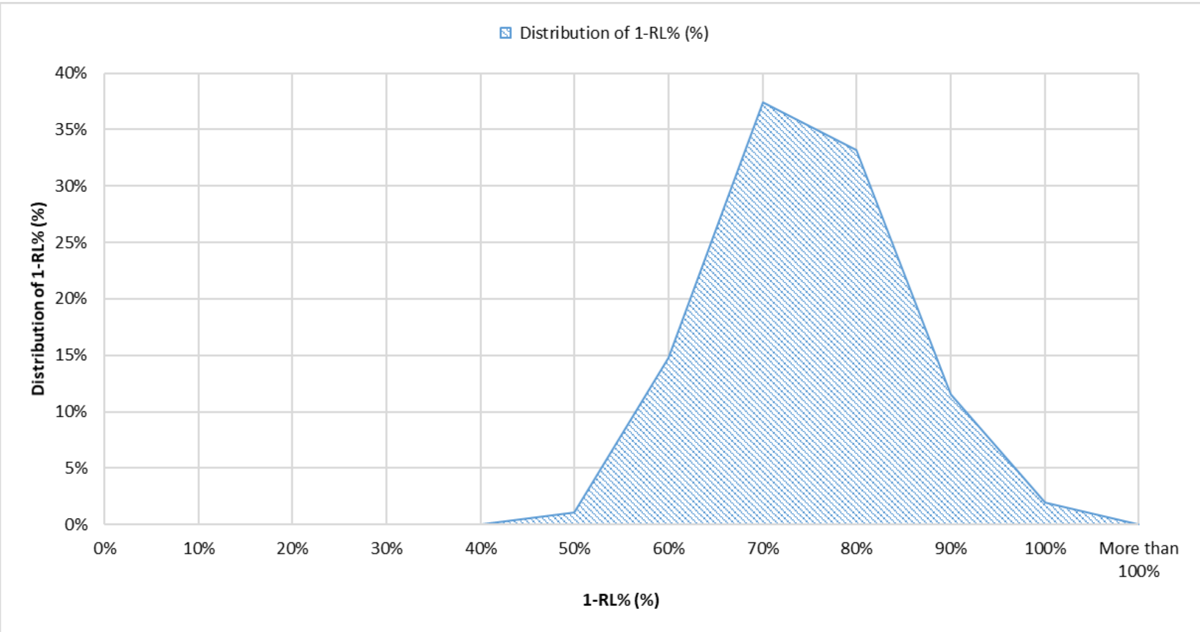
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=6,000MW Interconnected



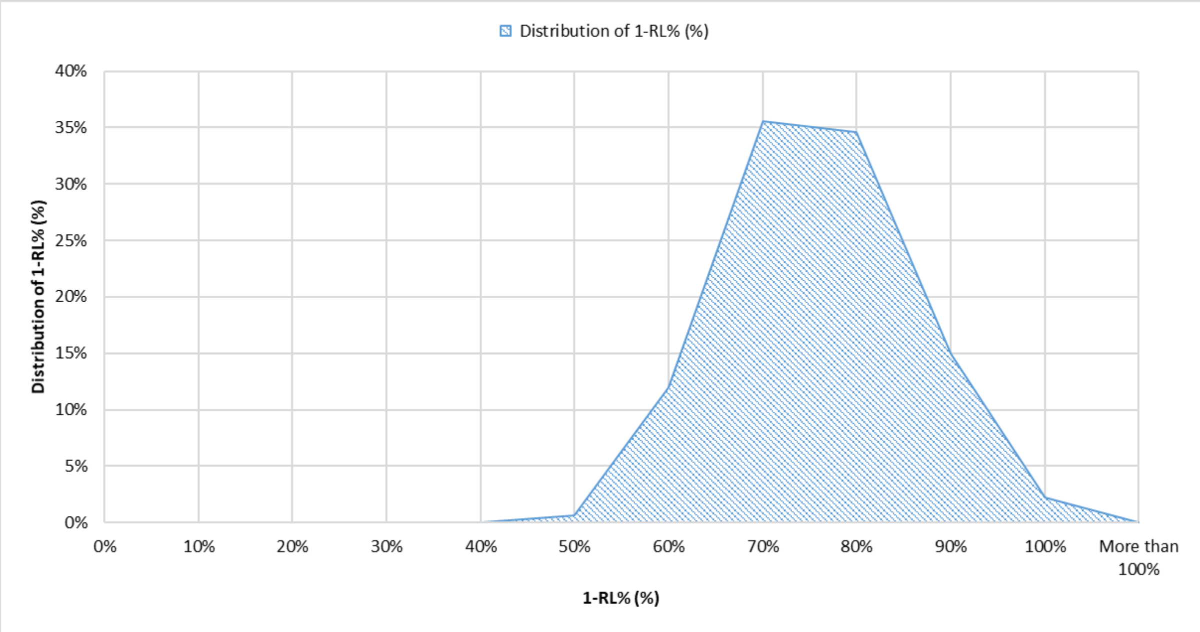
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=6,000MW Interconnected



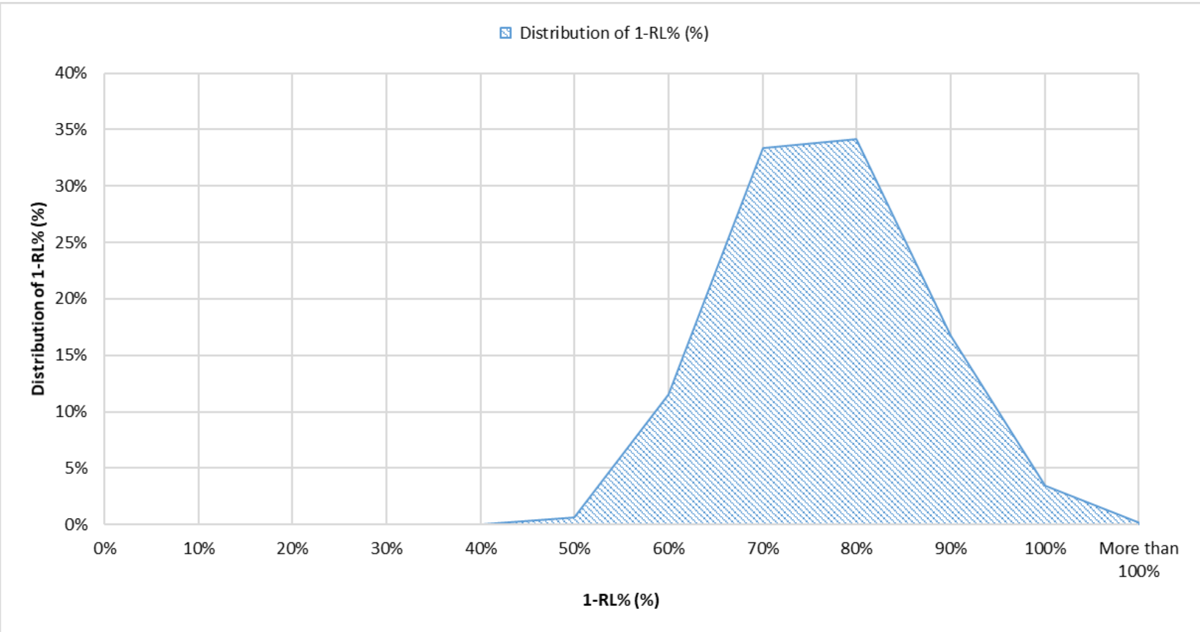
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=7,000MW Interconnected



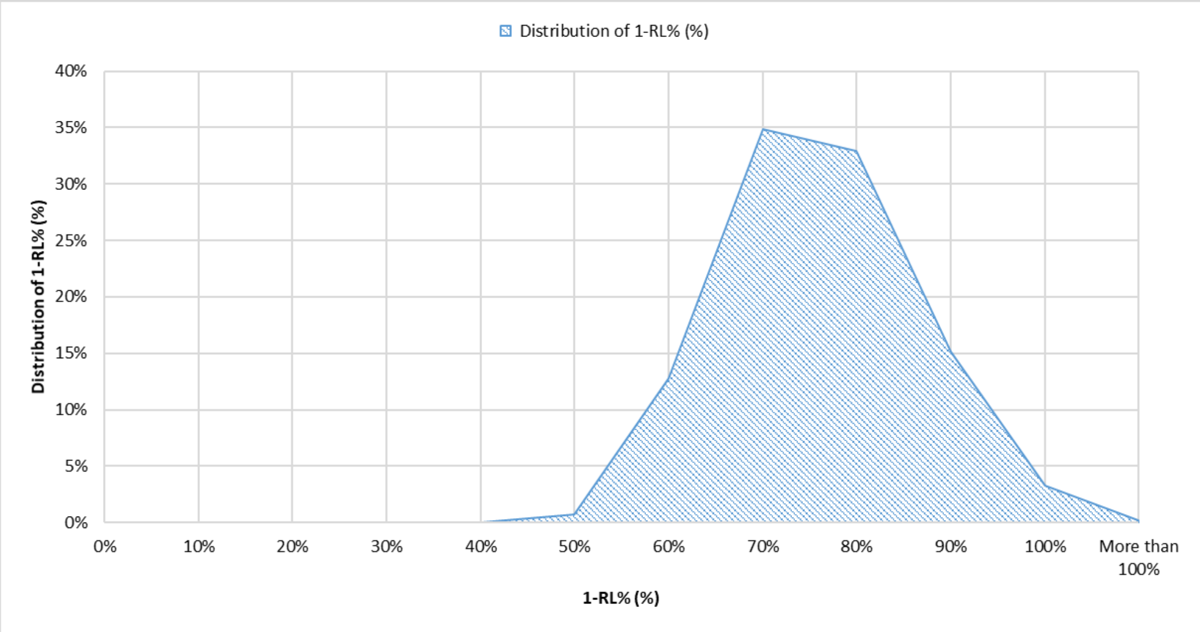
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=6,000MW Interconnected



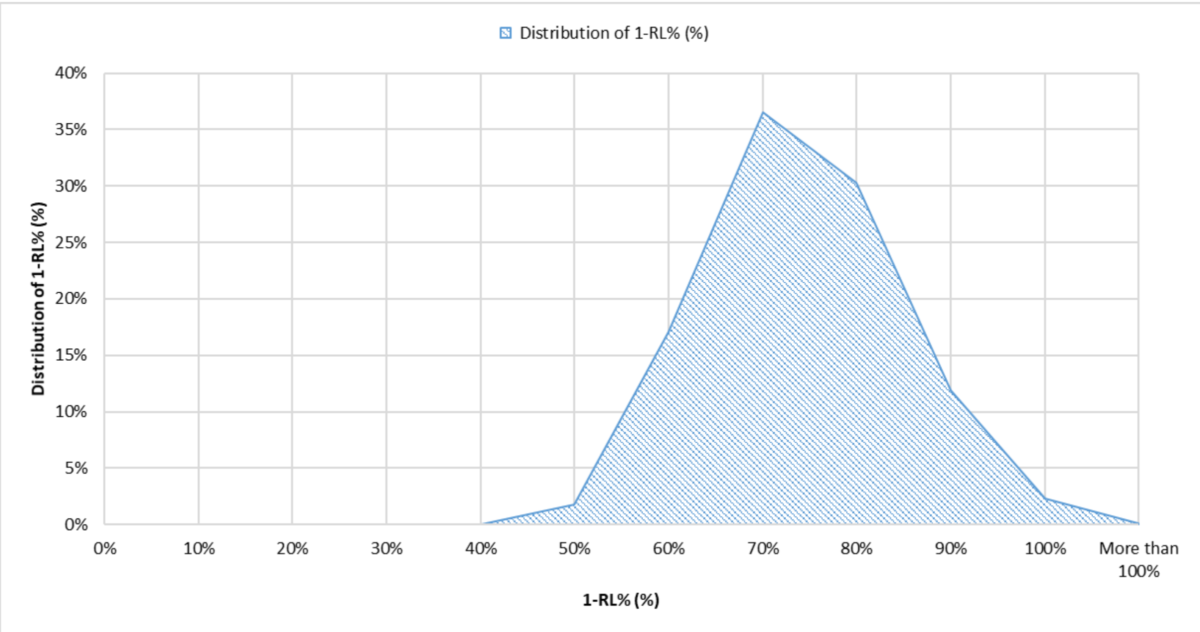
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,000MW Interconnected



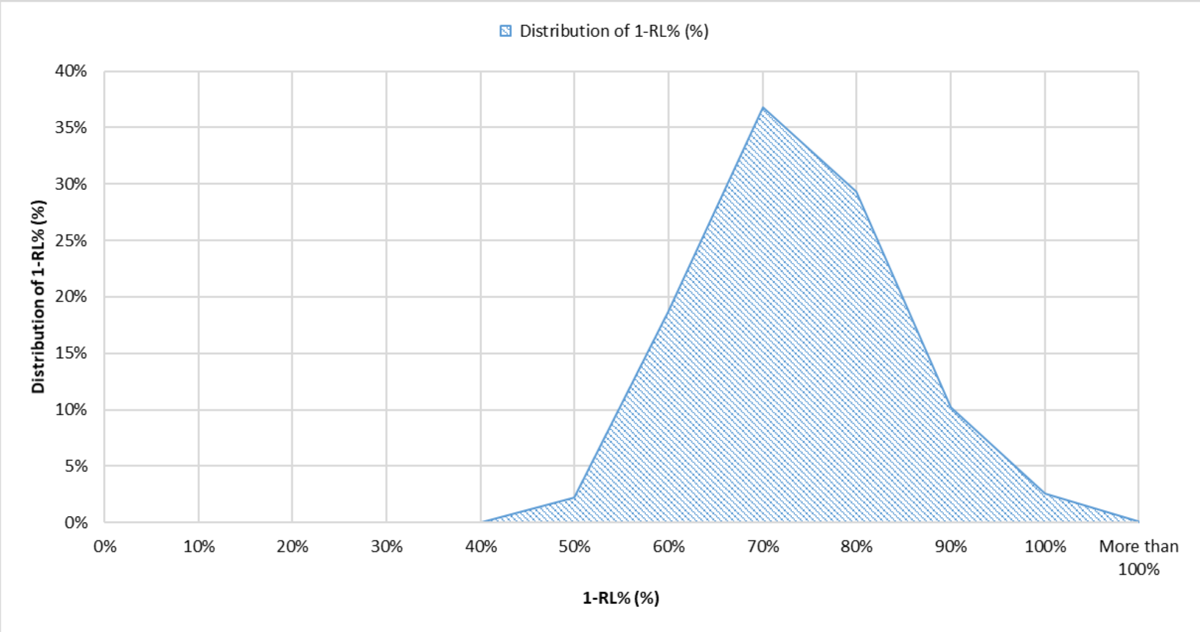
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,500MW Interconnected



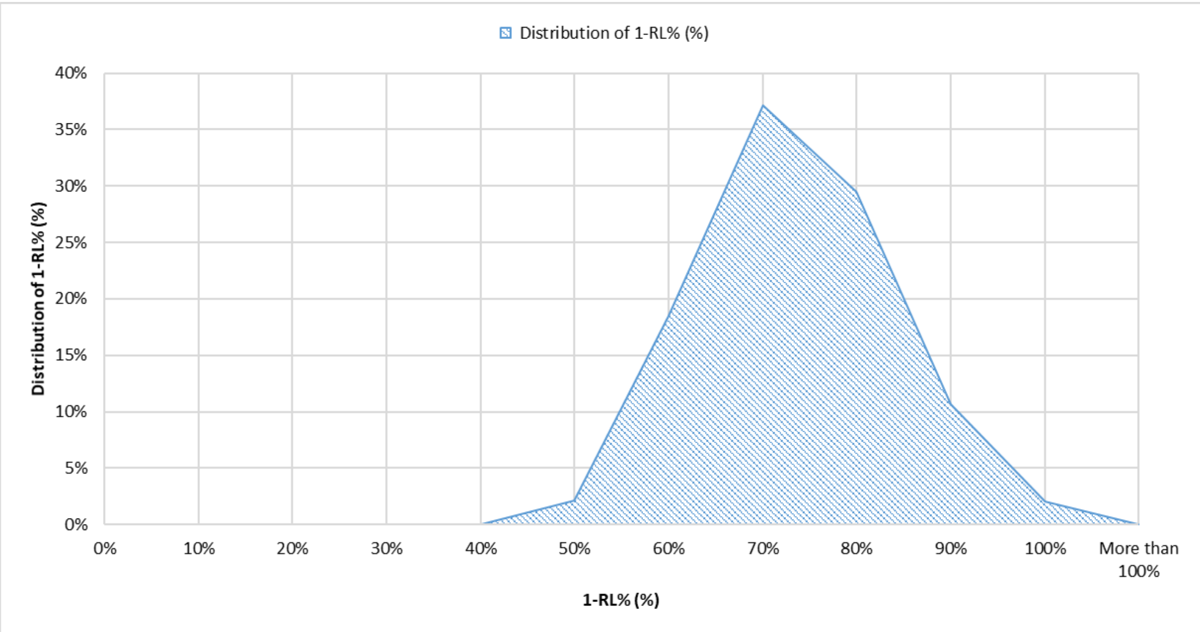
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,500MW Interconnected



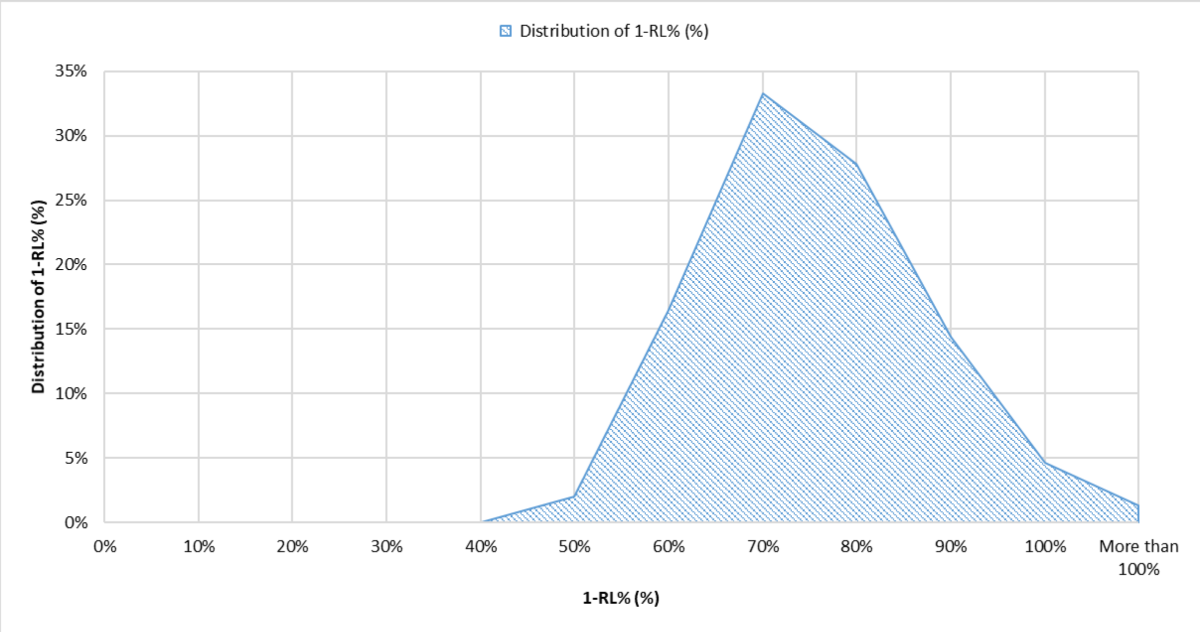
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=8,000MW Interconnected



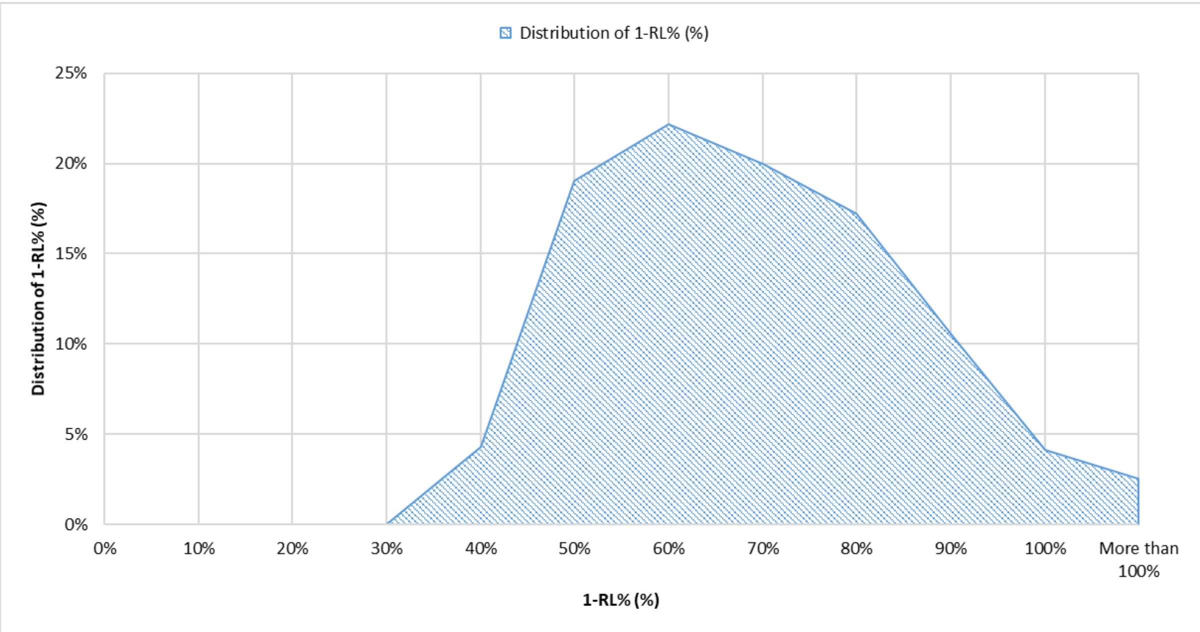
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Interconnected



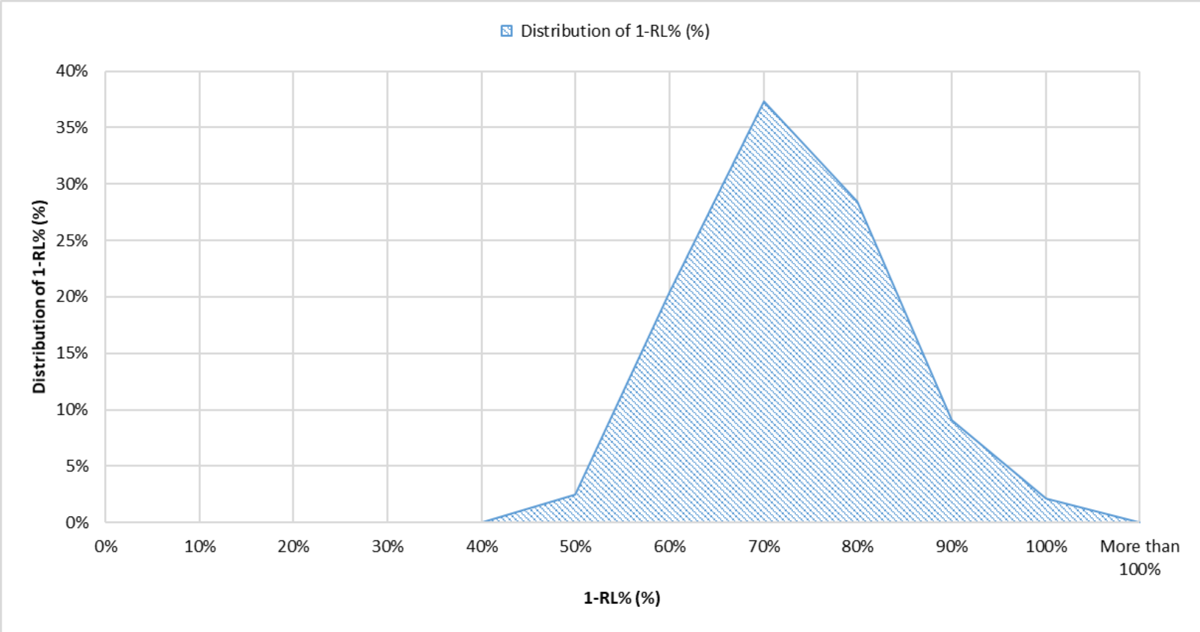
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Interconnected



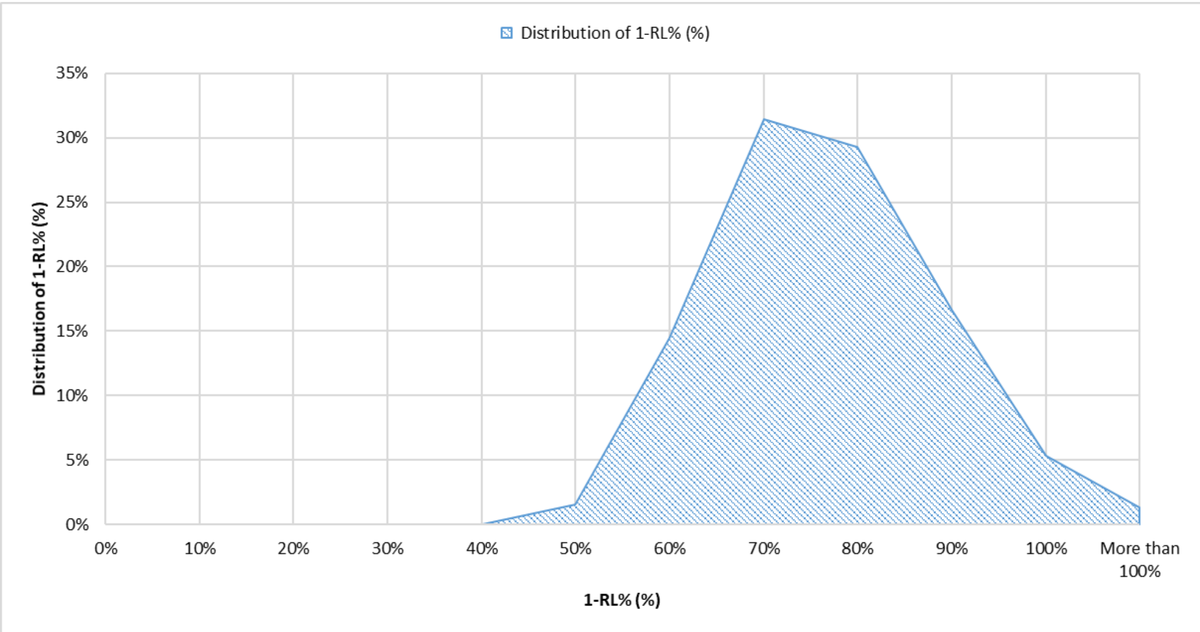
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Interconnected



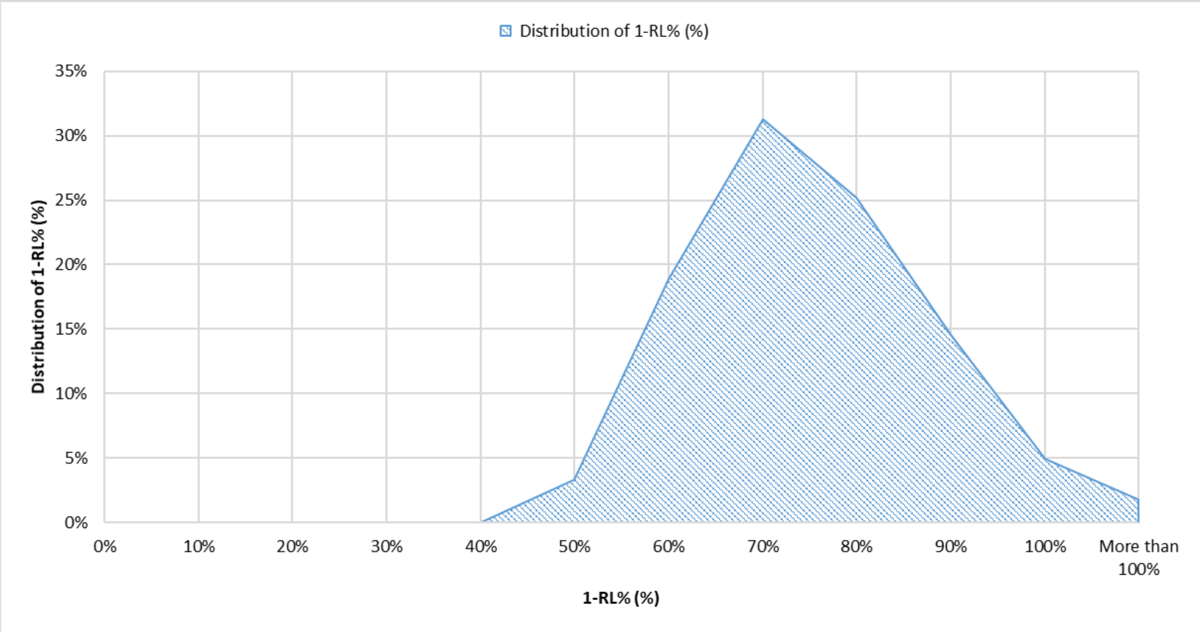
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Interconnected



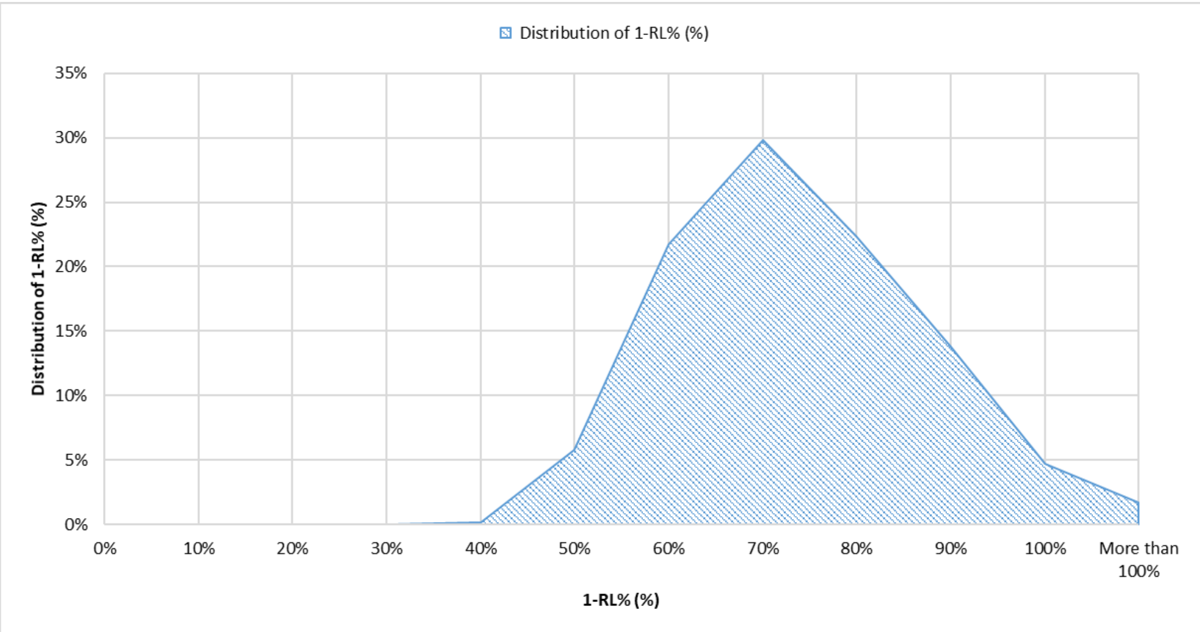
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Interconnected



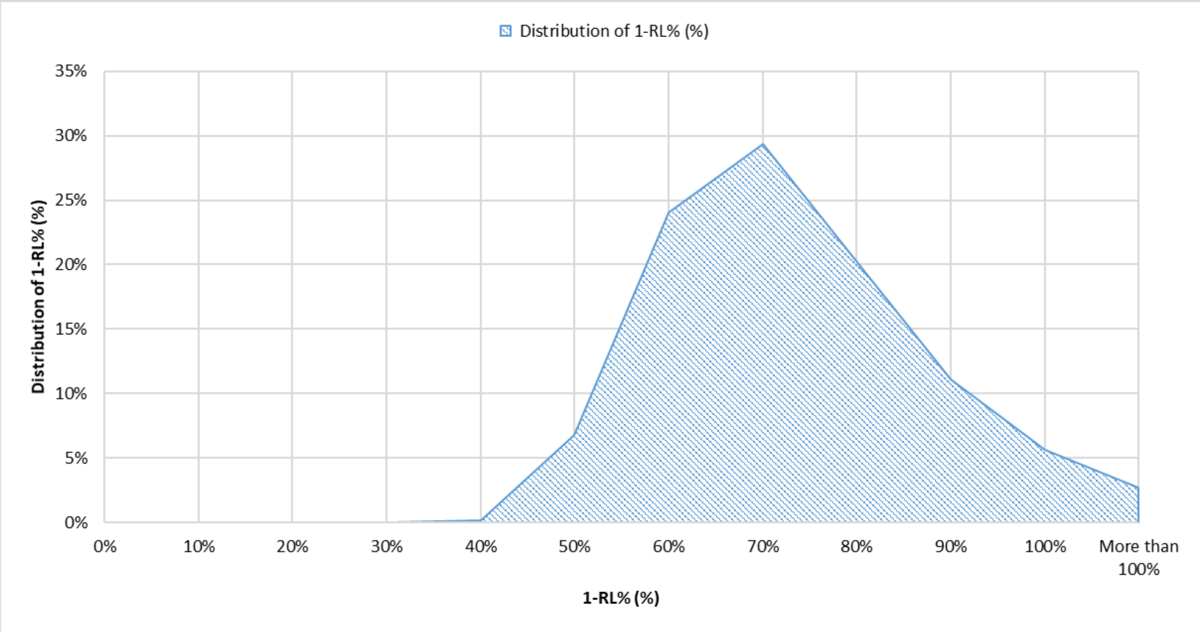
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Interconnected



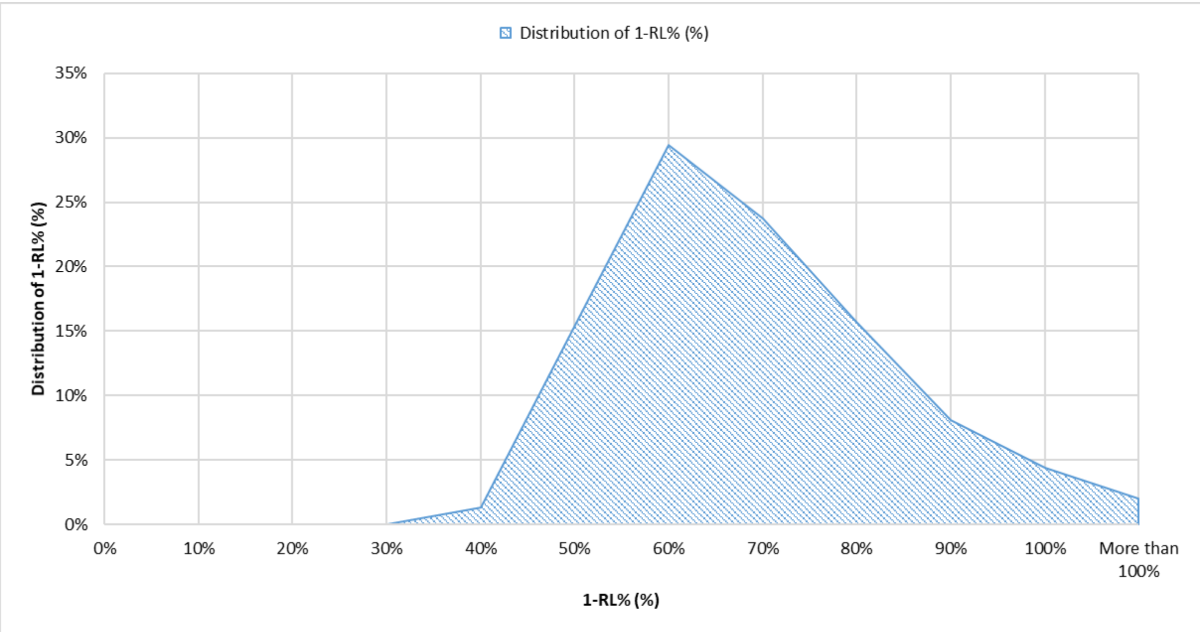
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Interconnected



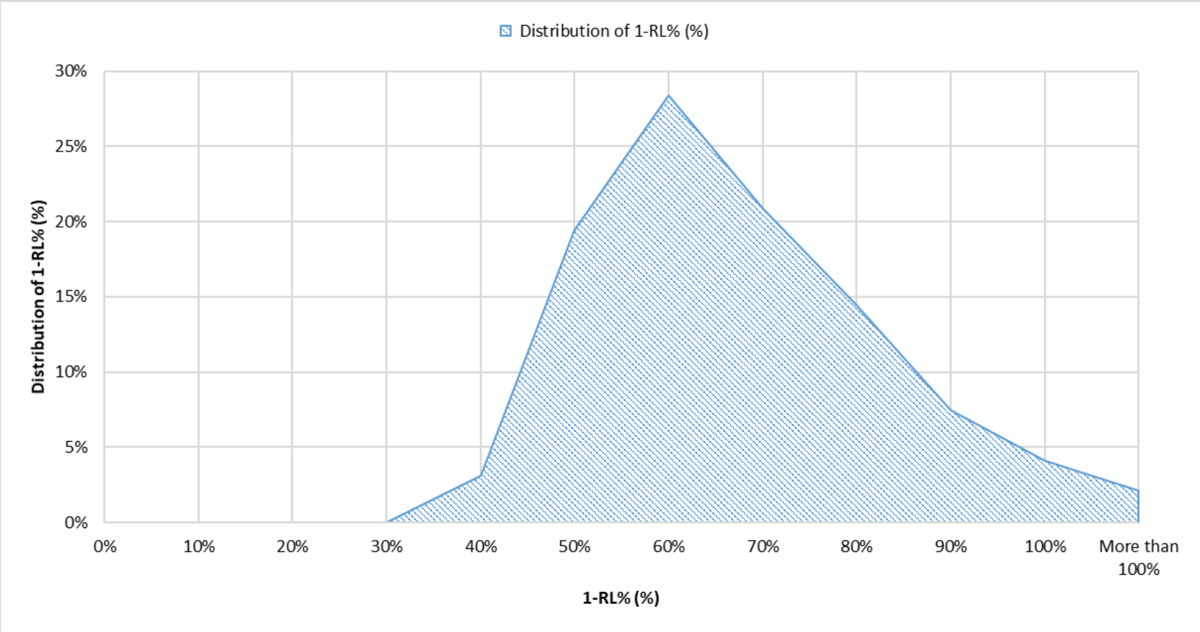
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Interconnected



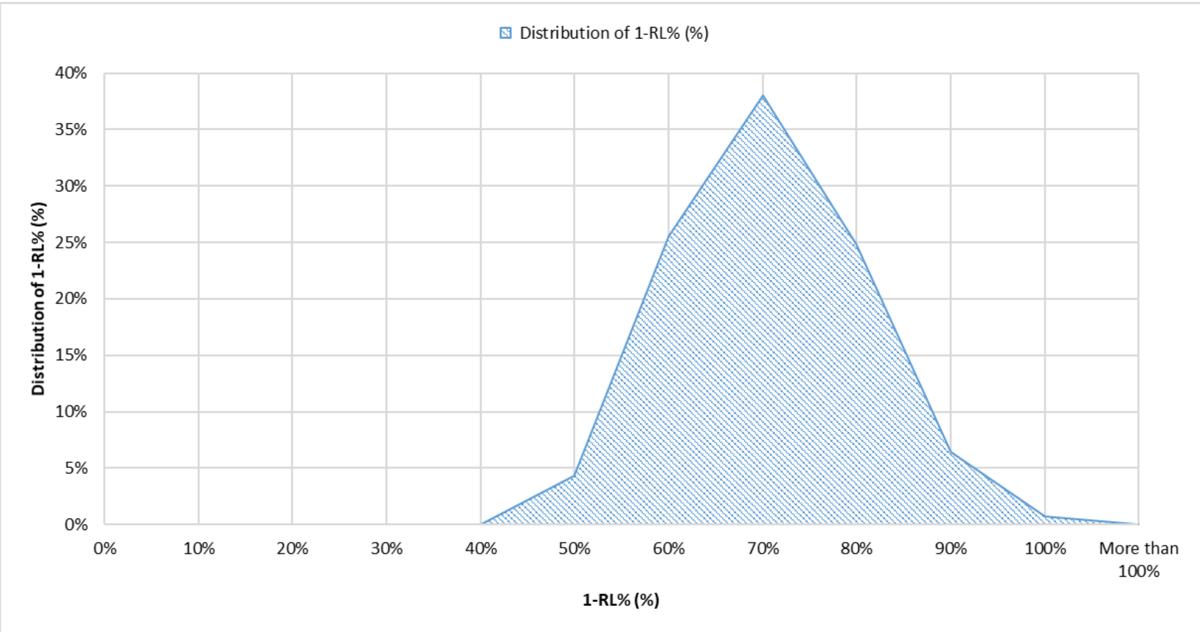
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Interconnected



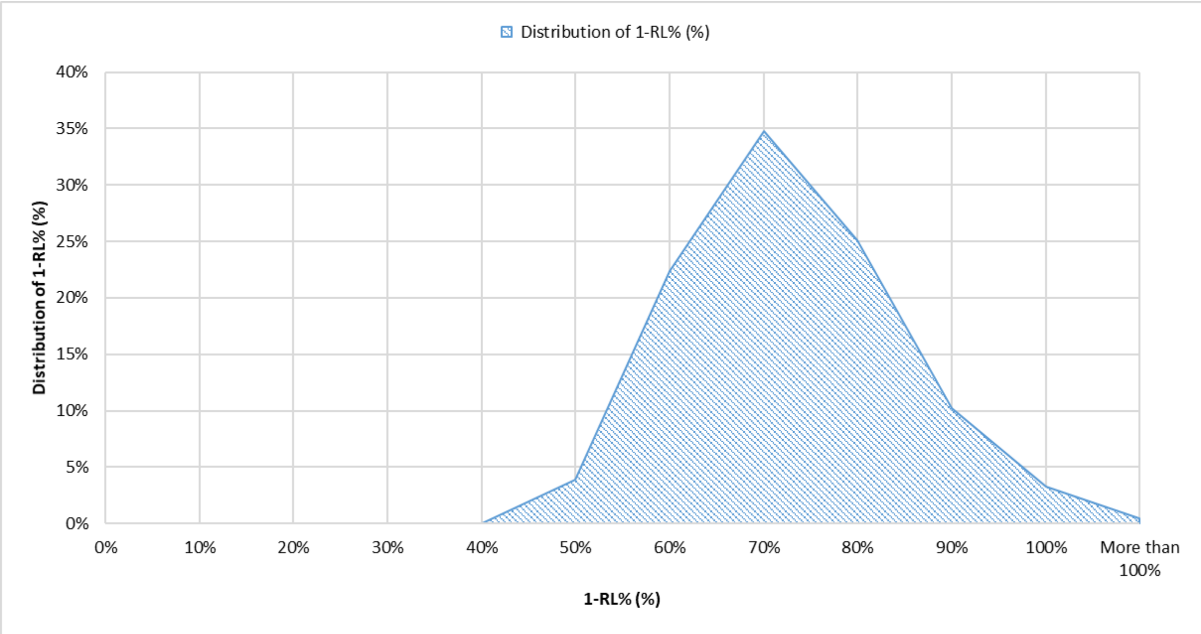
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Interconnected



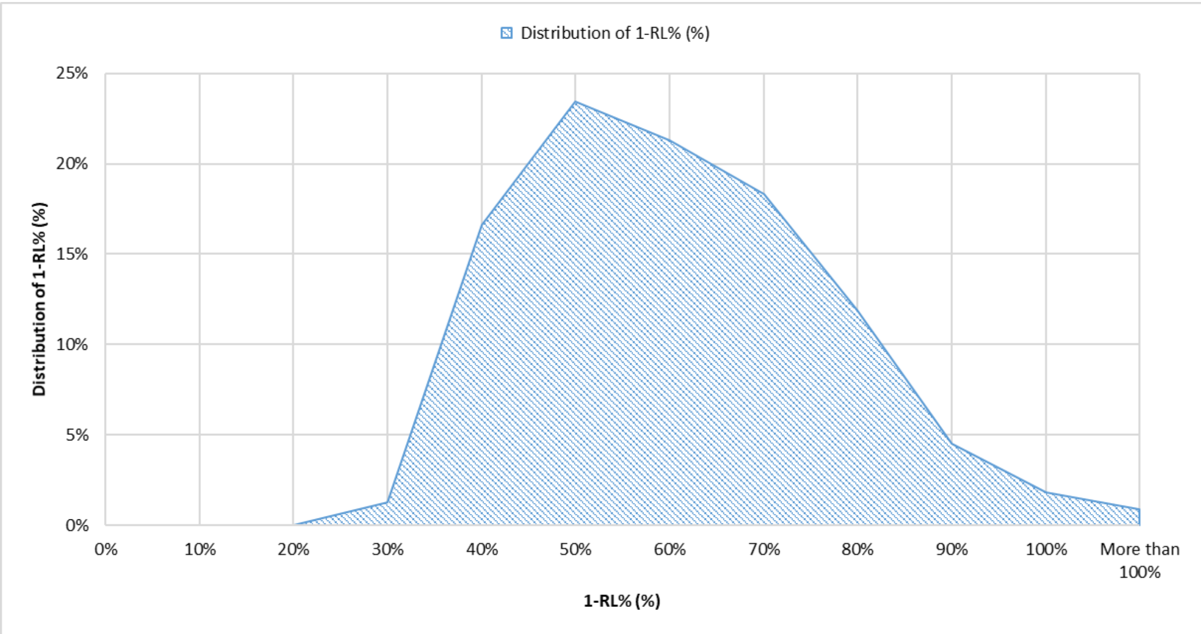
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Interconnected



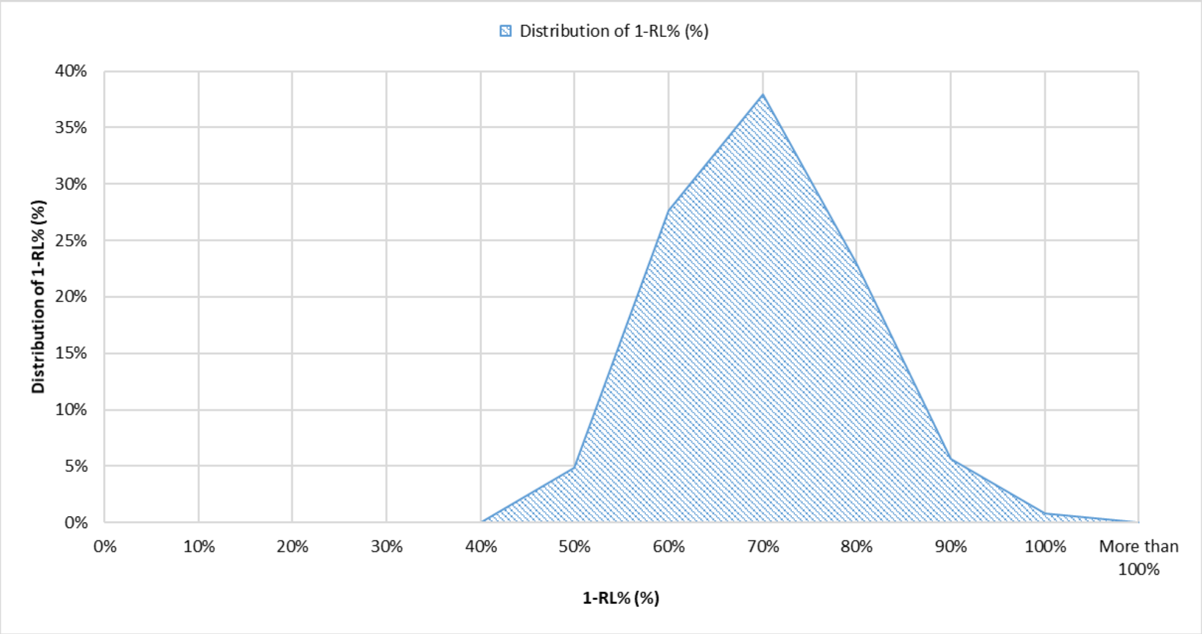
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Interconnected



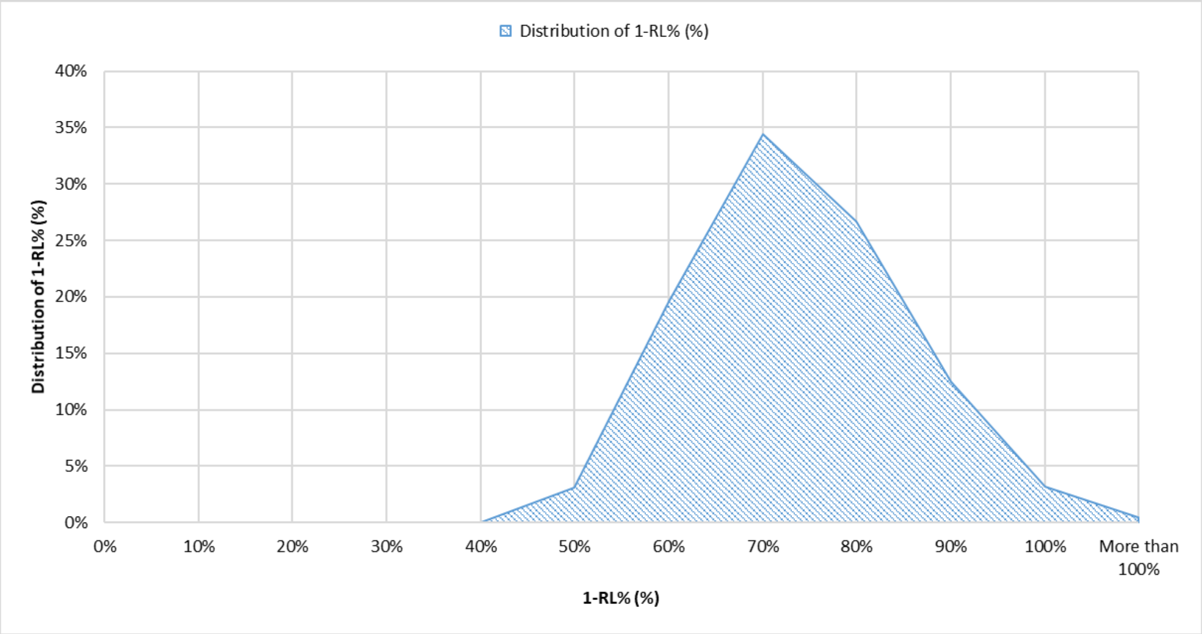
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Interconnected



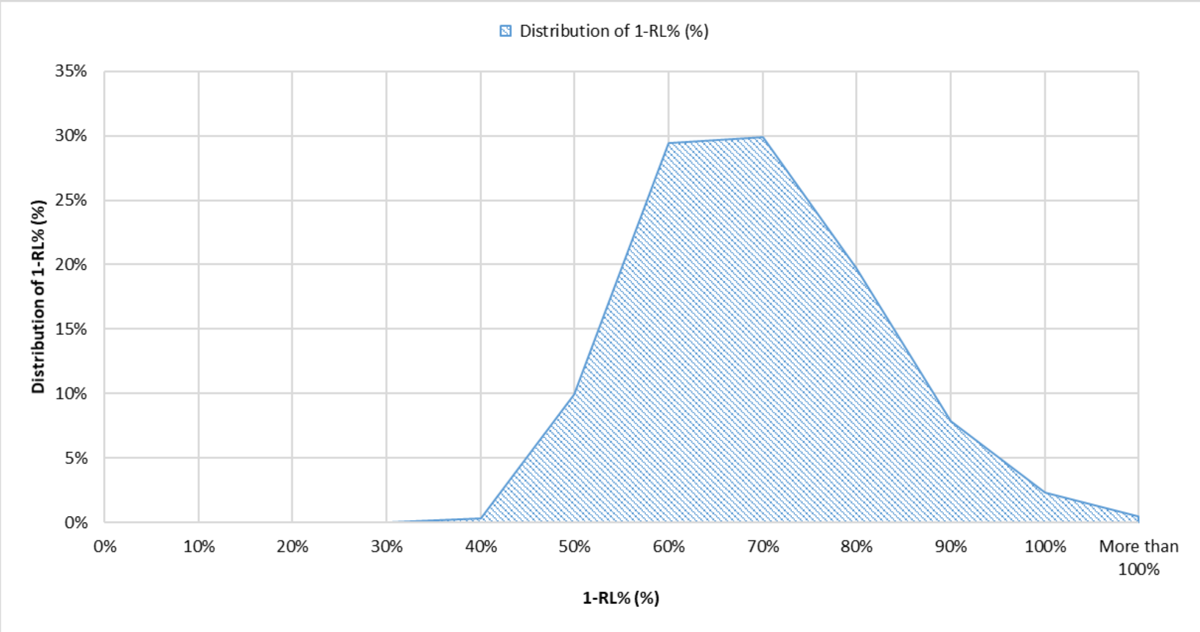
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Interconnected



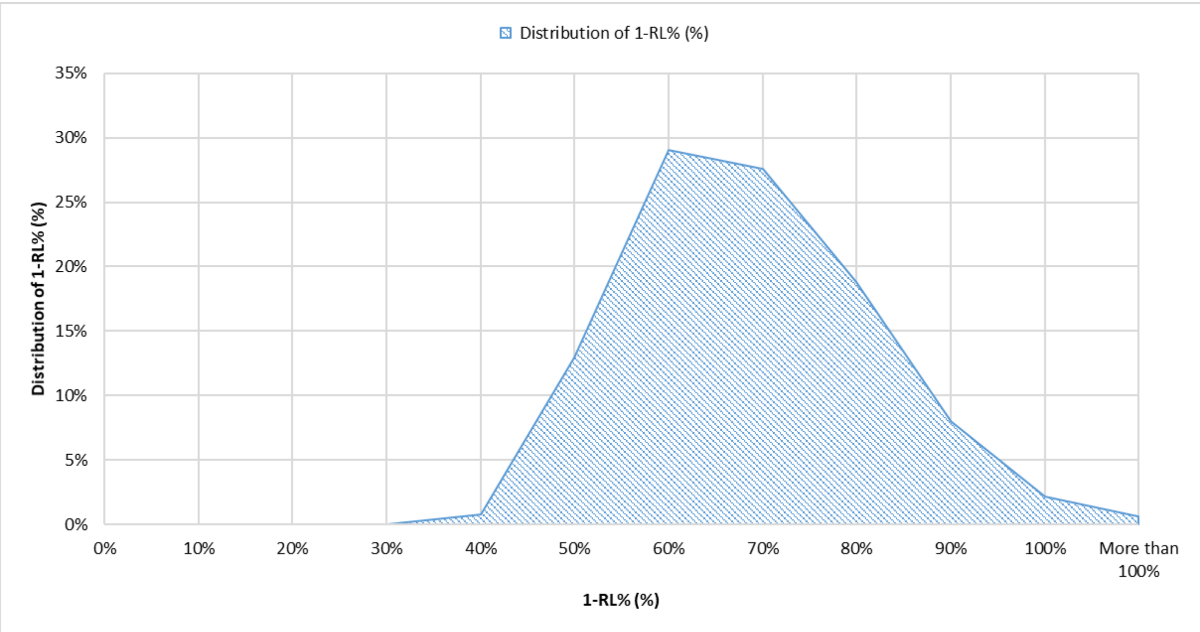
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Interconnected



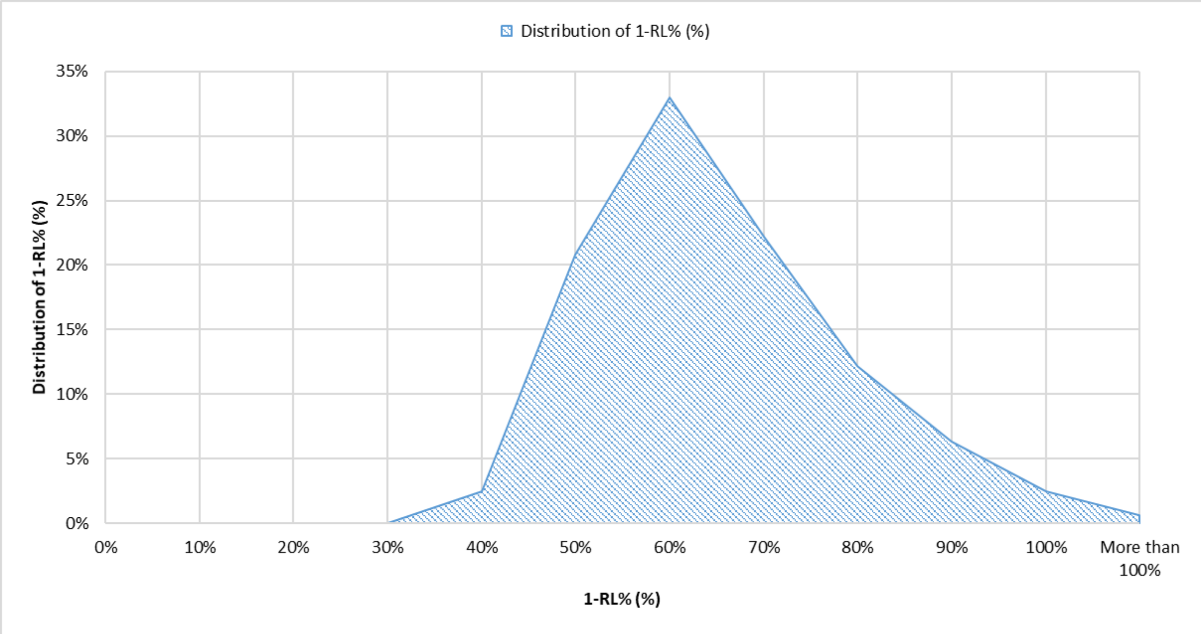
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Interconnected



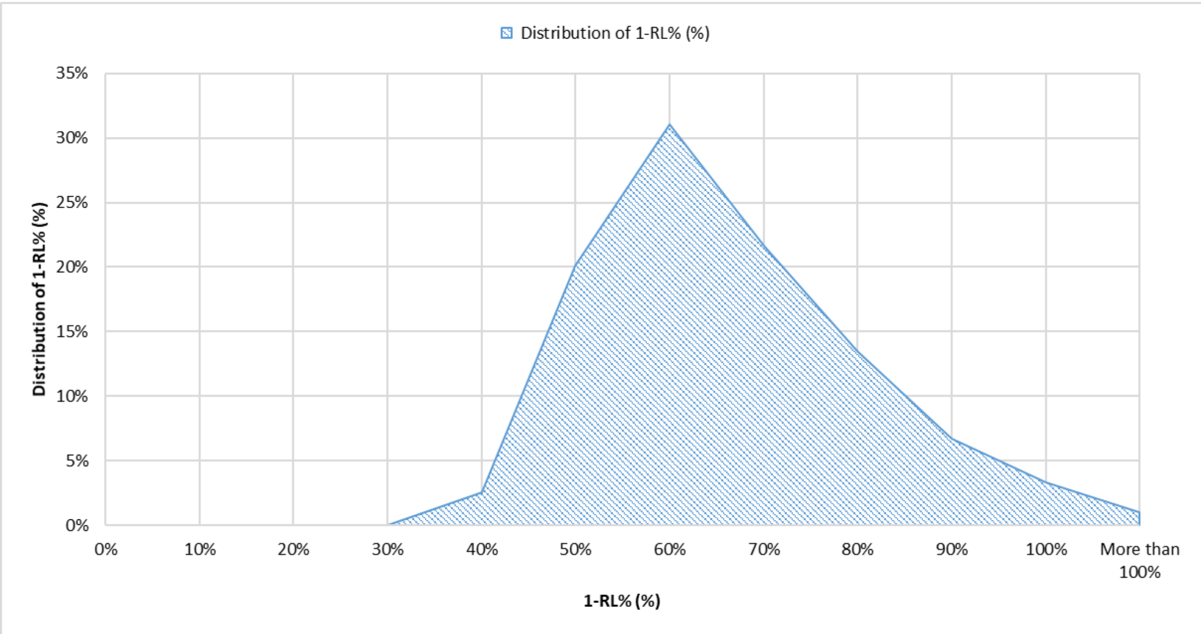
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Interconnected



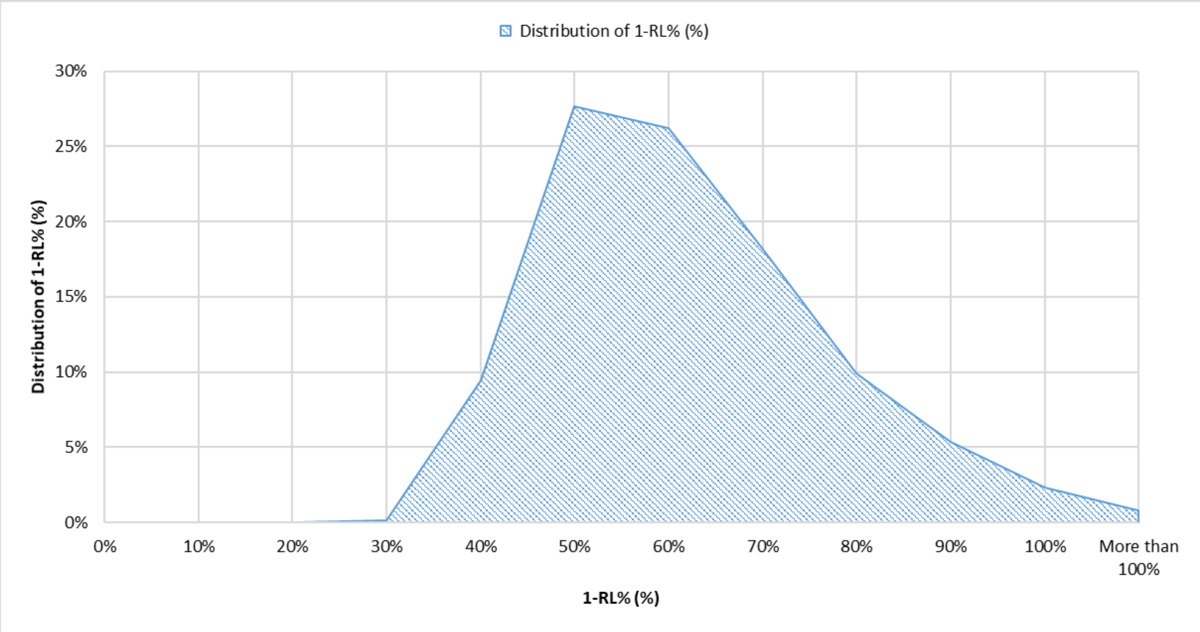
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Interconnected



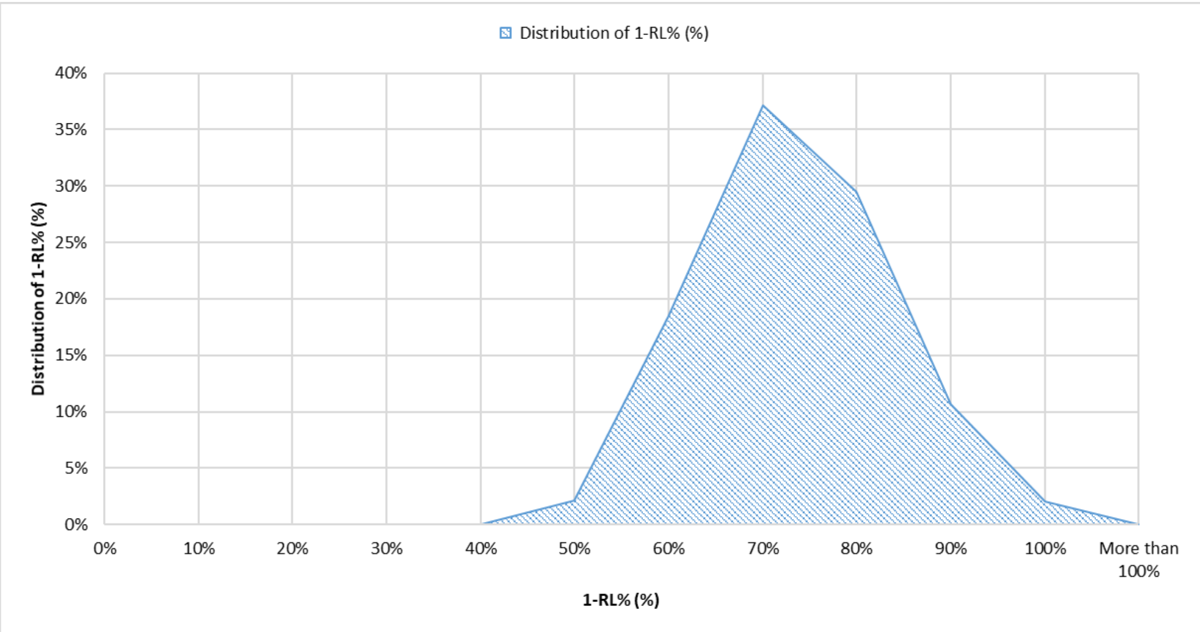
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Interconnected



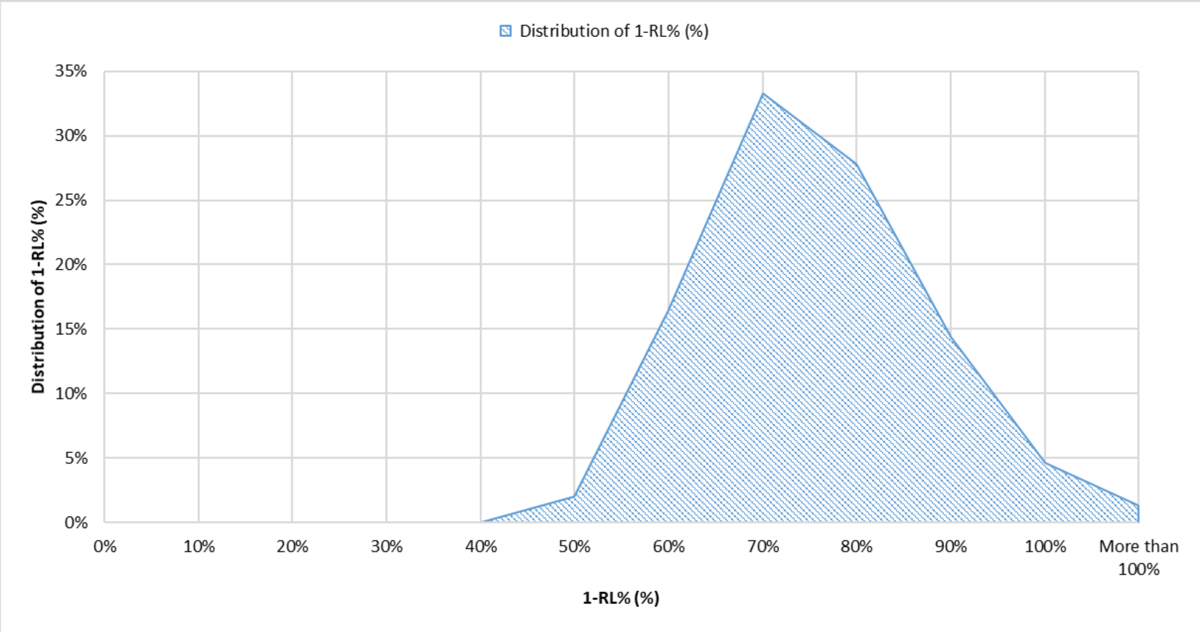
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Interconnected



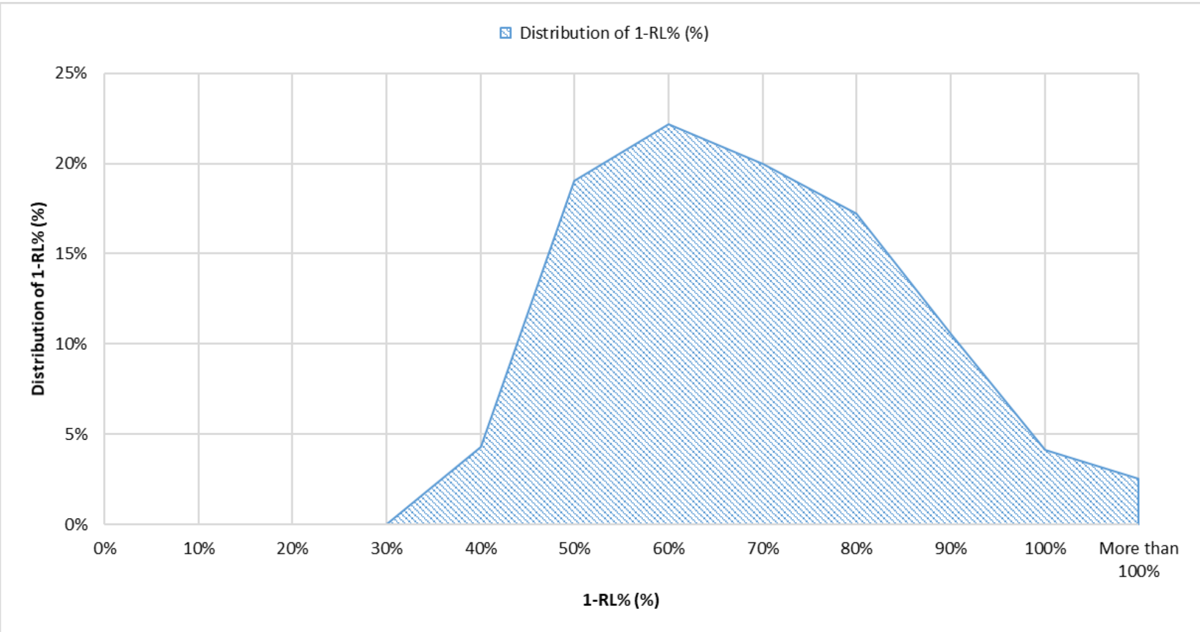
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Isolated



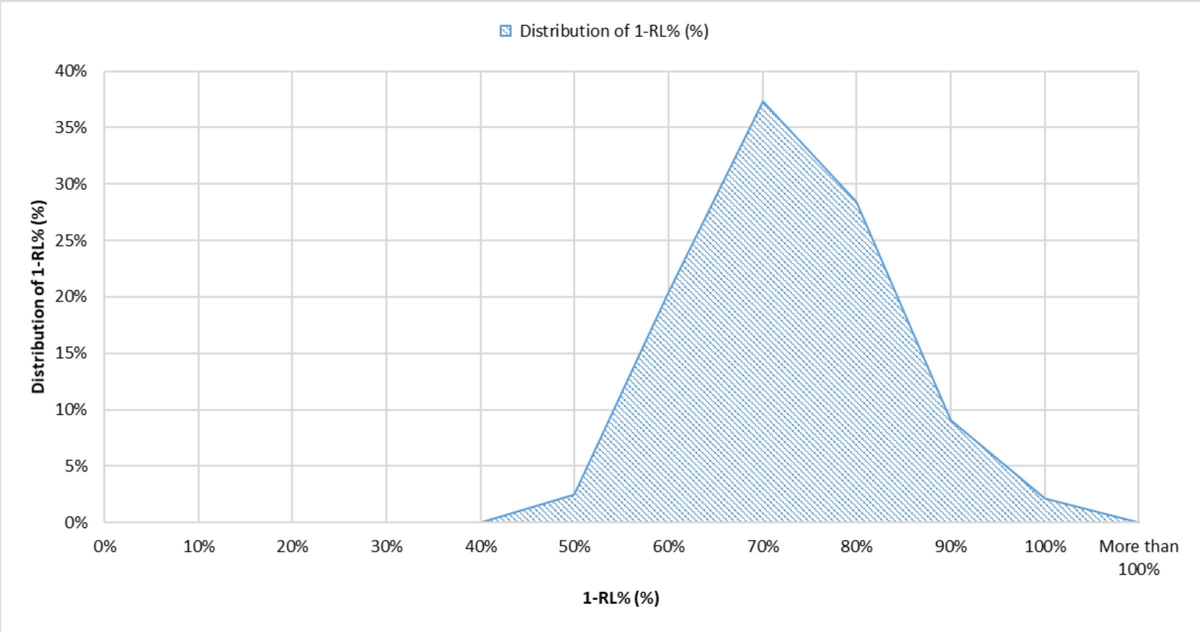
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Isolated



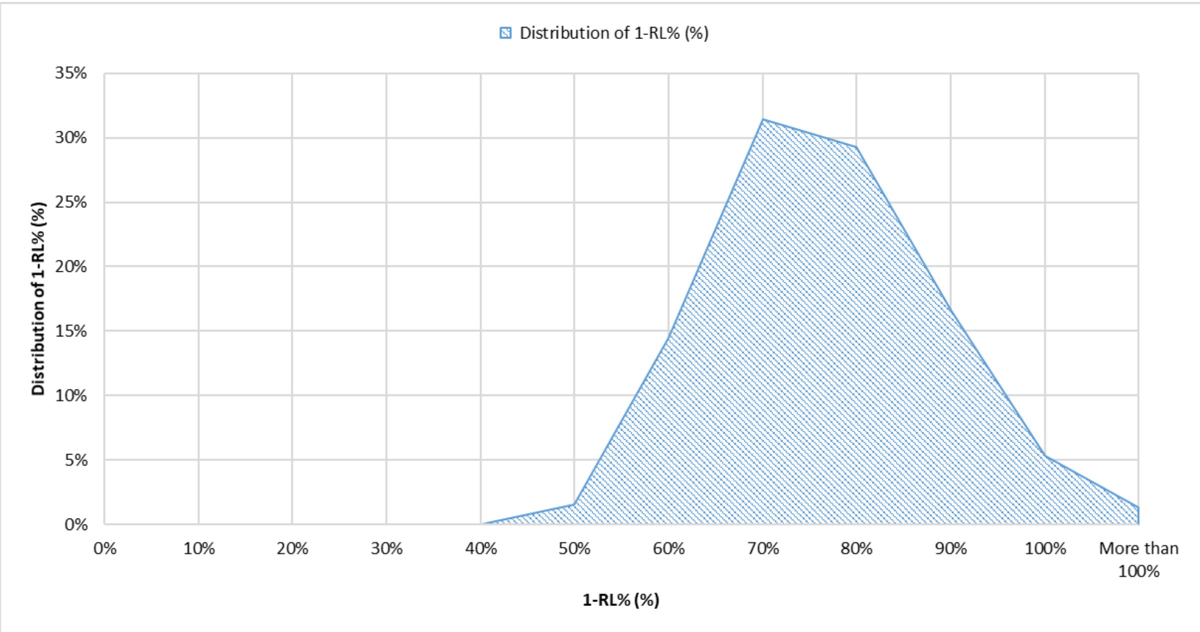
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Isolated



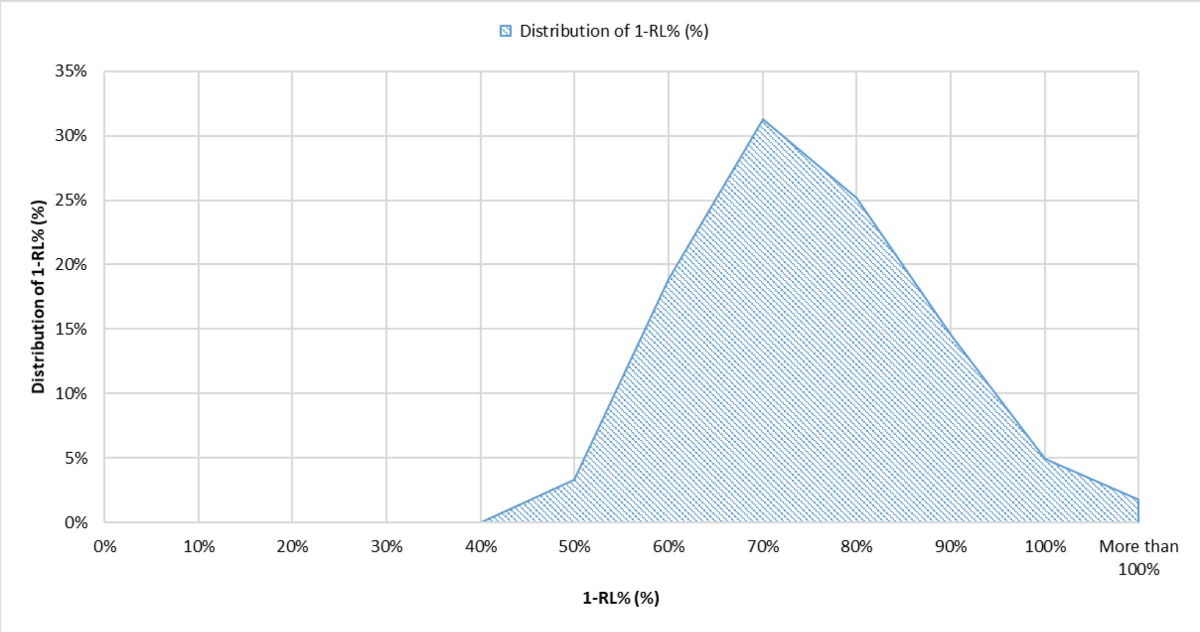
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Isolated



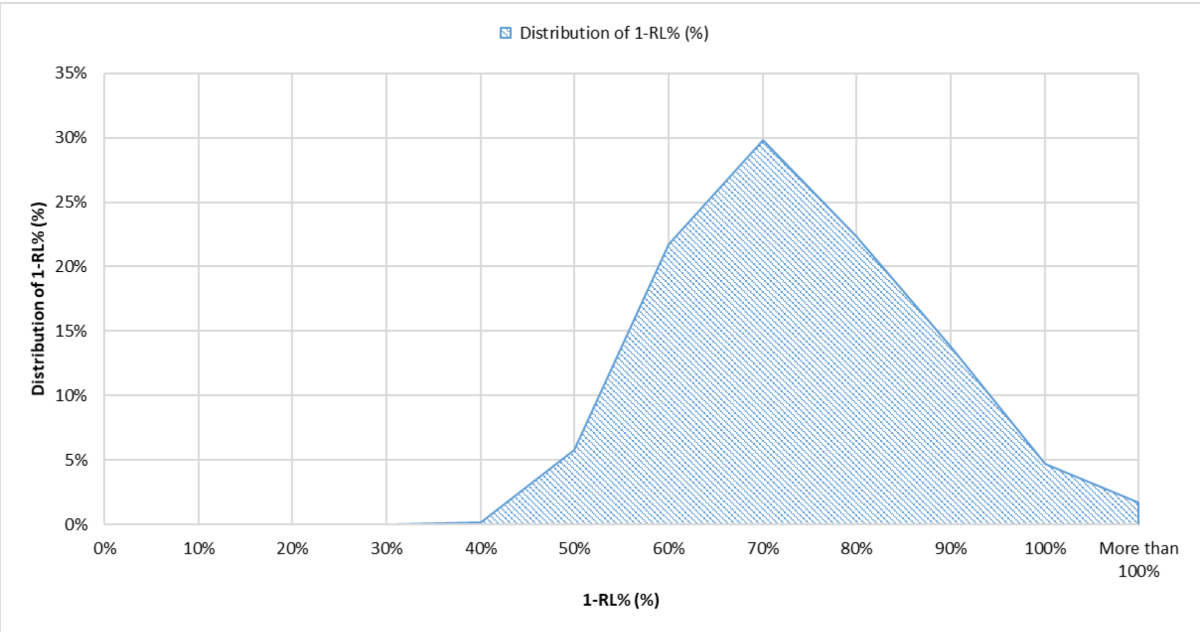
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Isolated



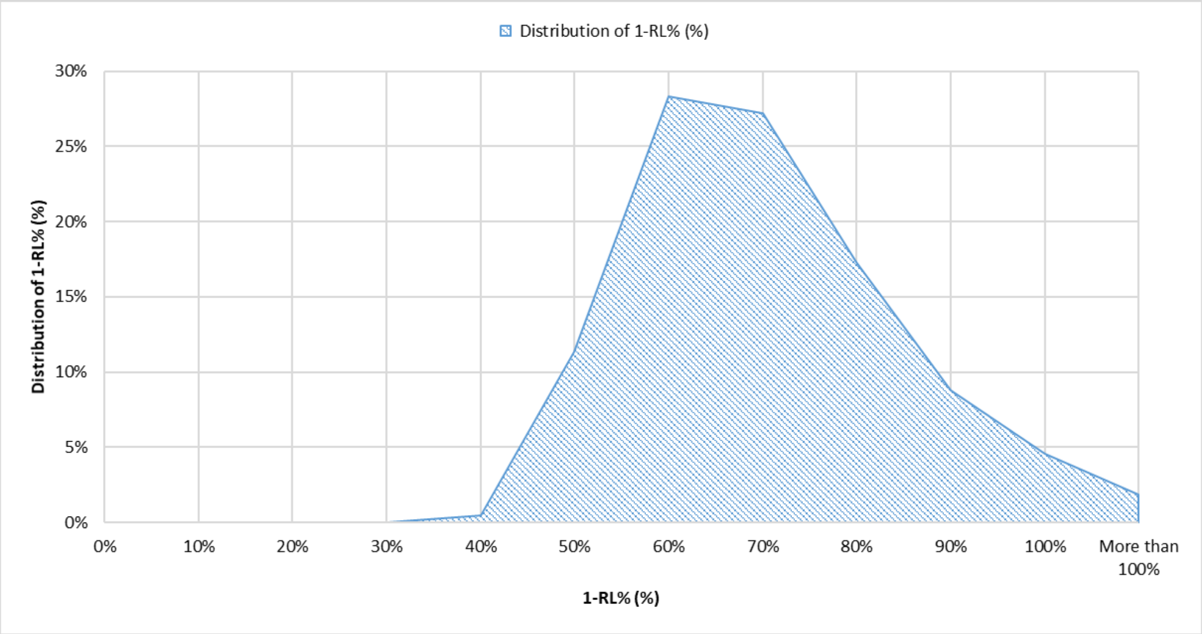
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Isolated



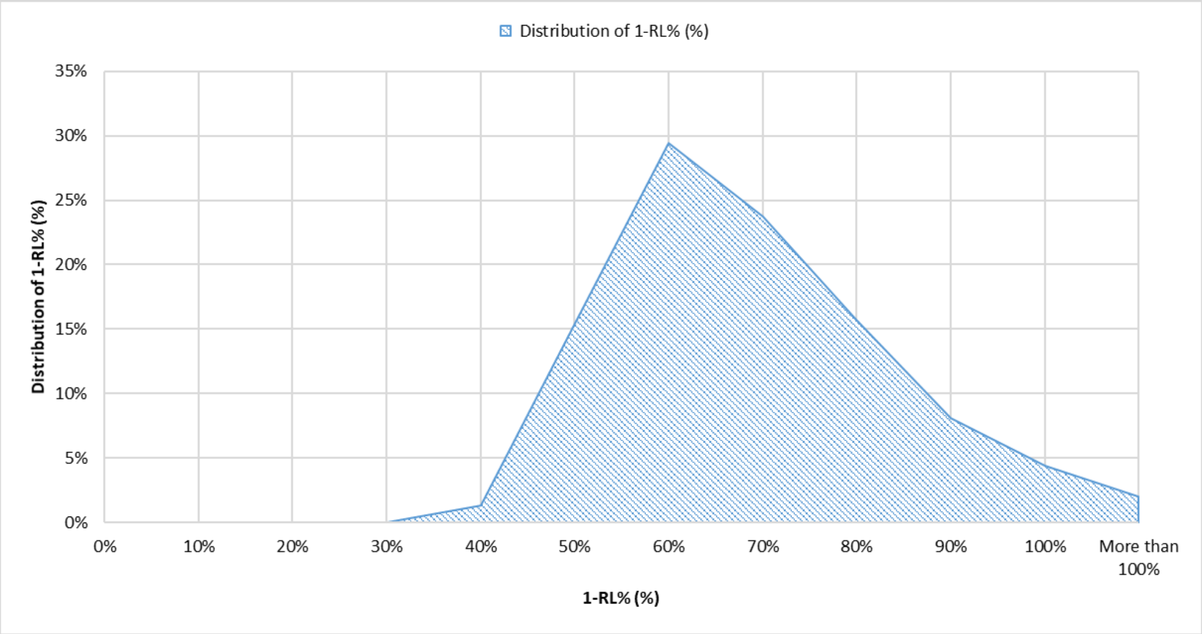
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Isolated



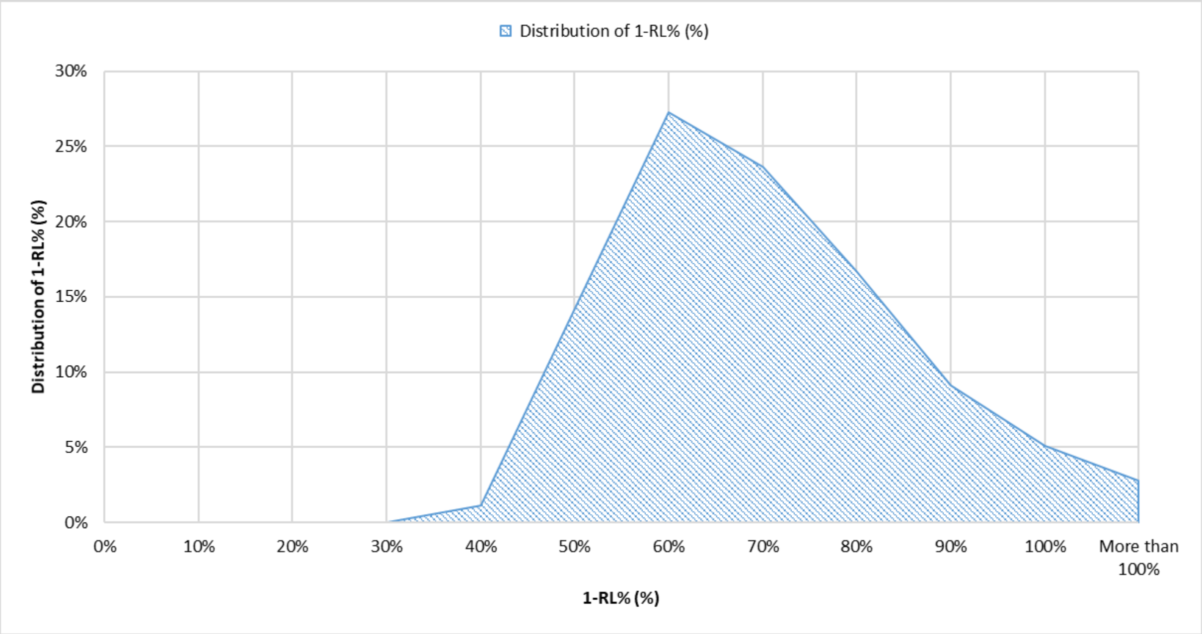
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Isolated



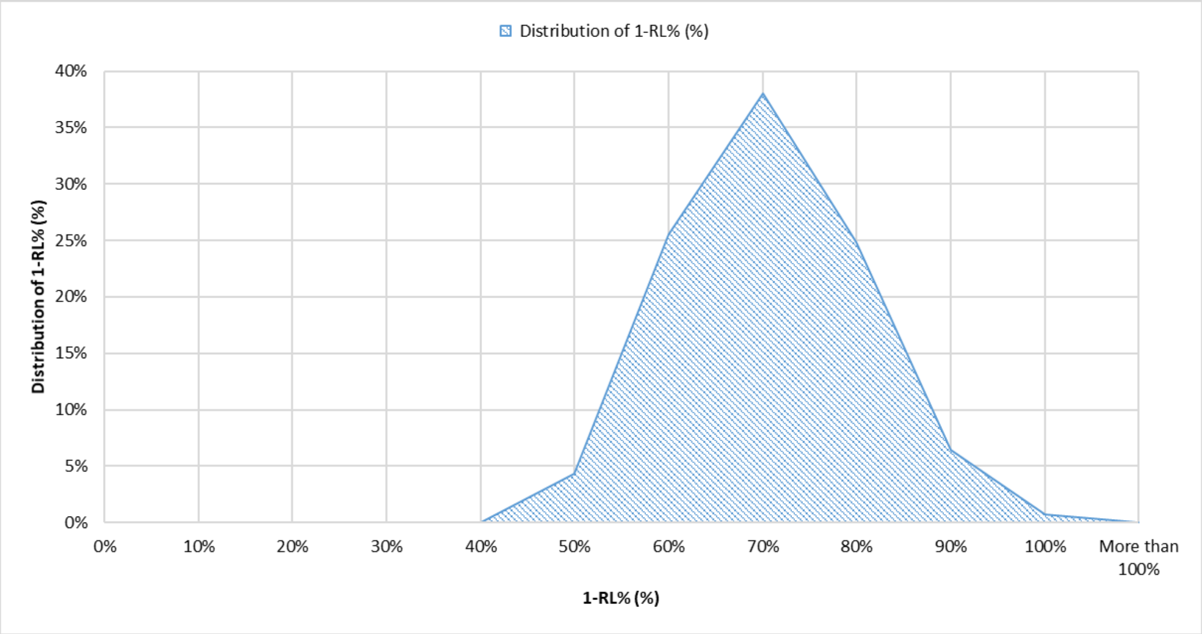
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Isolated



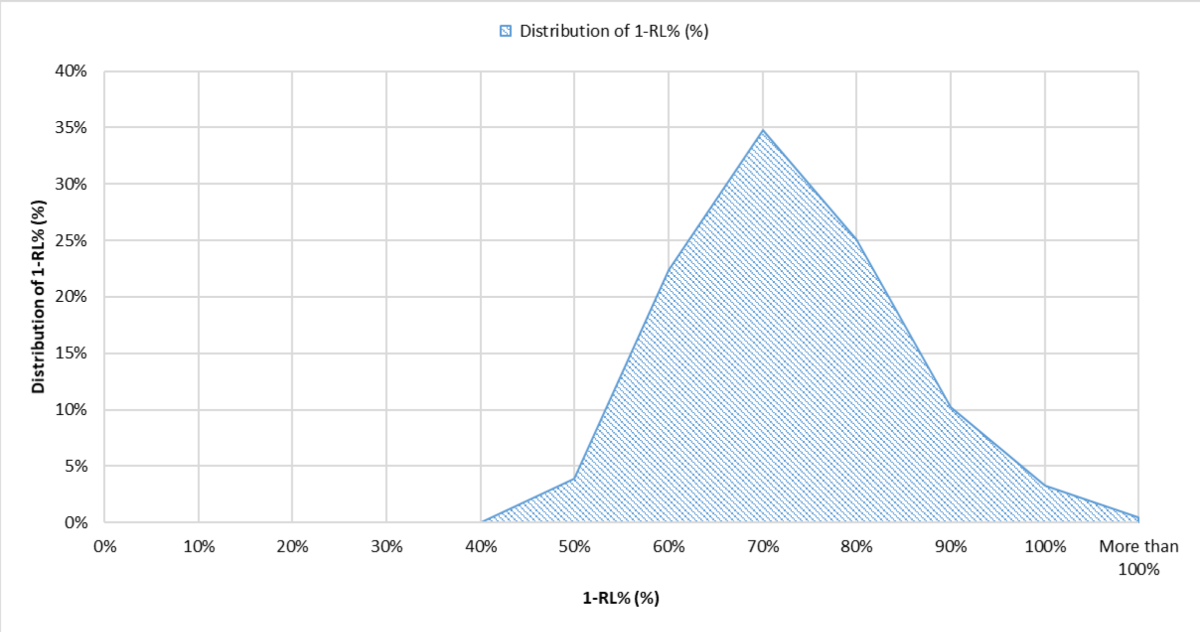
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Isolated



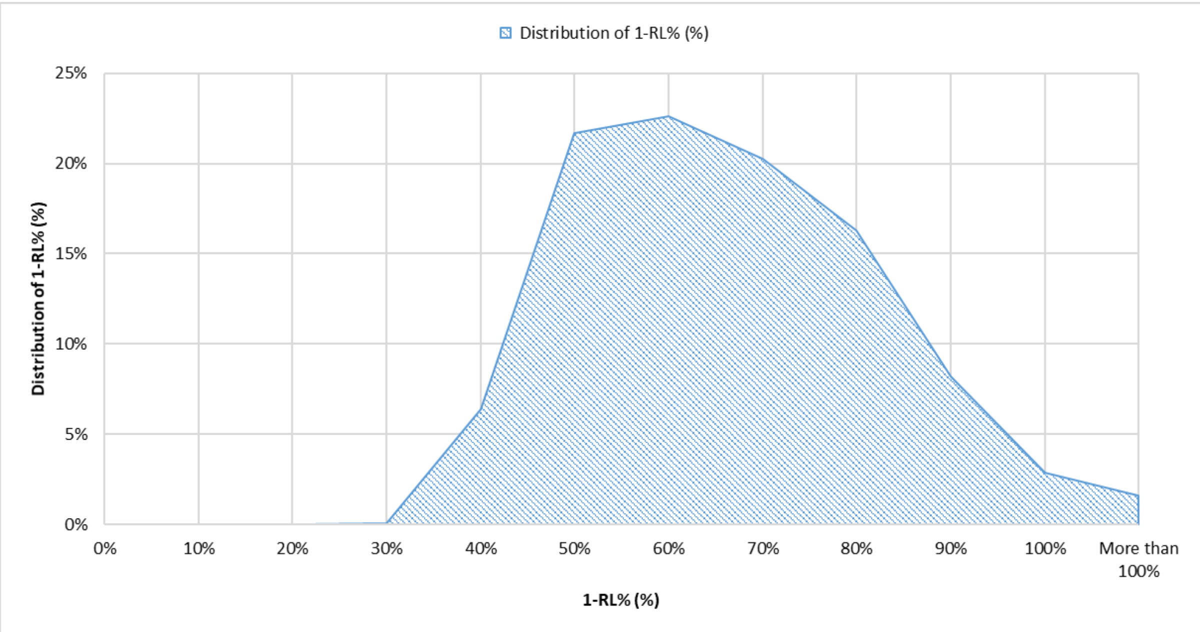
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Isolated



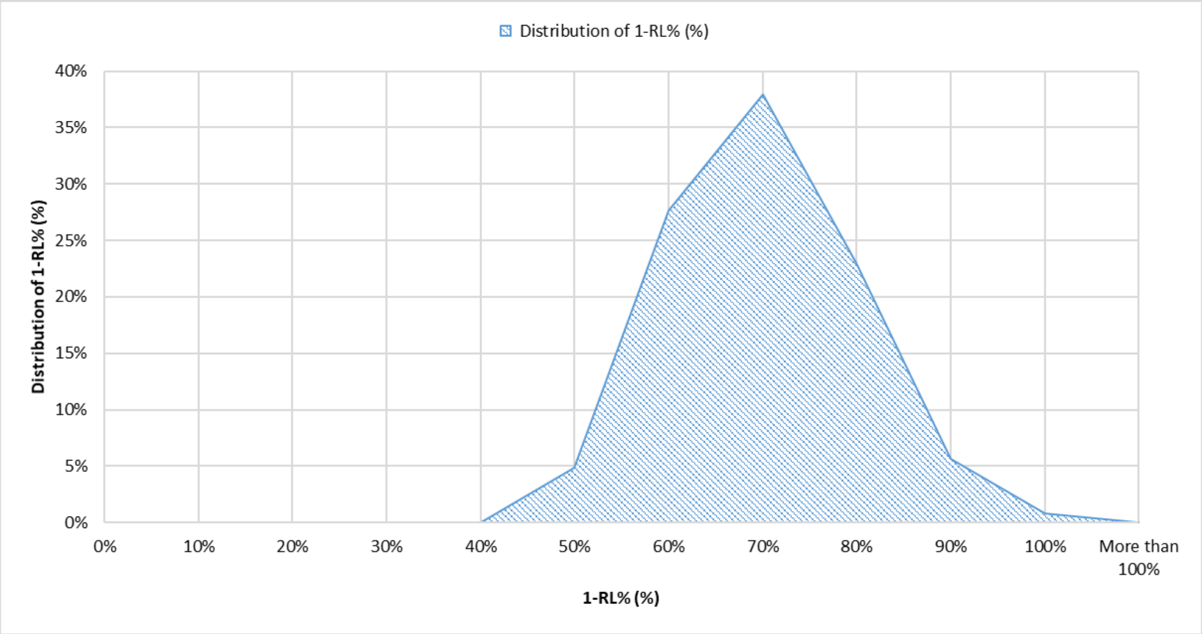
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Isolated



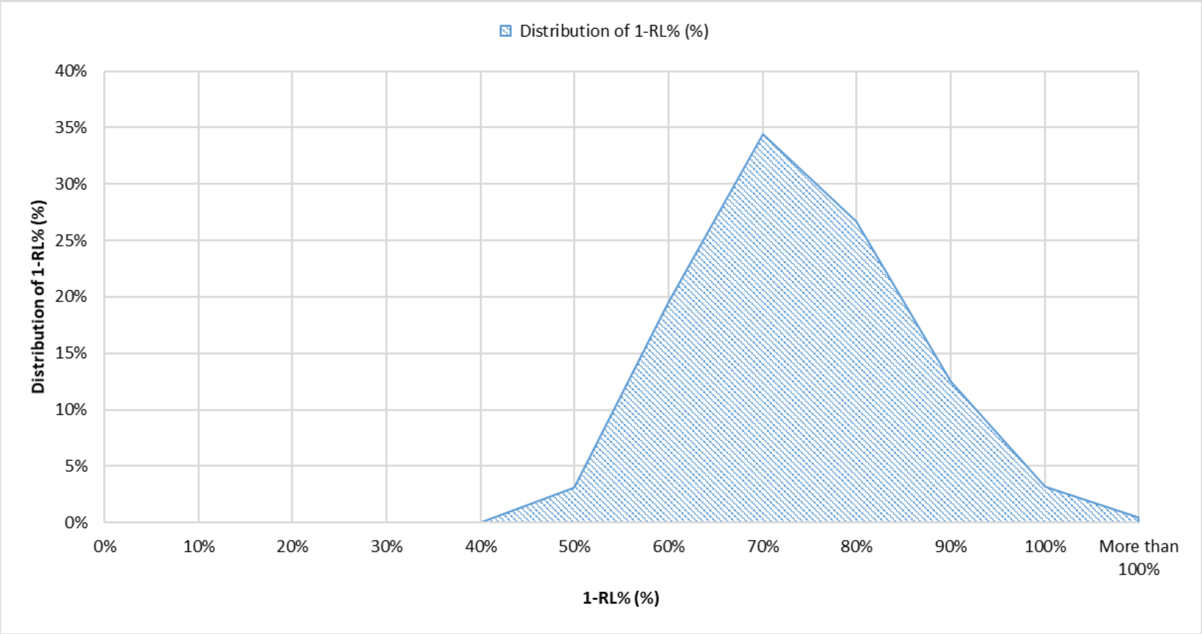
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Isolated



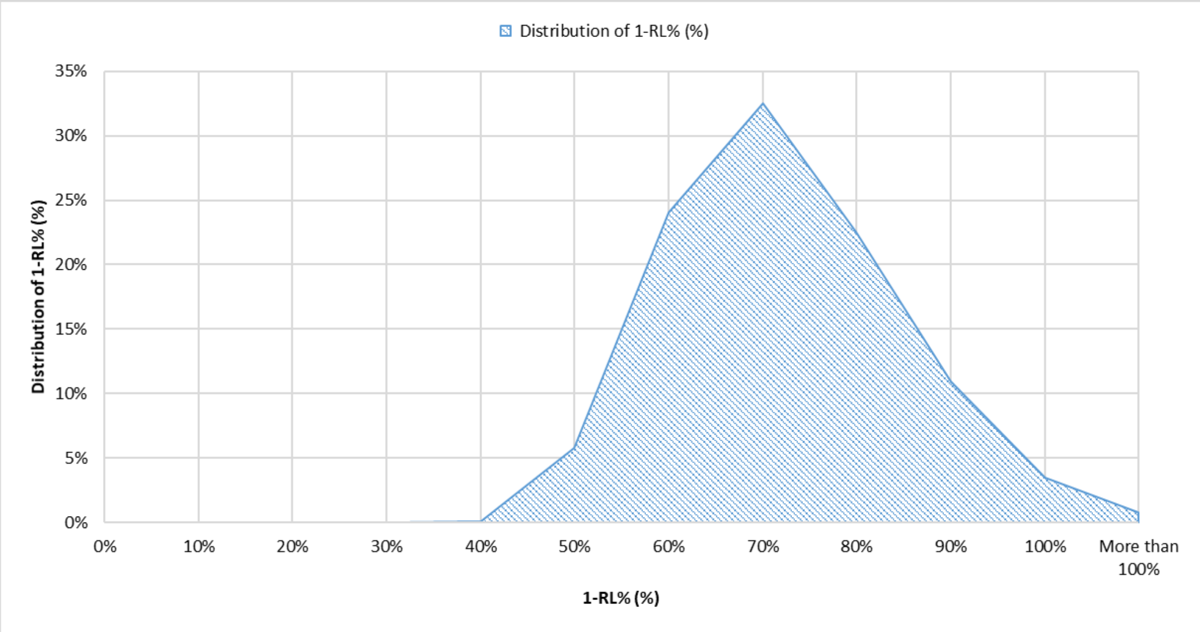
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Isolated



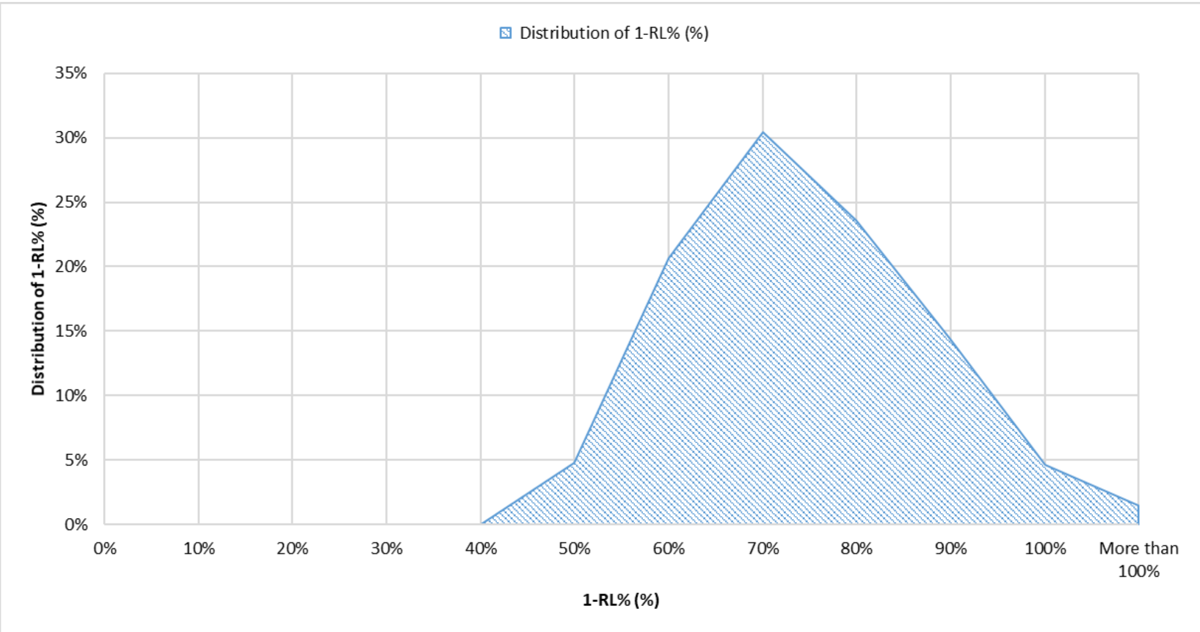
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Isolated



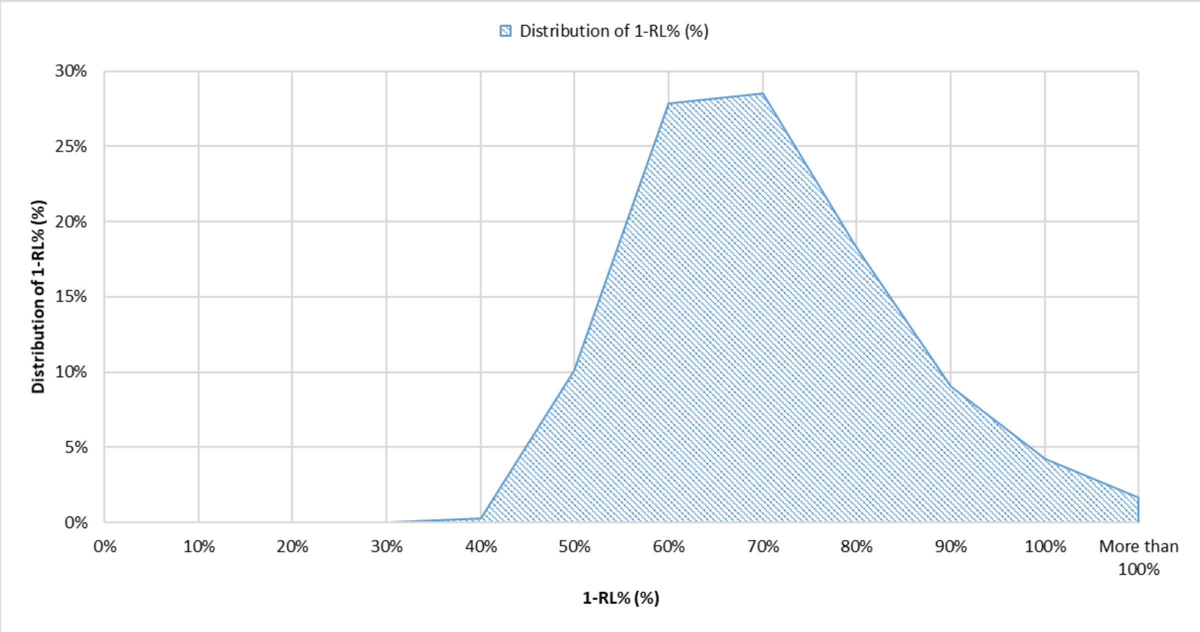
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Isolated



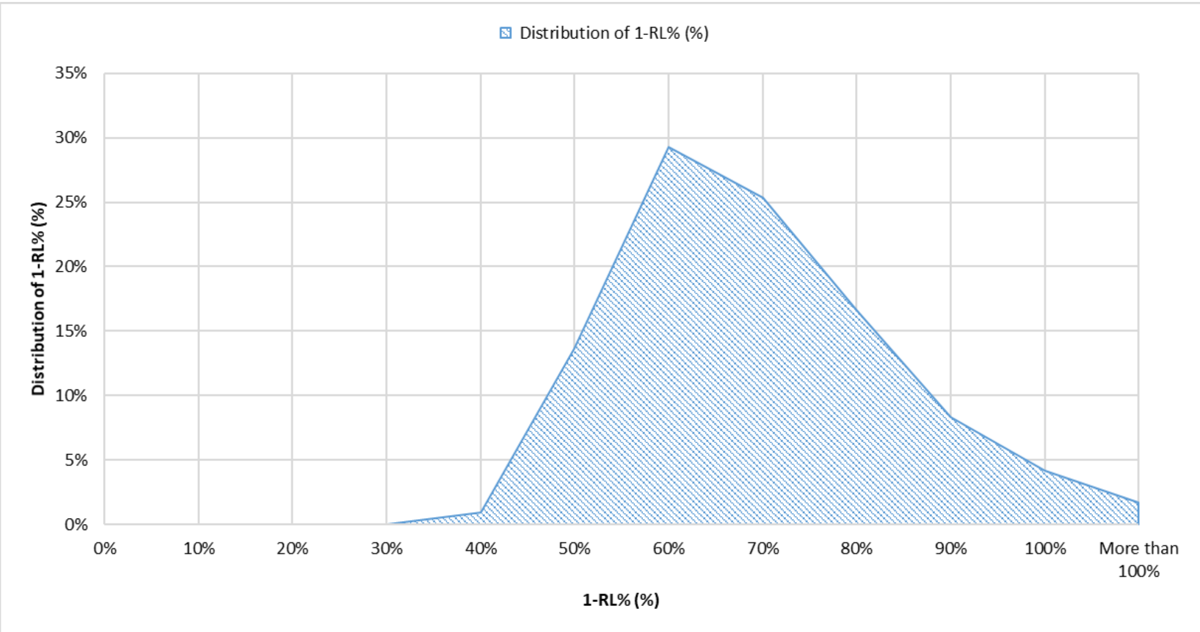
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Isolated



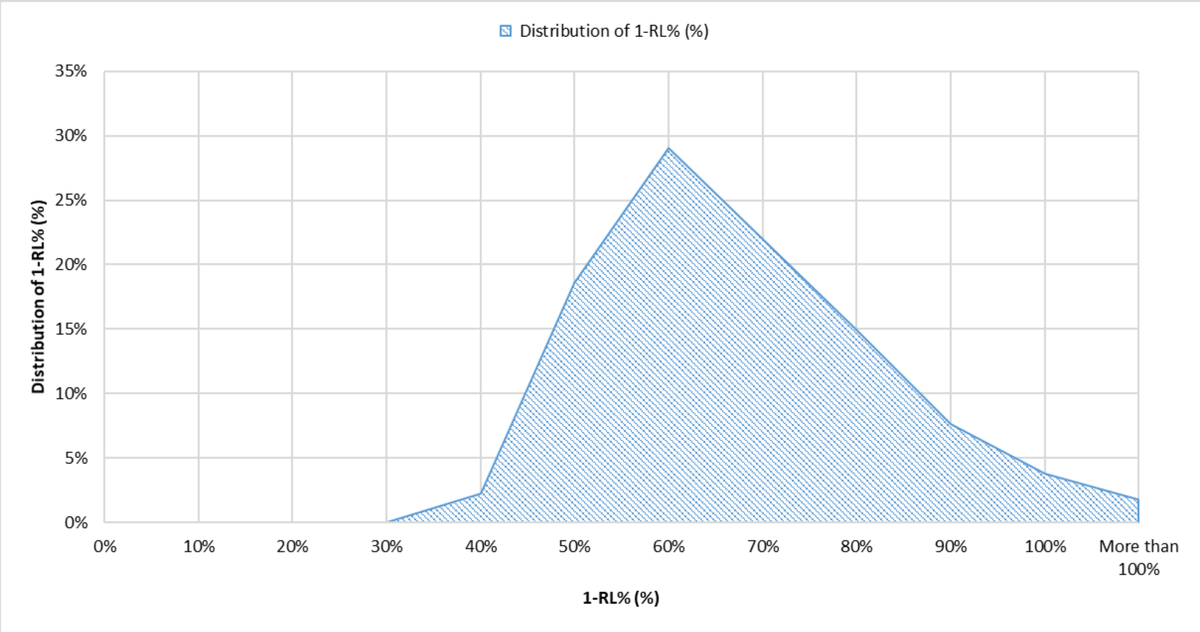
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Isolated



Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Isolated

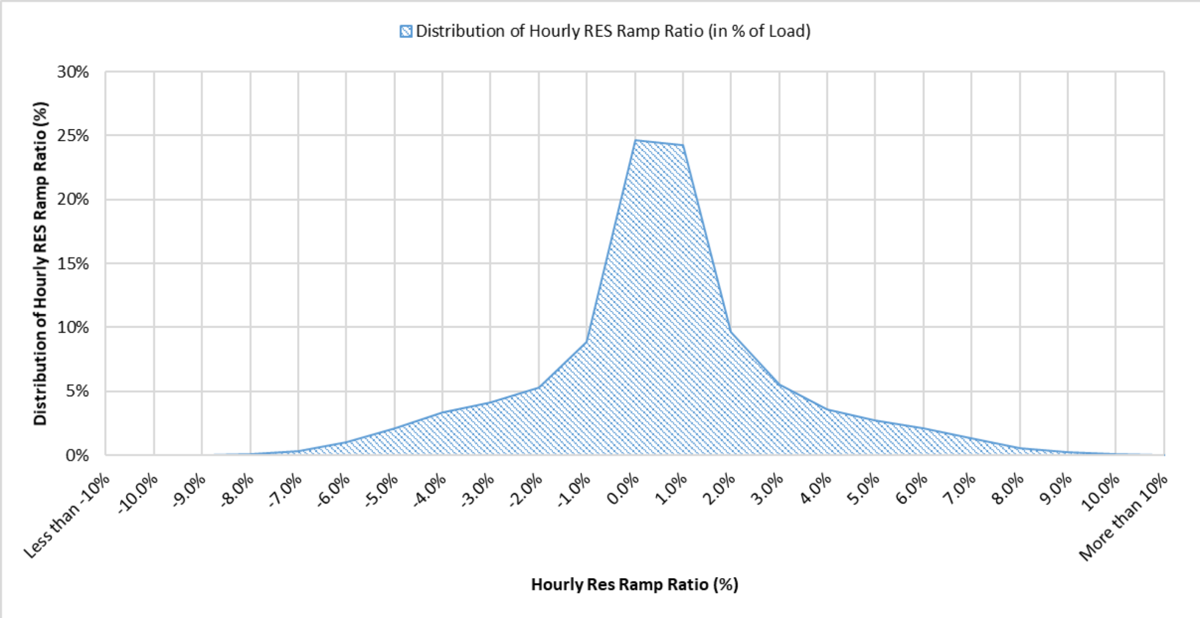


Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Isolated

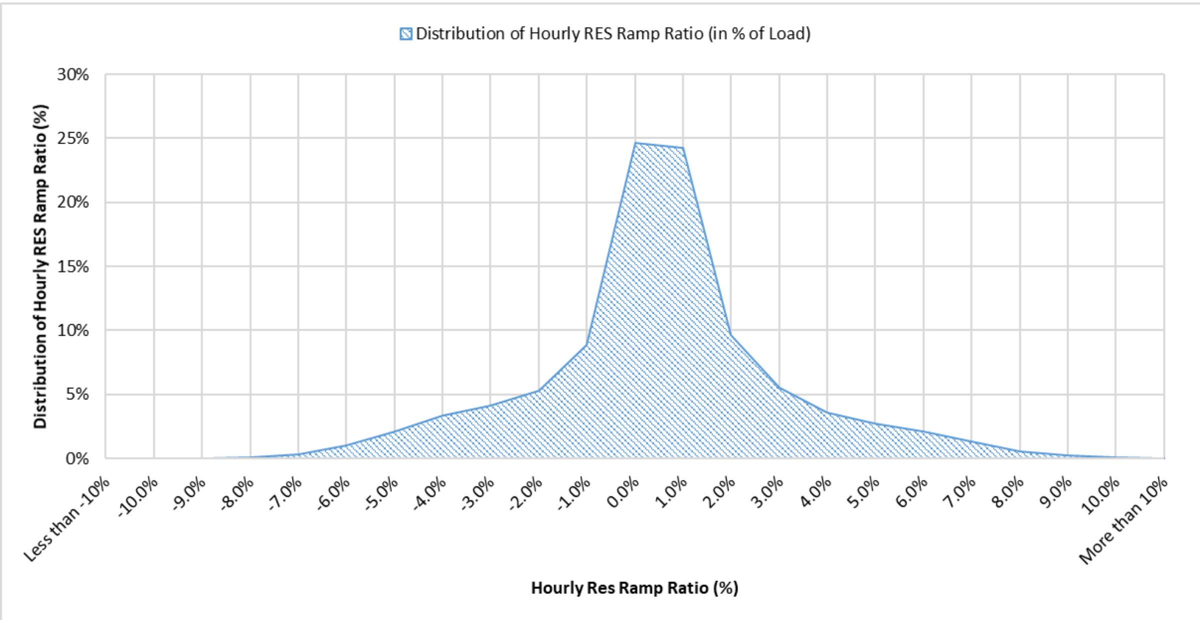


7.3. DETAILED RESULTS OF PROBABILISTIC DISTRIBUTION OF RES RAMP RATIO IN % OF LOAD

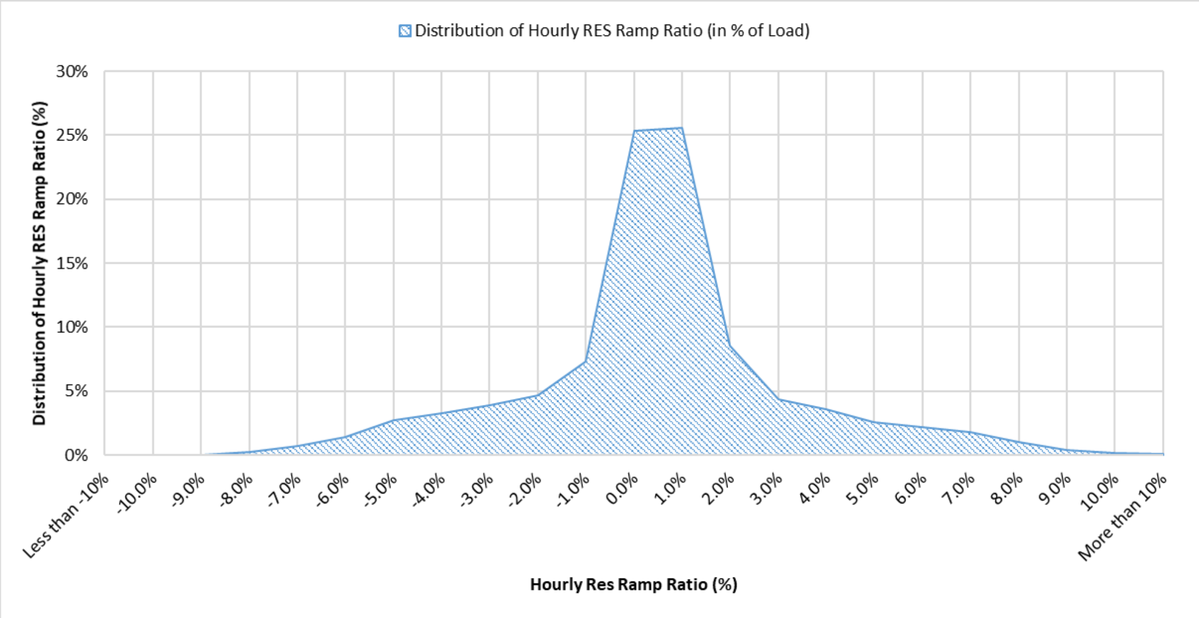
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



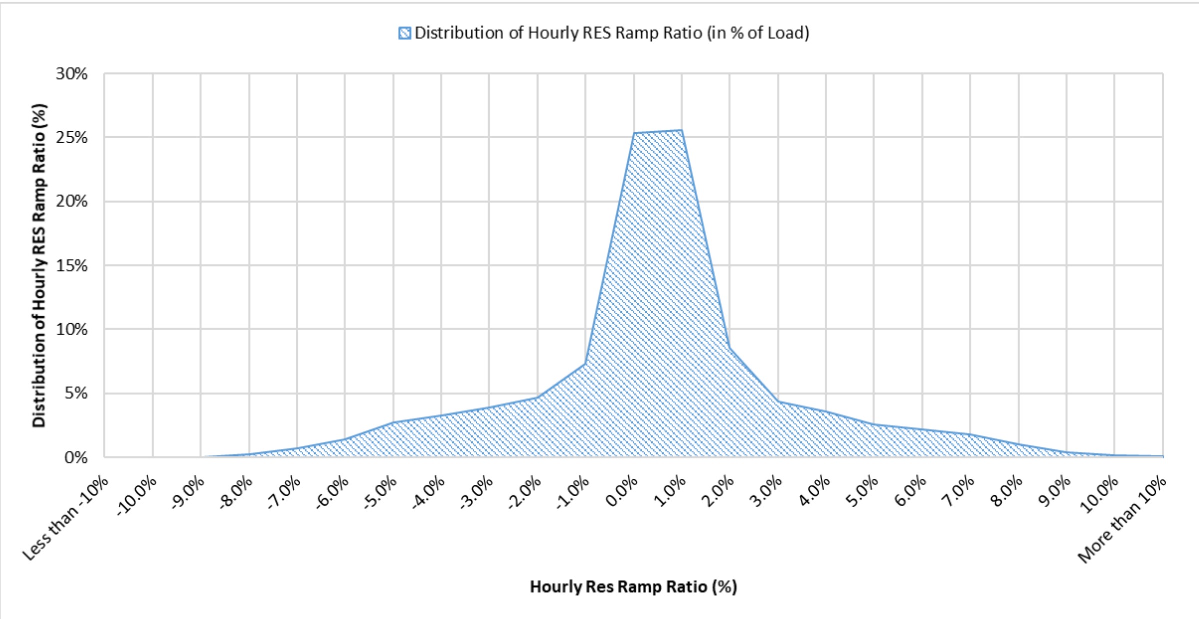
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=15% Reduction Interconnected



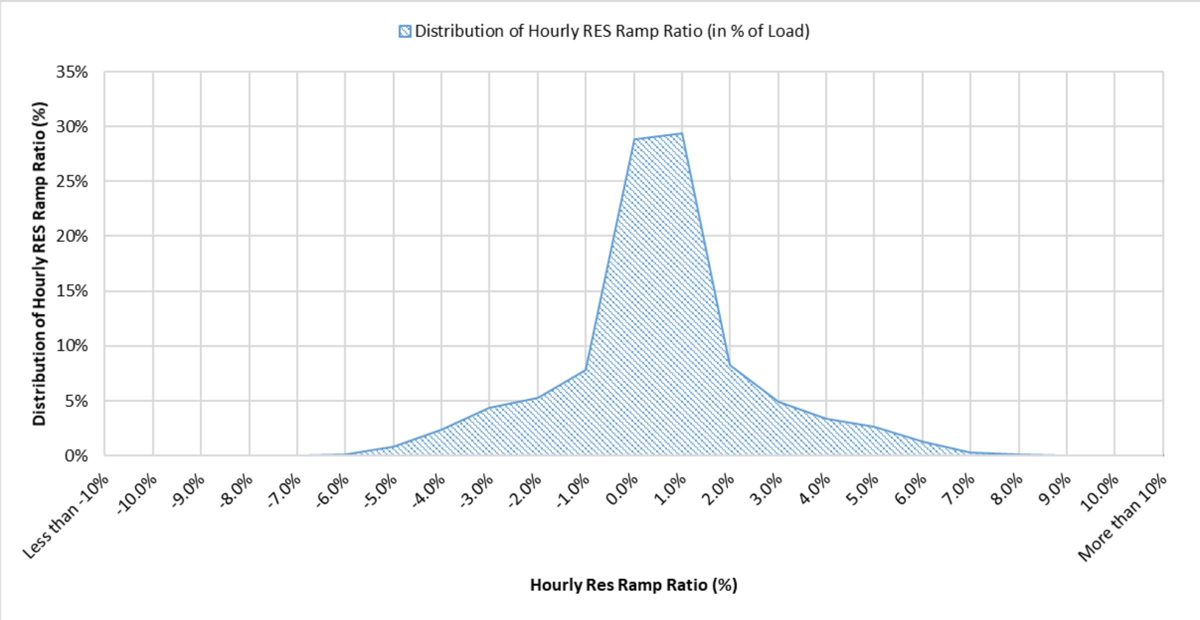
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



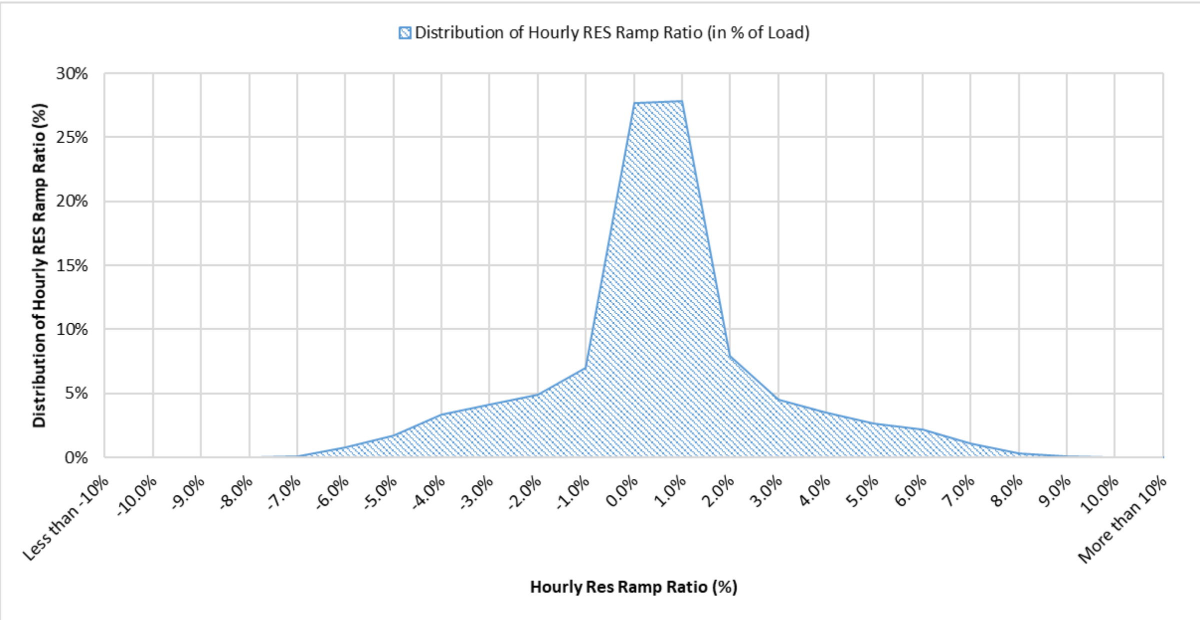
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=15% Reduction Interconnected



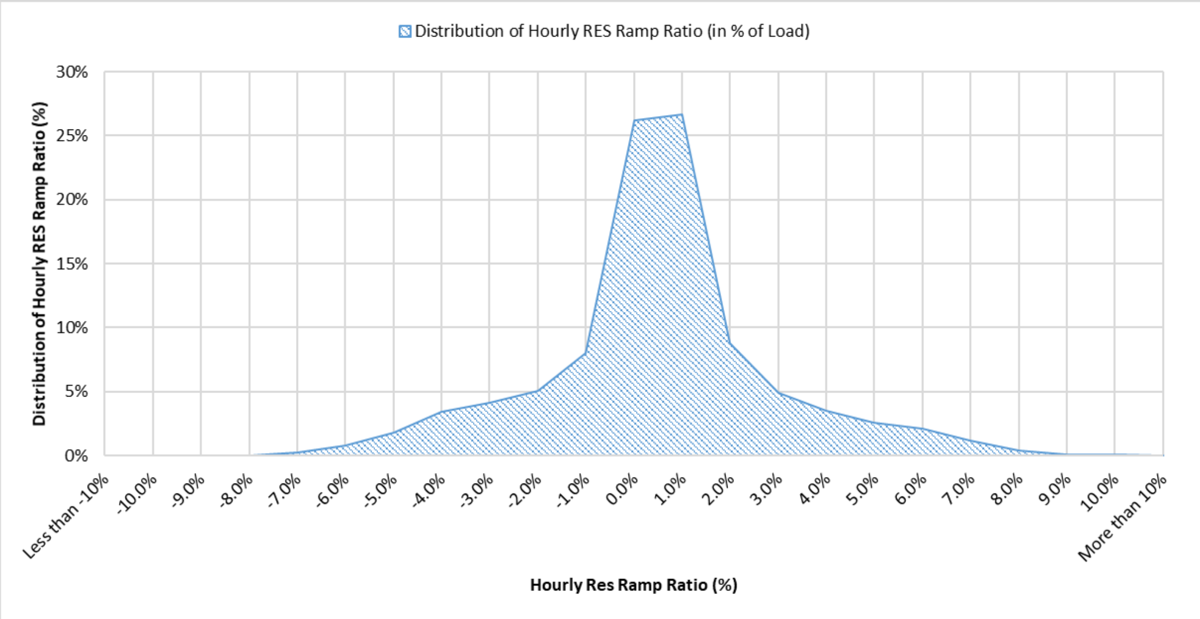
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=5,000MW Interconnected



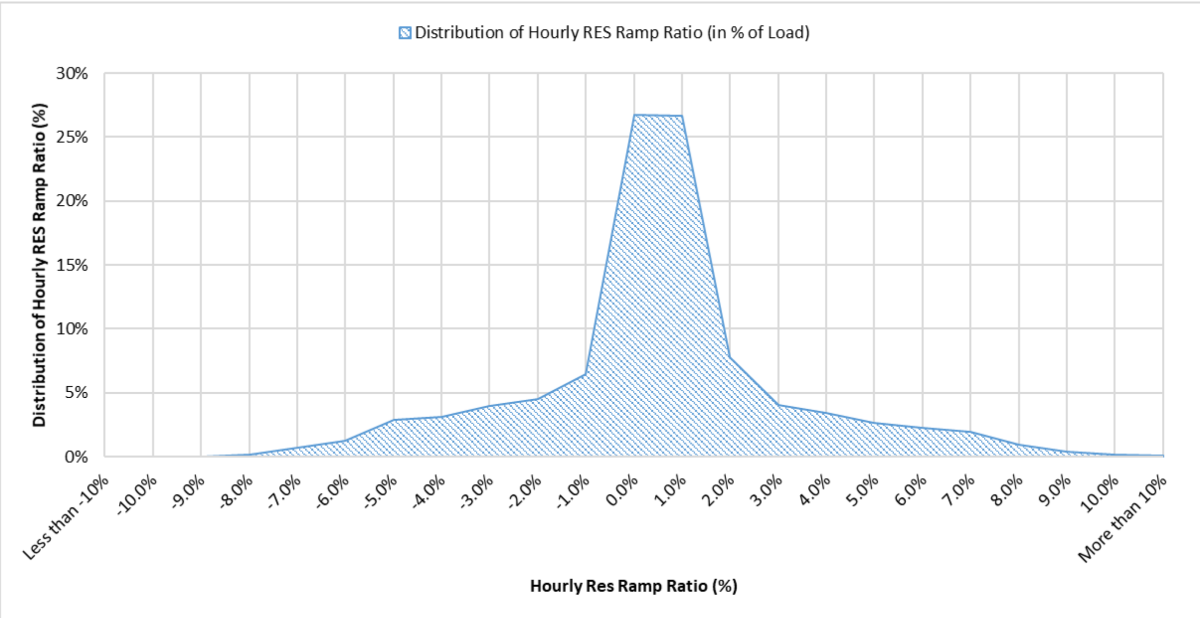
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=6,000MW Interconnected



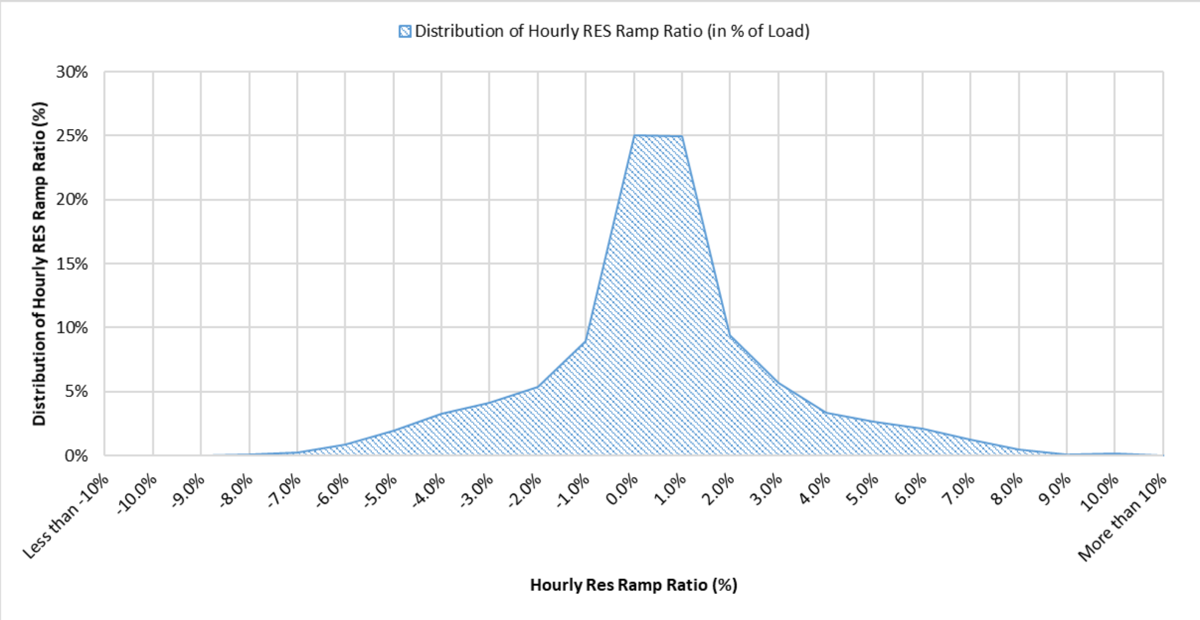
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=6,000MW Interconnected



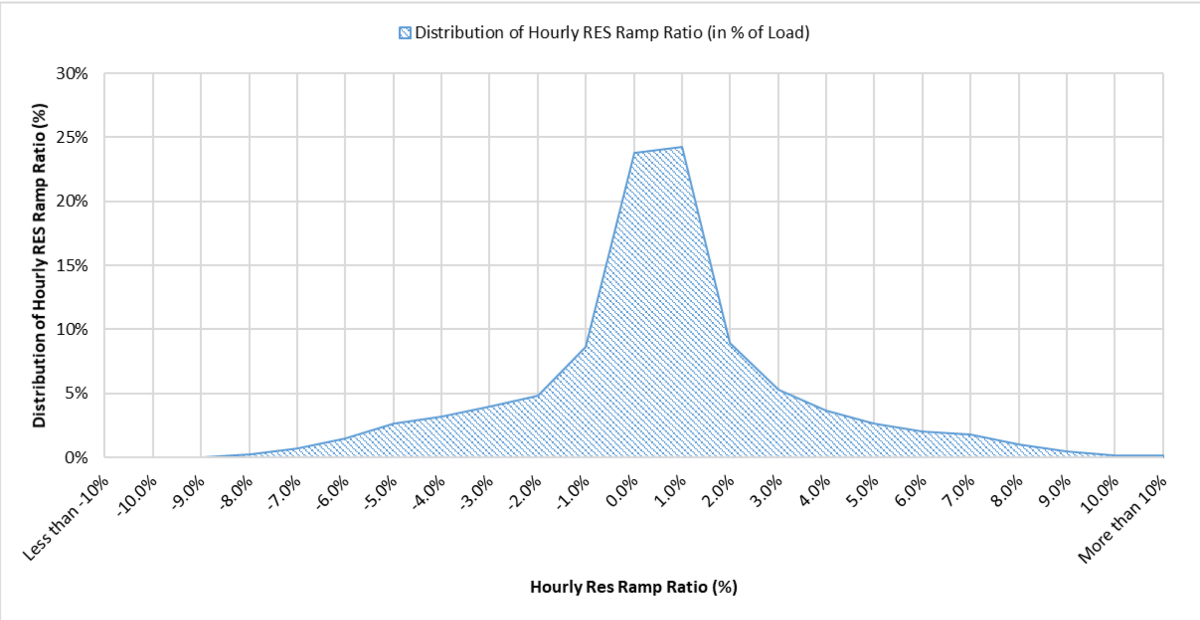
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=7,000MW Interconnected



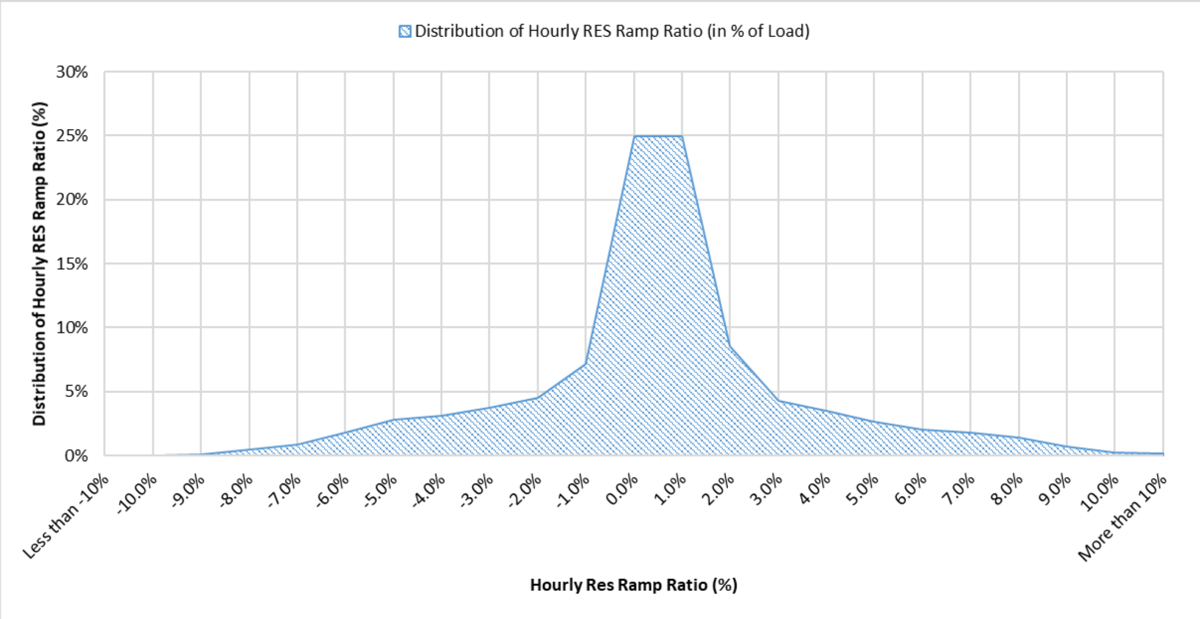
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=6,000MW Interconnected



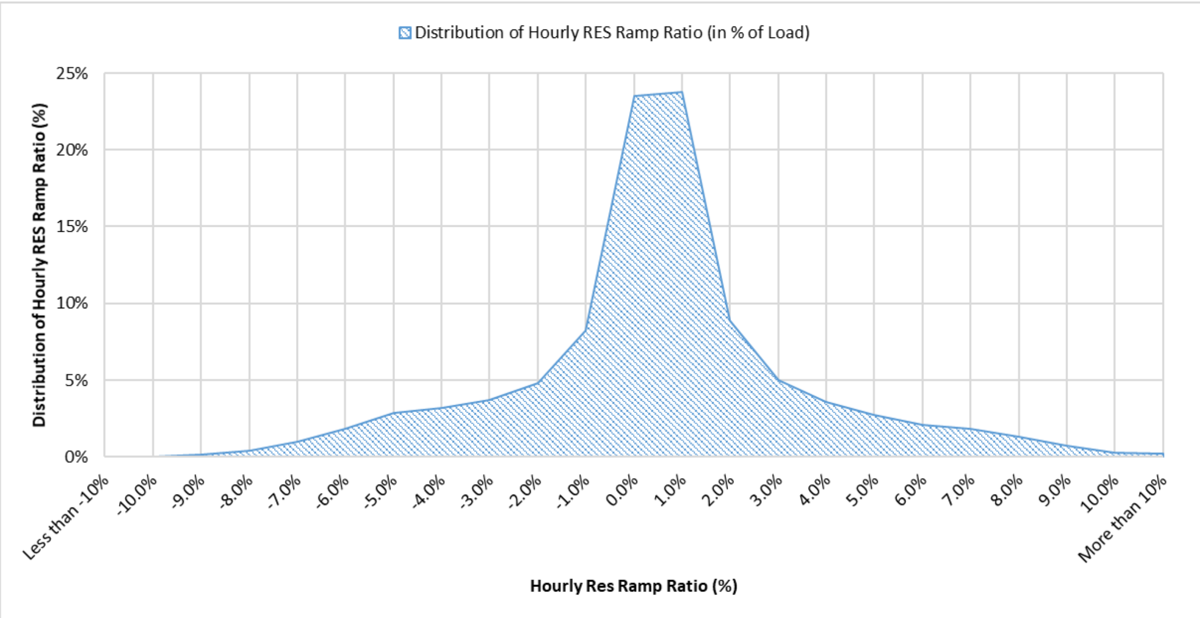
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,000MW Interconnected



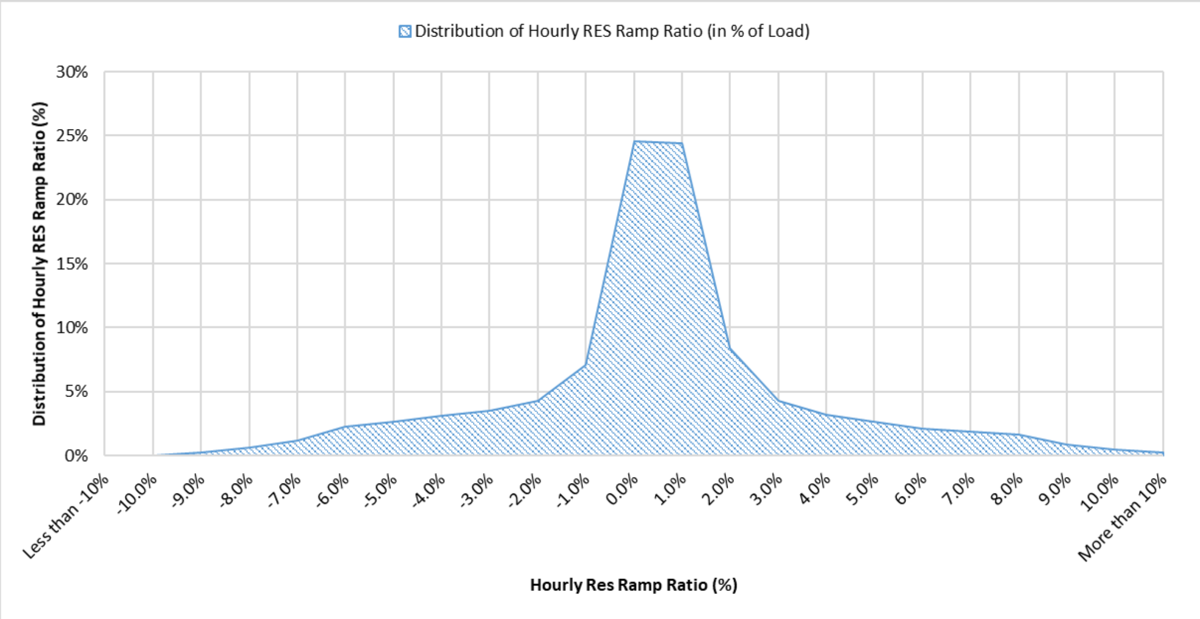
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,500MW Interconnected



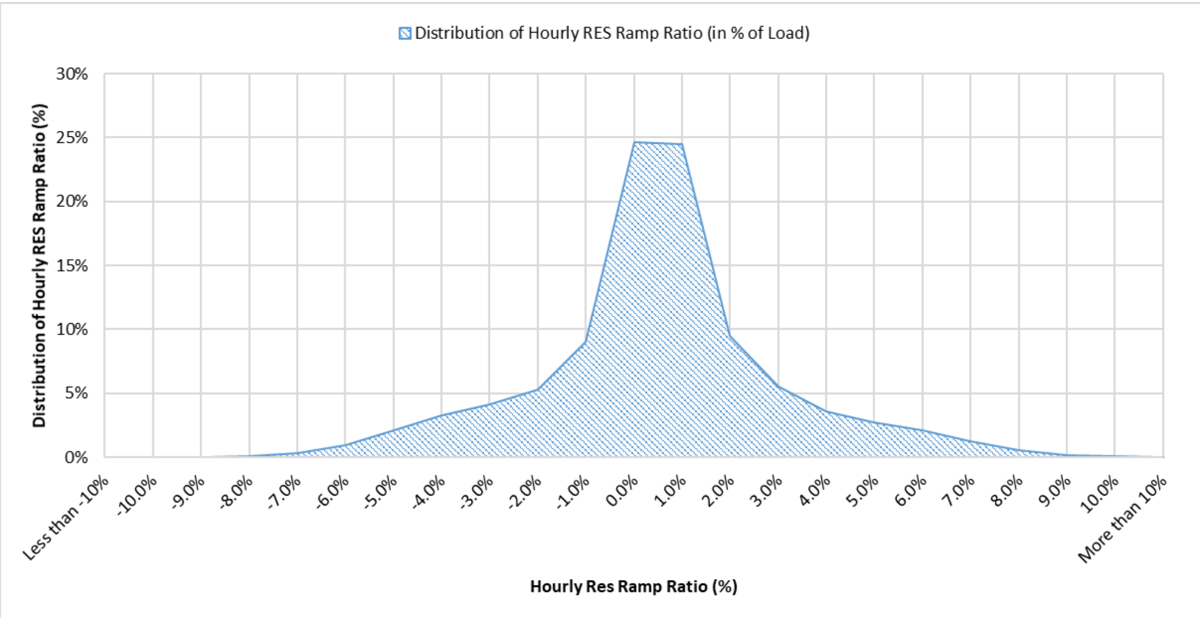
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,500MW Interconnected



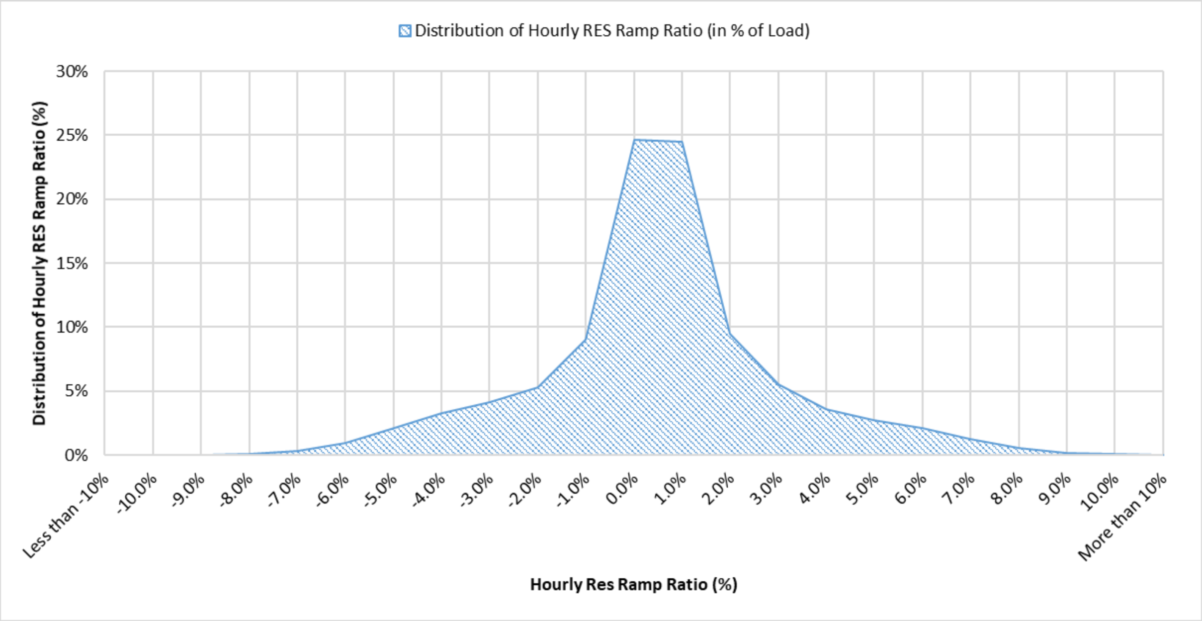
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=8,000MW Interconnected



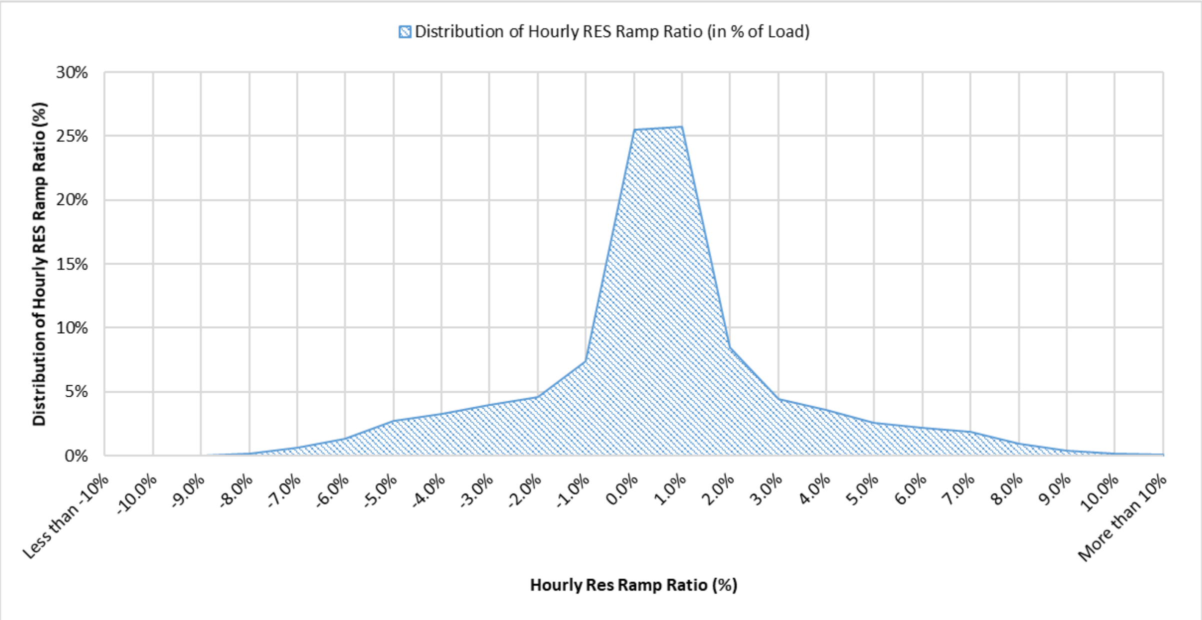
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=7.5% Reduction Interconnected



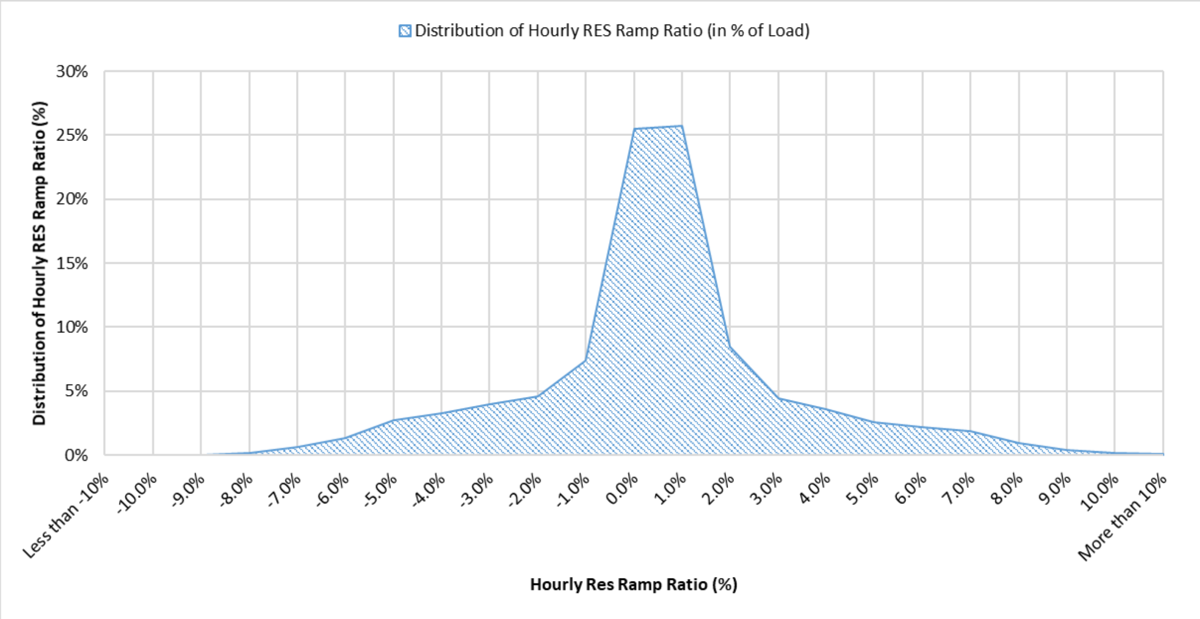
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=12.5% Reduction Interconnected



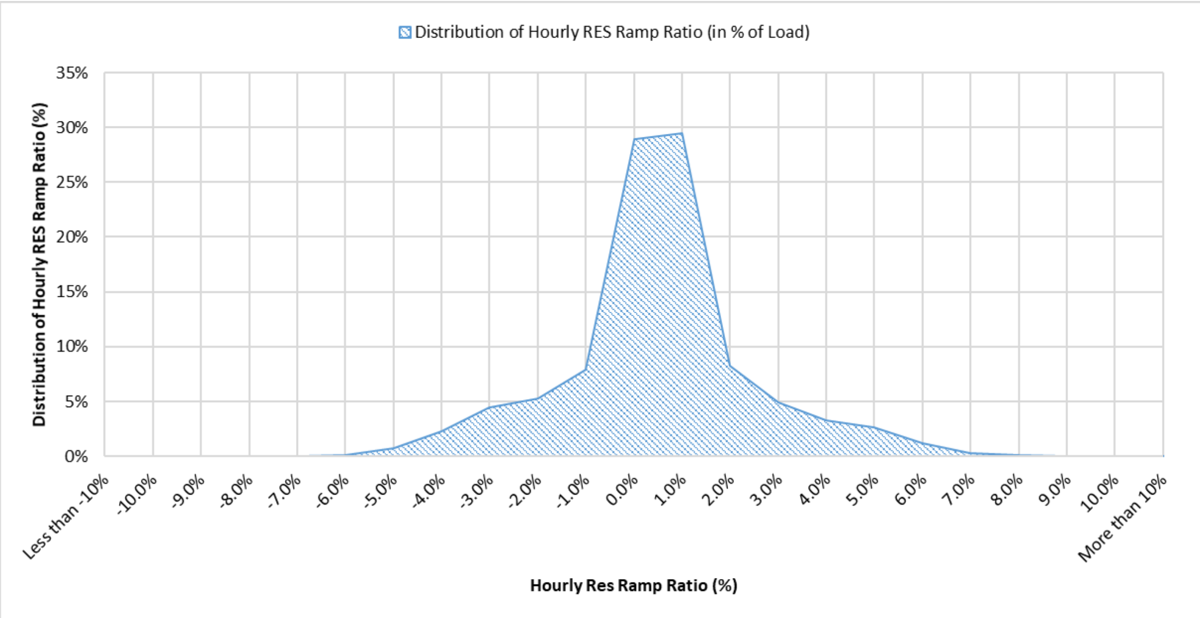
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=7.5% Reduction Interconnected



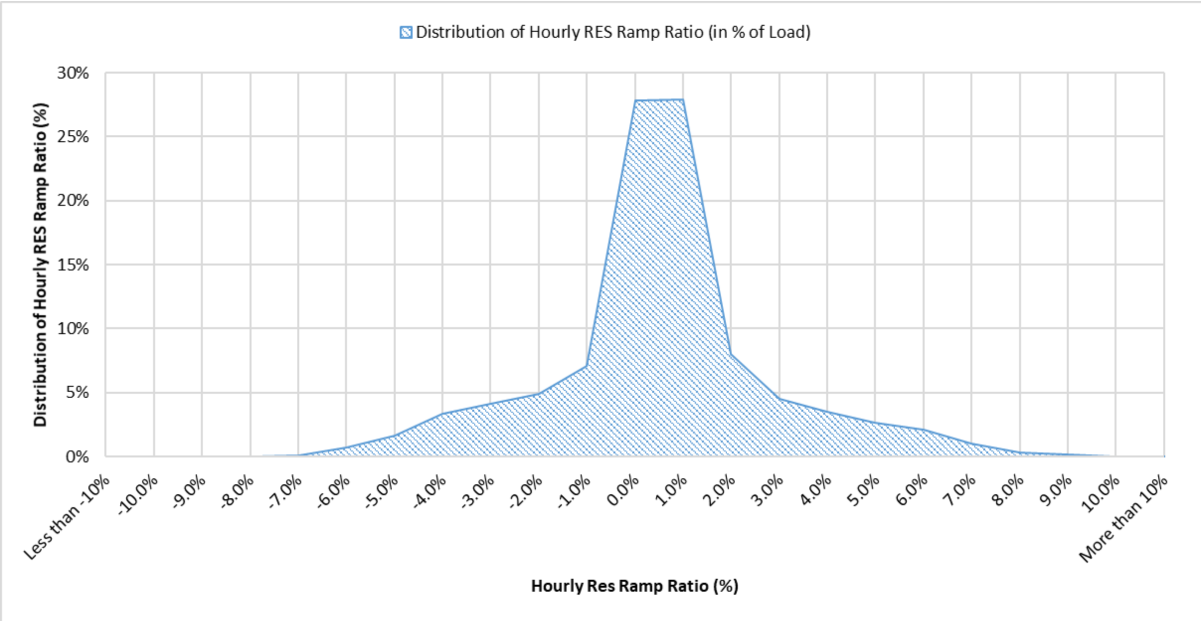
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=12.5% Reduction Interconnected



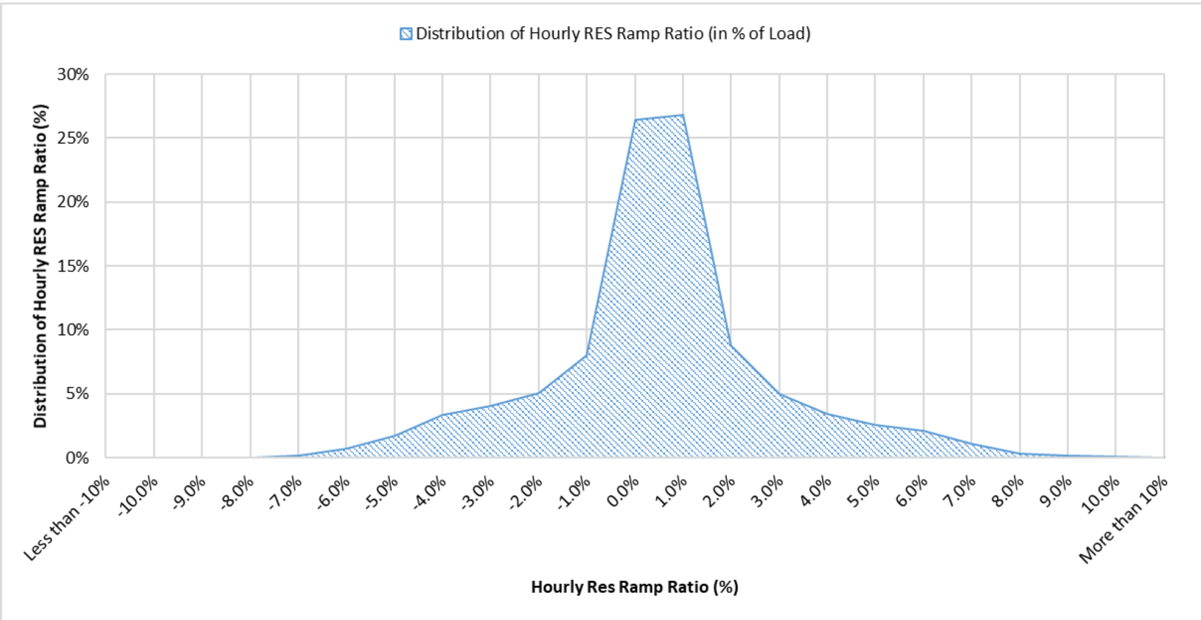
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=5,000MW Interconnected



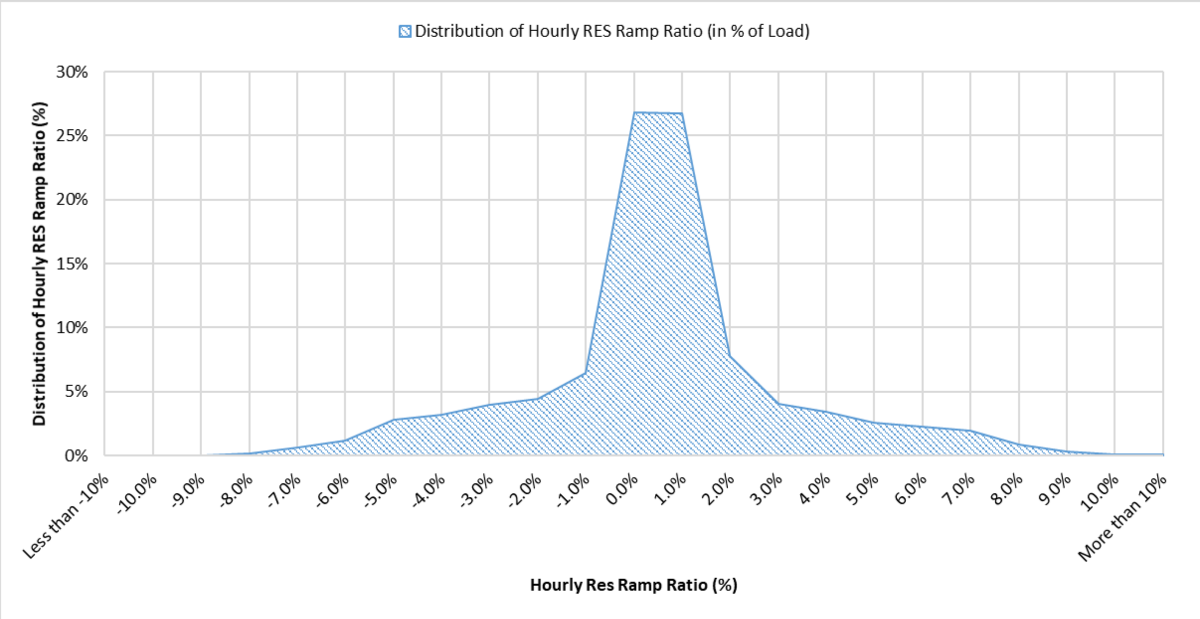
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=6,000MW Interconnected



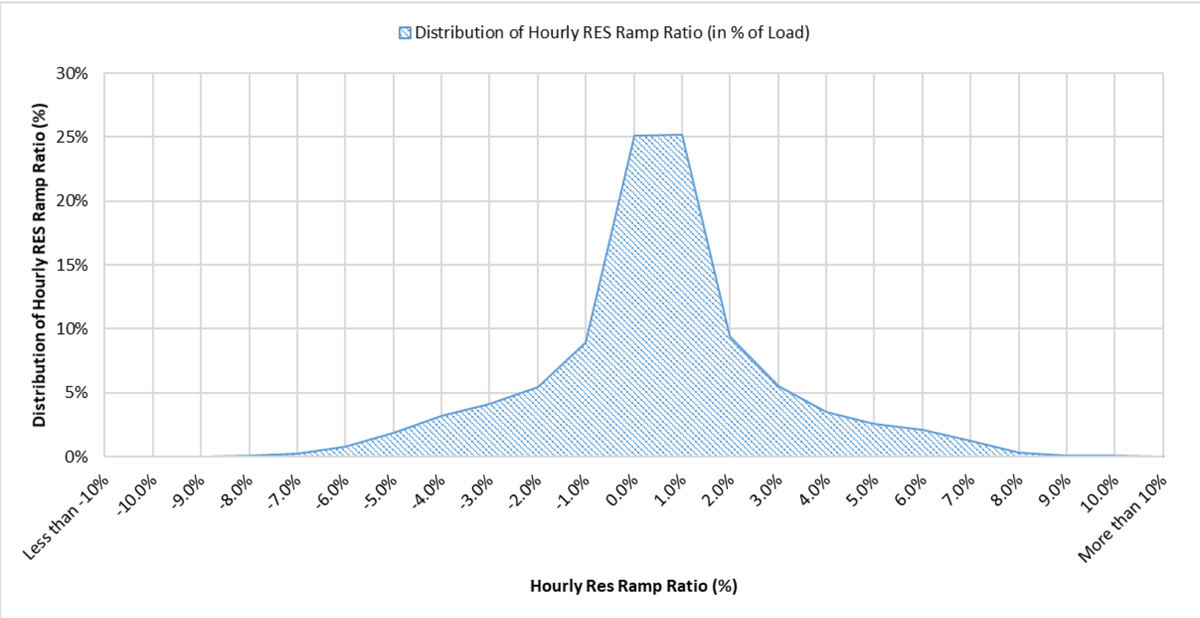
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=6,000MW Interconnected



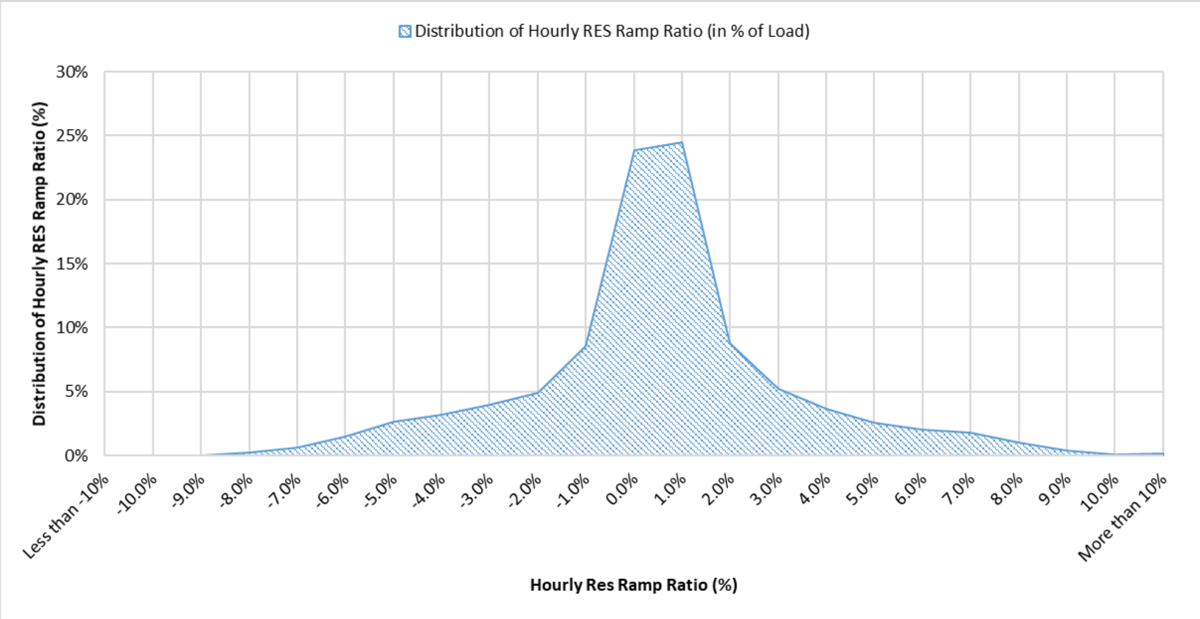
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=7,000MW Interconnected



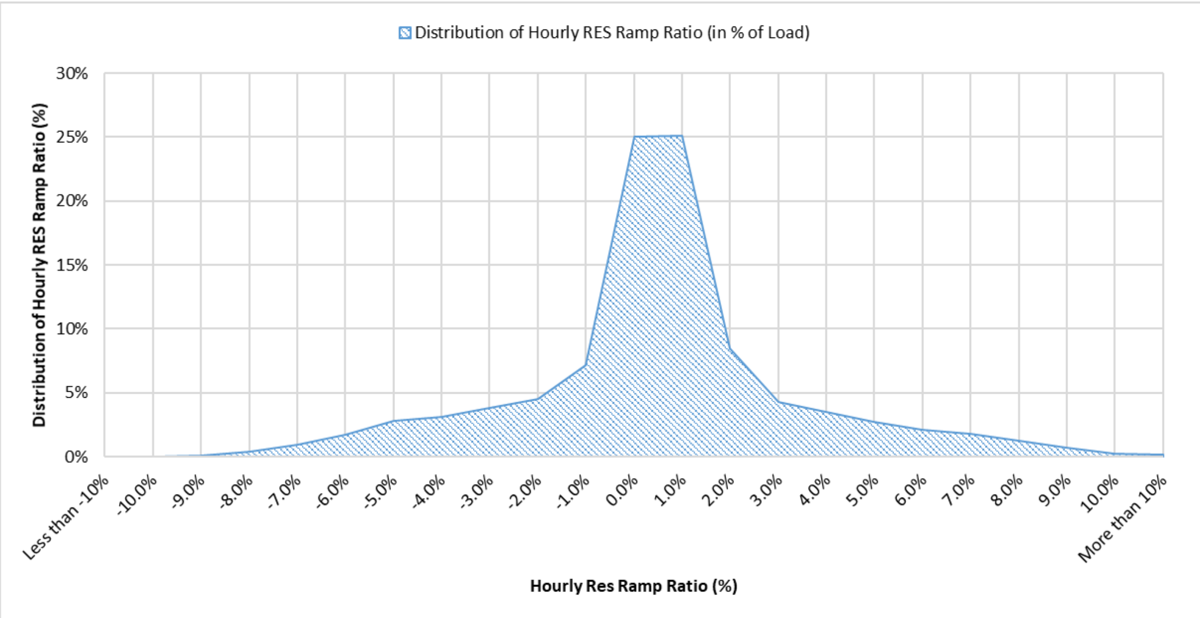
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=6,000MW Interconnected



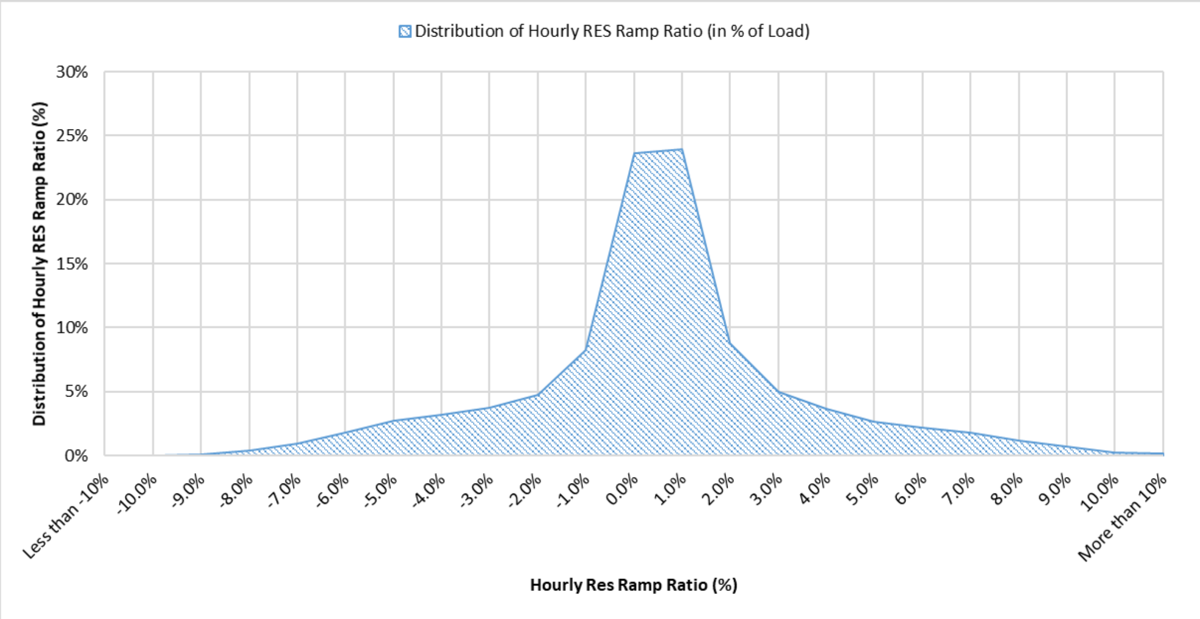
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,000MW Interconnected



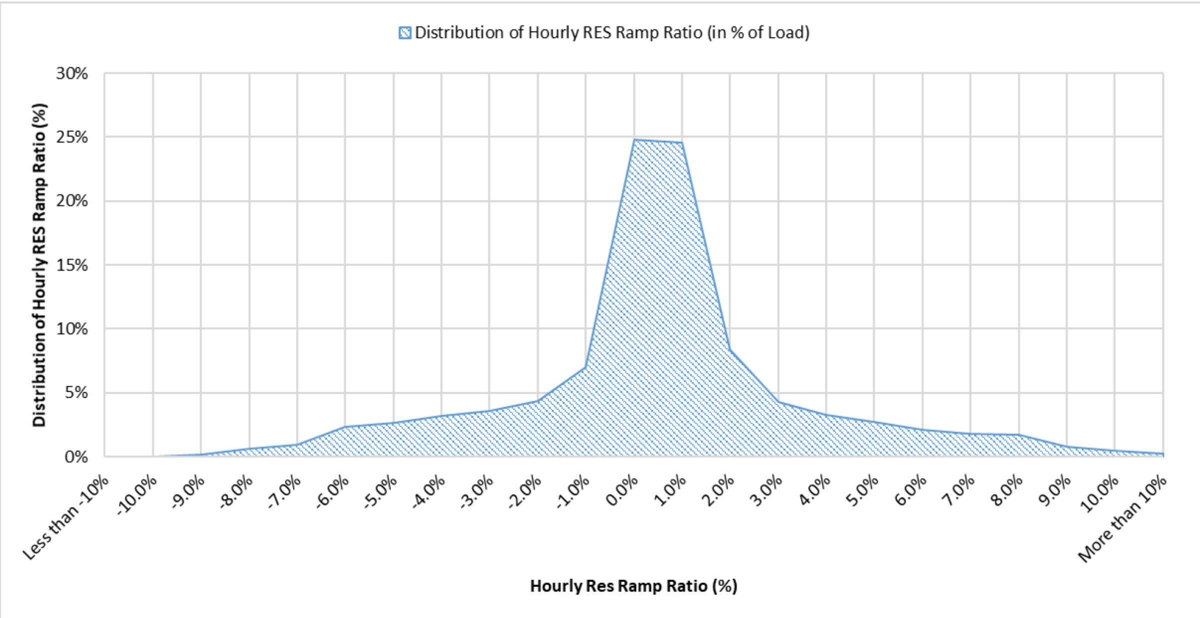
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,500MW Interconnected



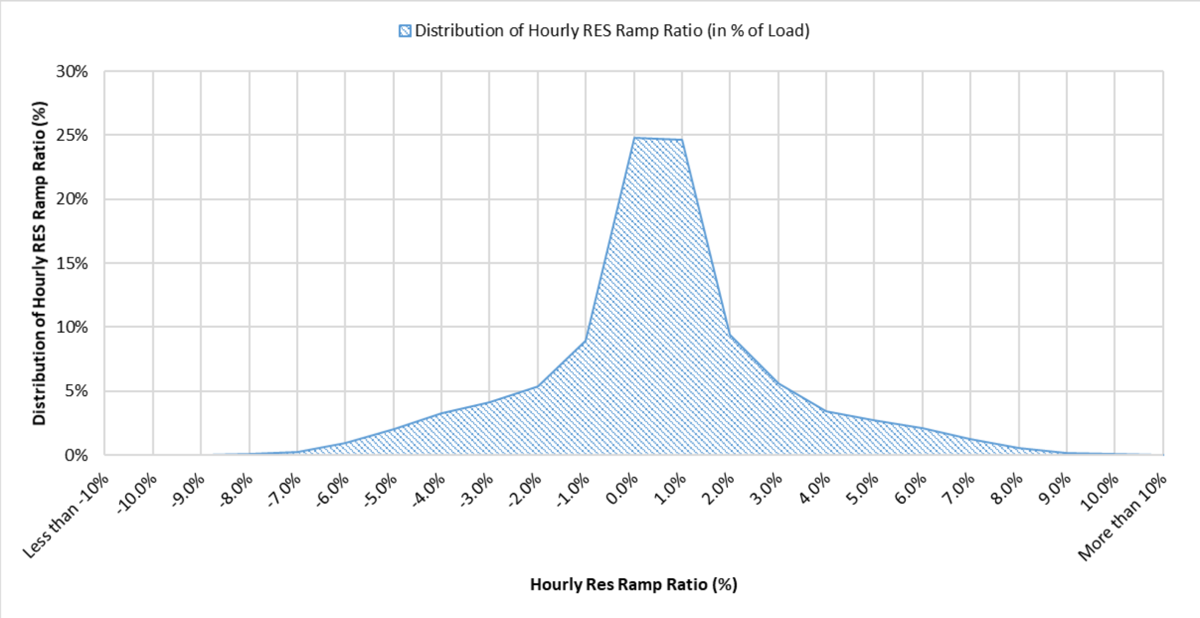
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,500MW Interconnected



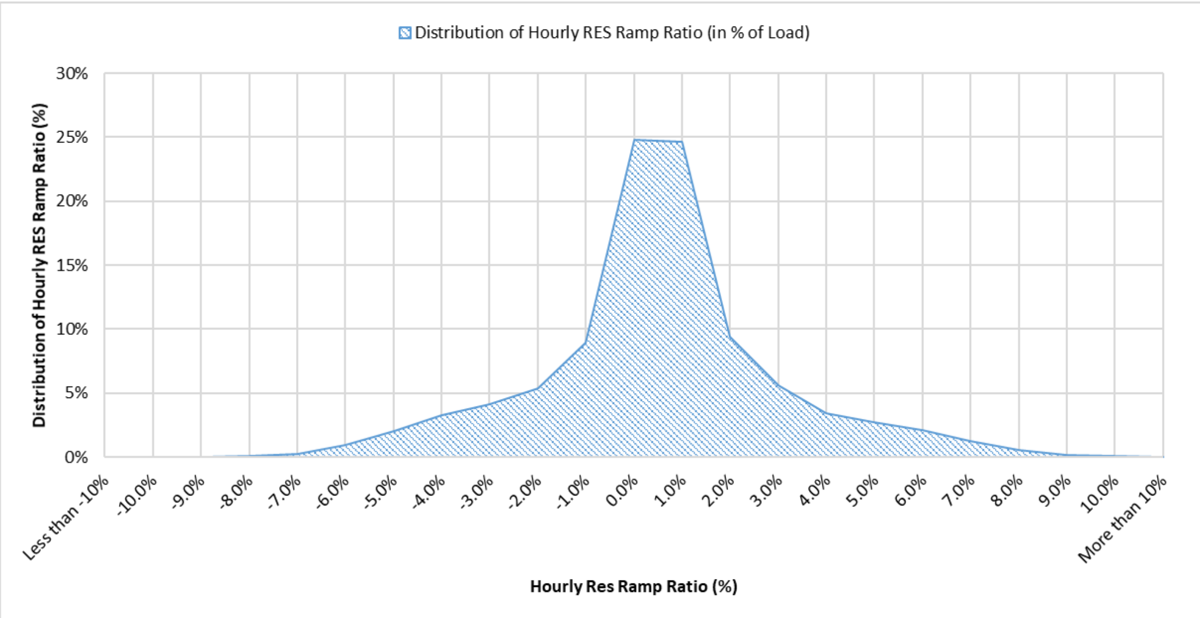
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=8,000MW Interconnected



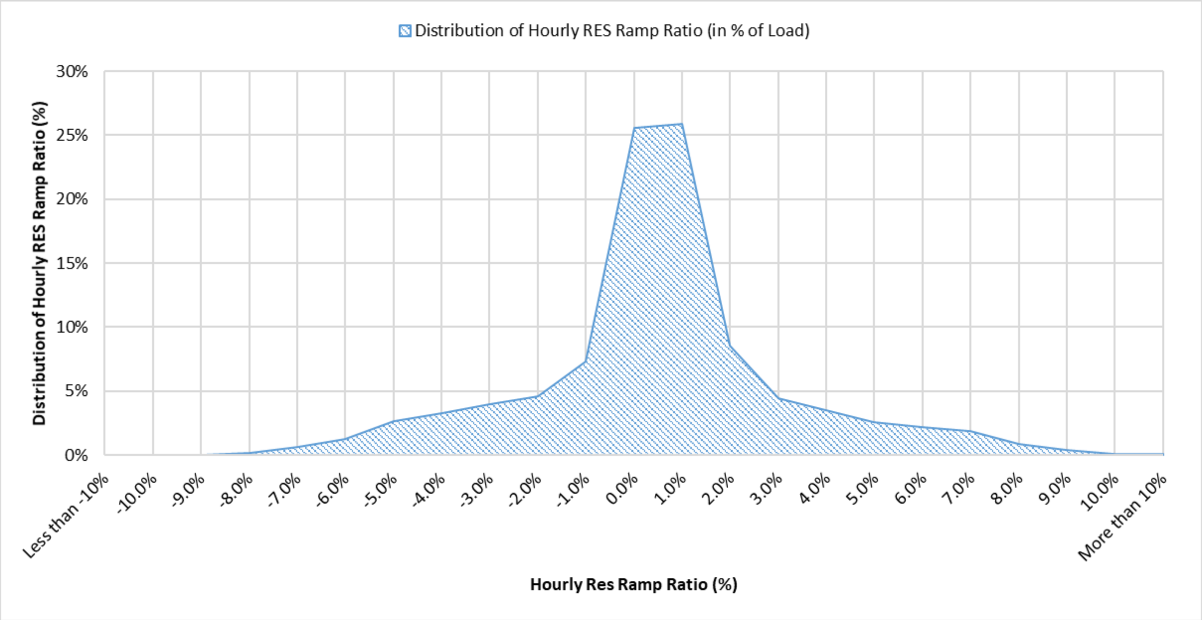
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=5% Reduction Interconnected



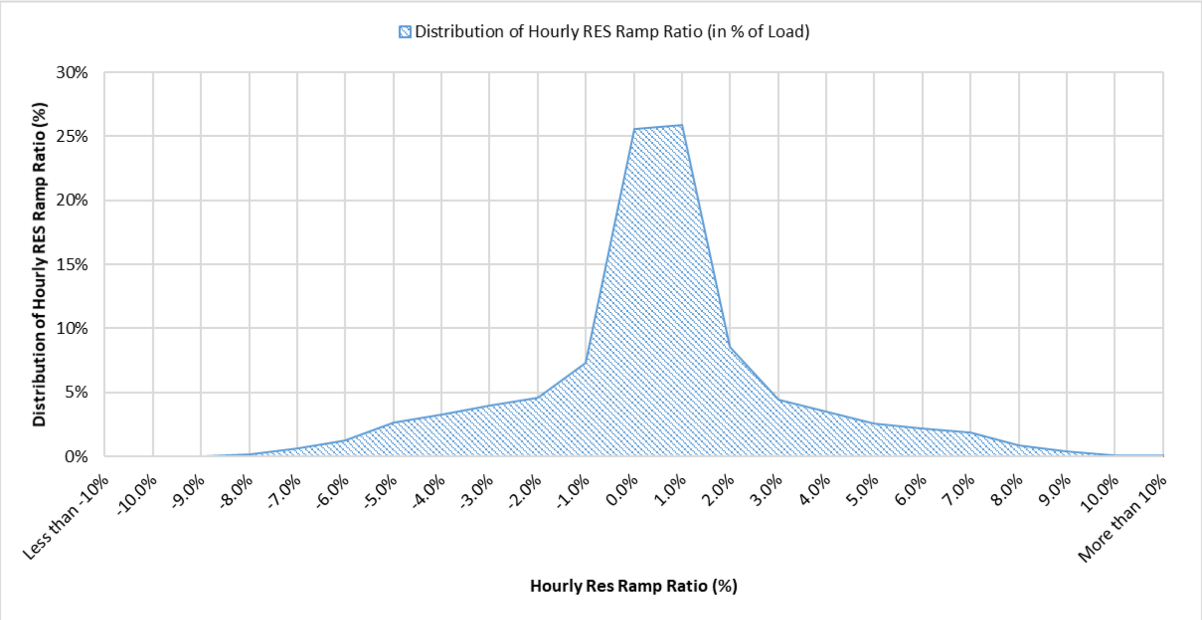
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



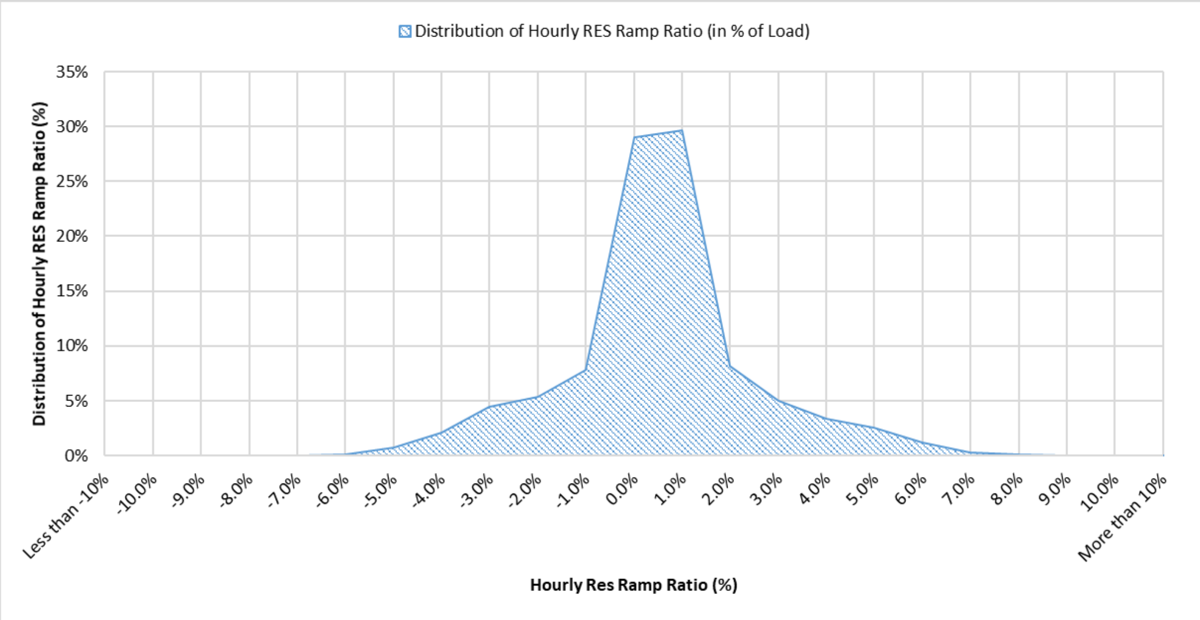
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=5% Reduction Interconnected



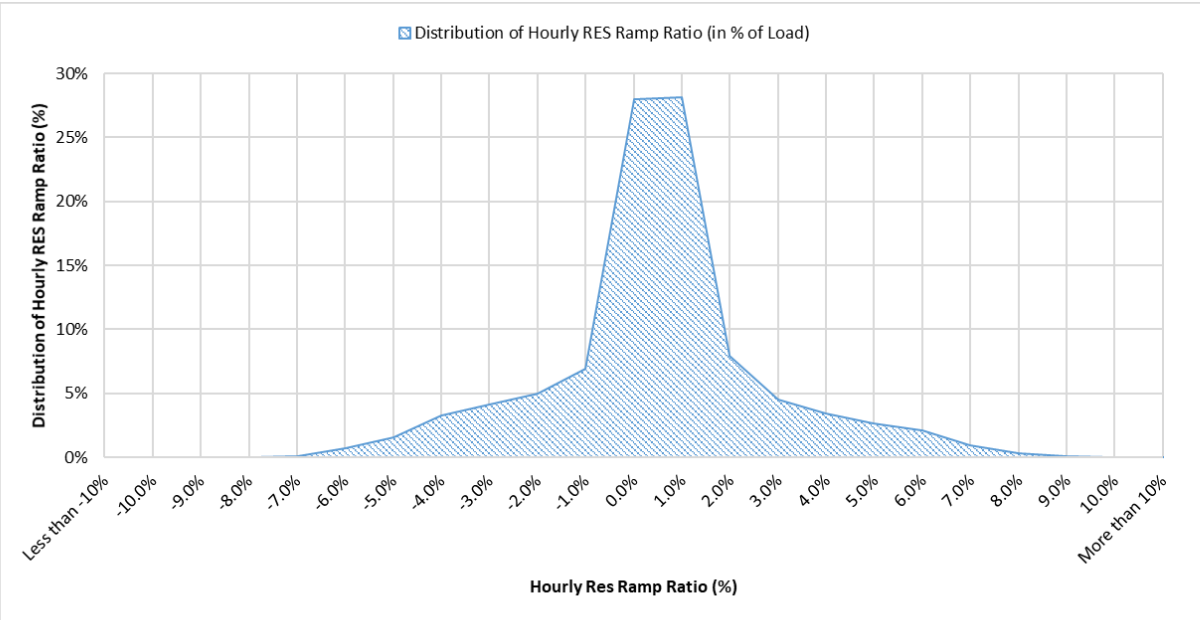
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



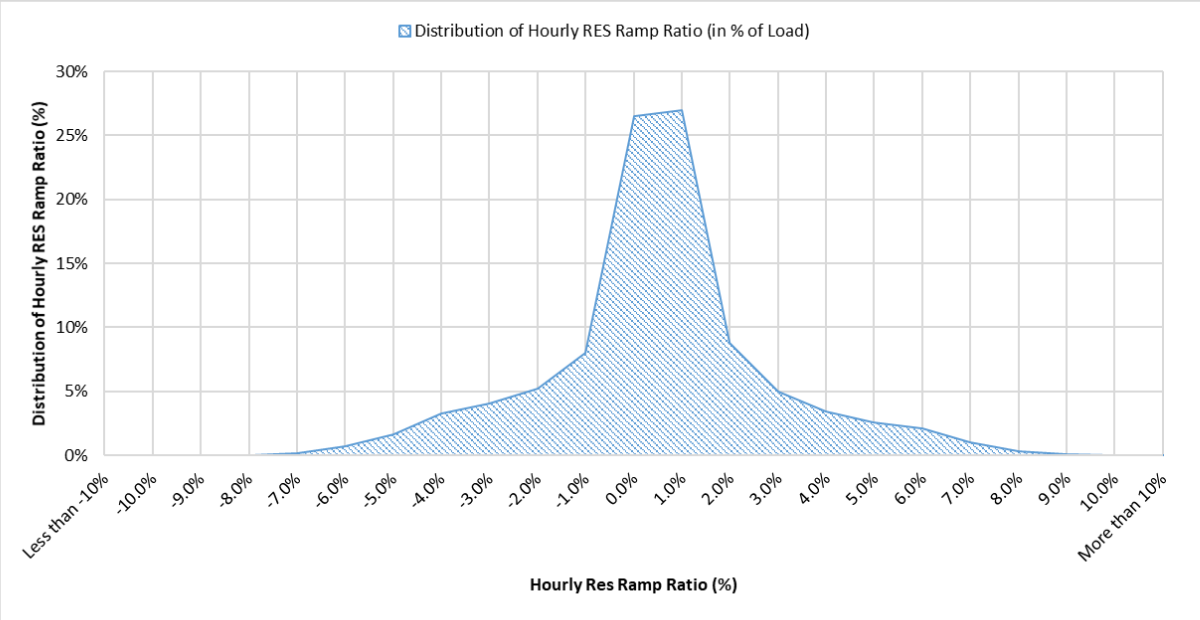
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=5,000MW Interconnected



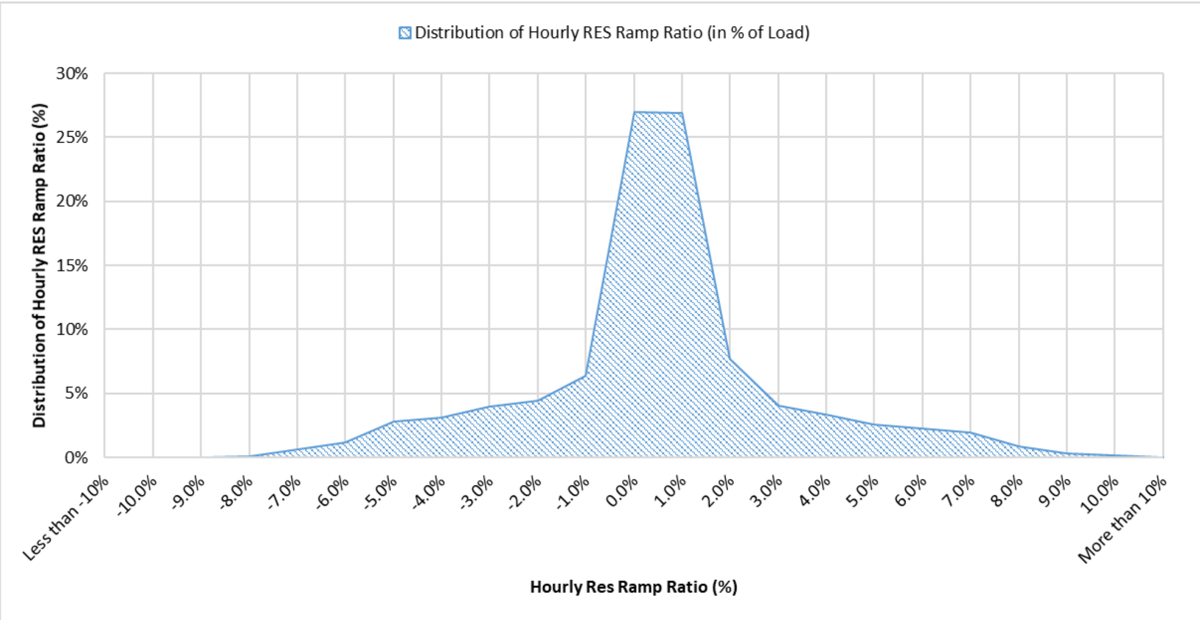
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=6,000MW Interconnected



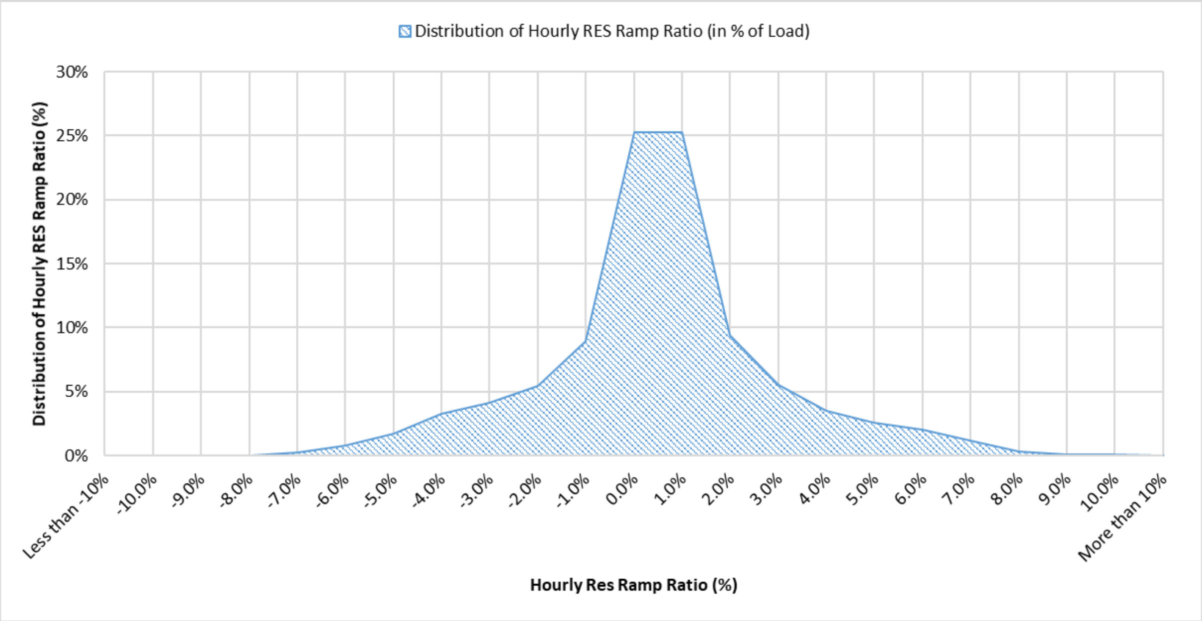
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=6,000MW Interconnected



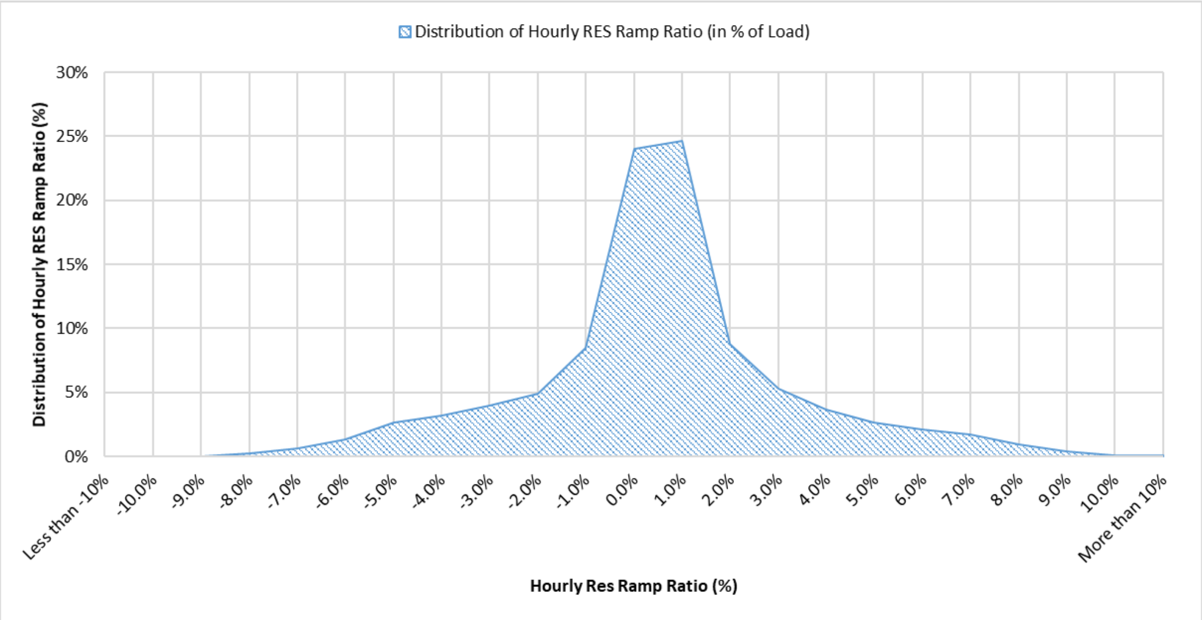
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=7,000MW Interconnected



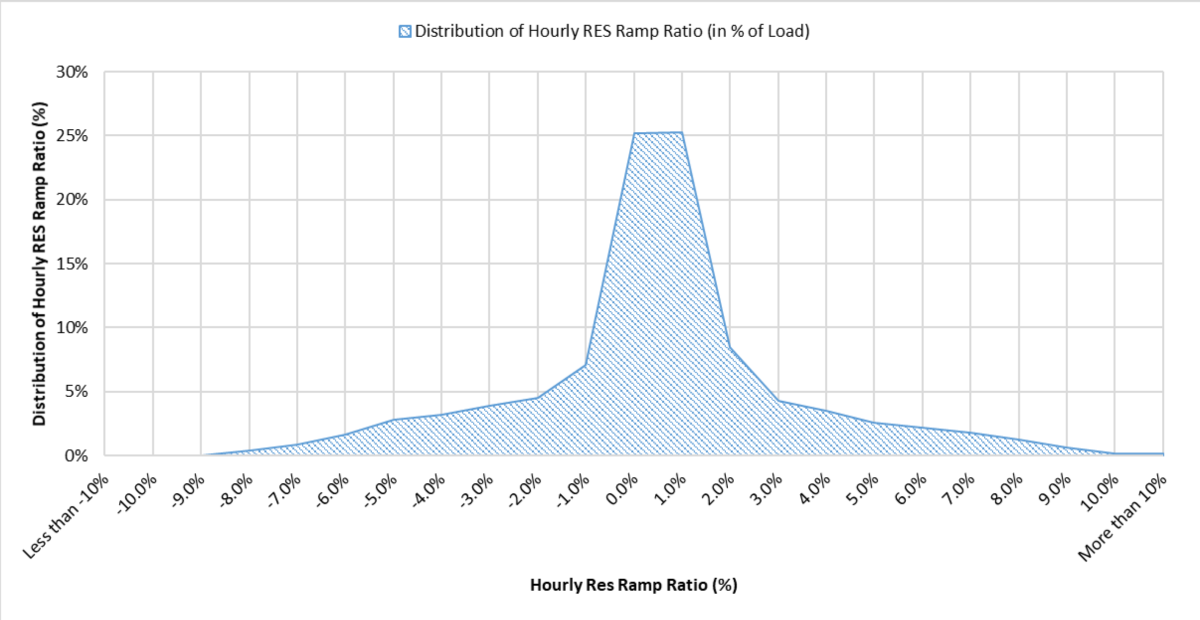
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=6,000MW Interconnected



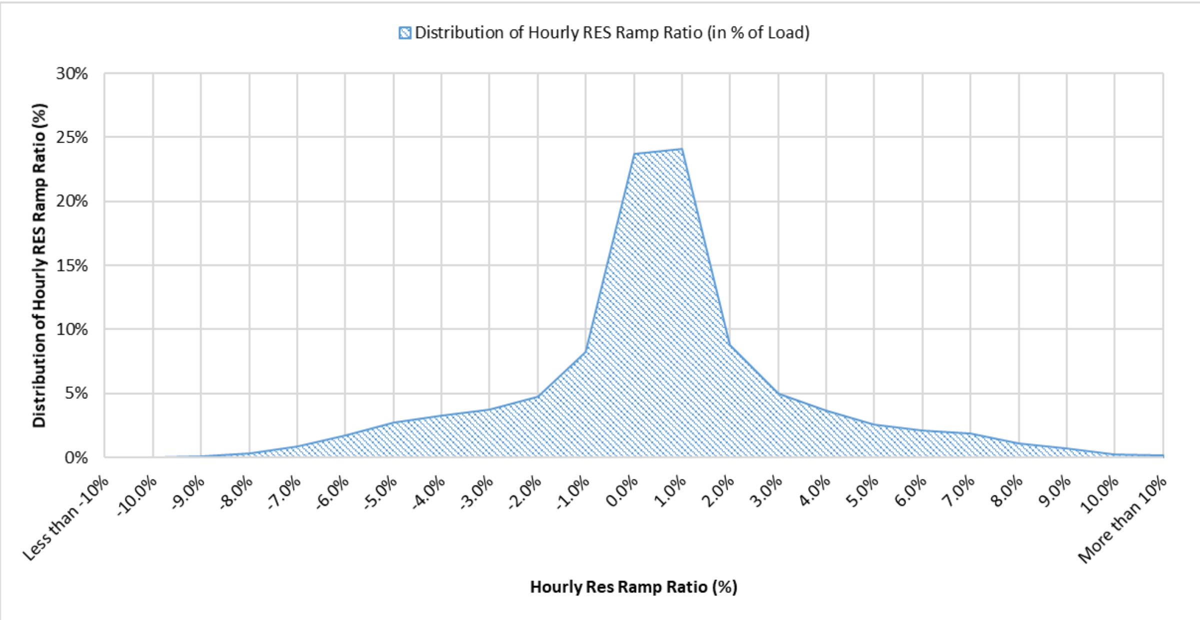
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,000MW Interconnected



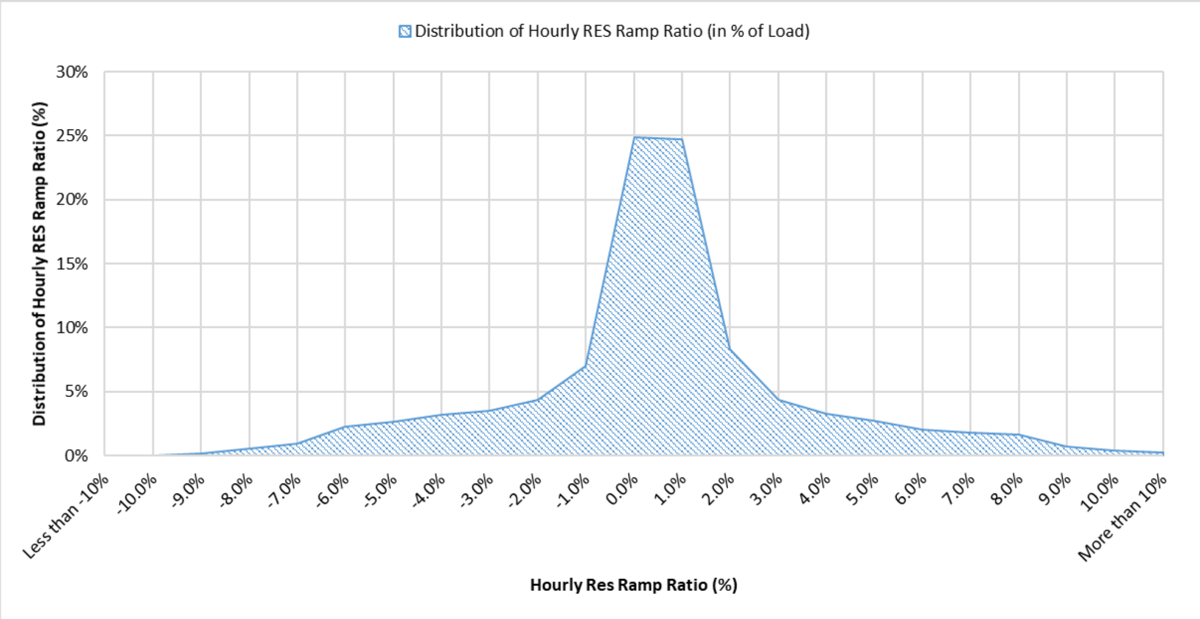
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,500MW Interconnected



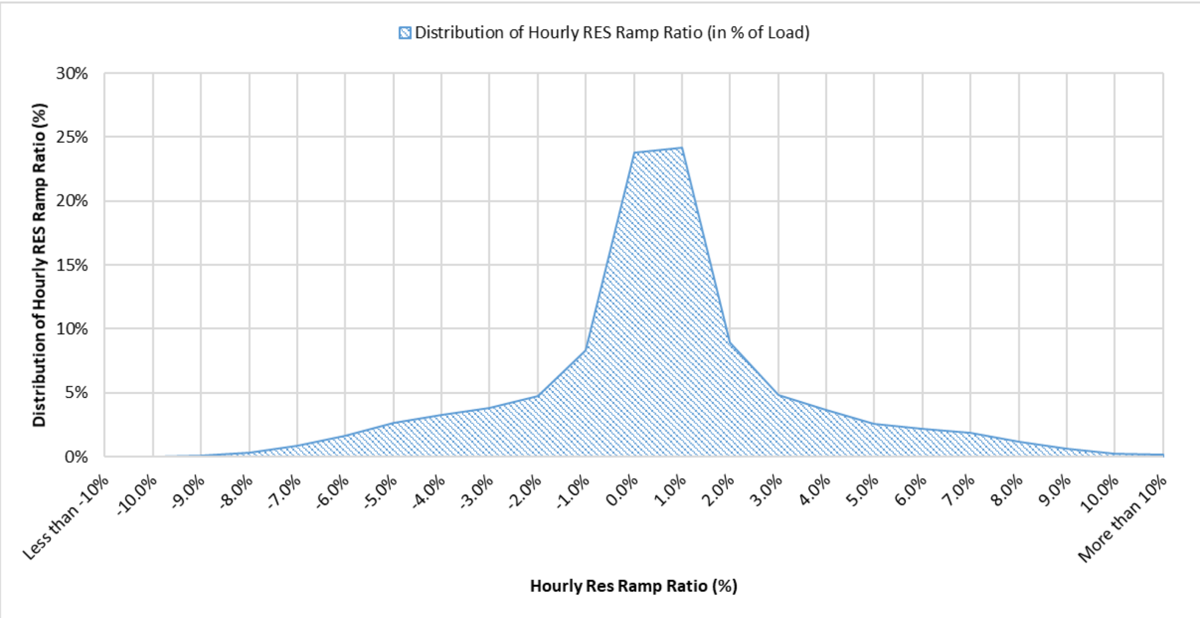
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,500MW Interconnected



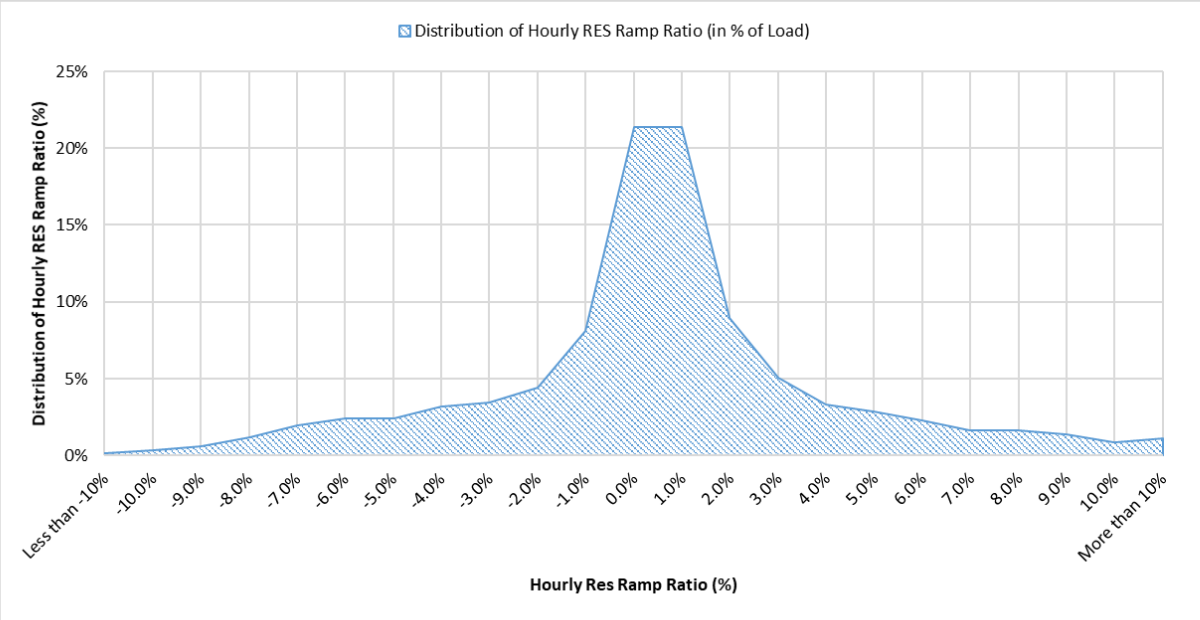
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=8,000MW Interconnected



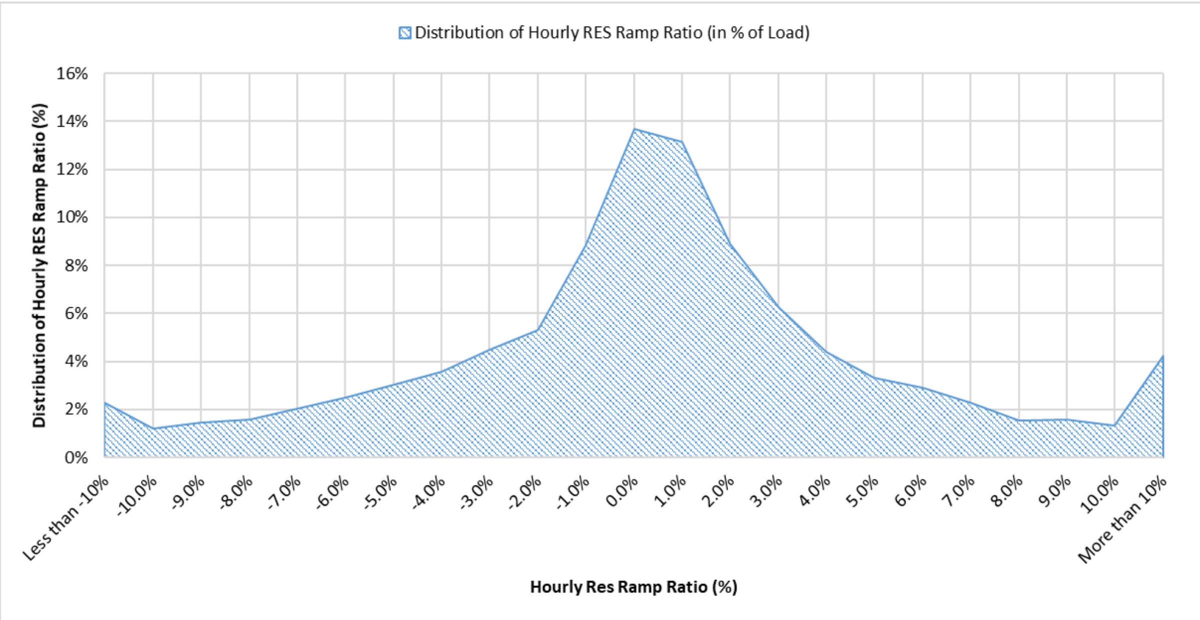
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Interconnected



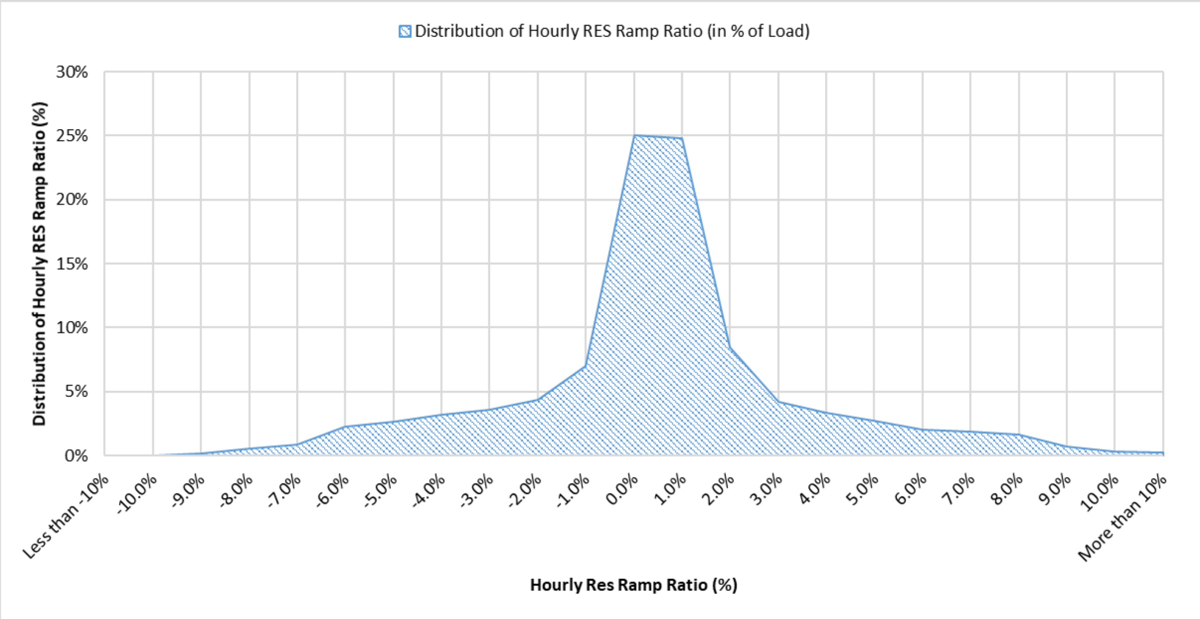
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Interconnected



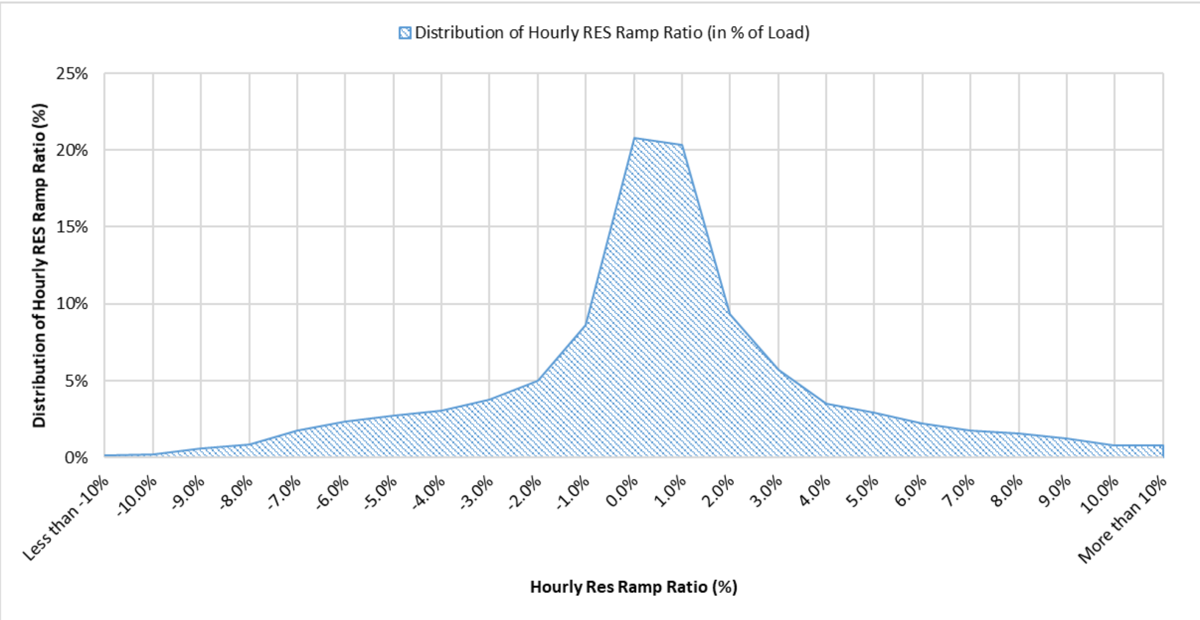
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Interconnected



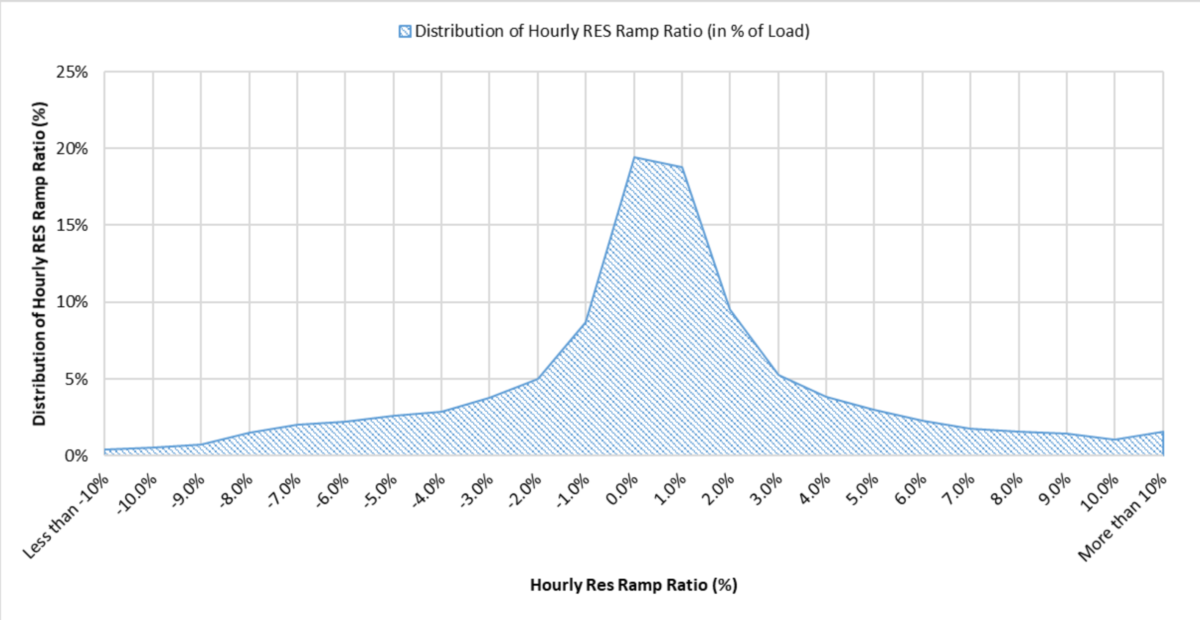
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Interconnected



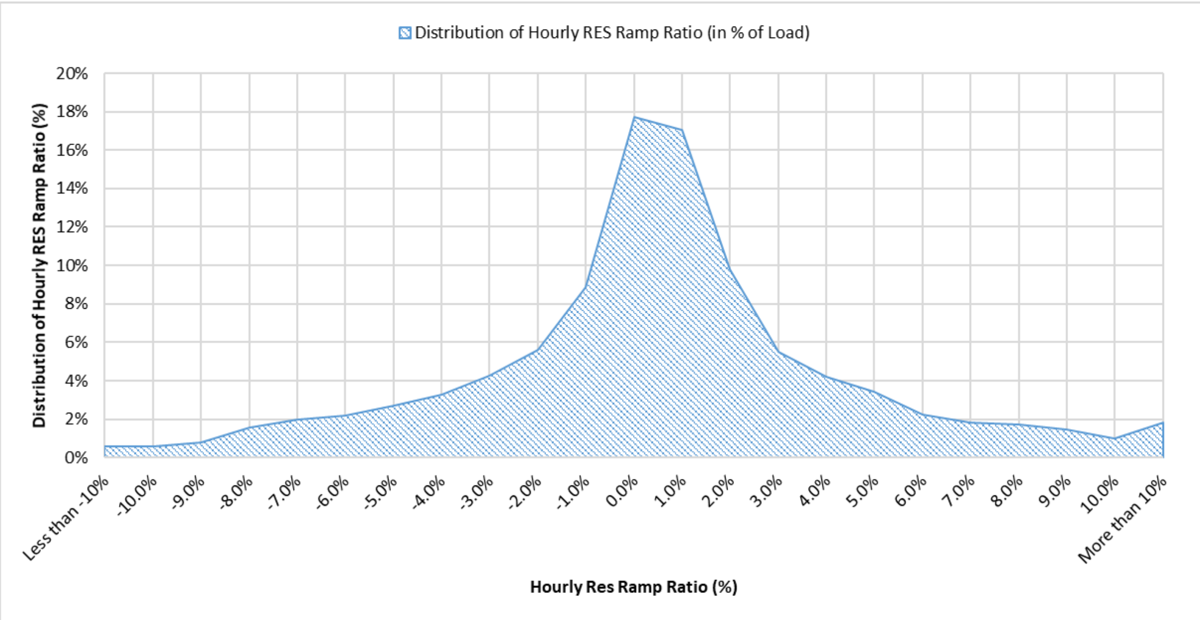
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Interconnected



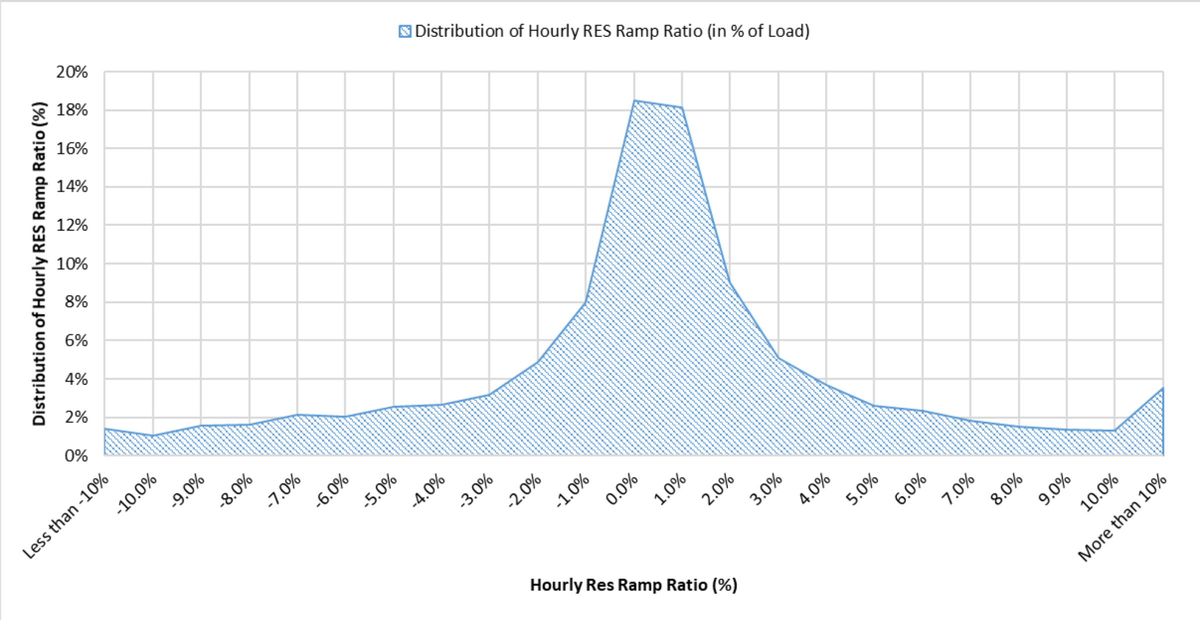
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Interconnected



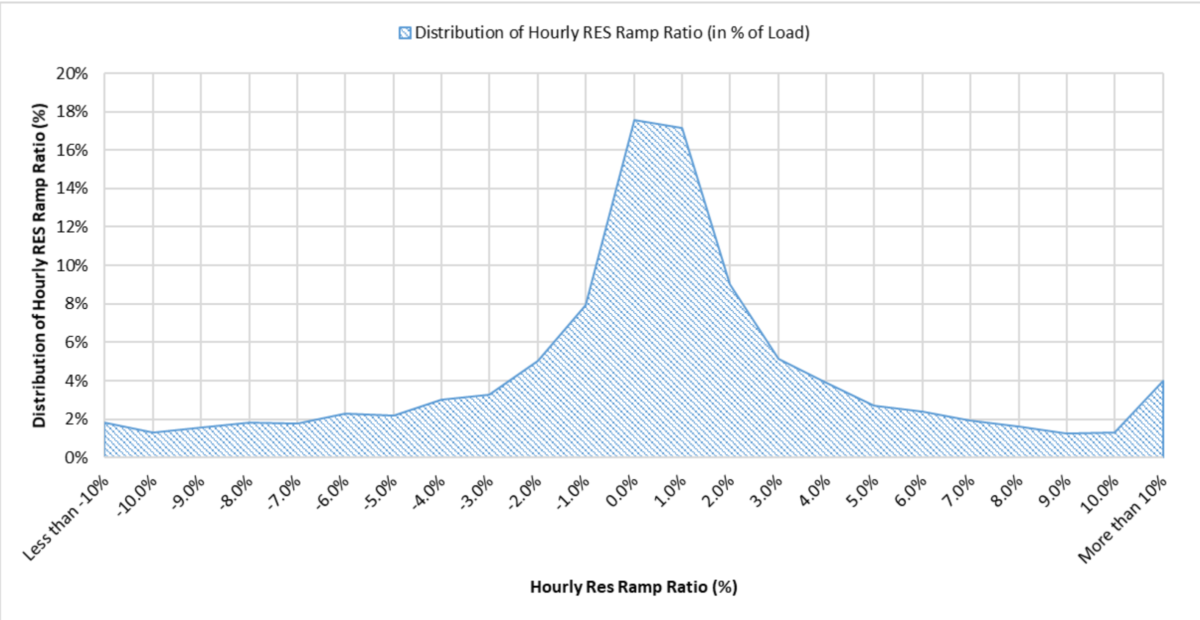
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Interconnected



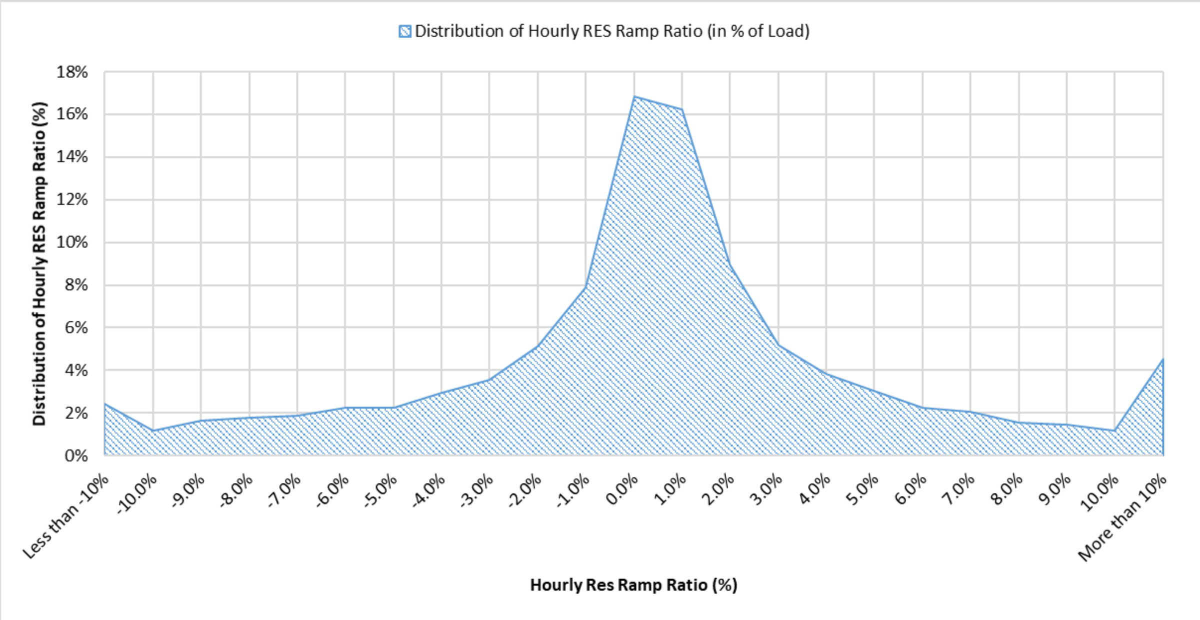
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Interconnected



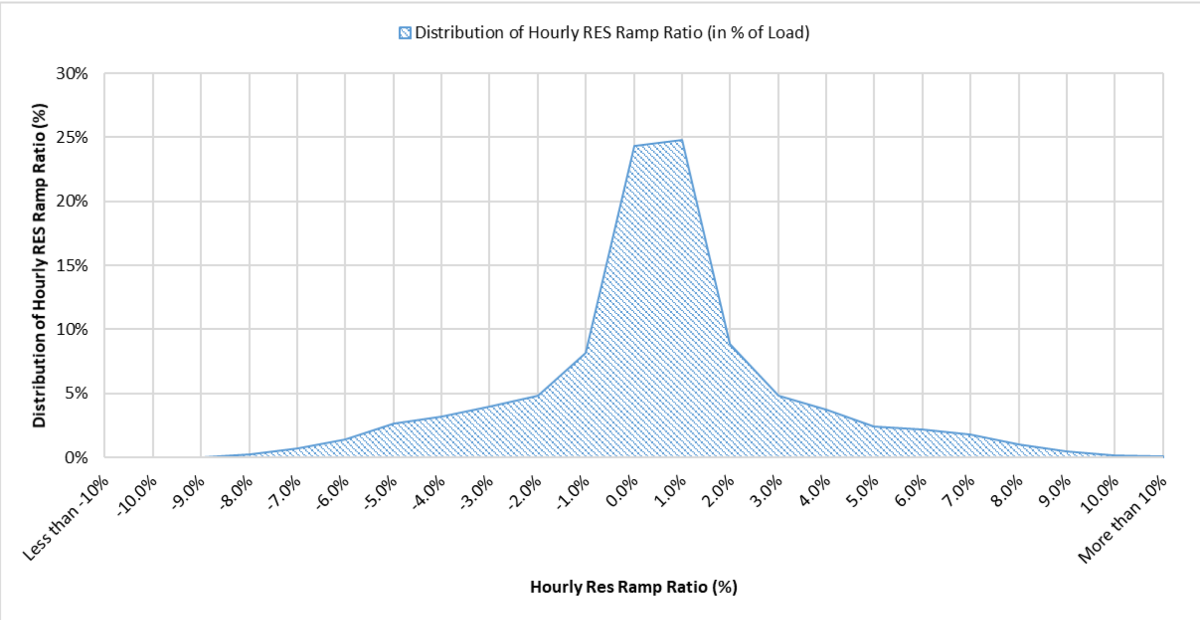
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Interconnected



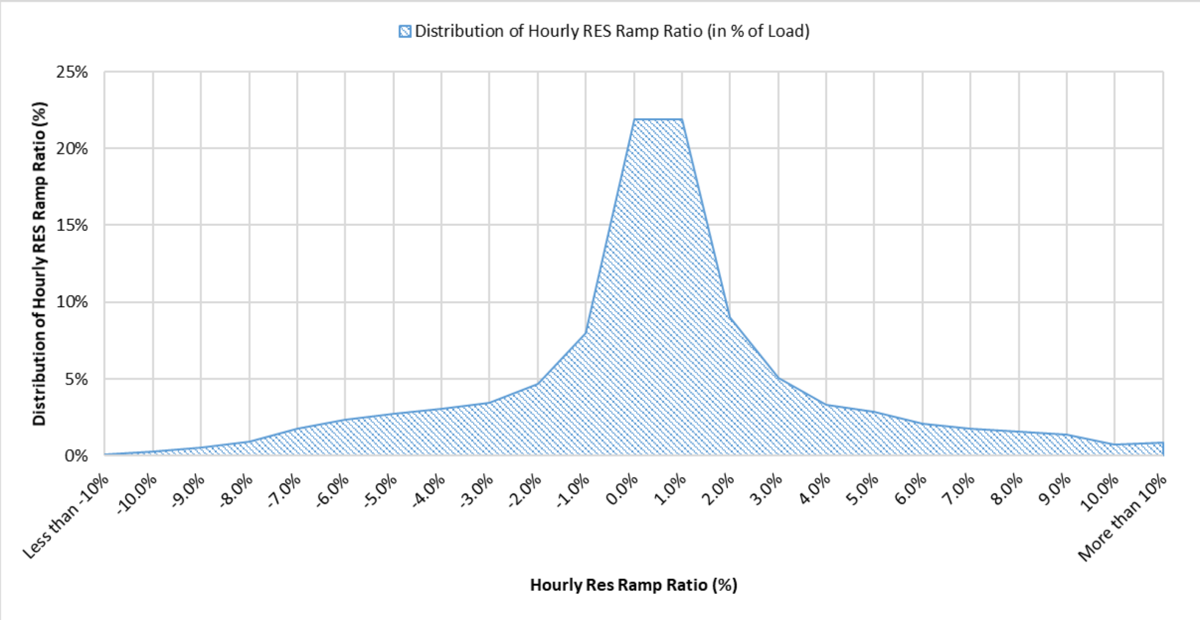
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Interconnected



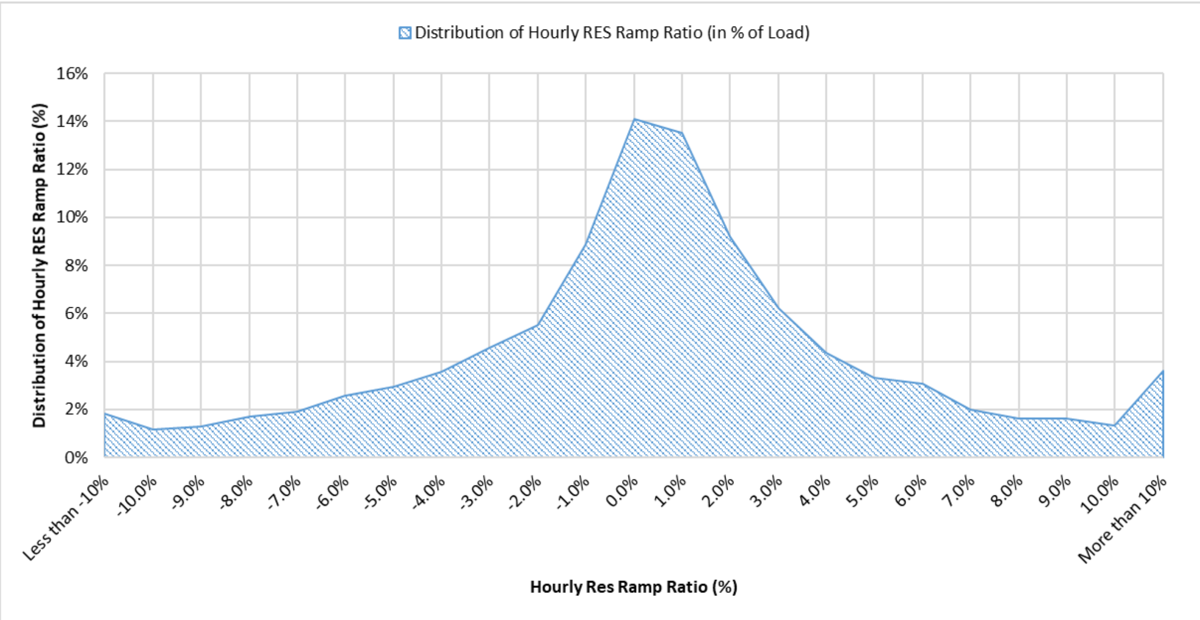
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Interconnected



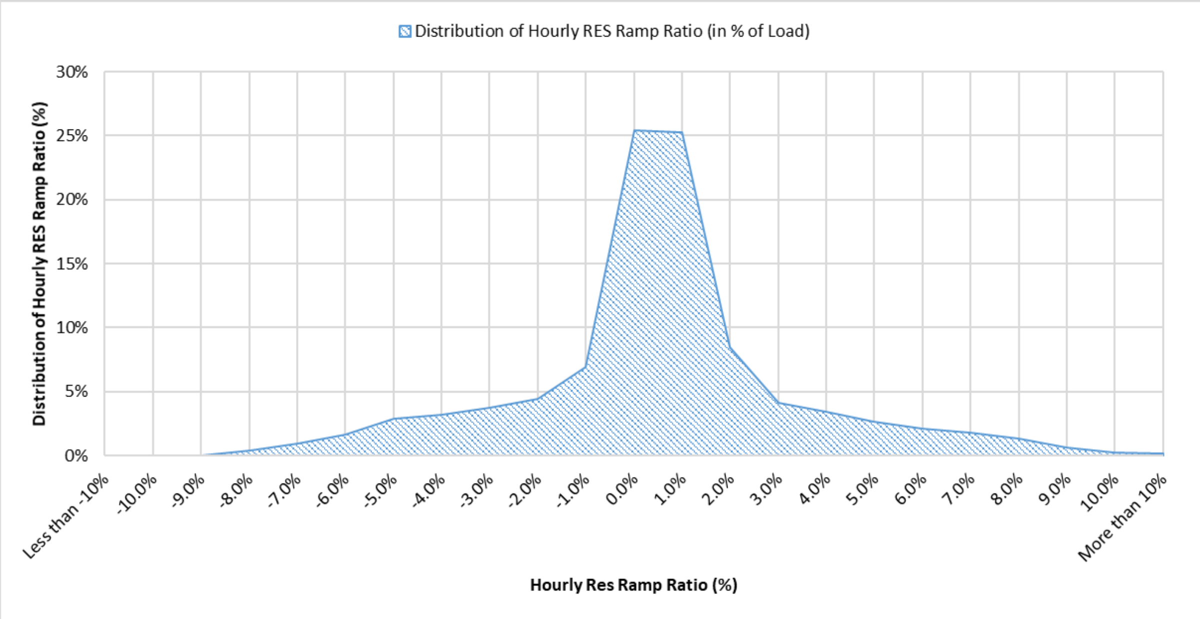
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Interconnected



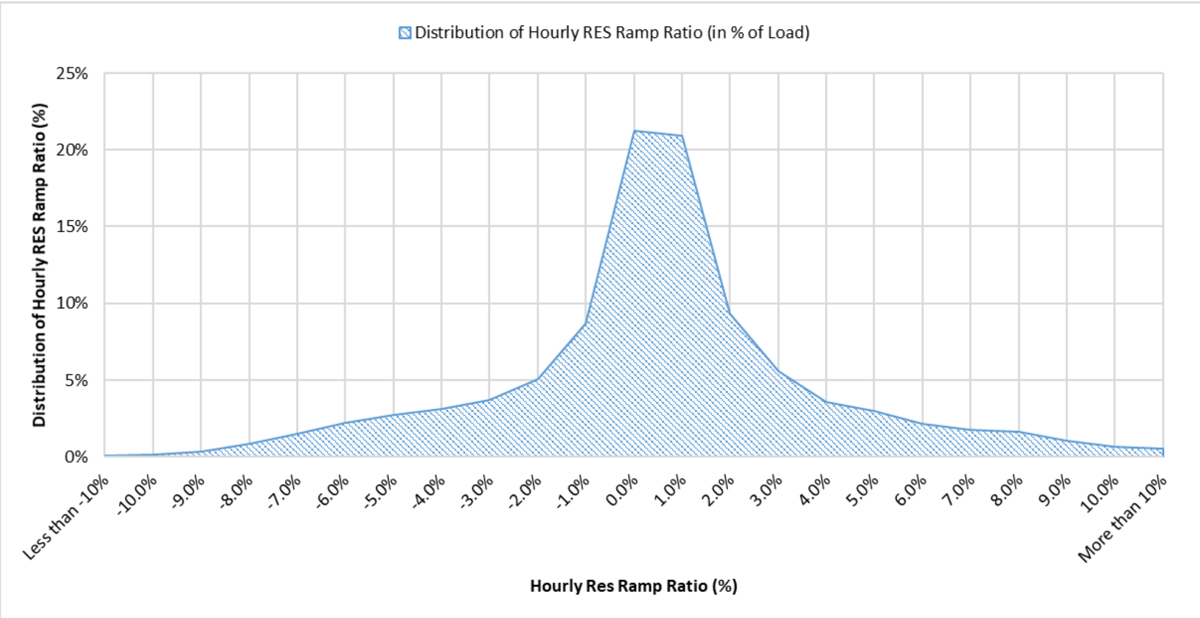
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Interconnected



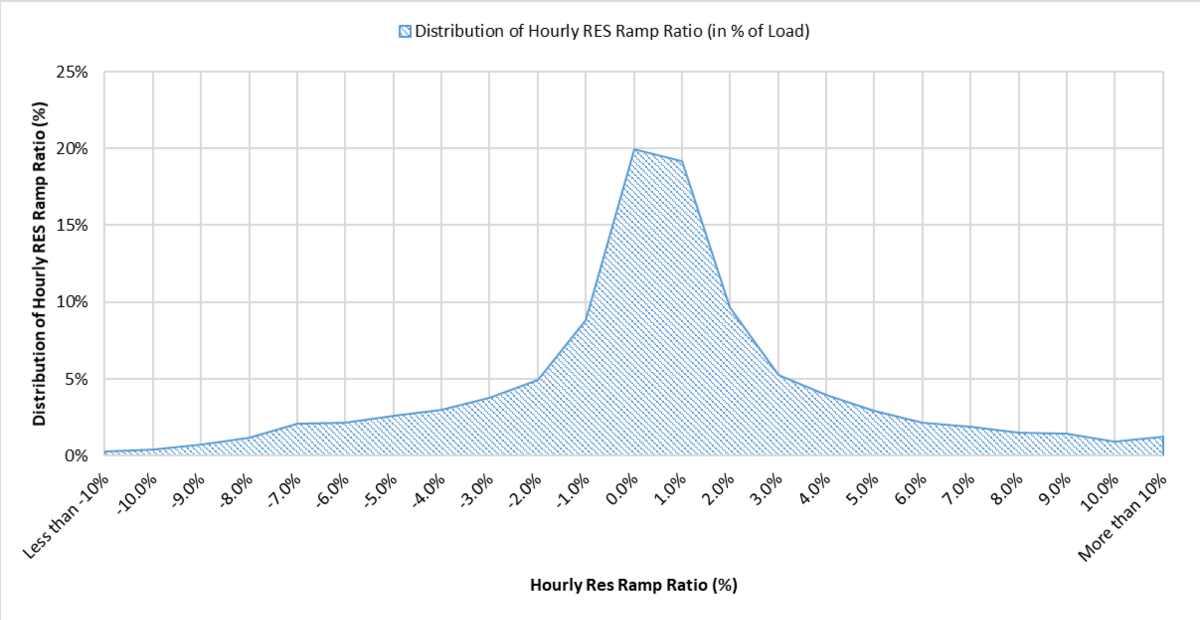
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Interconnected



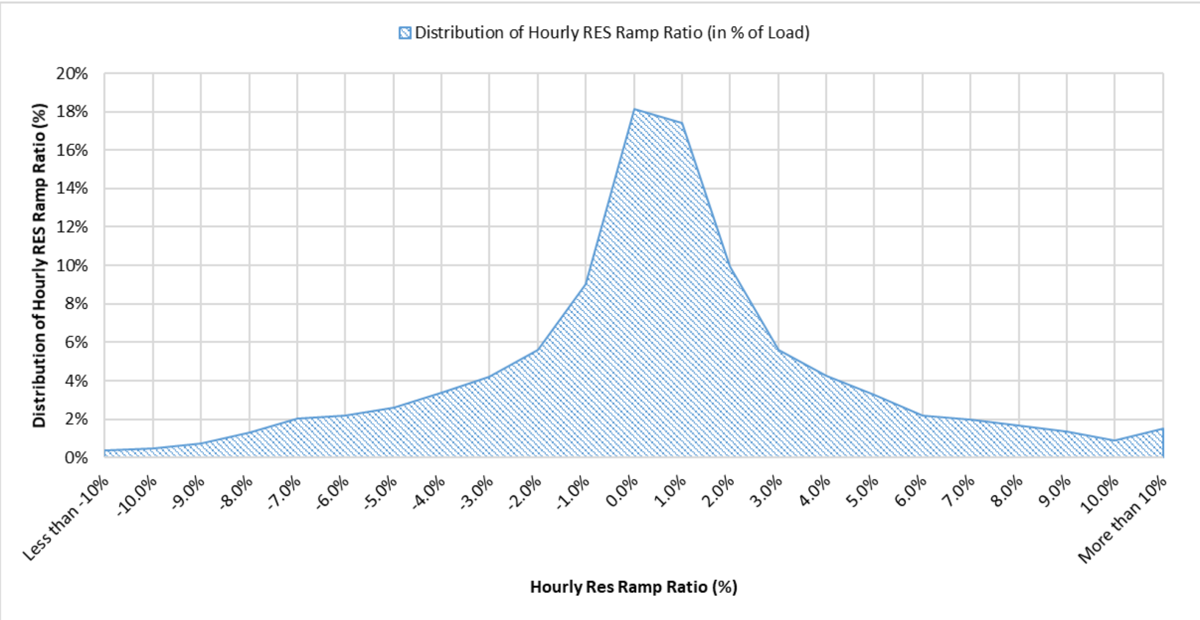
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Interconnected



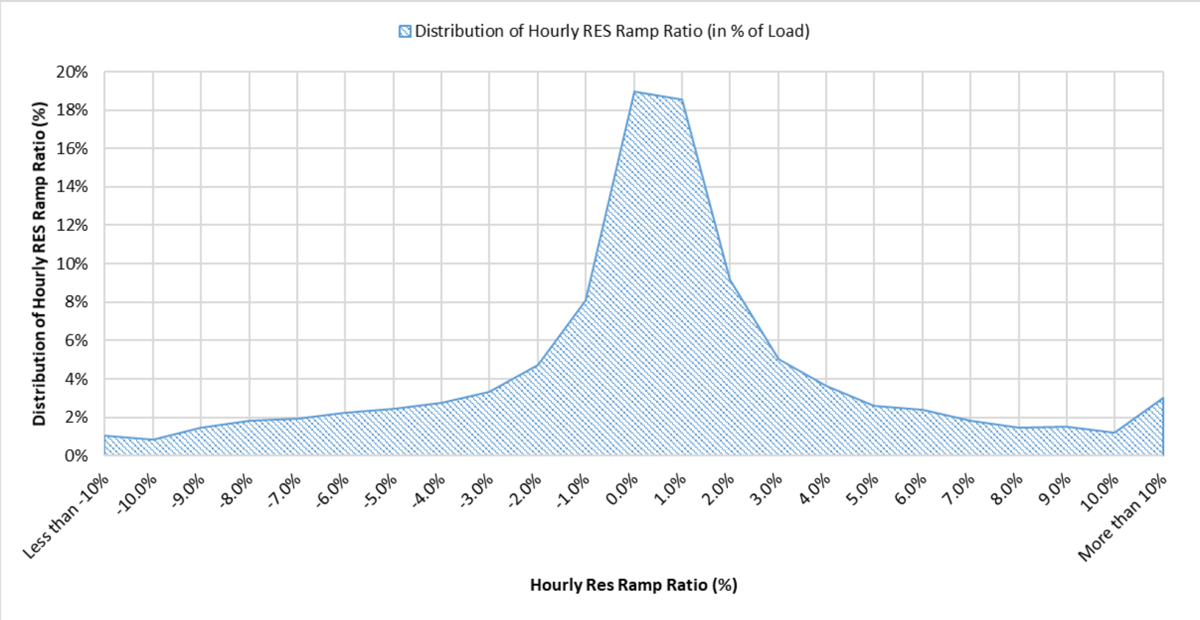
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Interconnected



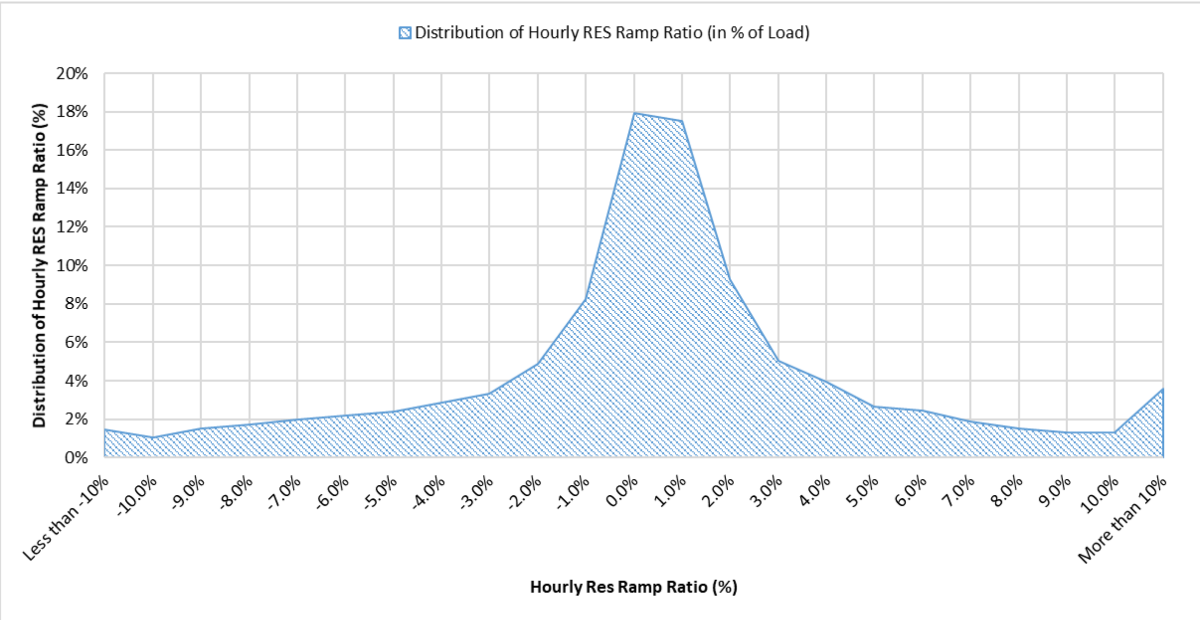
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Interconnected



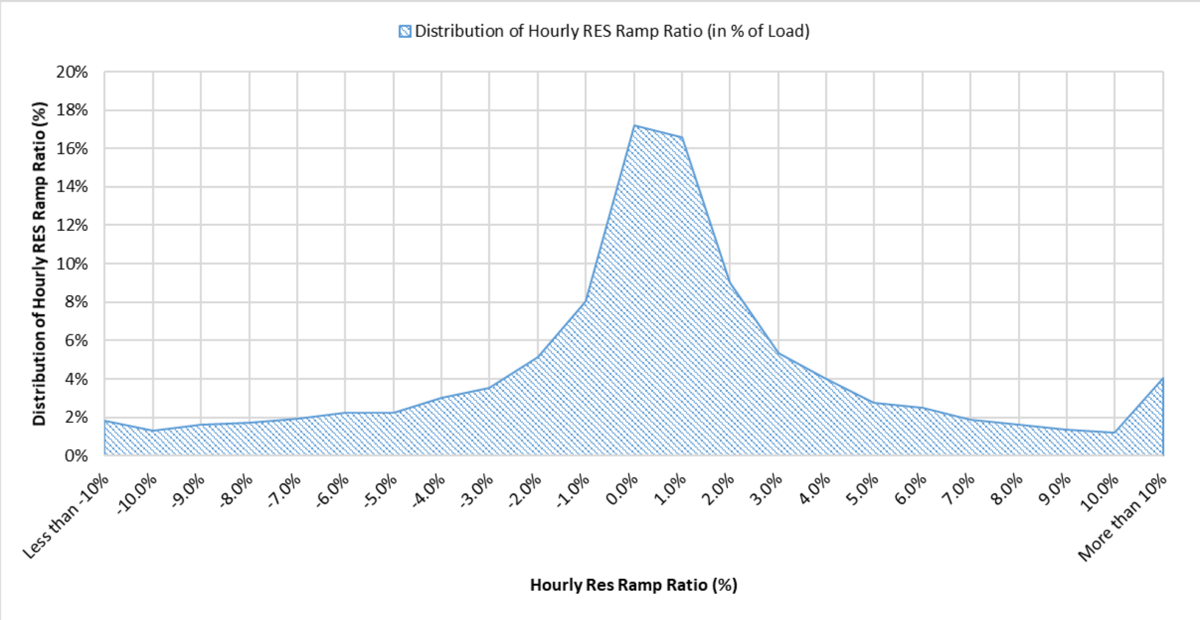
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Interconnected



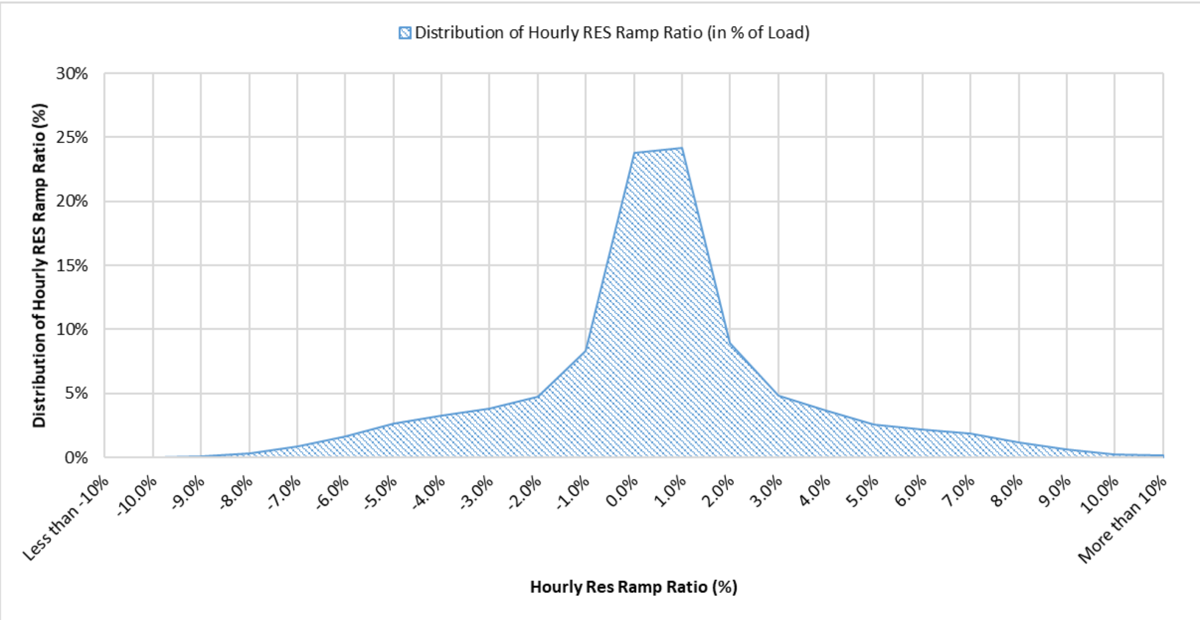
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Interconnected



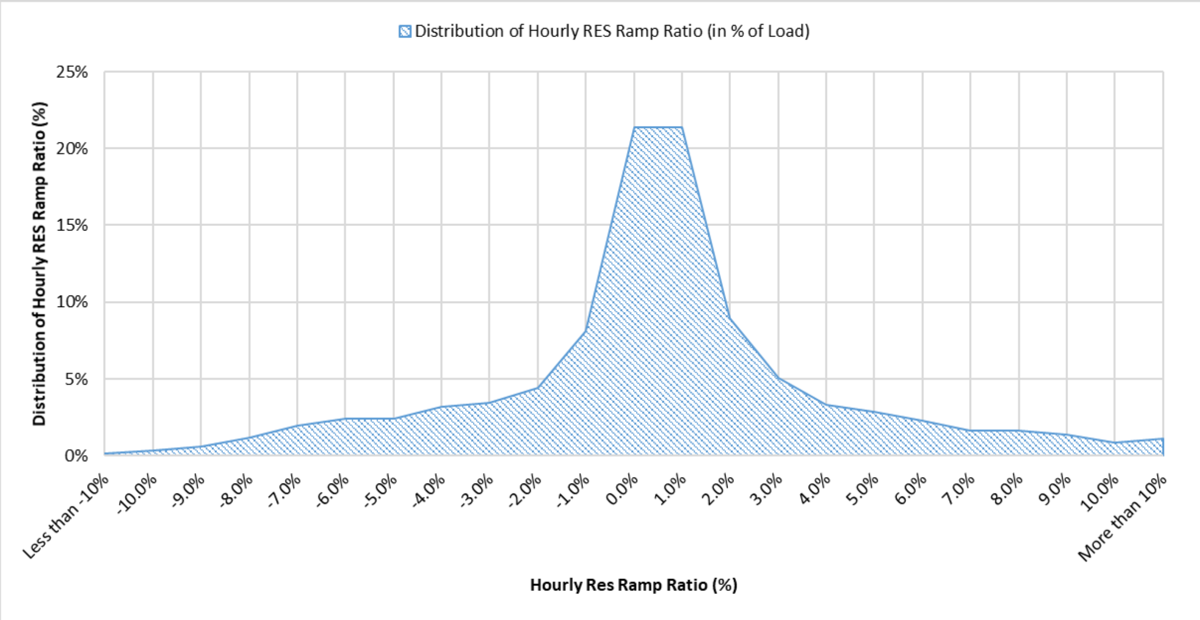
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Interconnected



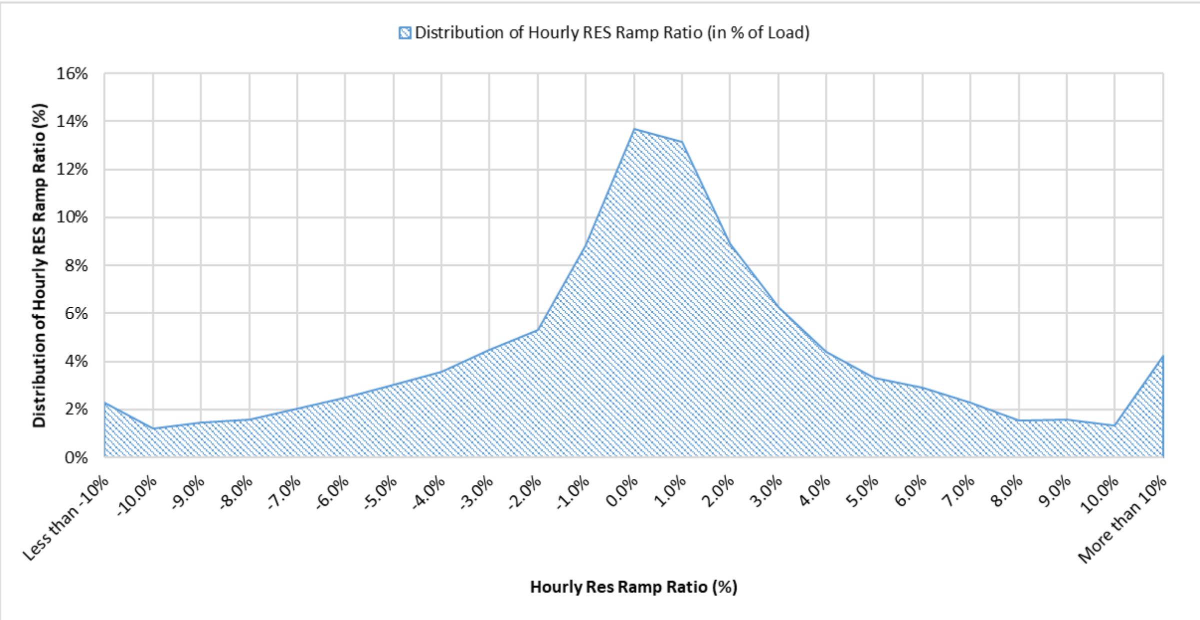
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Isolated



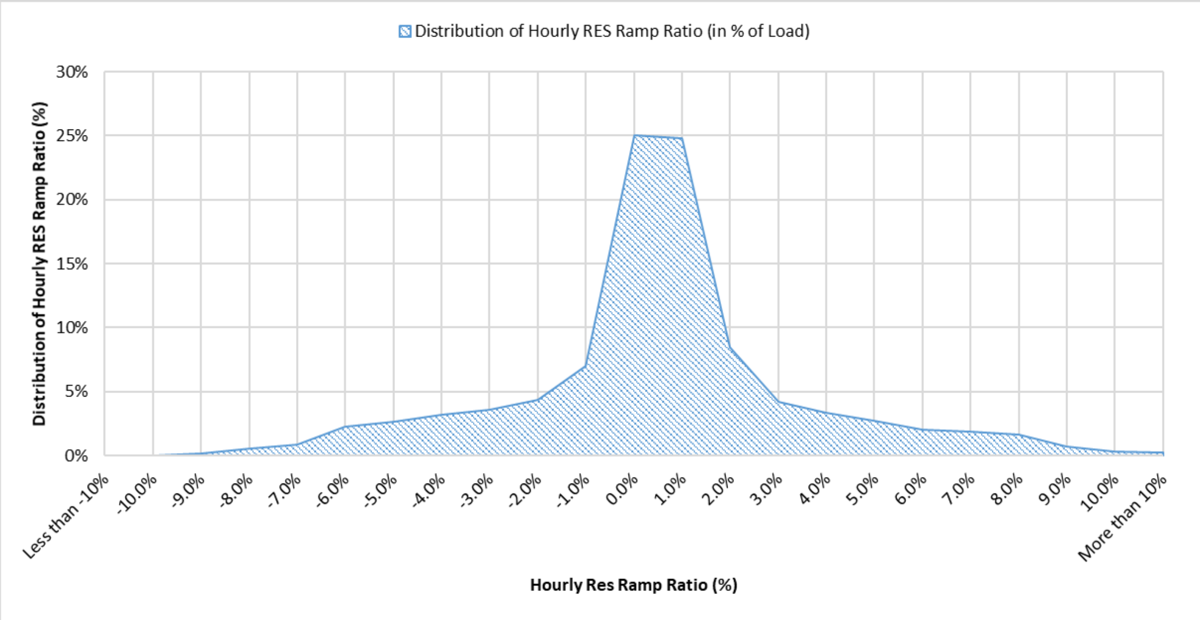
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Isolated



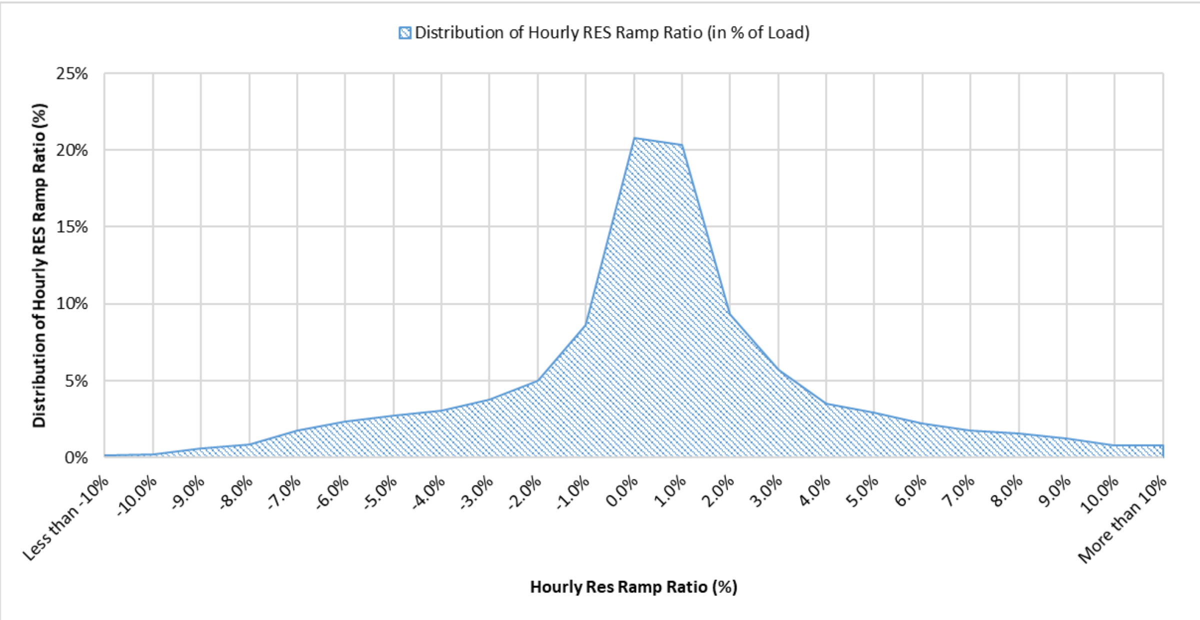
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Isolated



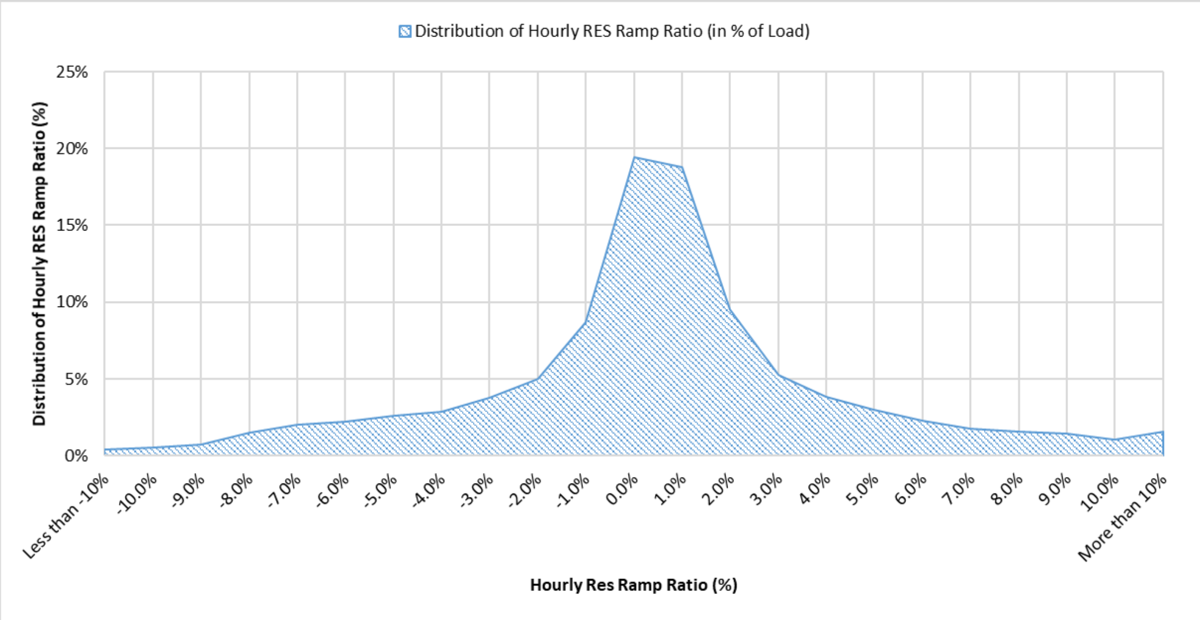
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Isolated



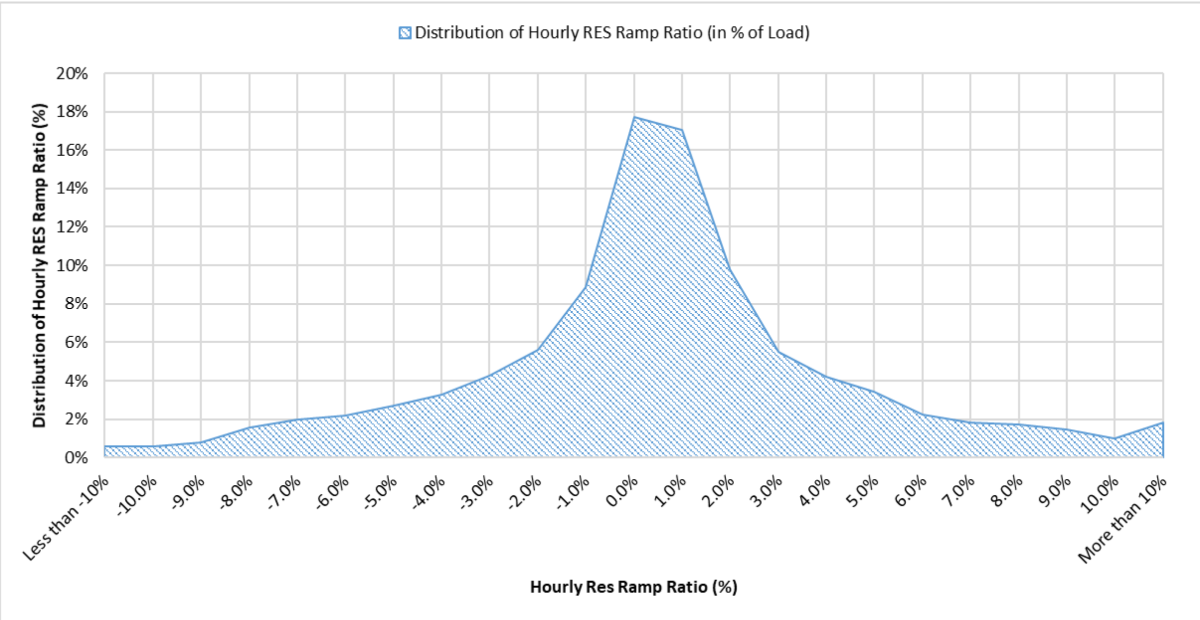
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Isolated



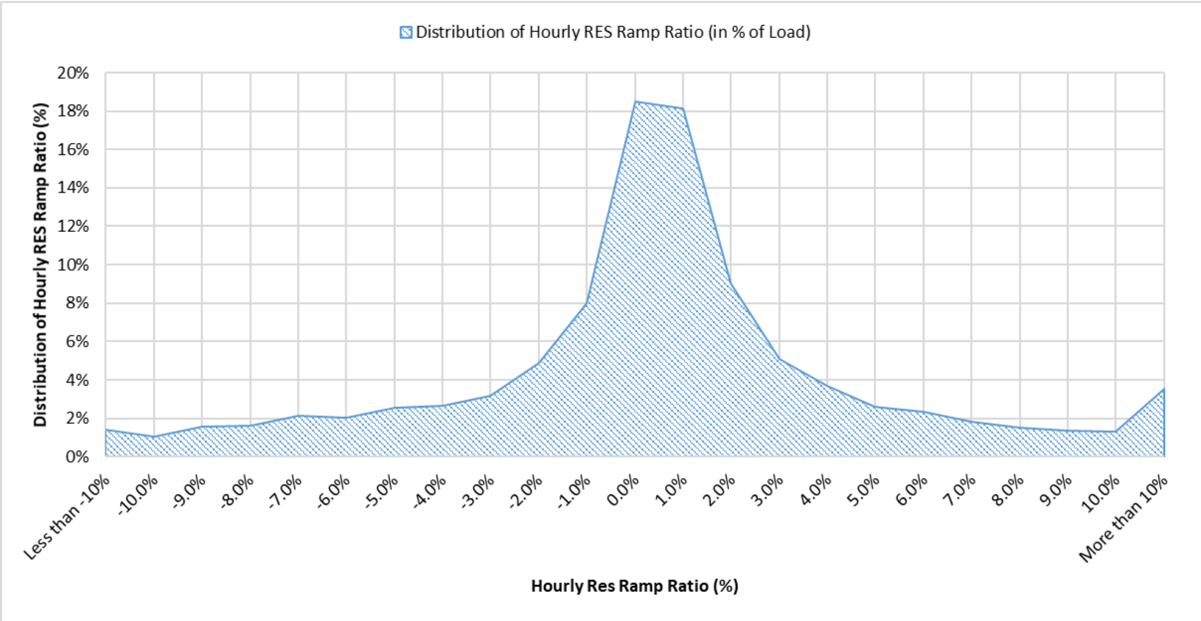
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Isolated



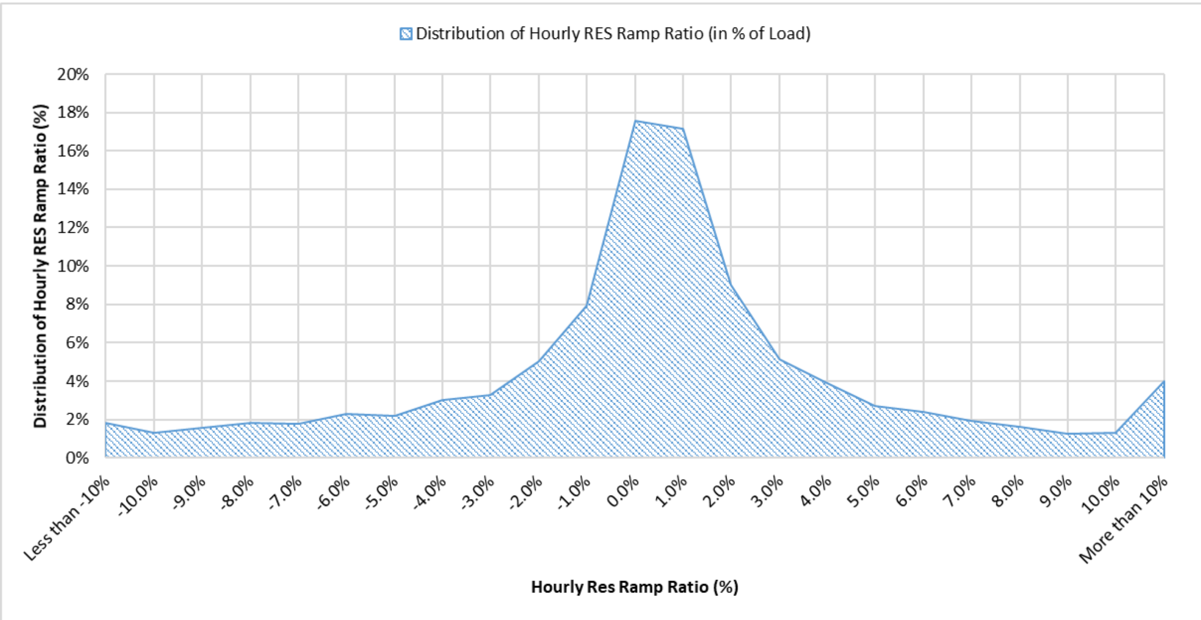
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Isolated



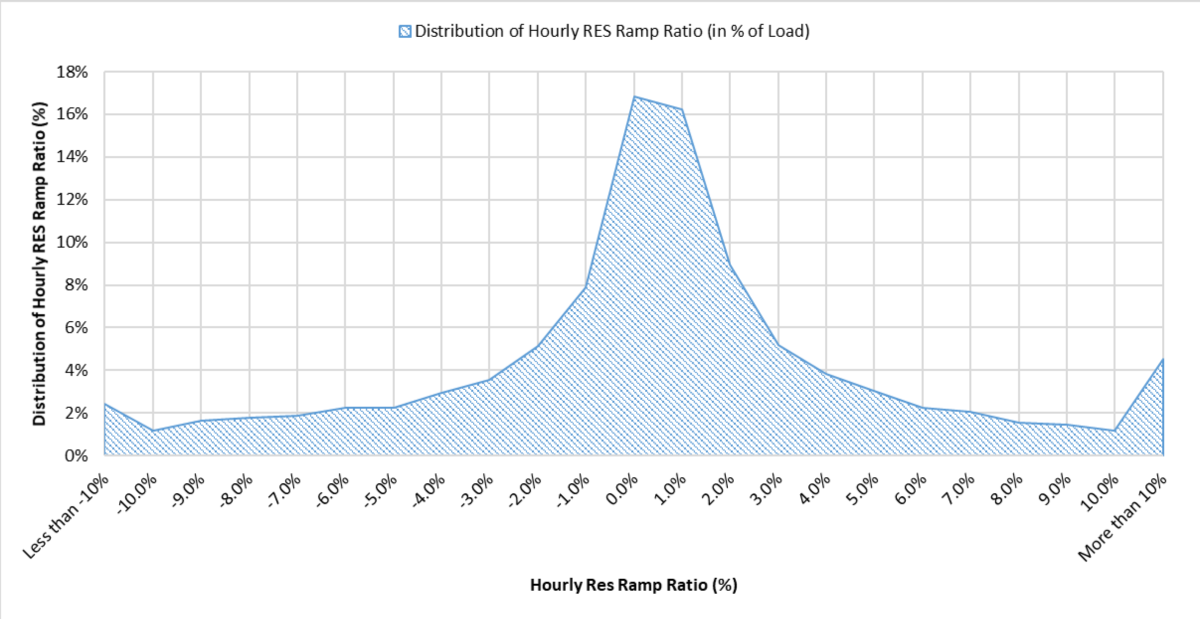
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Isolated



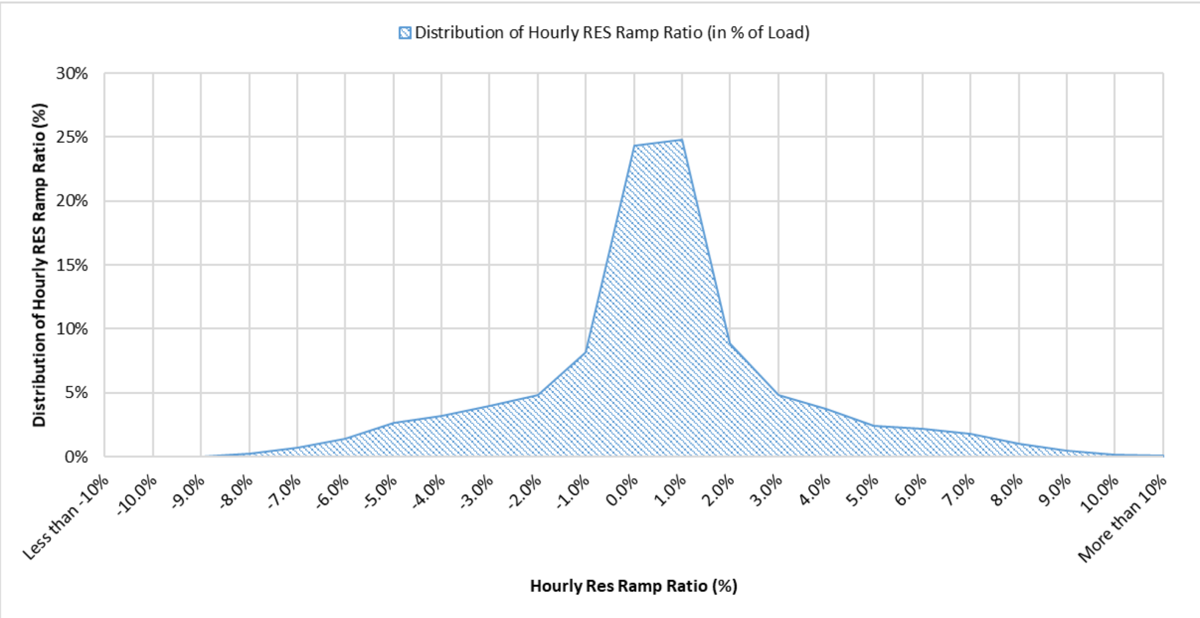
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Isolated



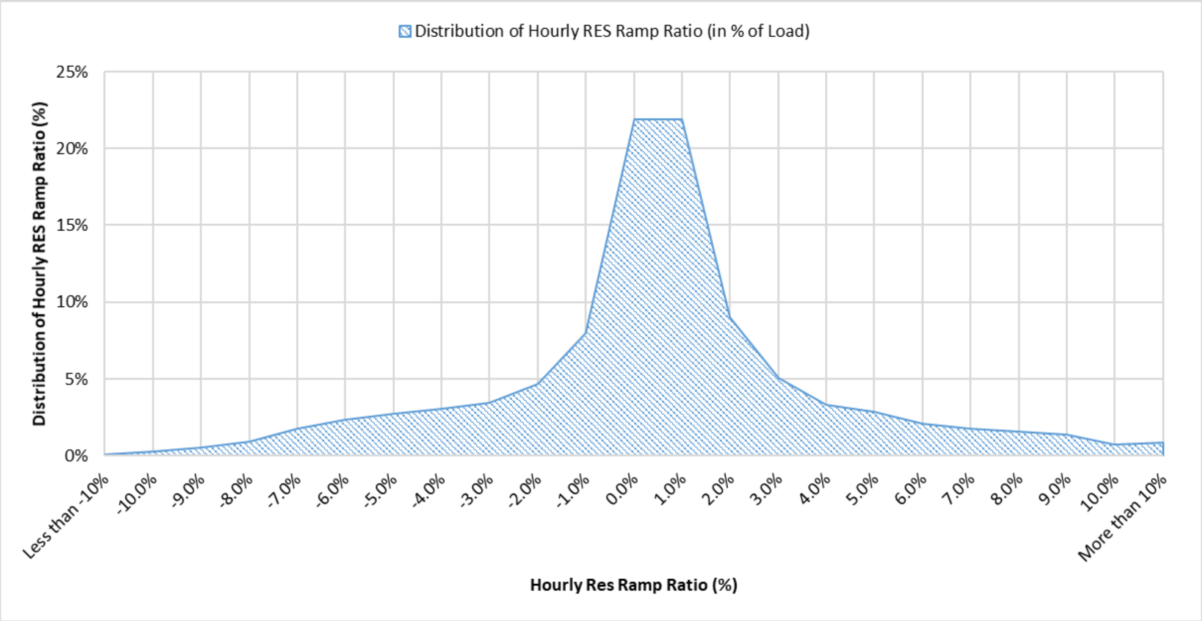
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Isolated



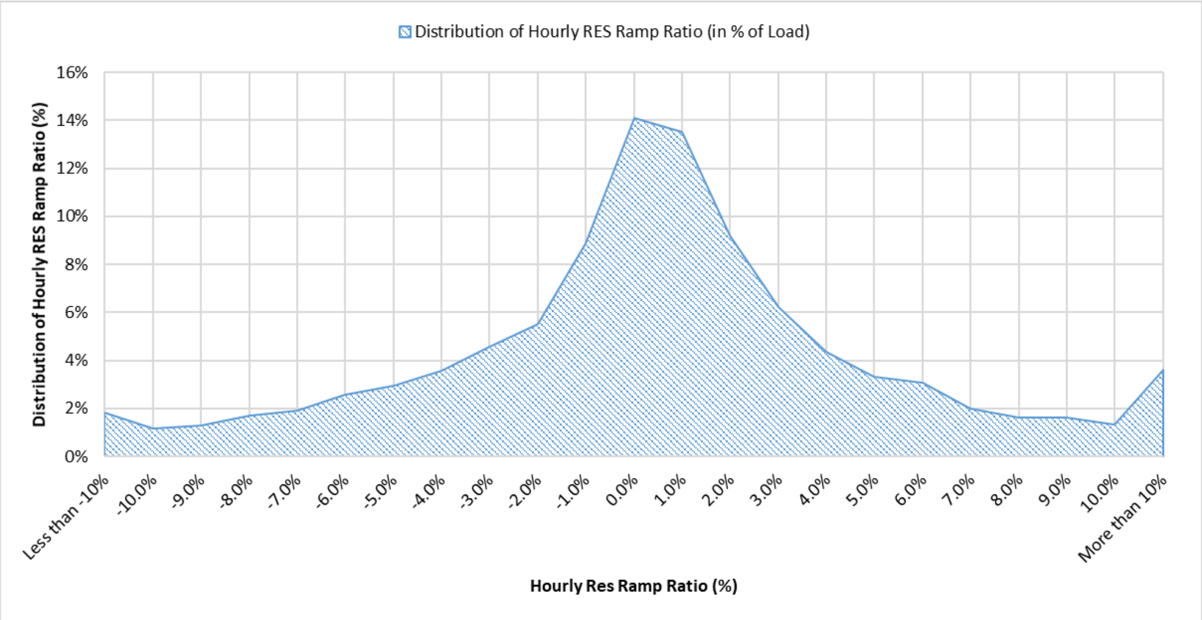
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Isolated



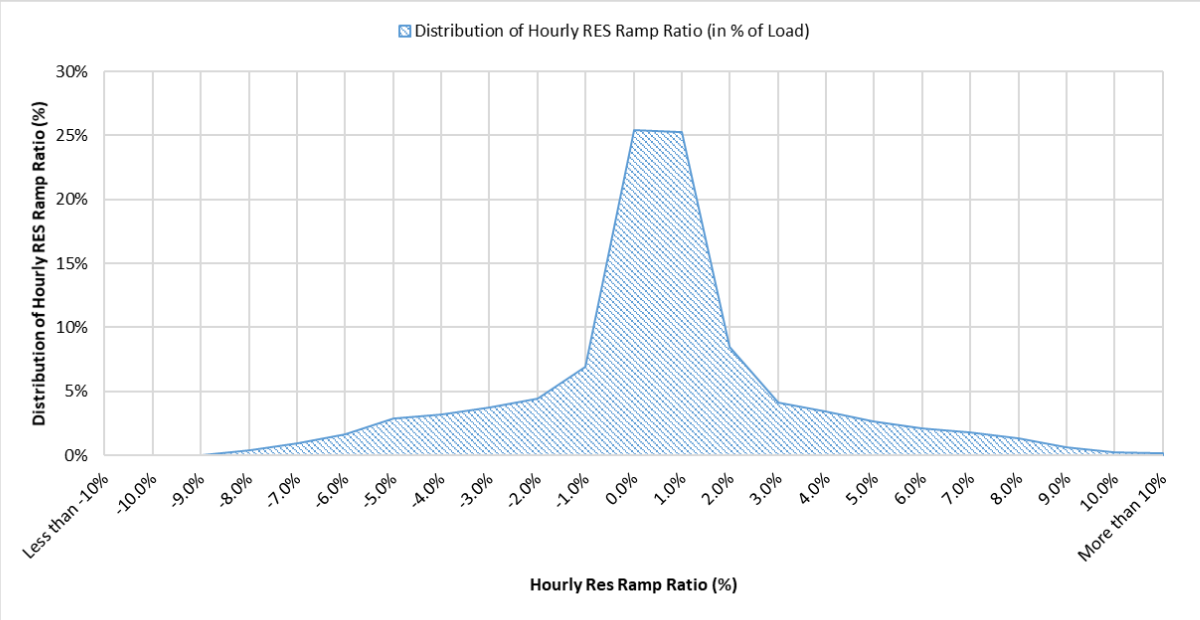
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Isolated



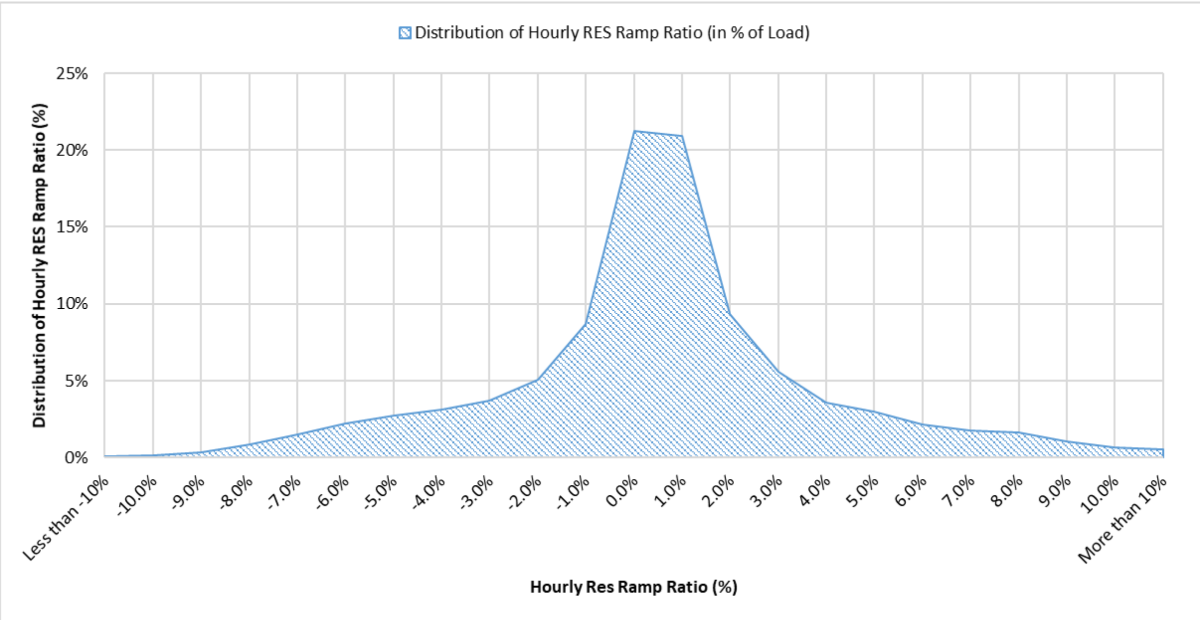
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Isolated



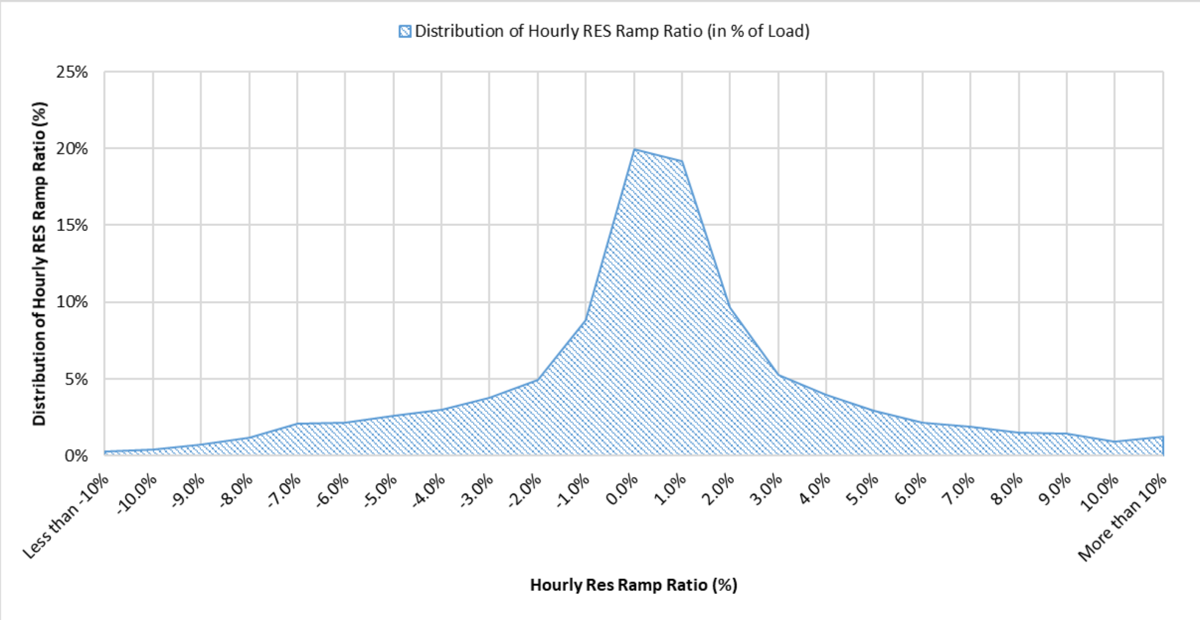
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Isolated



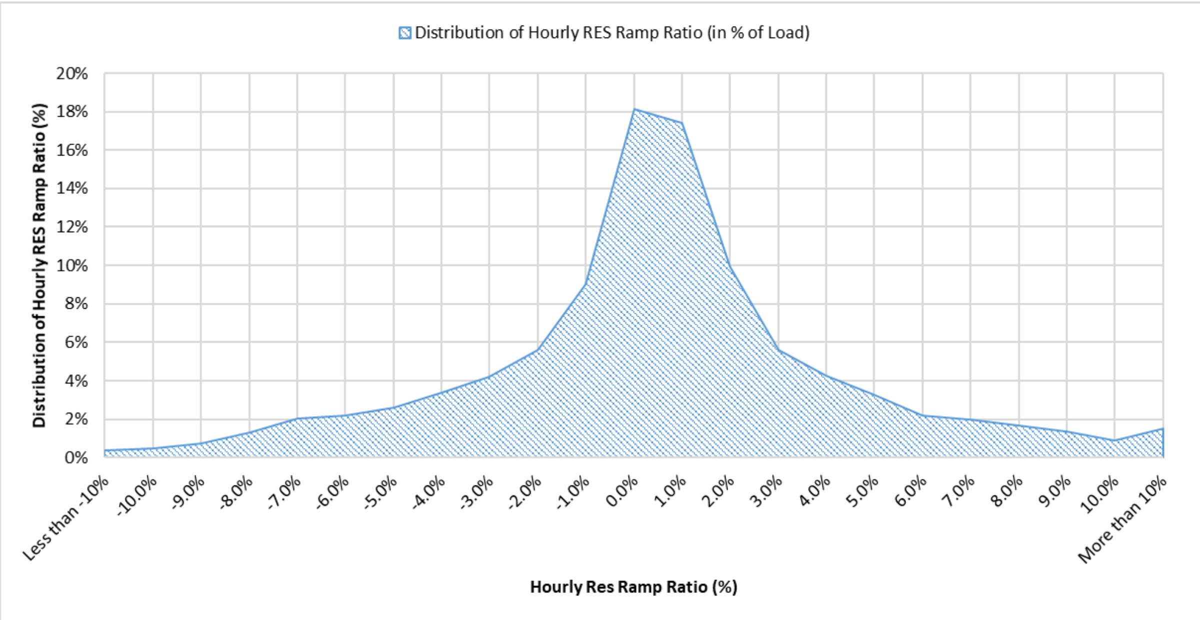
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Isolated



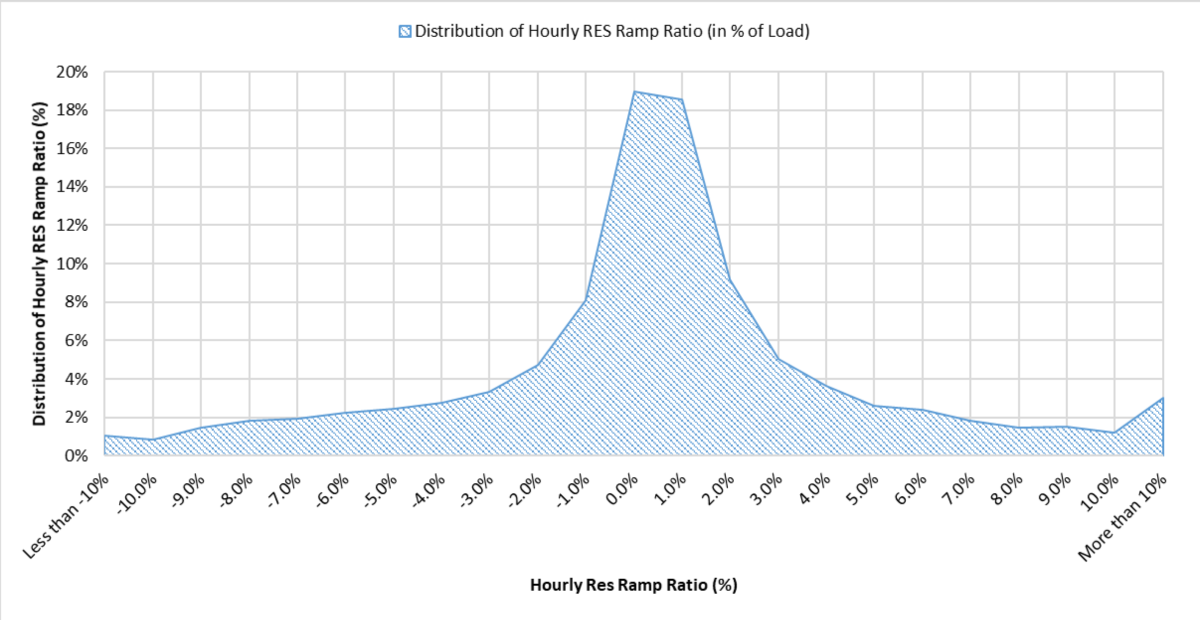
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Isolated



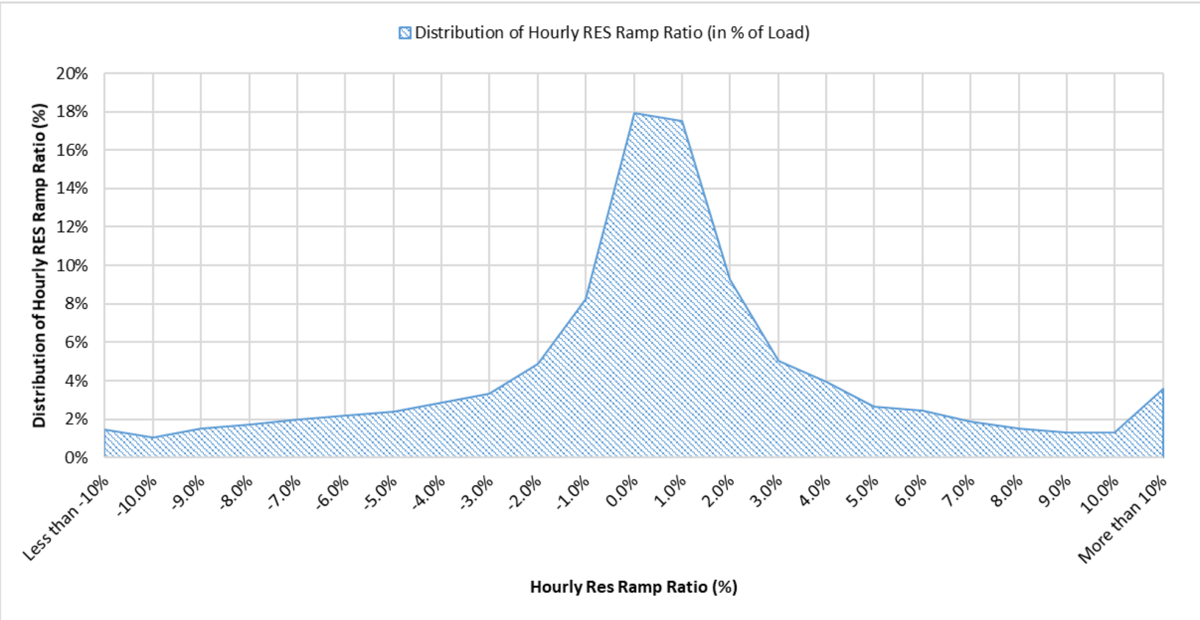
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Isolated



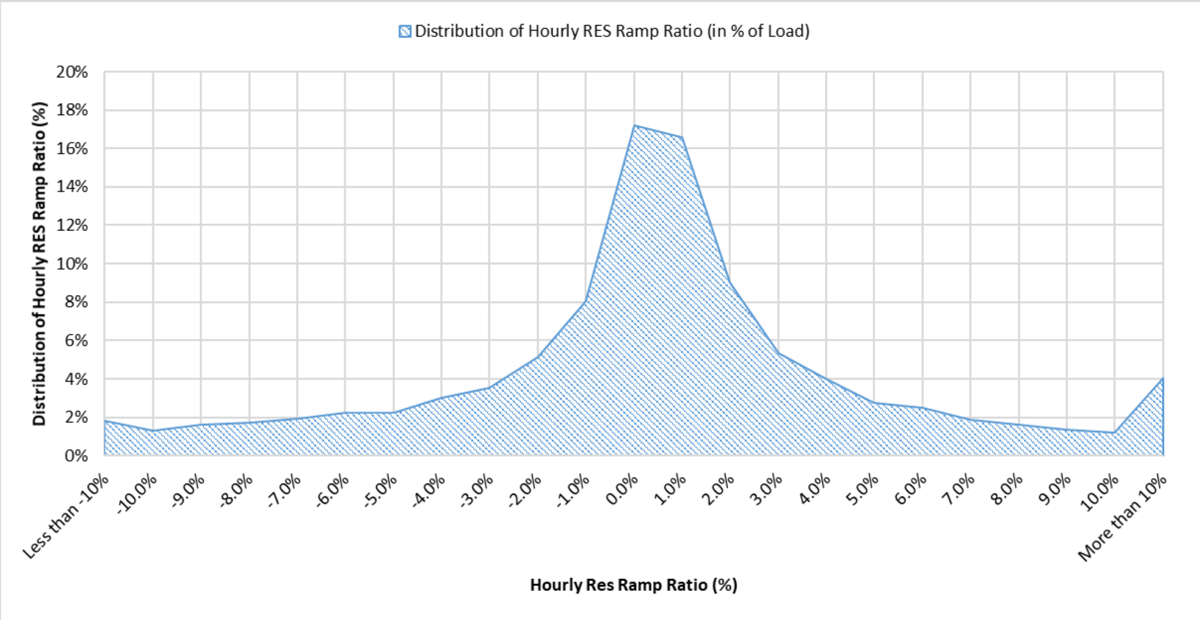
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Isolated



Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Isolated

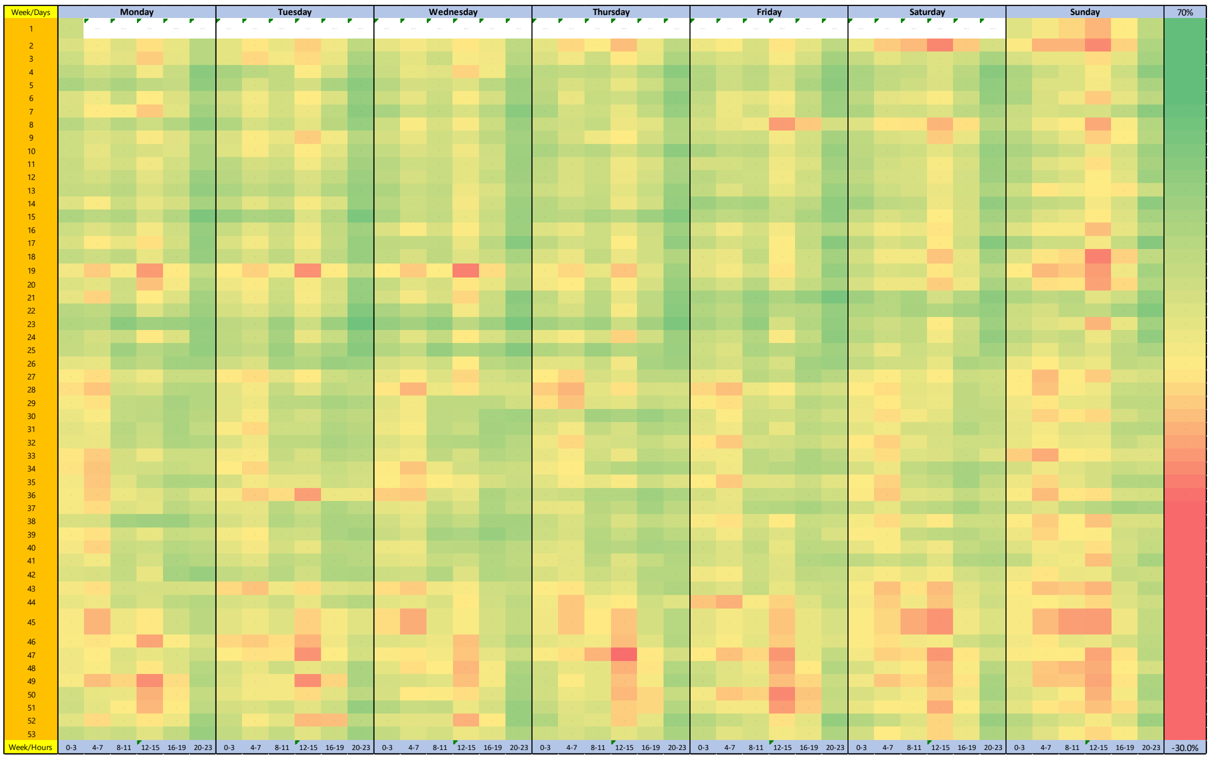


Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Isolated

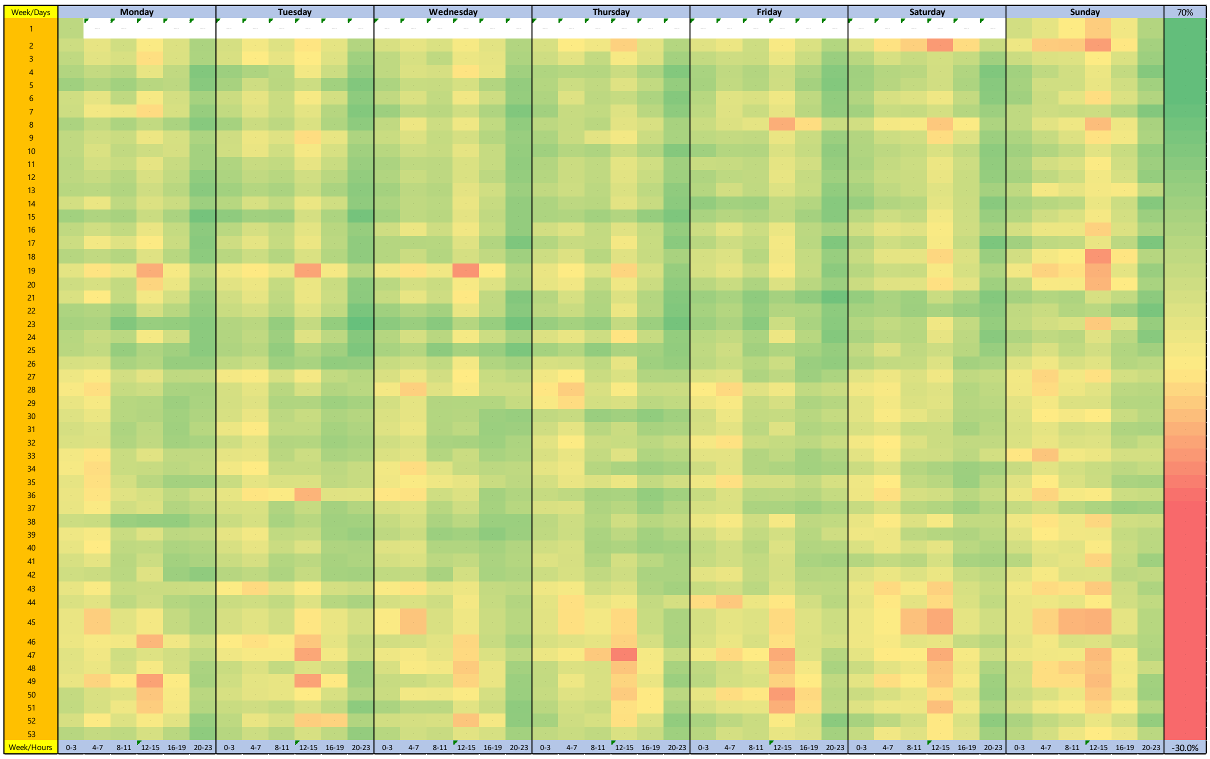


7.4. DETAILED RESULTS OF CHROMATIC ILLUSTRATION OF RL IN % OF LOAD

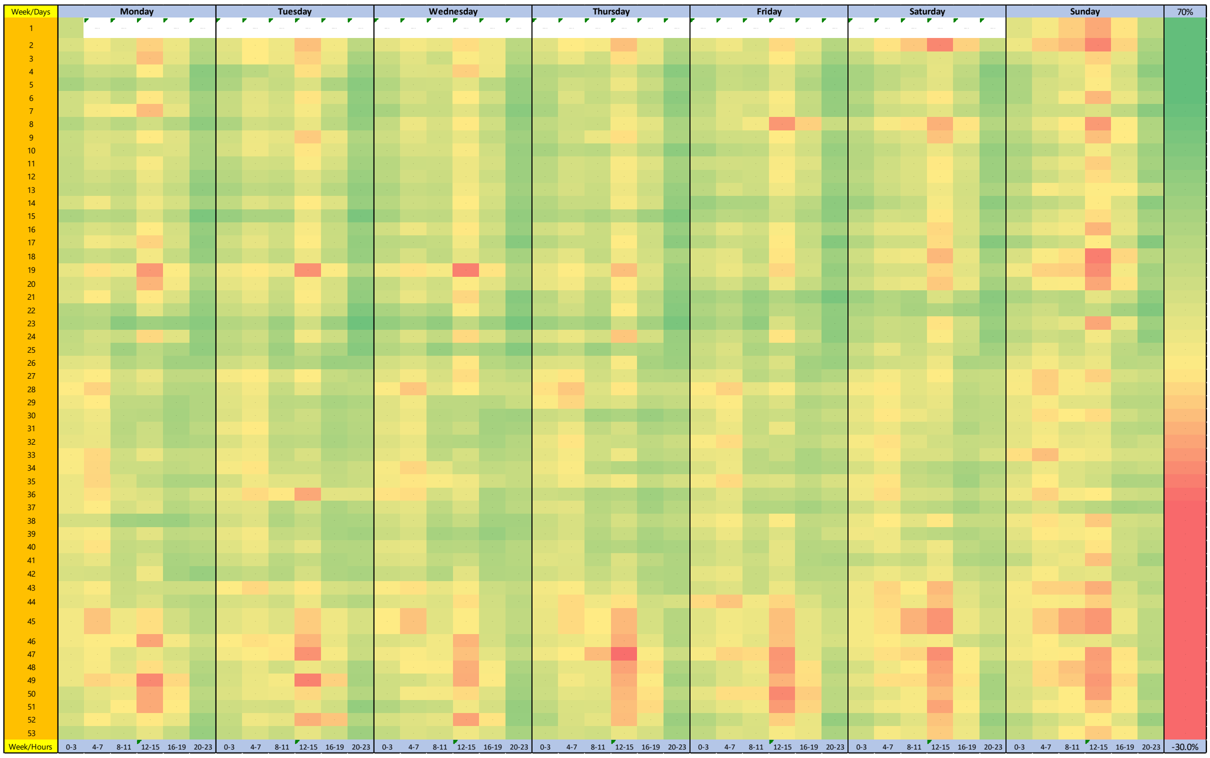
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



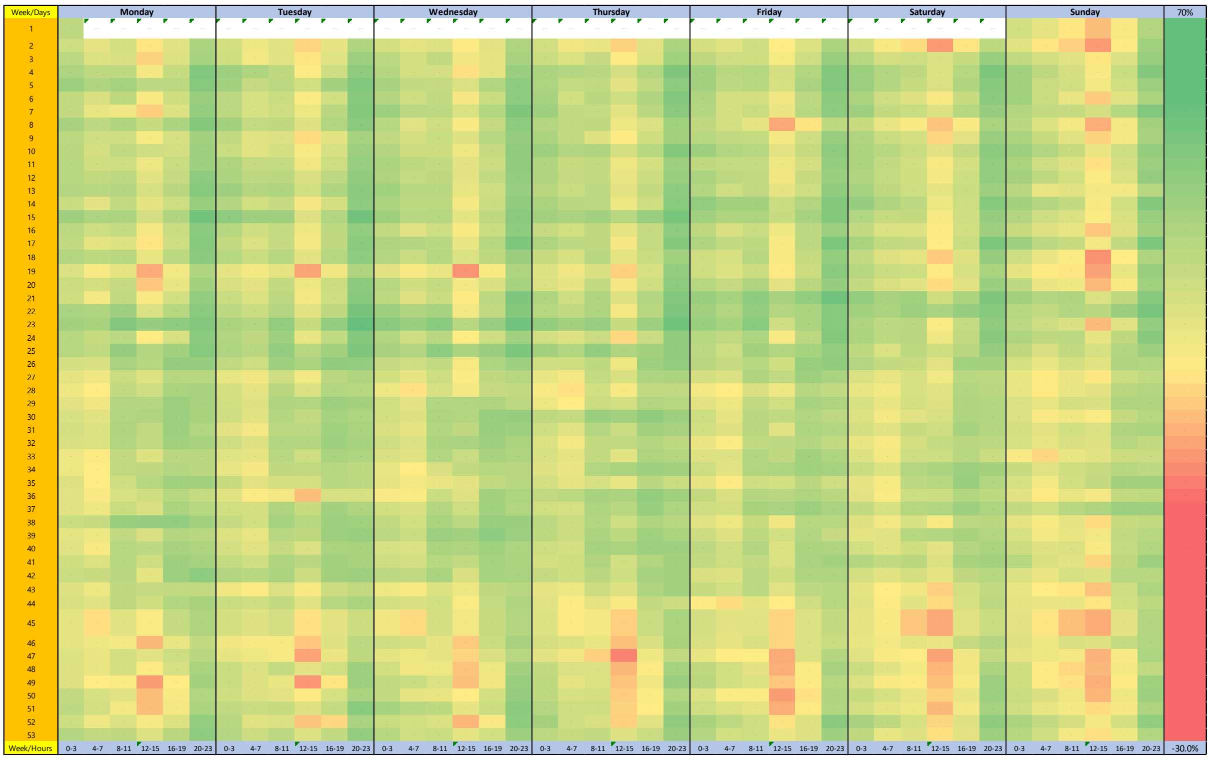
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,585MW SPP=6,241MW NPP=15% Reduction Interconnected



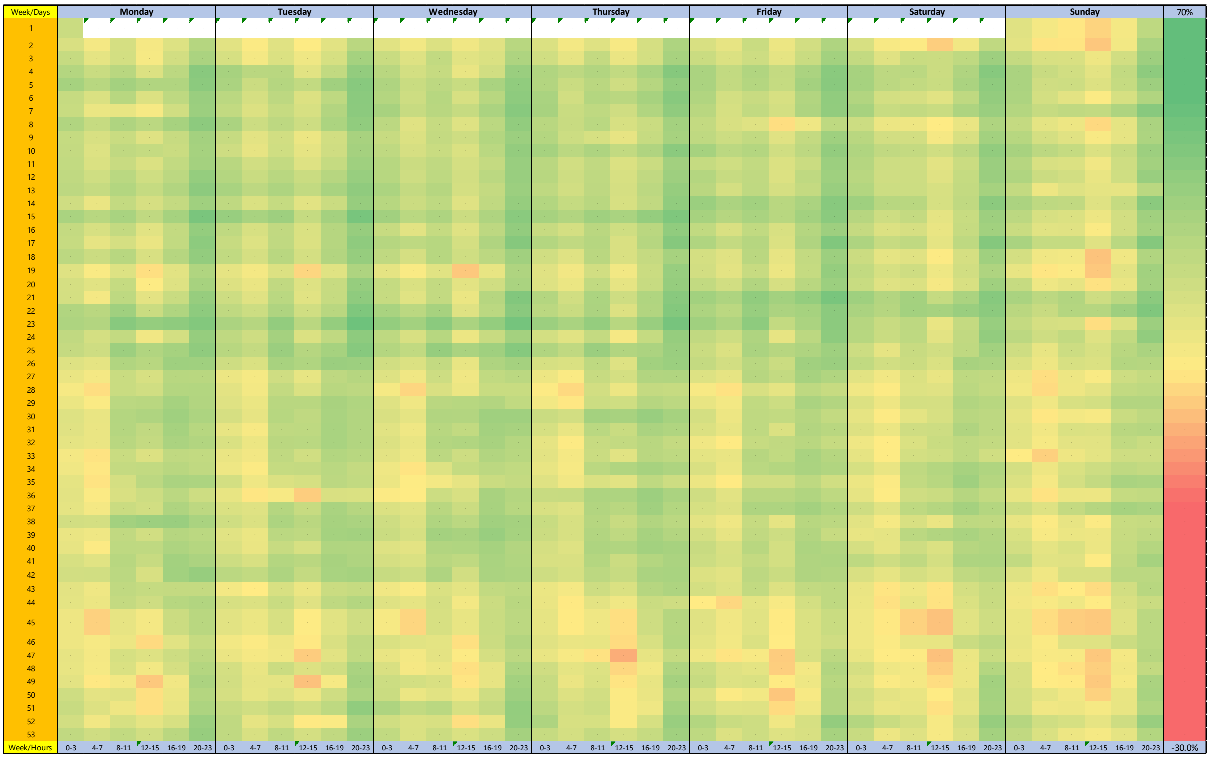
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



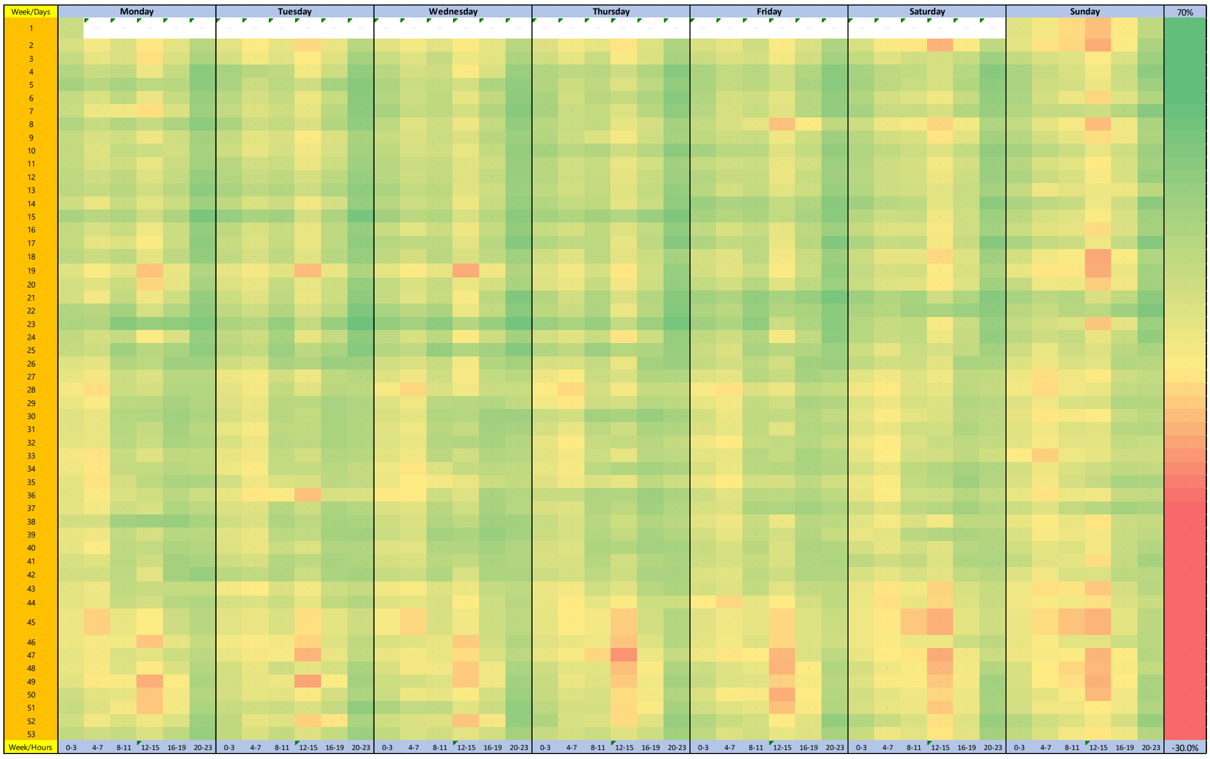
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,000MW NPP=15% Reduction Interconnected



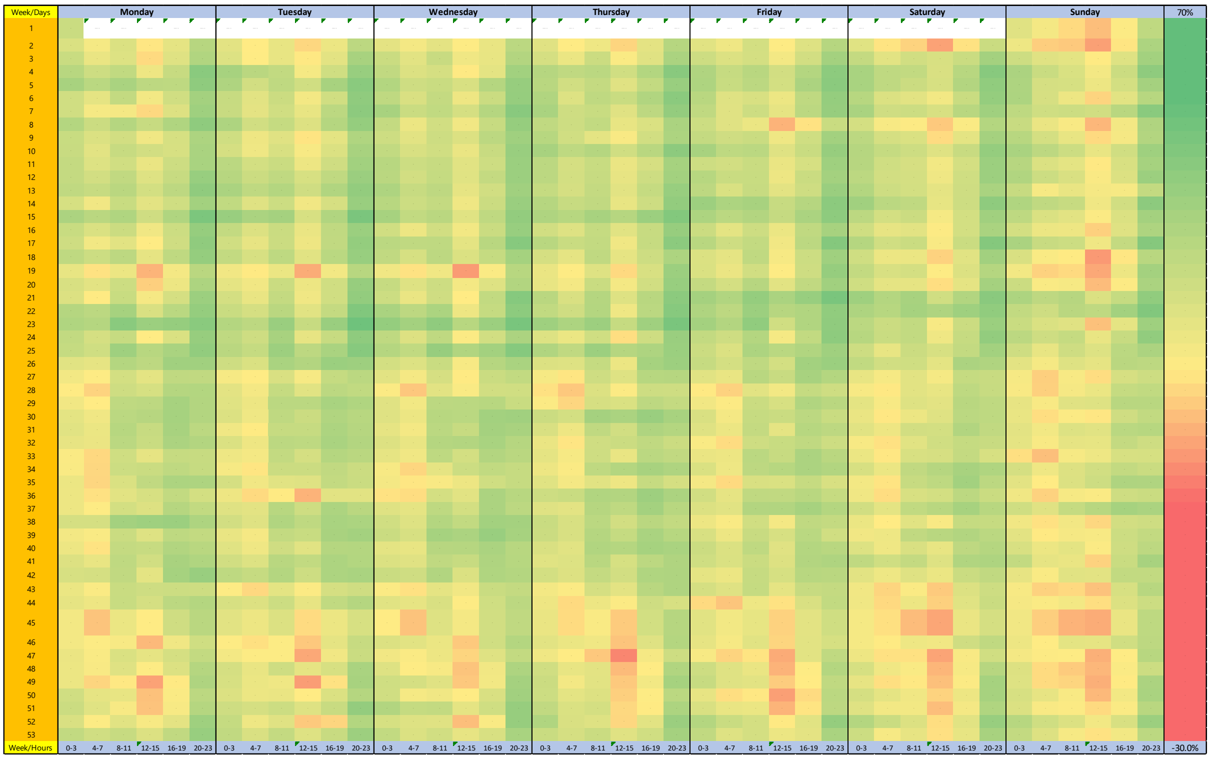
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=5,000MW Interconnected



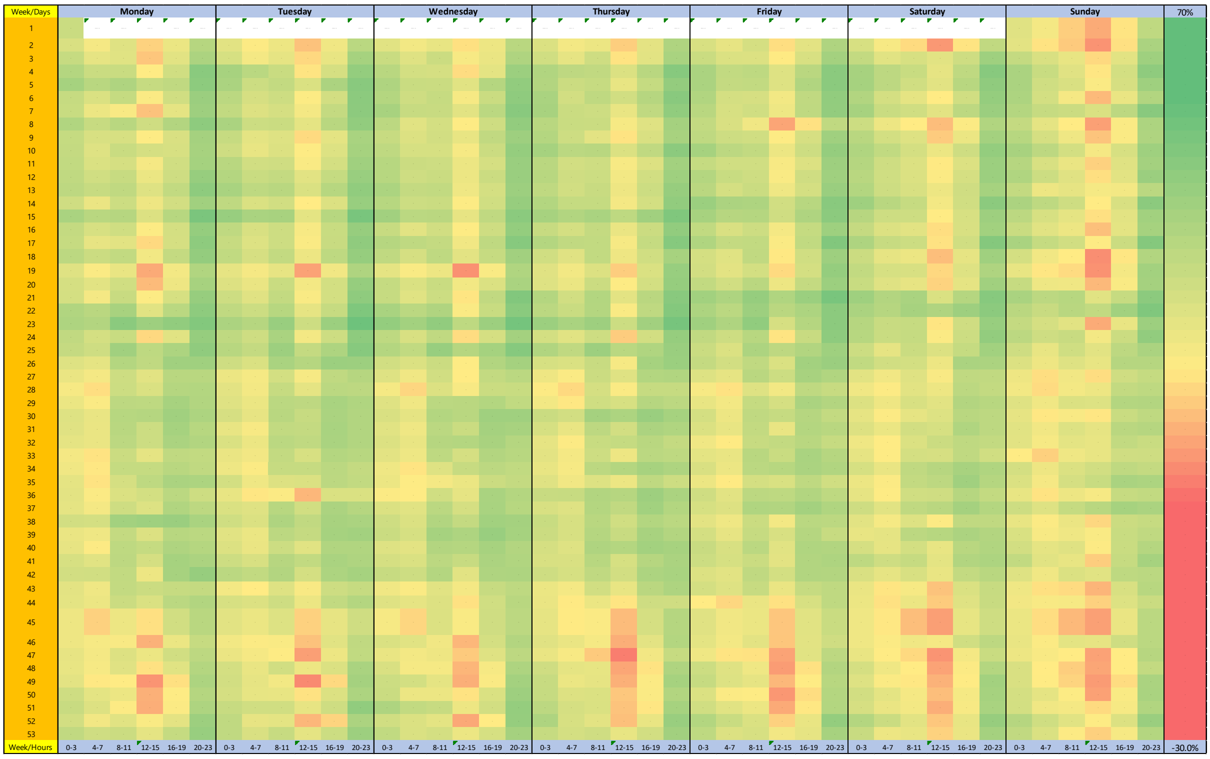
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=6,000MW Interconnected



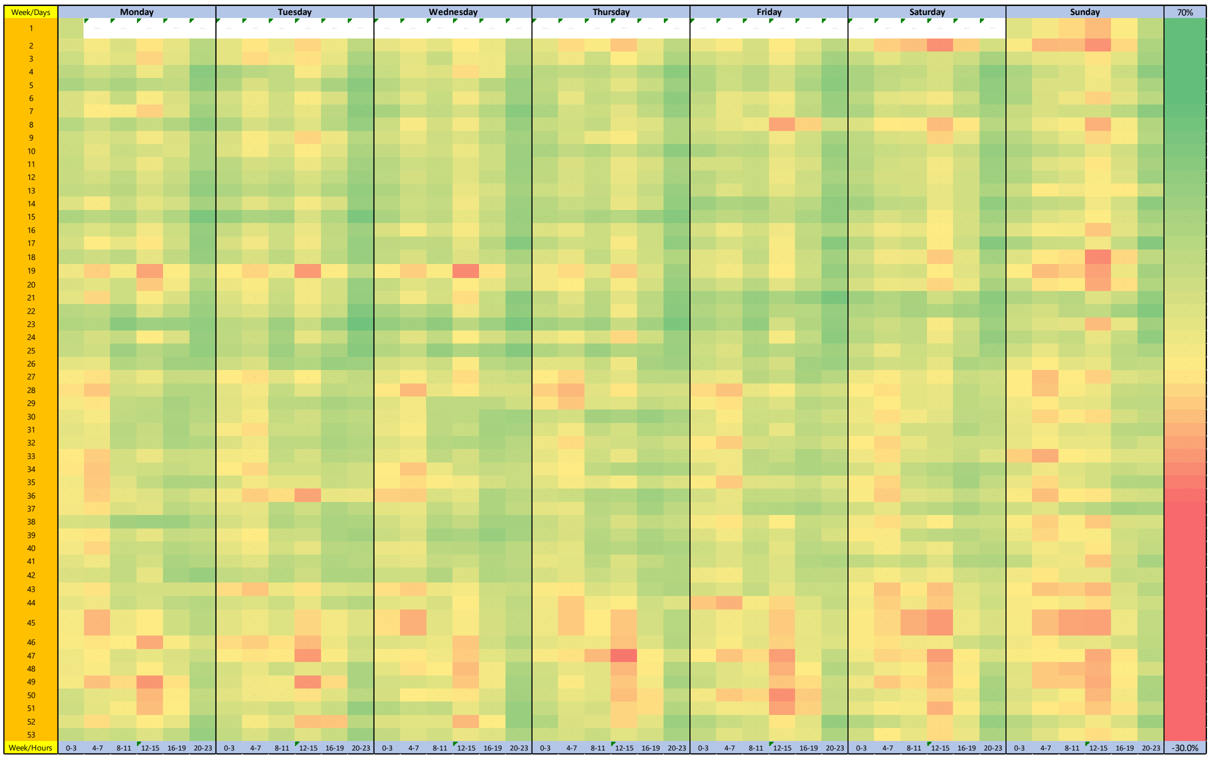
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=6,000MW Interconnected



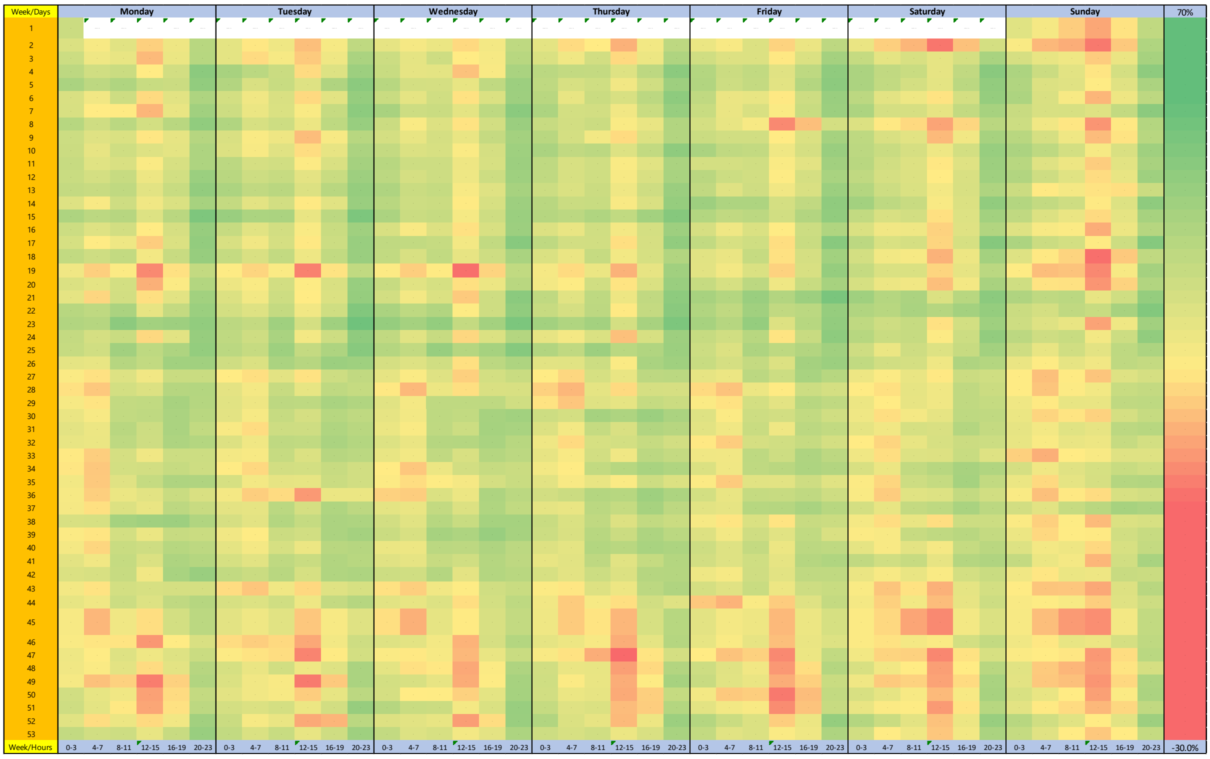
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=1,500MW SPP=7,000MW Interconnected



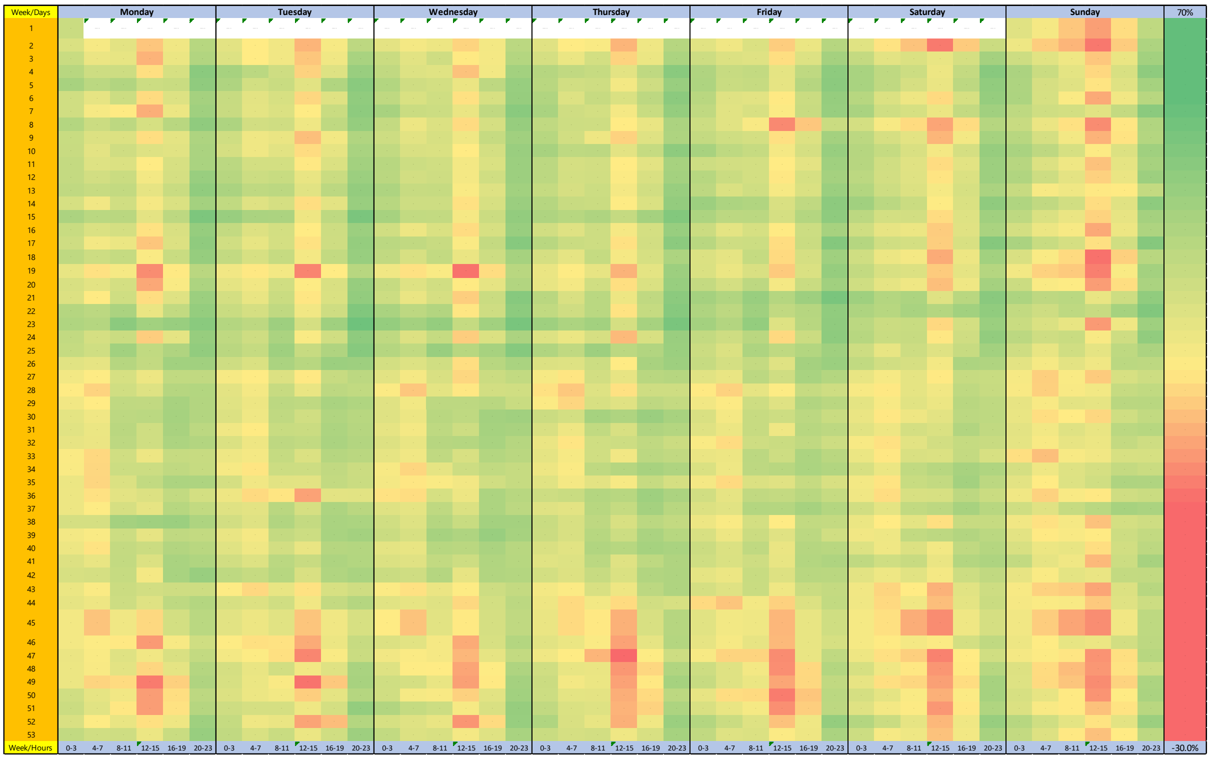
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=6,000MW Interconnected



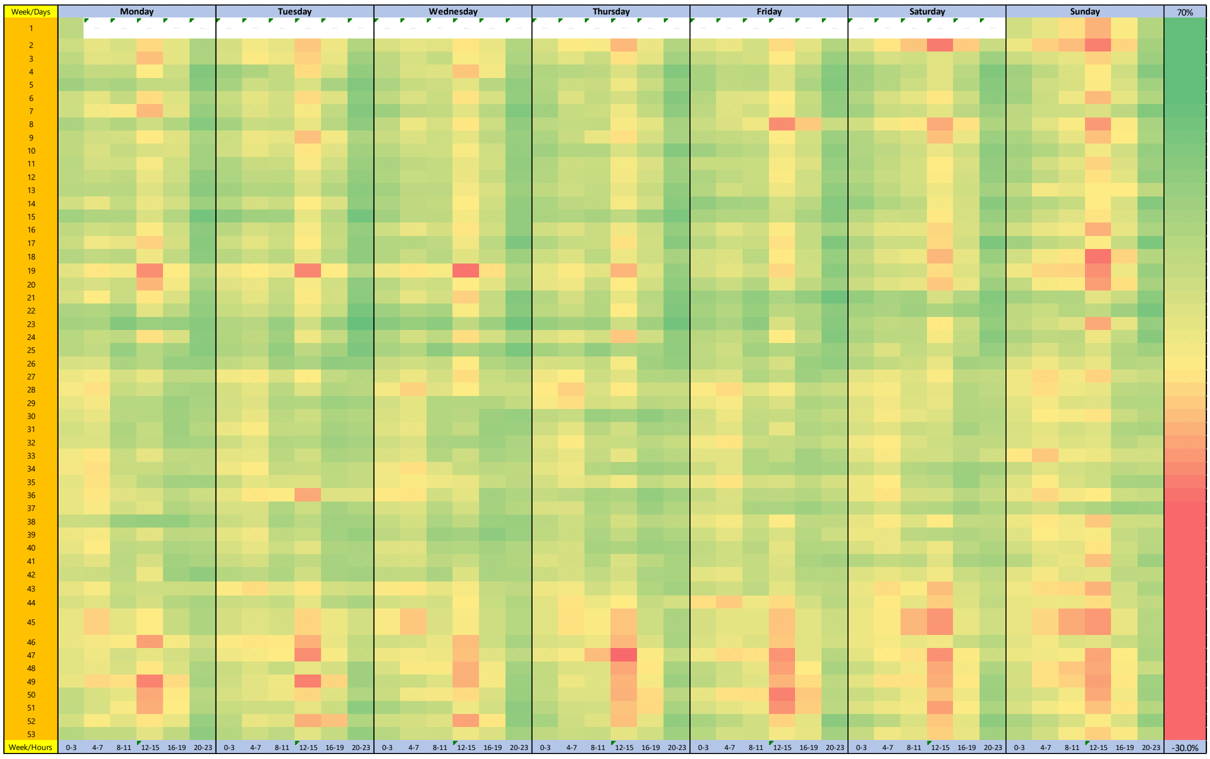
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,000MW Interconnected



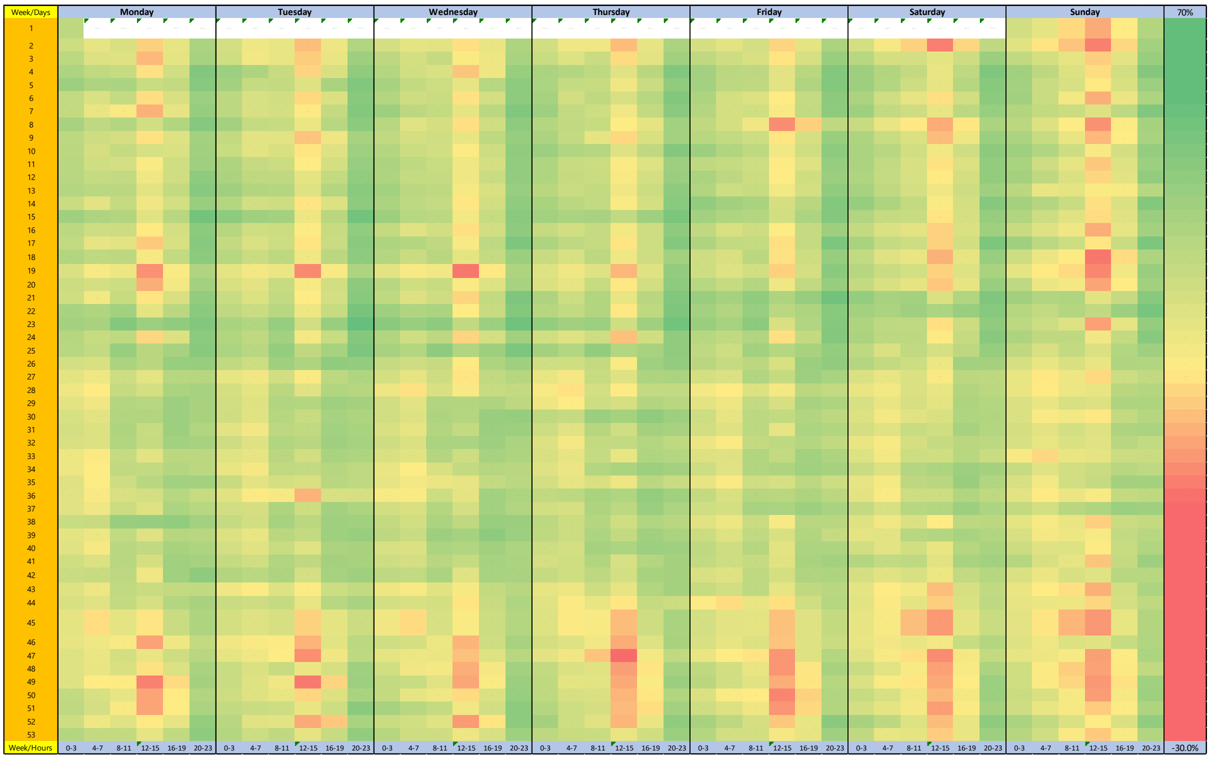
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=7,500MW Interconnected



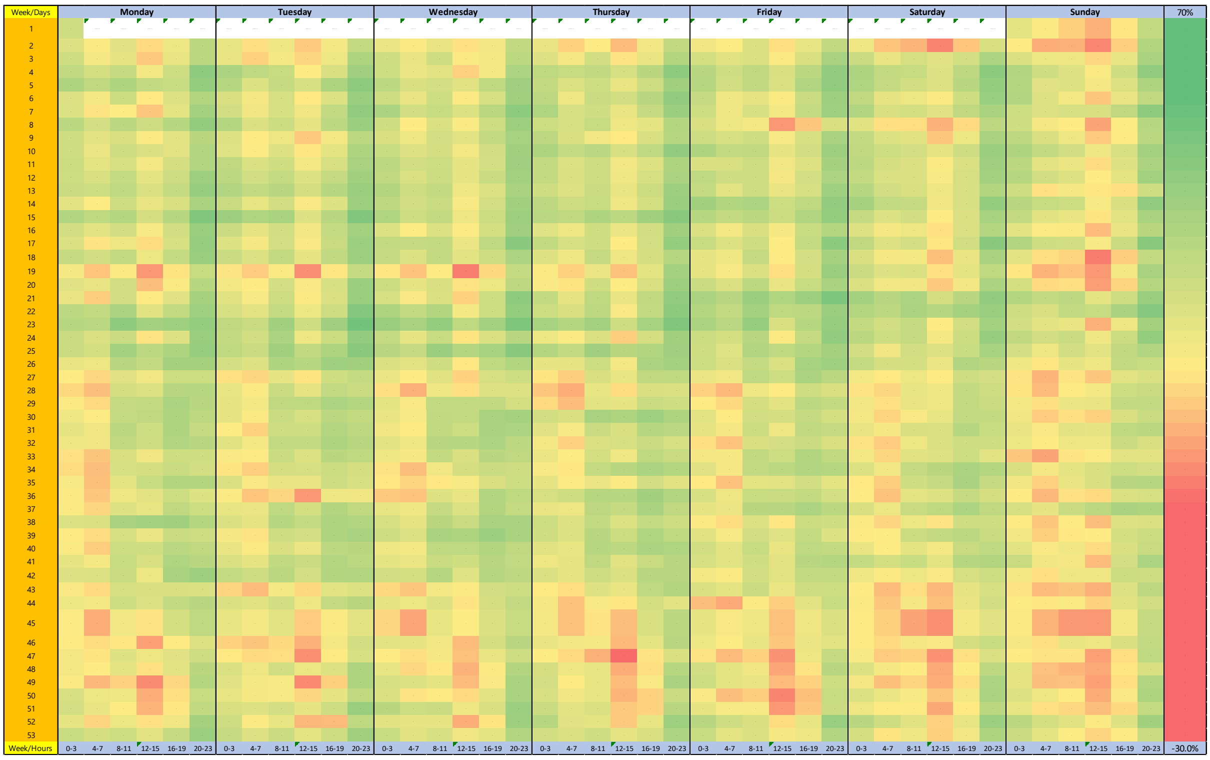
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,500MW SPP=7,500MW Interconnected



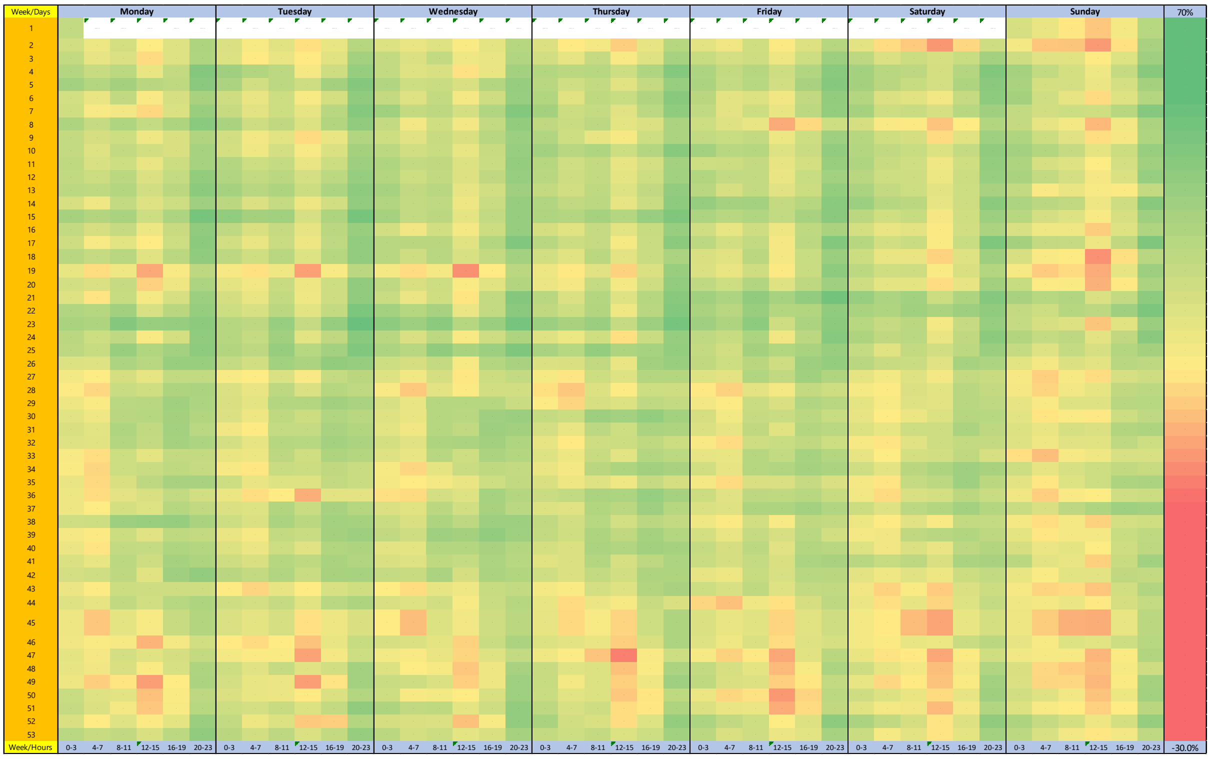
Scenario: Year 2021, Annual Load Growth 0.0%, WPP=2,000MW SPP=8,000MW Interconnected



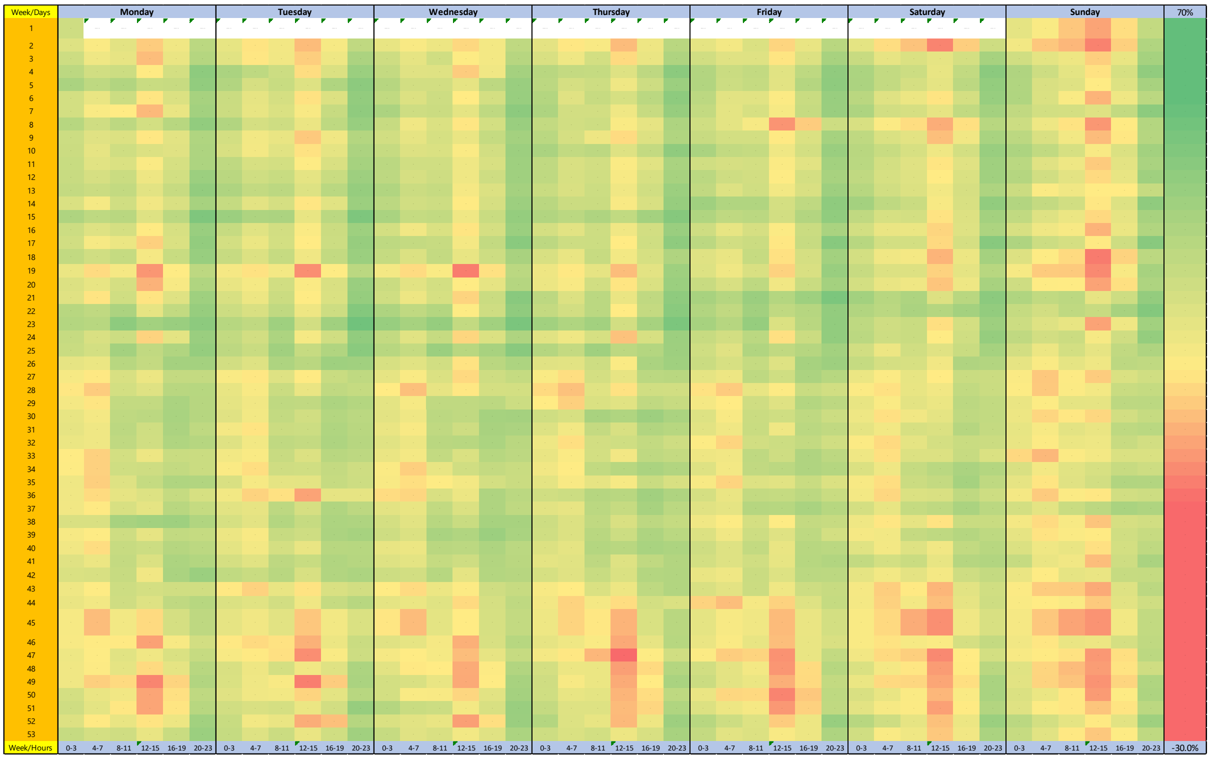
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=7.5% Reduction Interconnected



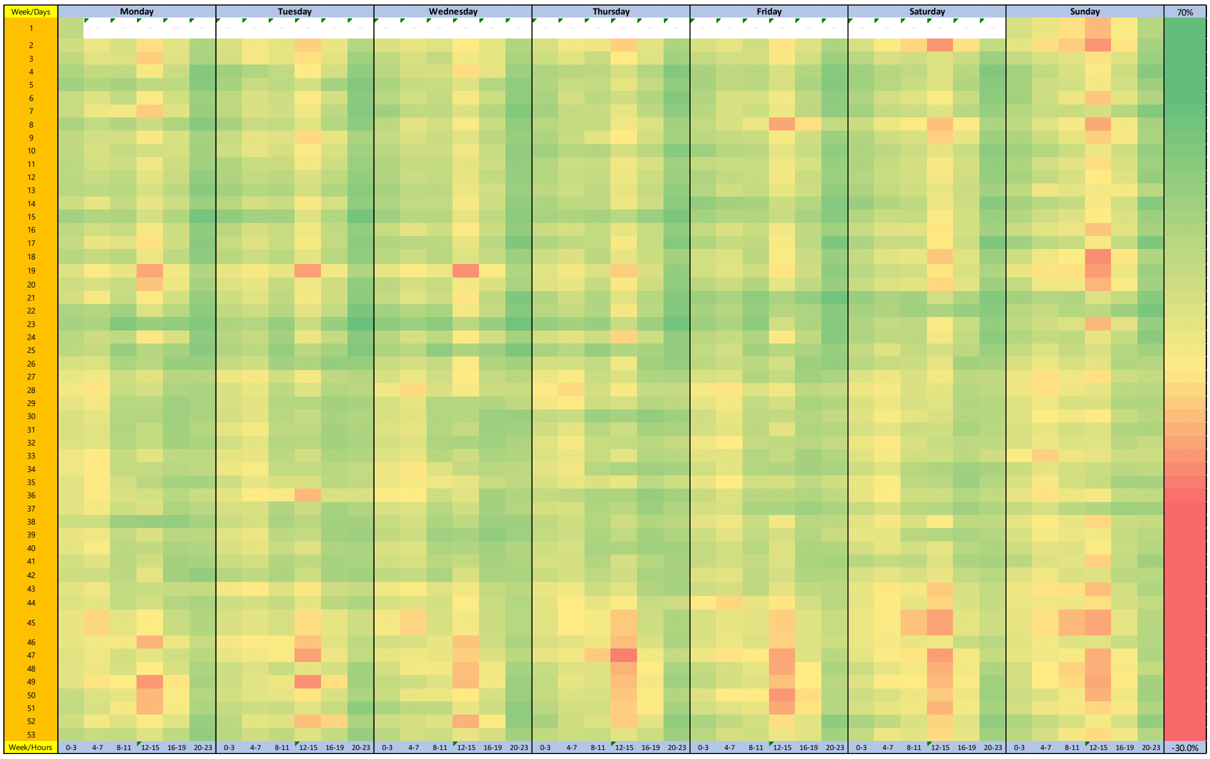
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,585MW SPP=6,241MW NPP=12.5% Reduction Interconnected



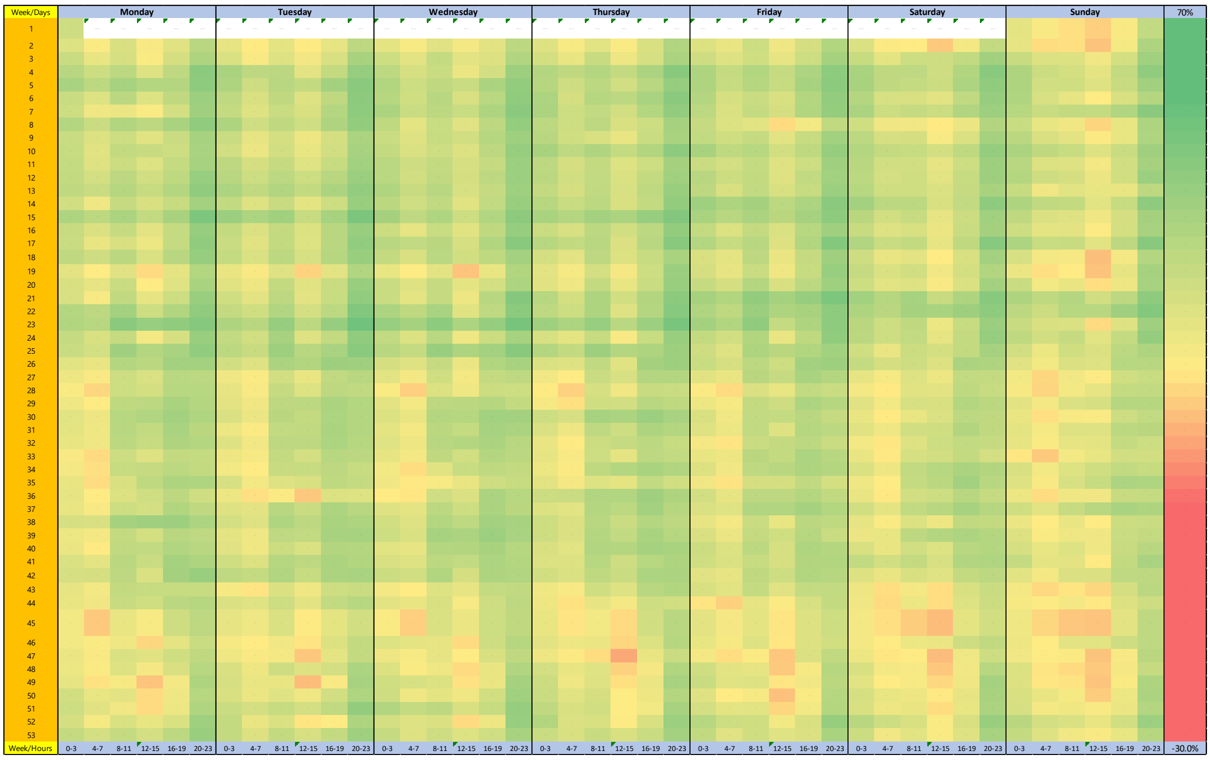
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=7.5% Reduction Interconnected



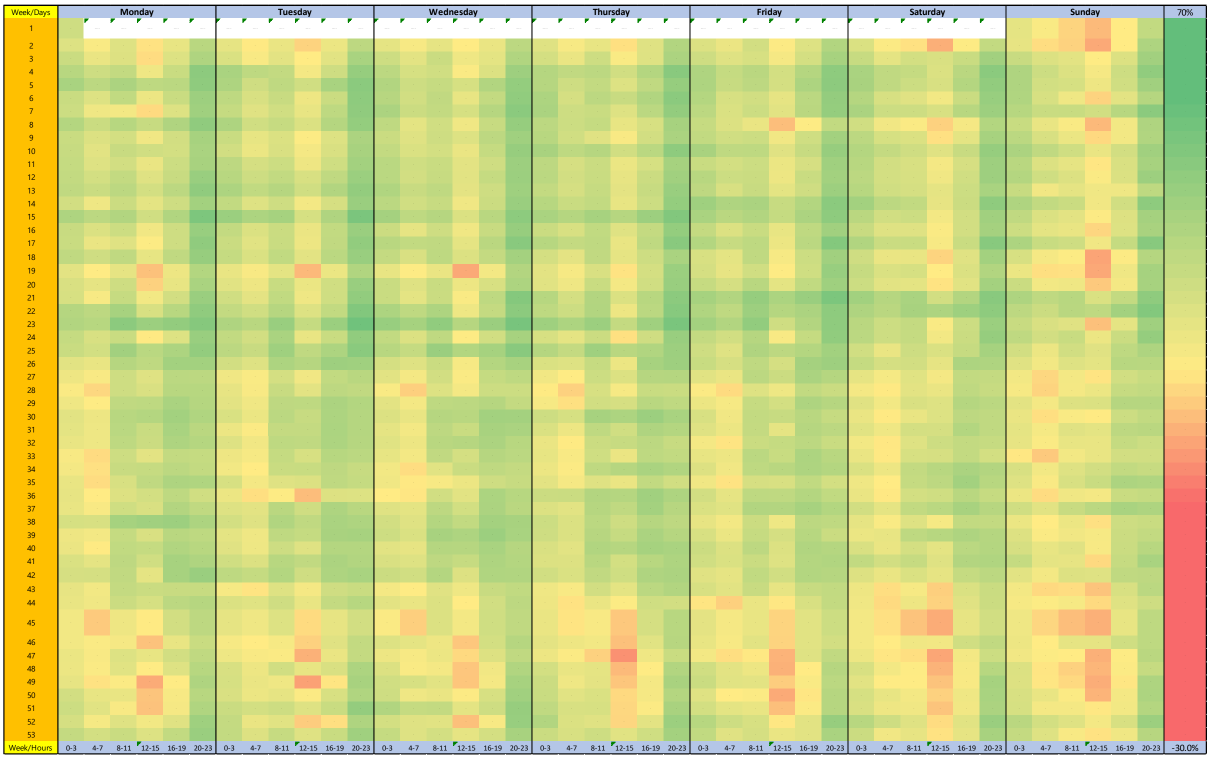
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,000MW NPP=12.5% Reduction Interconnected



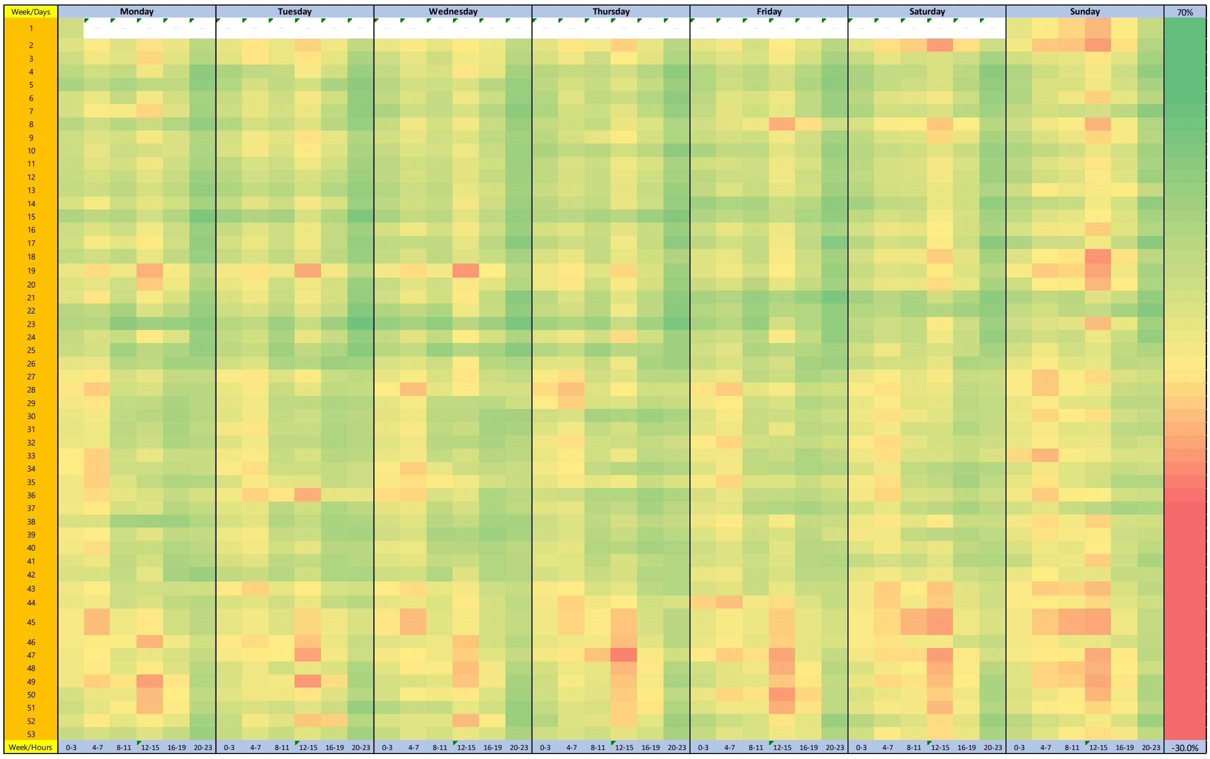
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=5,000MW Interconnected



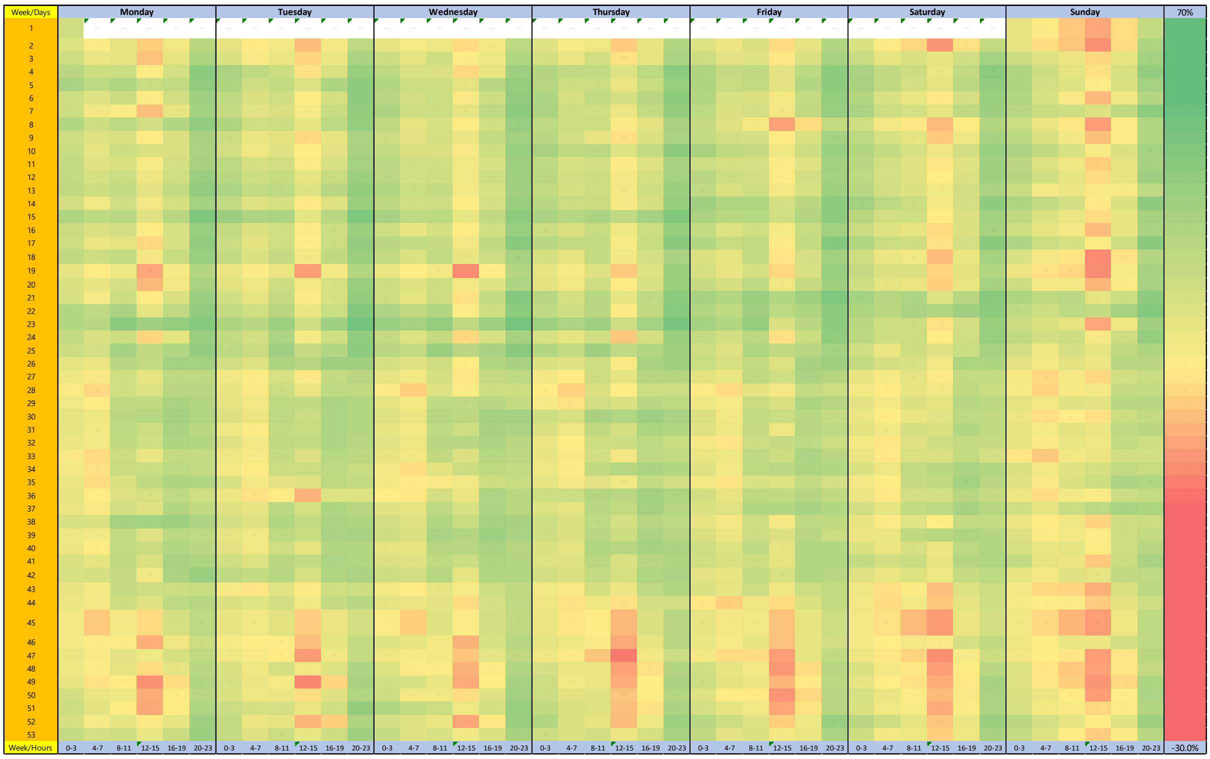
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=6,000MW Interconnected



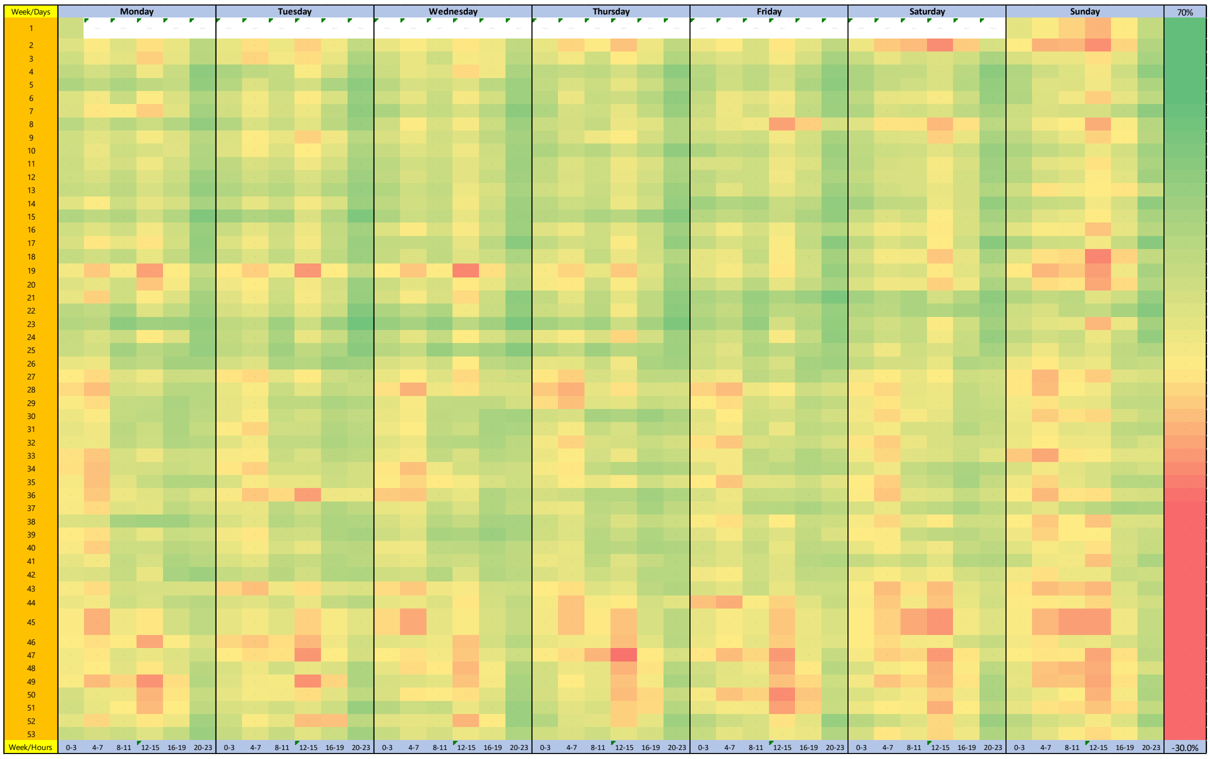
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=6,000MW Interconnected



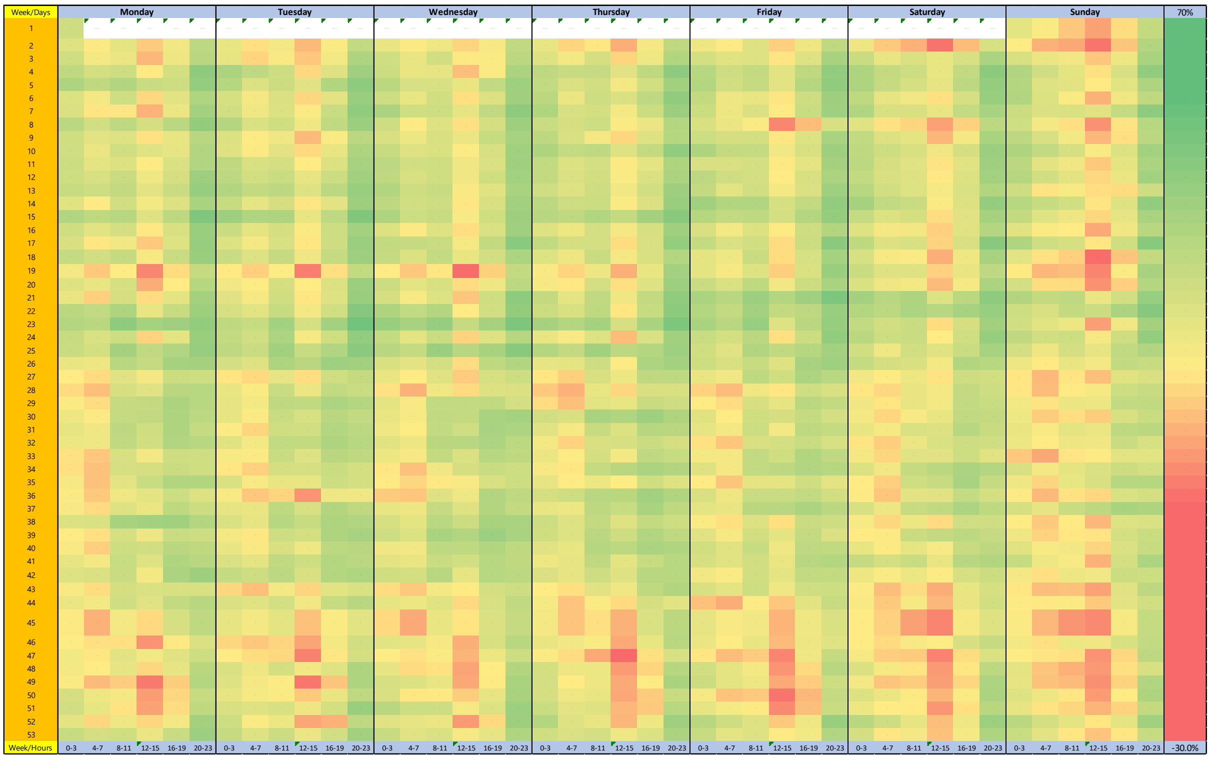
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=1,500MW SPP=7,000MW Interconnected



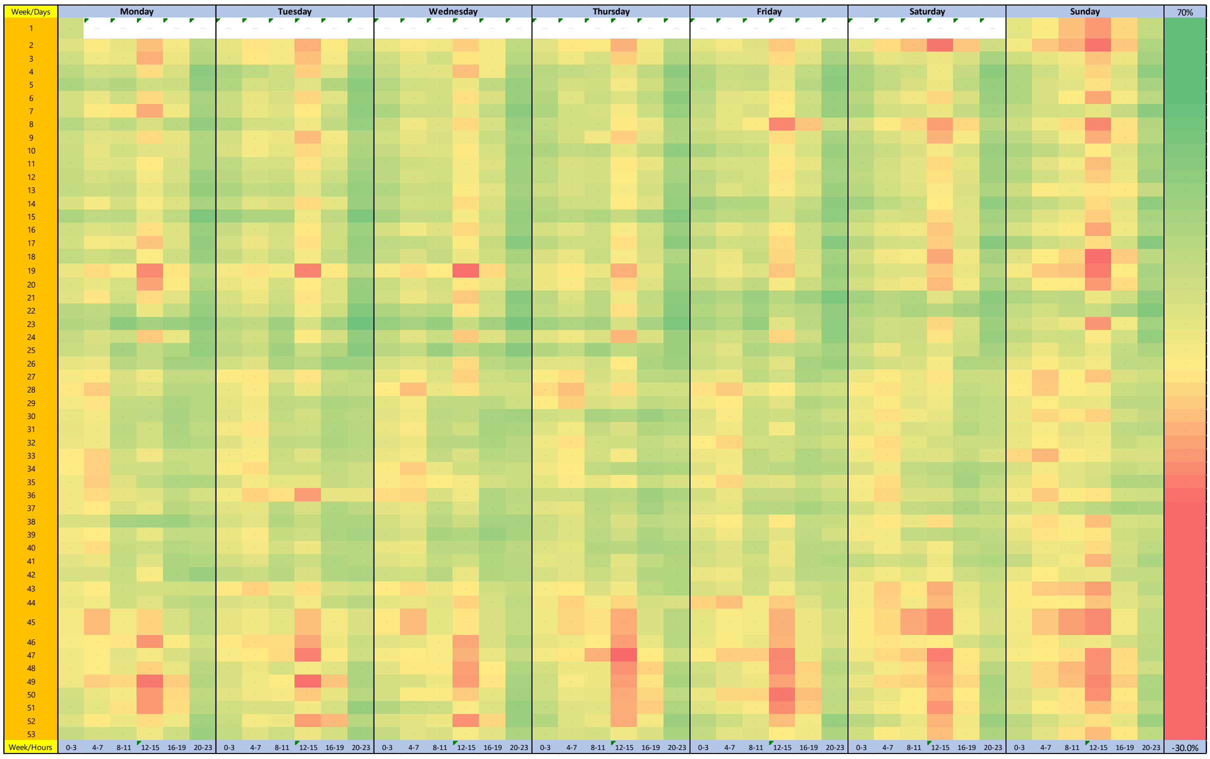
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=6,000MW Interconnected



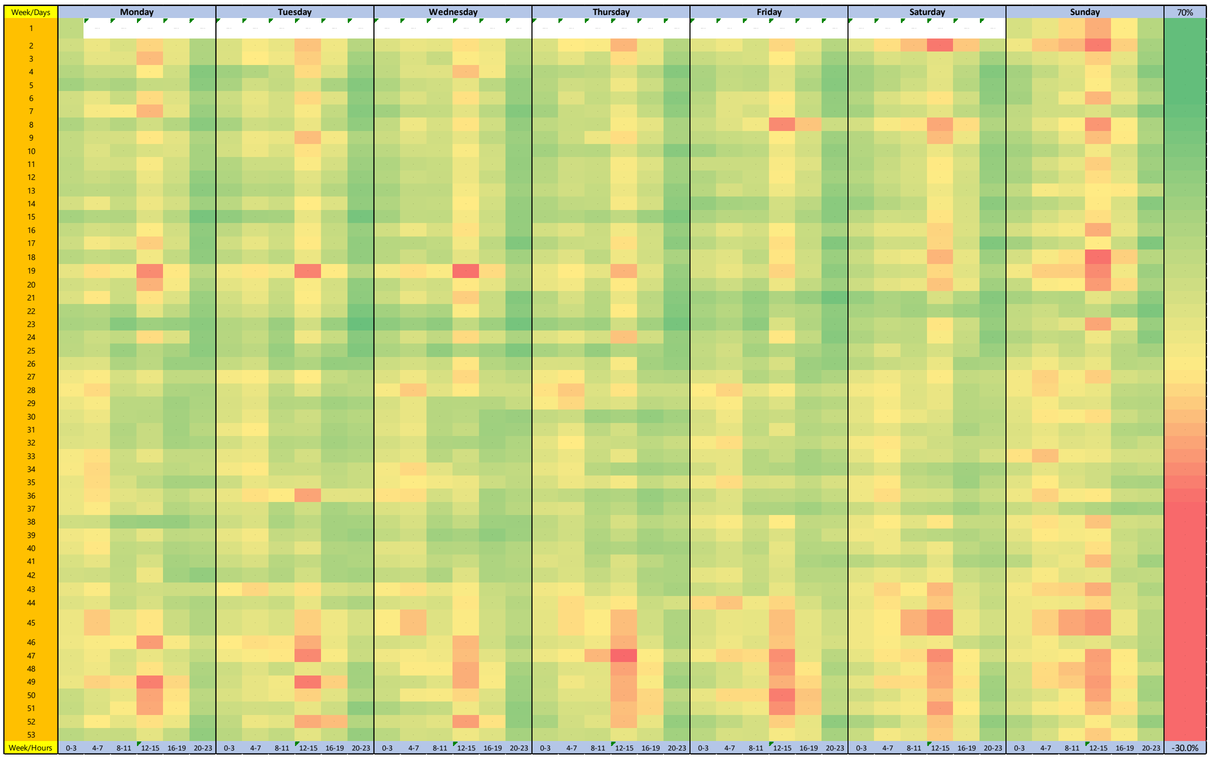
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,000MW Interconnected



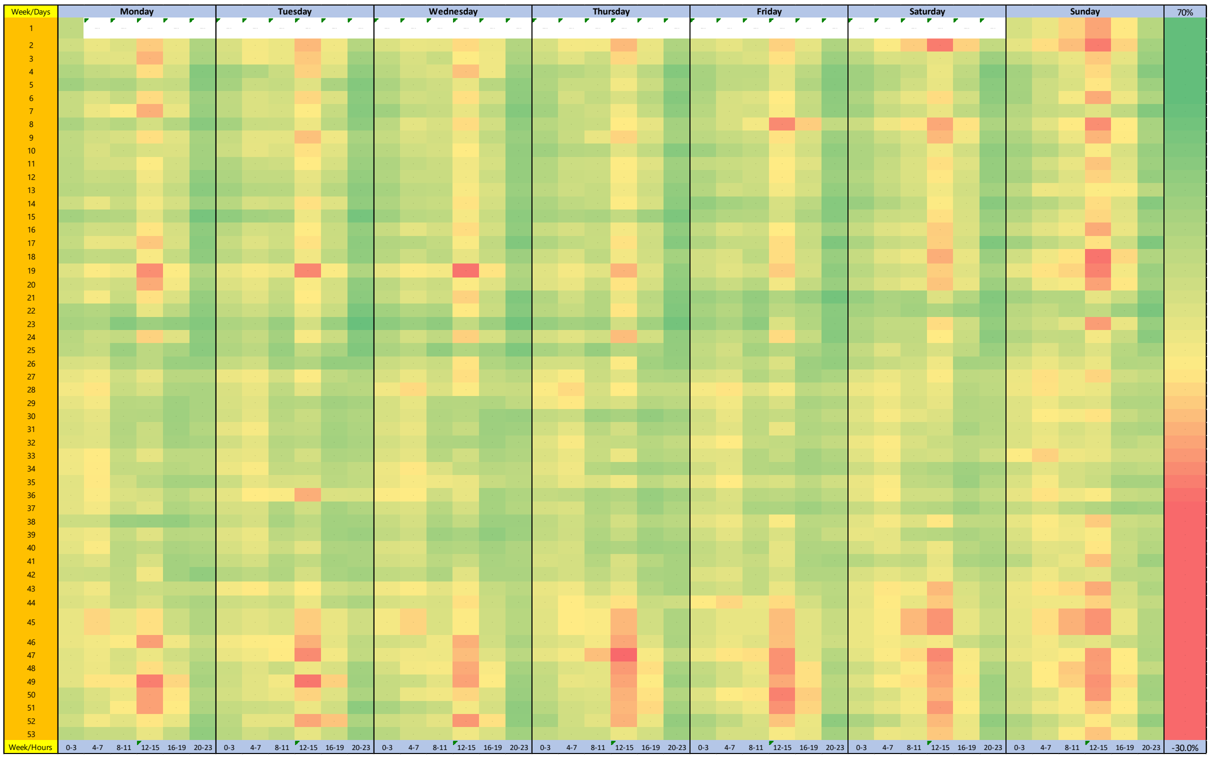
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=7,500MW Interconnected



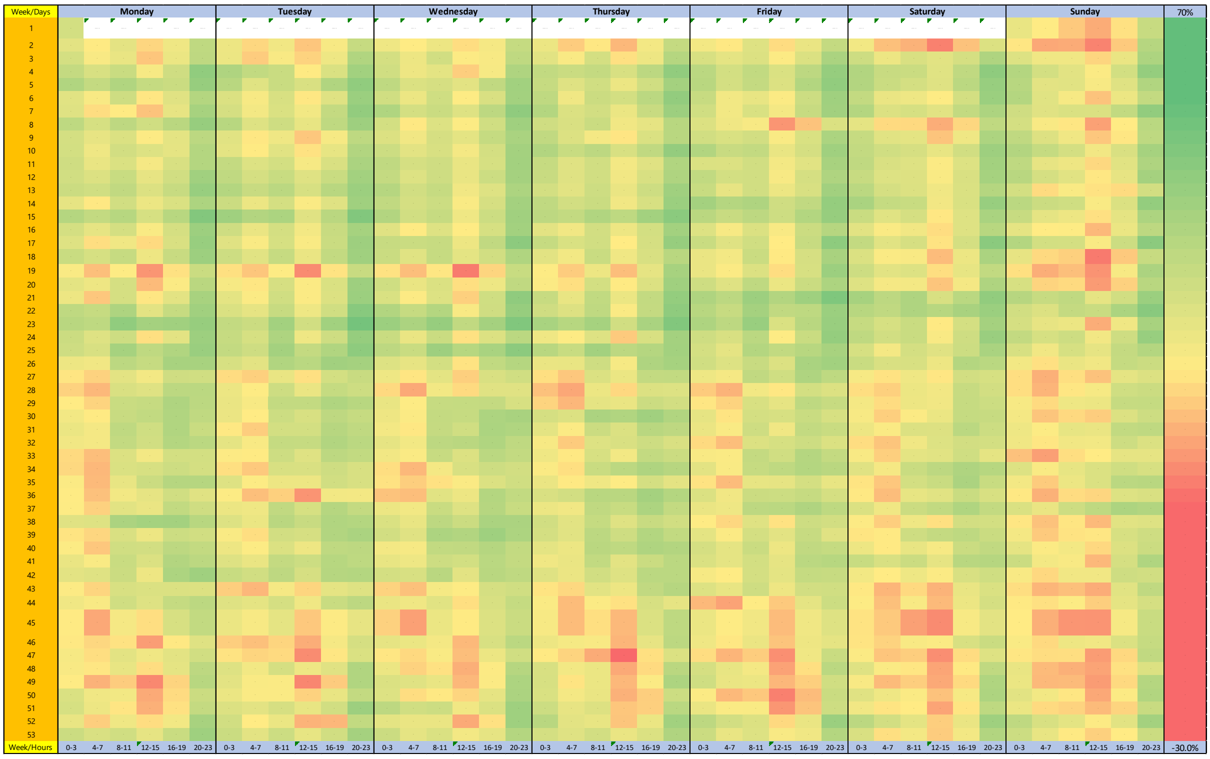
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,500MW SPP=7,500MW Interconnected



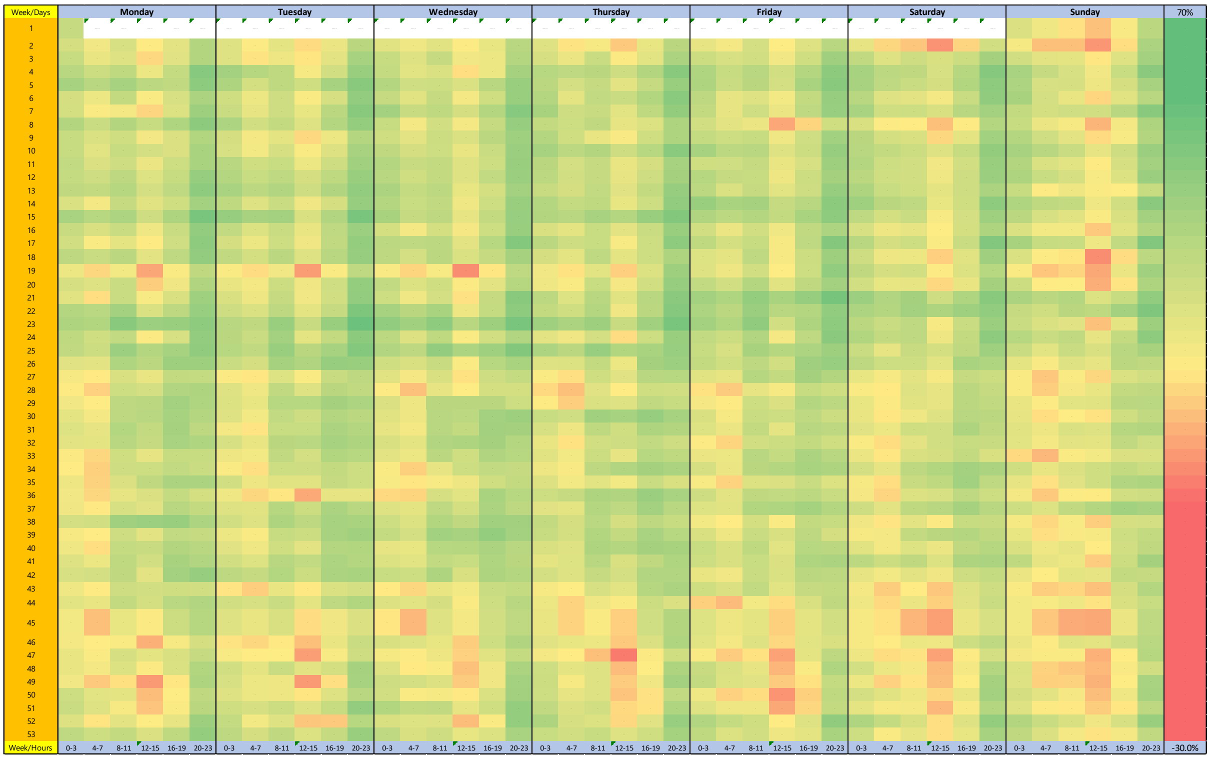
Scenario: Year 2021, Annual Load Growth 0.5%, WPP=2,000MW SPP=8,000MW Interconnected



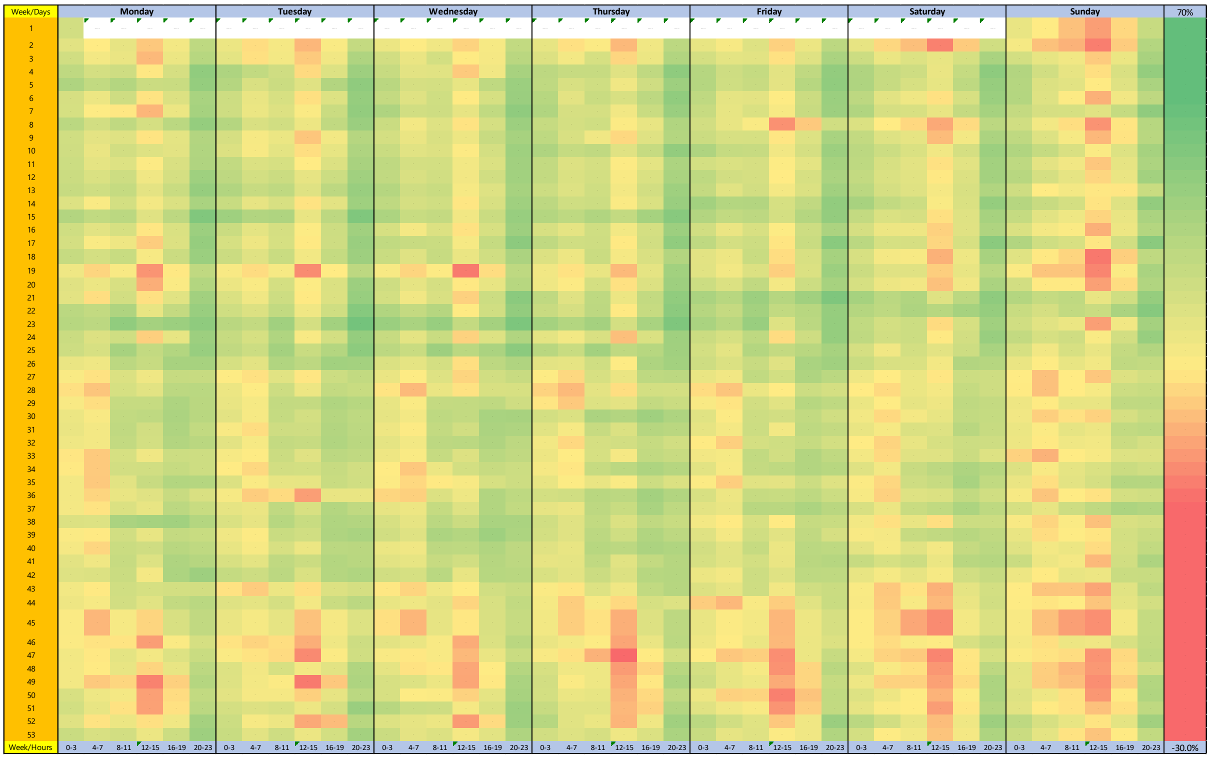
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=5% Reduction Interconnected



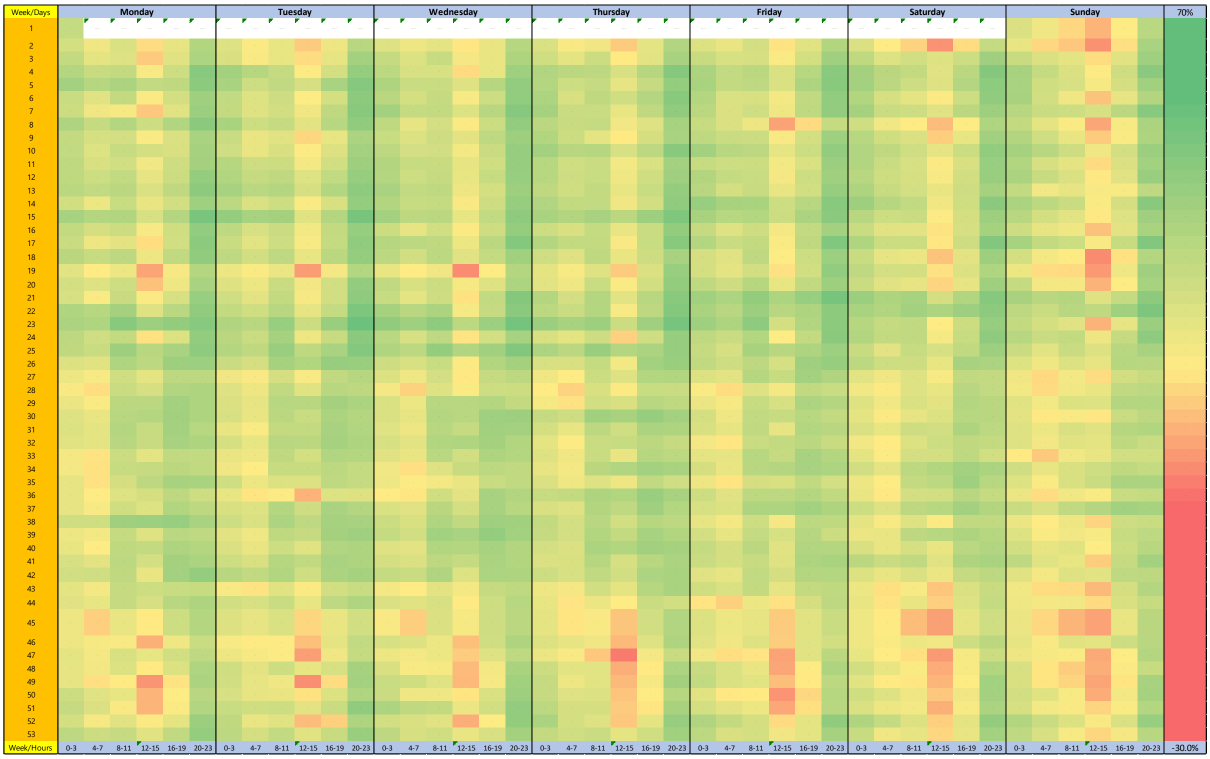
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,585MW SPP=6,241MW NPP=10% Reduction Interconnected



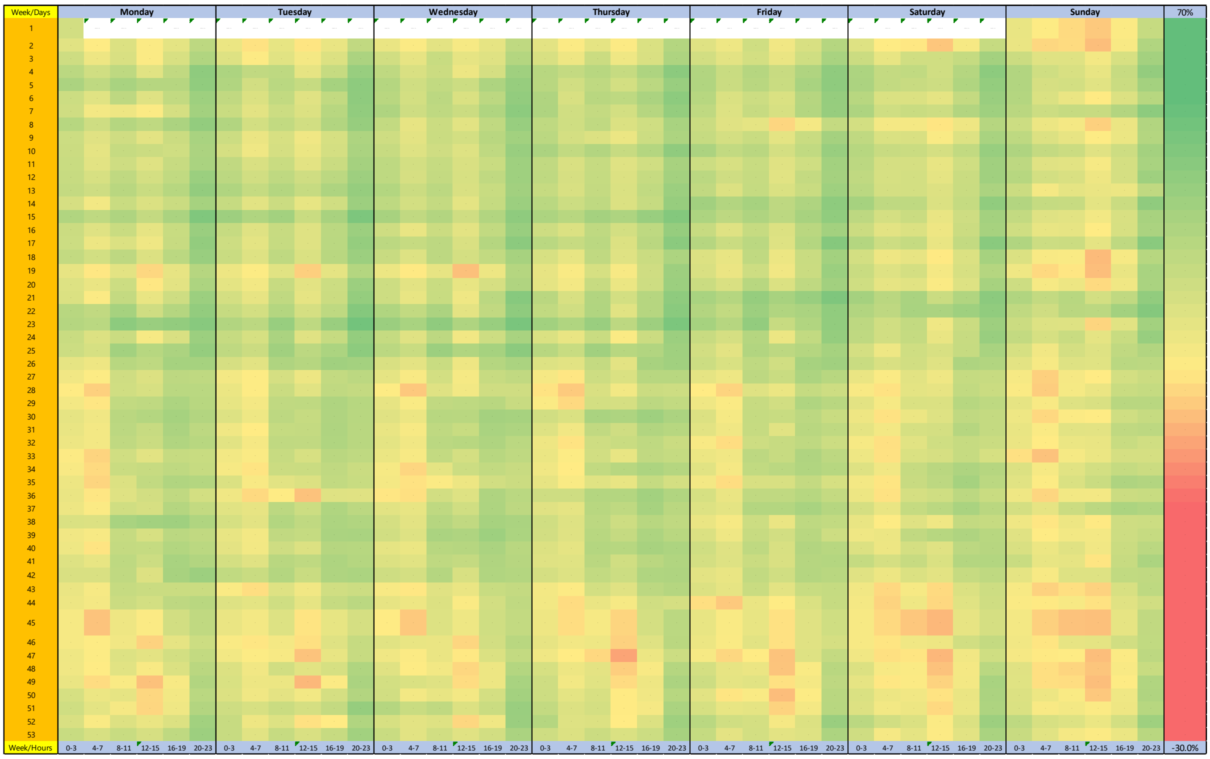
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=5% Reduction Interconnected



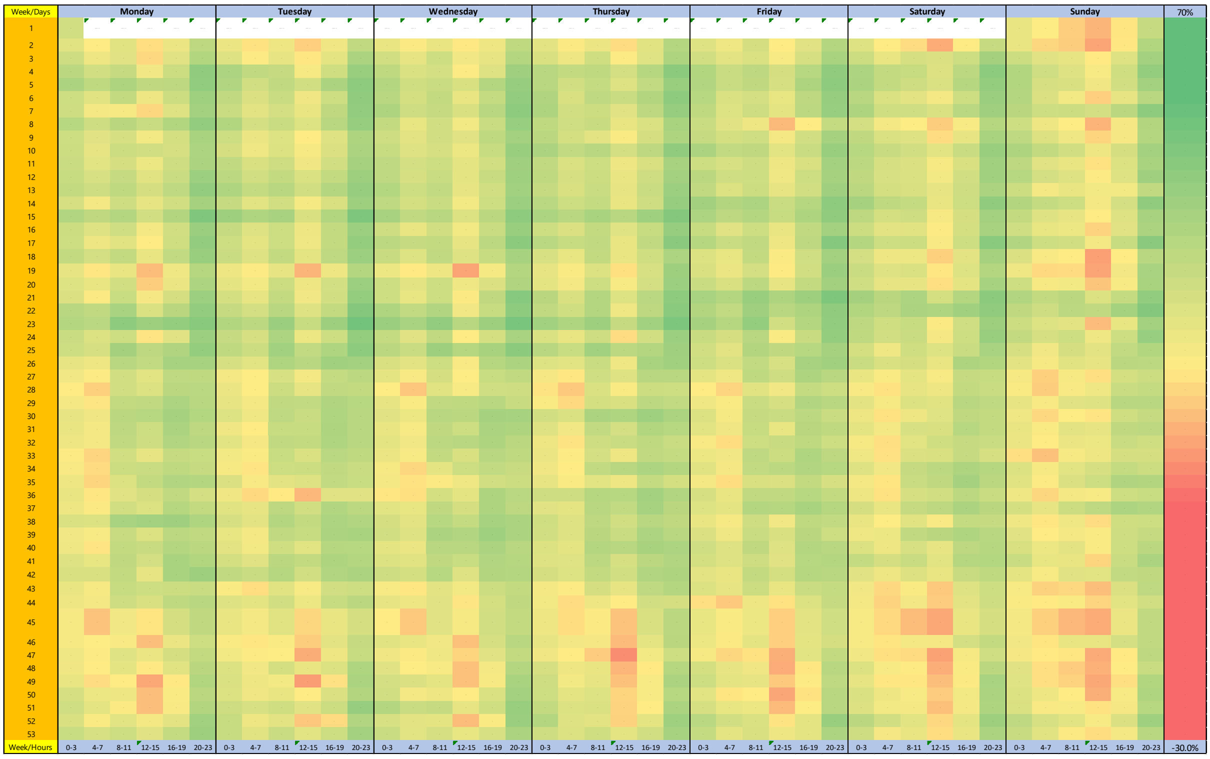
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,000MW NPP=10% Reduction Interconnected



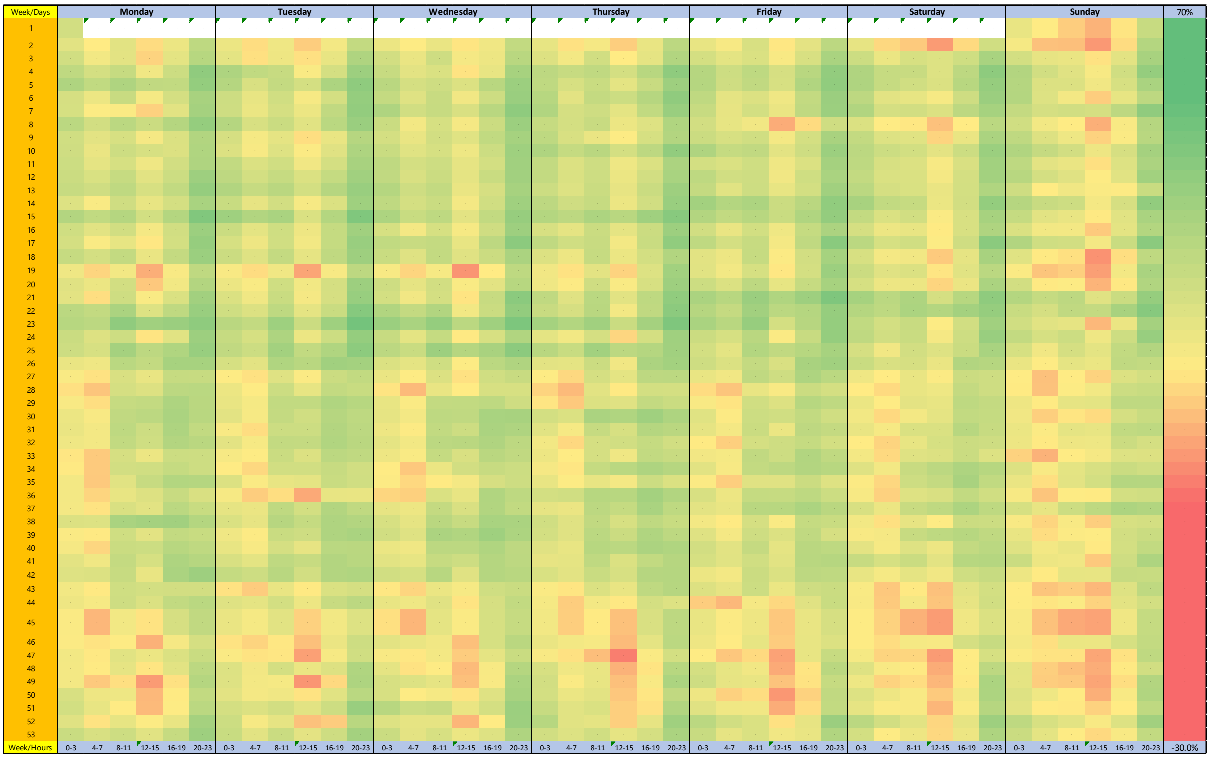
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=5,000MW Interconnected



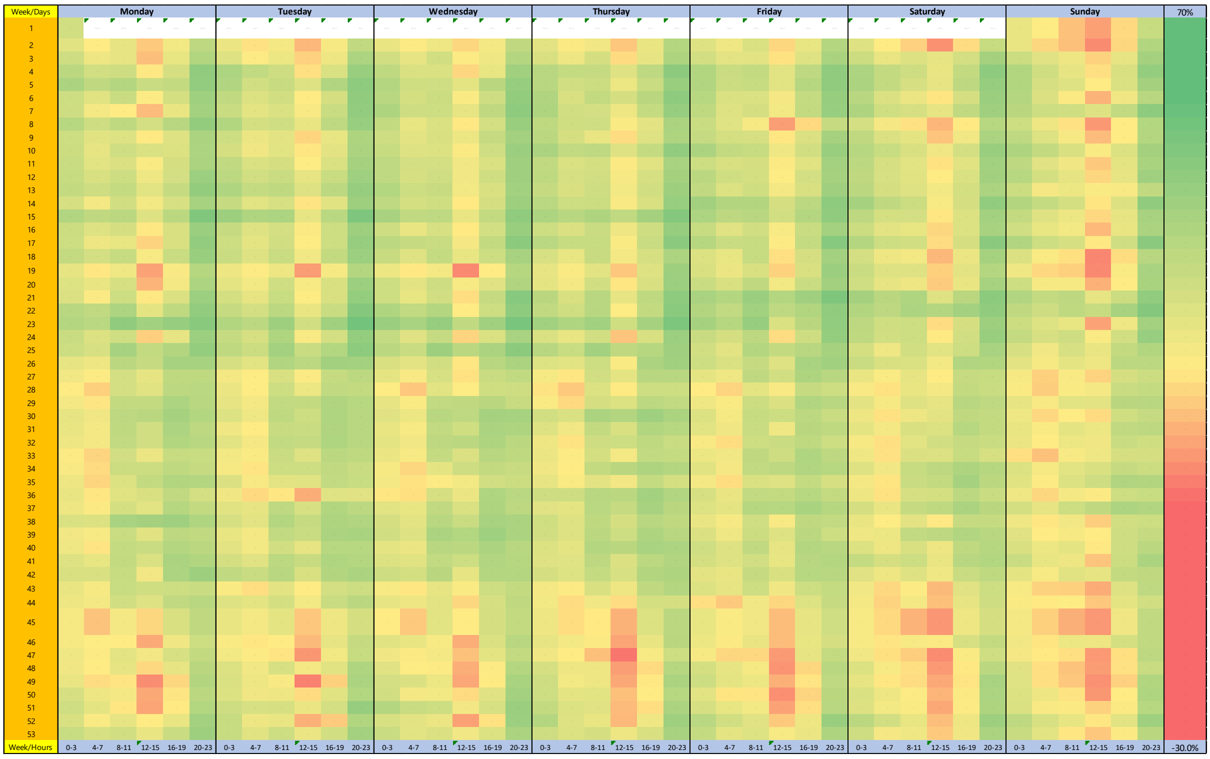
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=6,000MW Interconnected



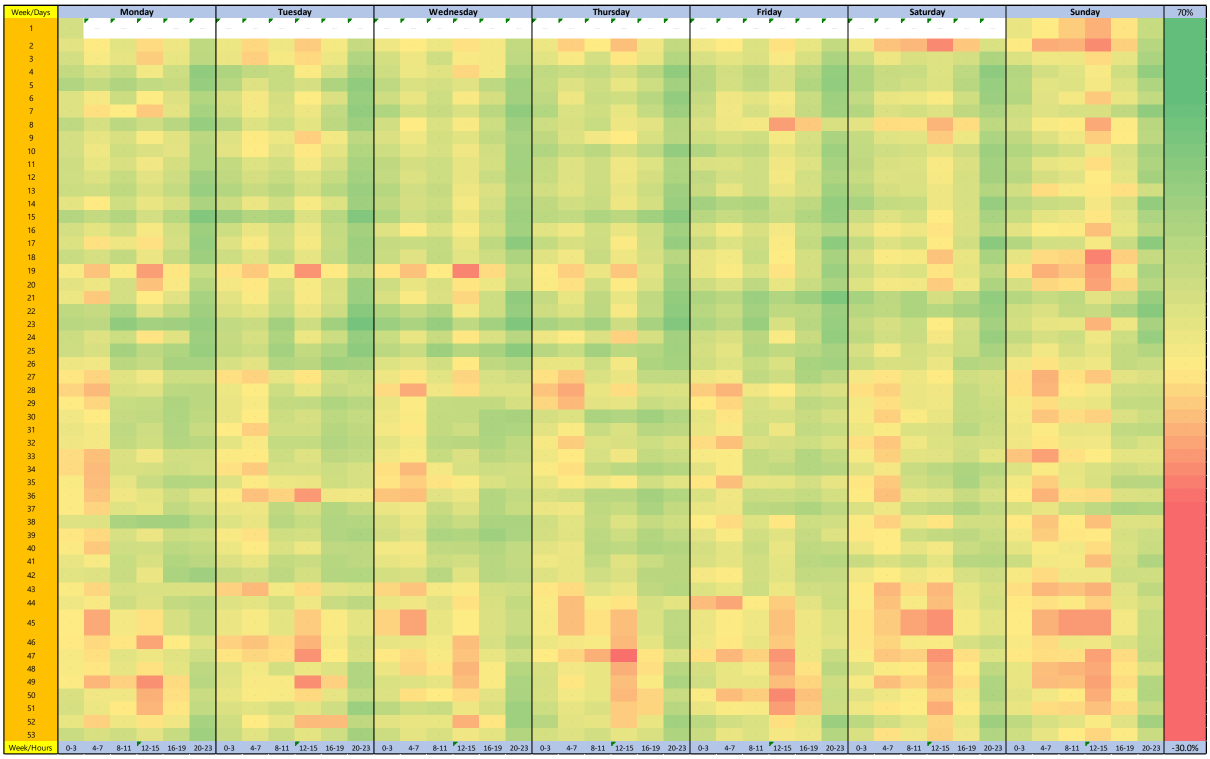
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=6,000MW Interconnected



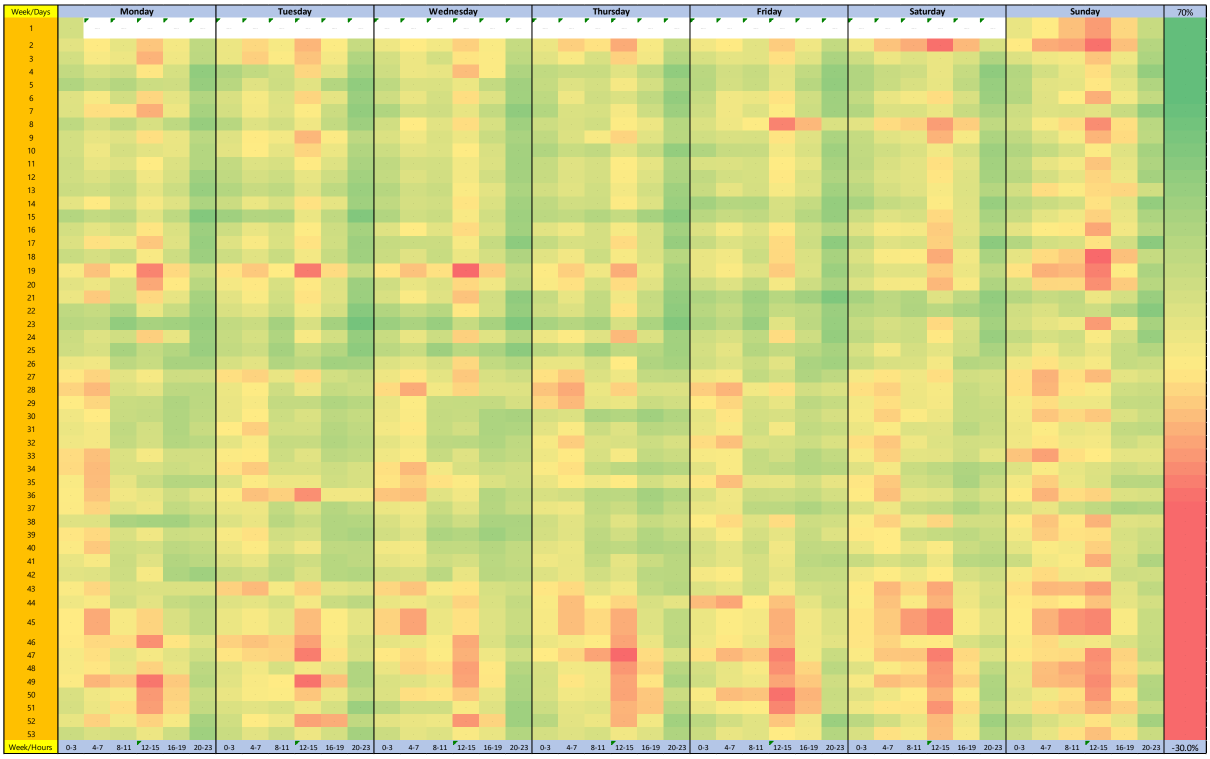
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=1,500MW SPP=7,000MW Interconnected



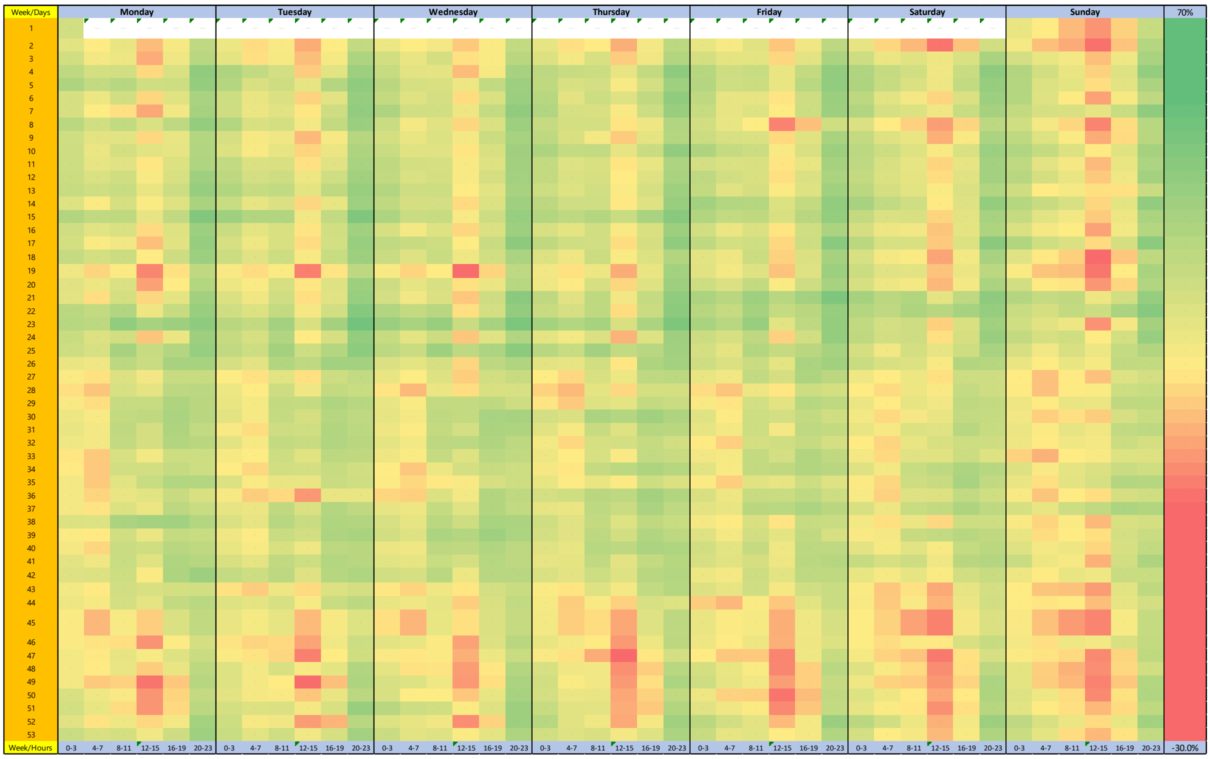
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=6,000MW Interconnected



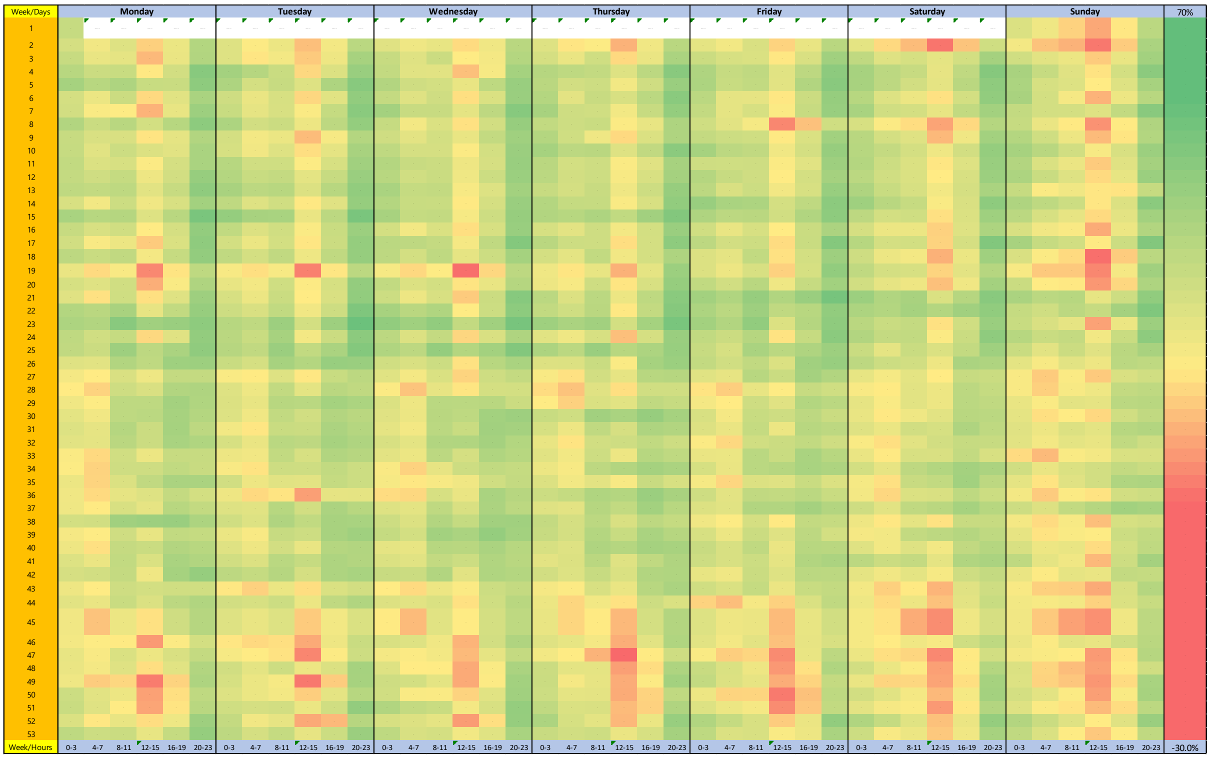
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,000MW Interconnected



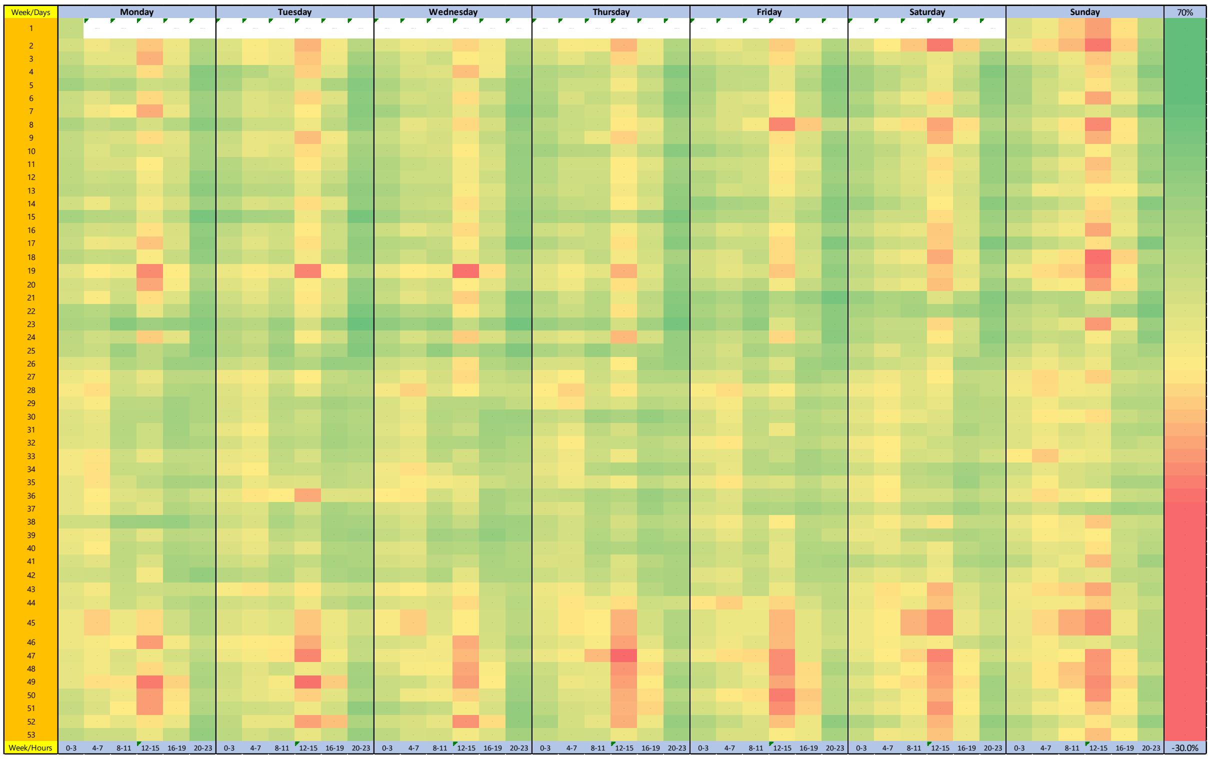
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=7,500MW Interconnected



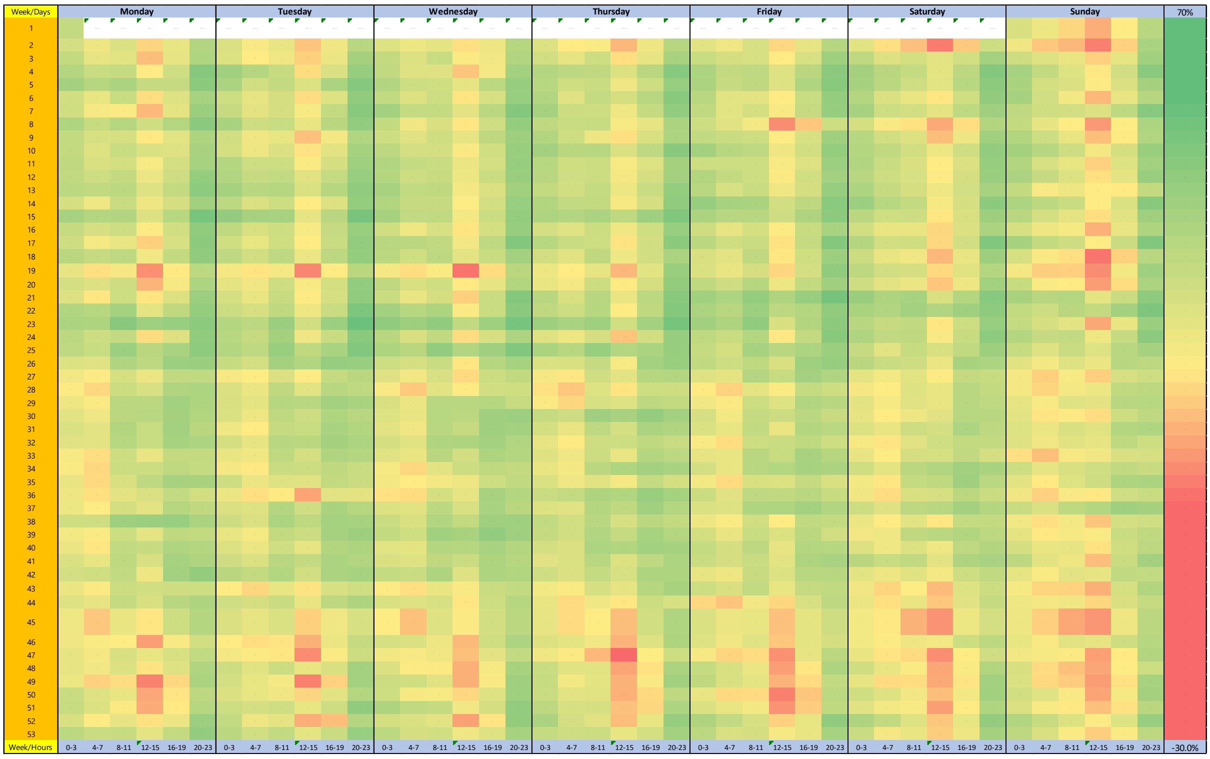
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,500MW SPP=7,500MW Interconnected



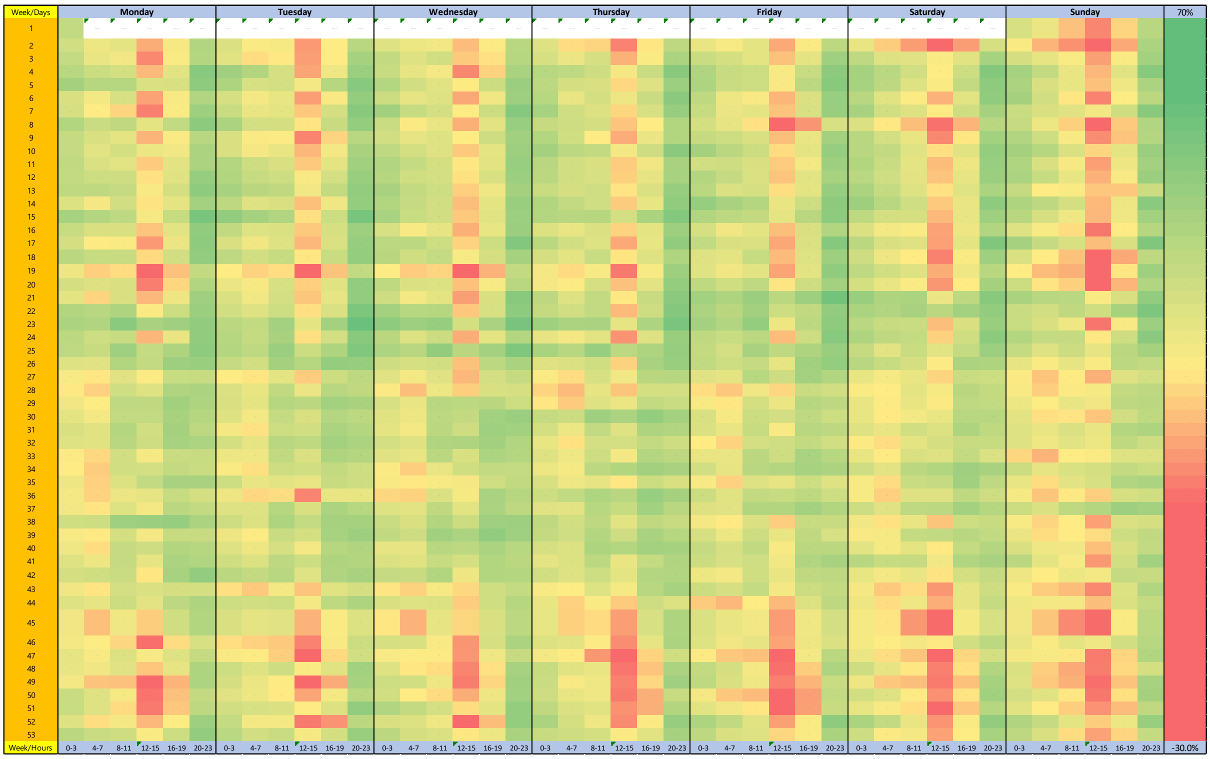
Scenario: Year 2021, Annual Load Growth 1.0%, WPP=2,000MW SPP=8,000MW Interconnected



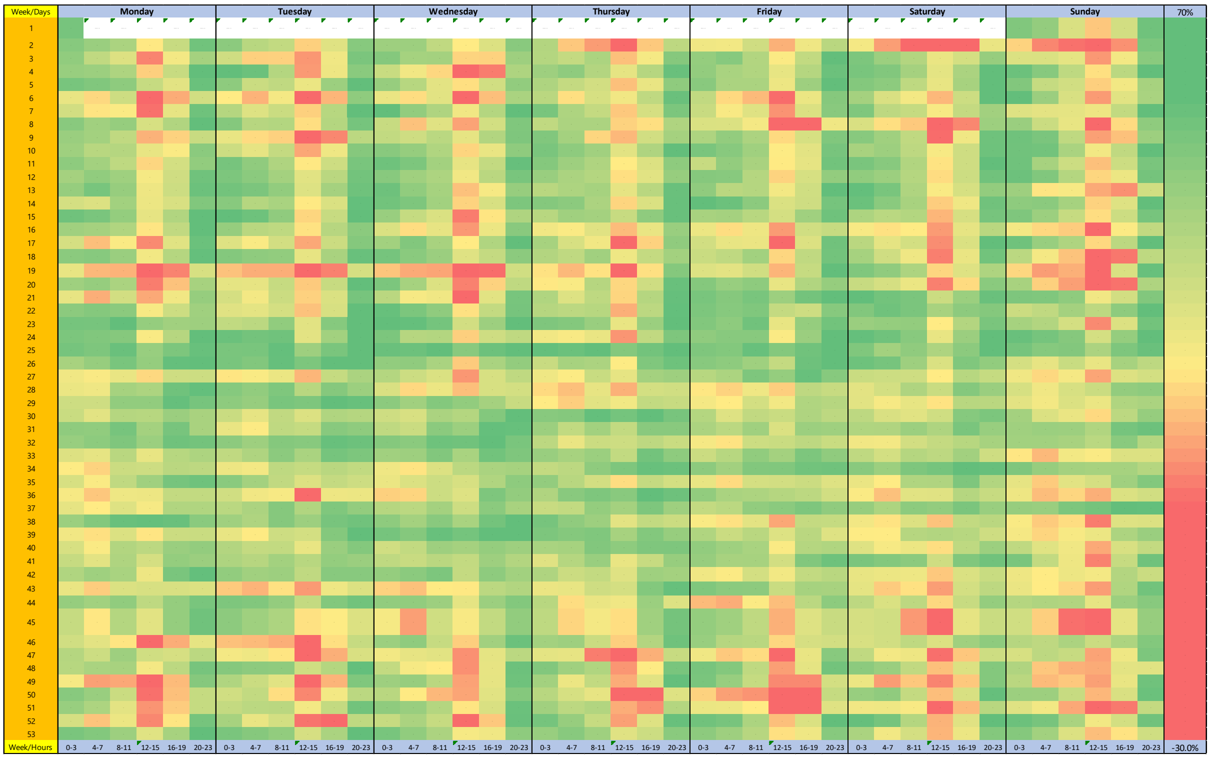
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Interconnected



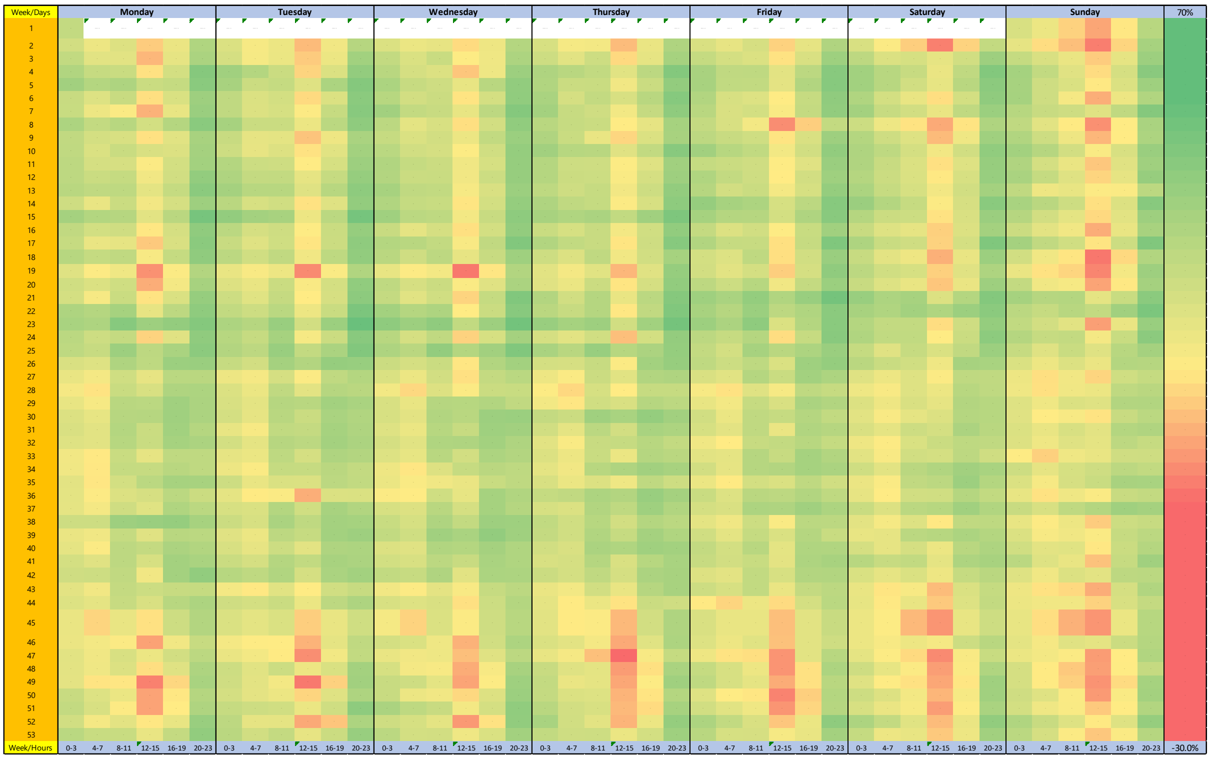
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Interconnected



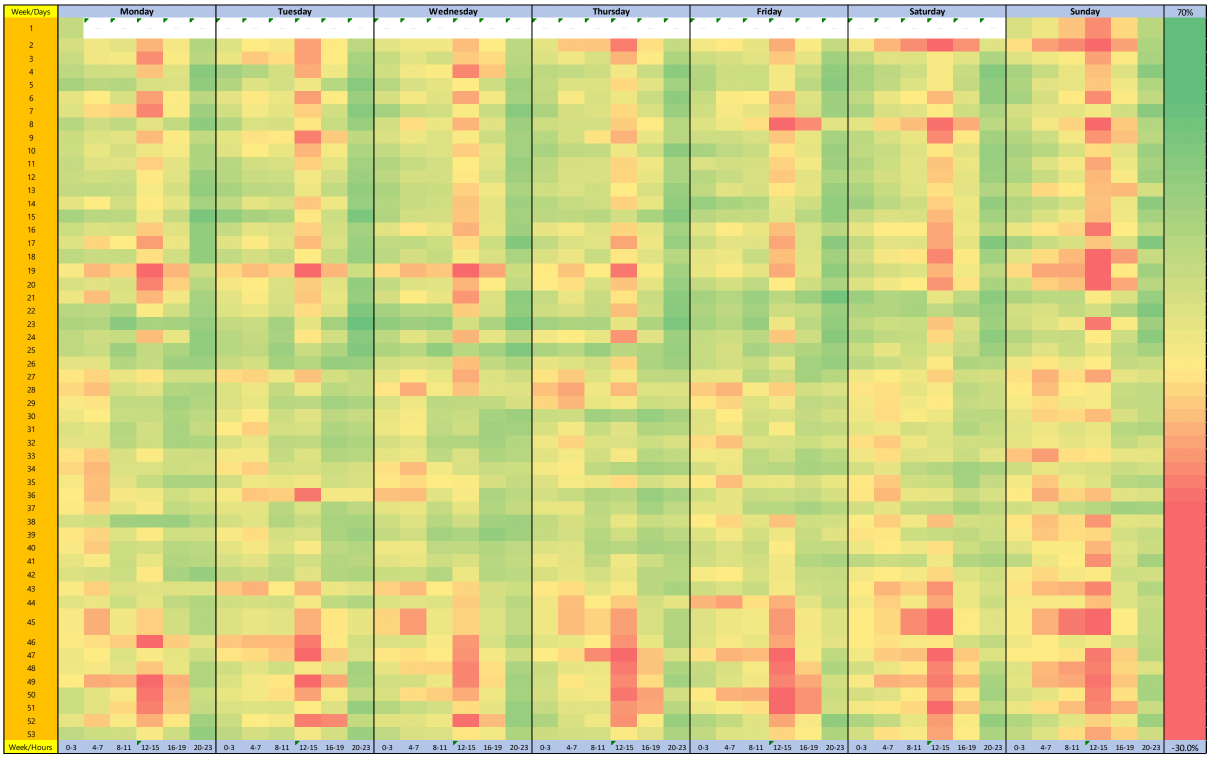
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Interconnected



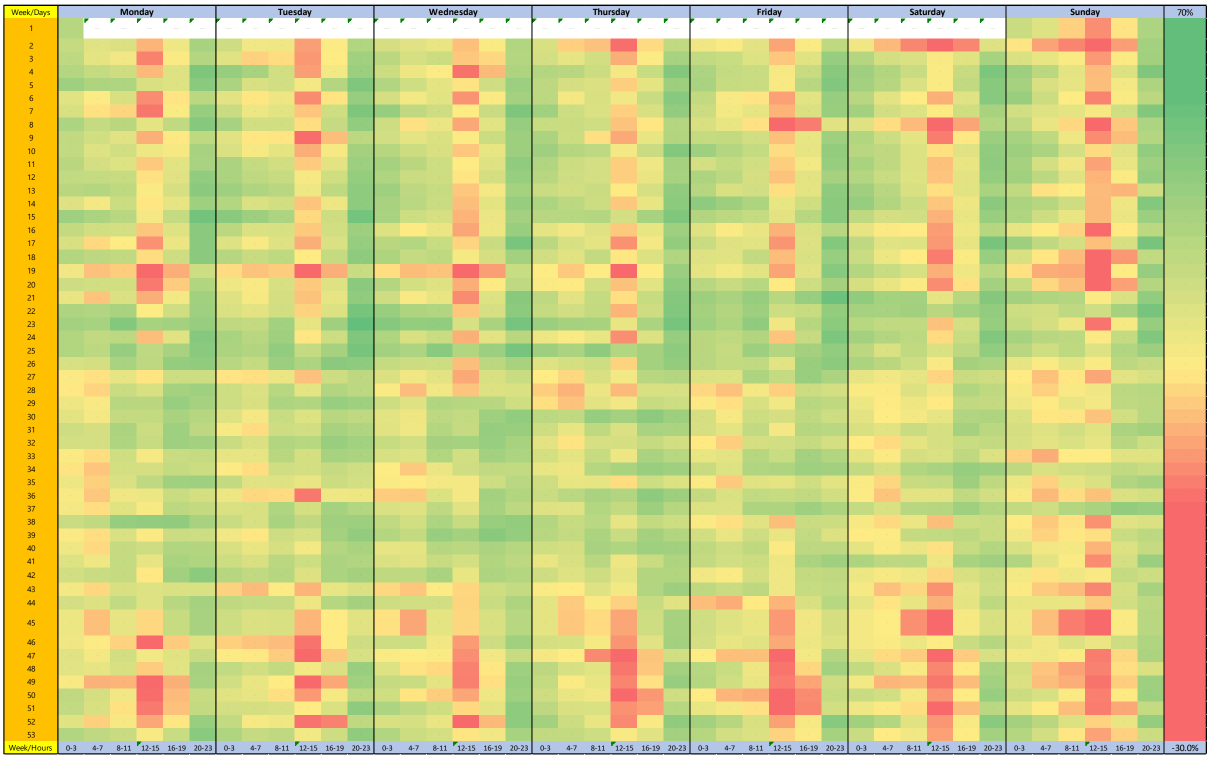
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Interconnected



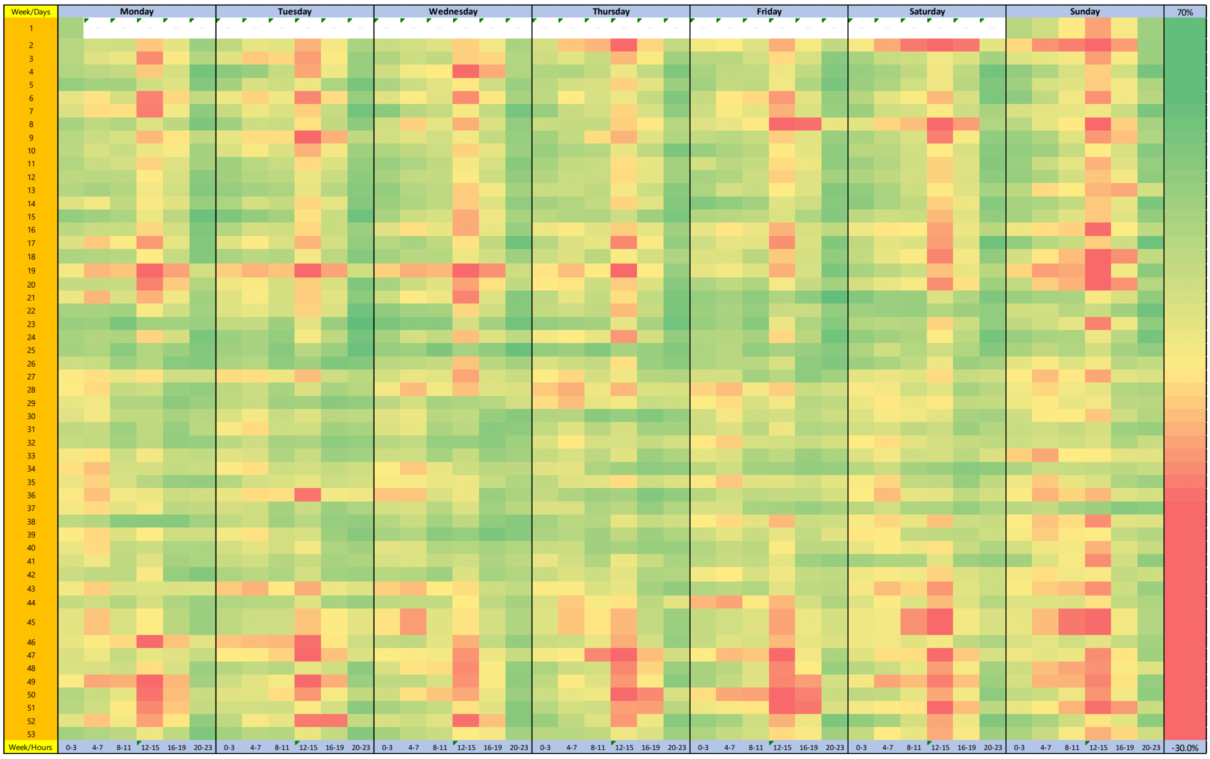
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Interconnected



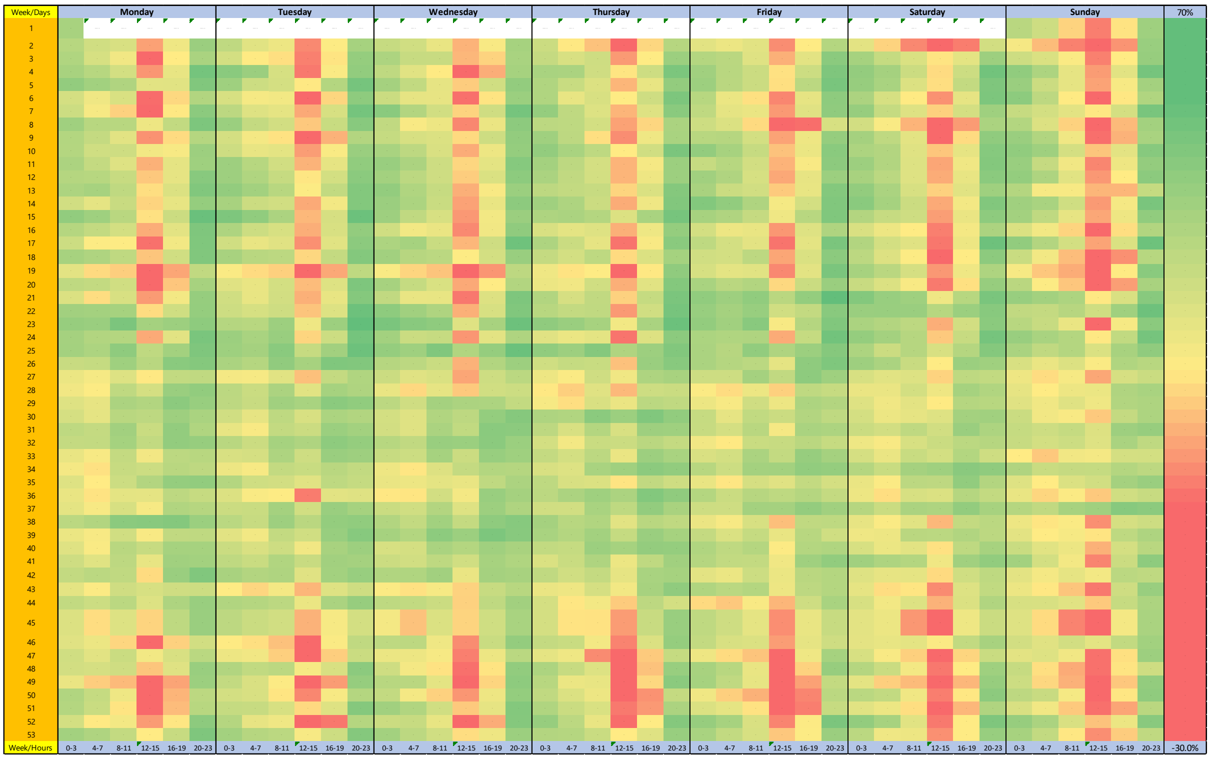
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Interconnected



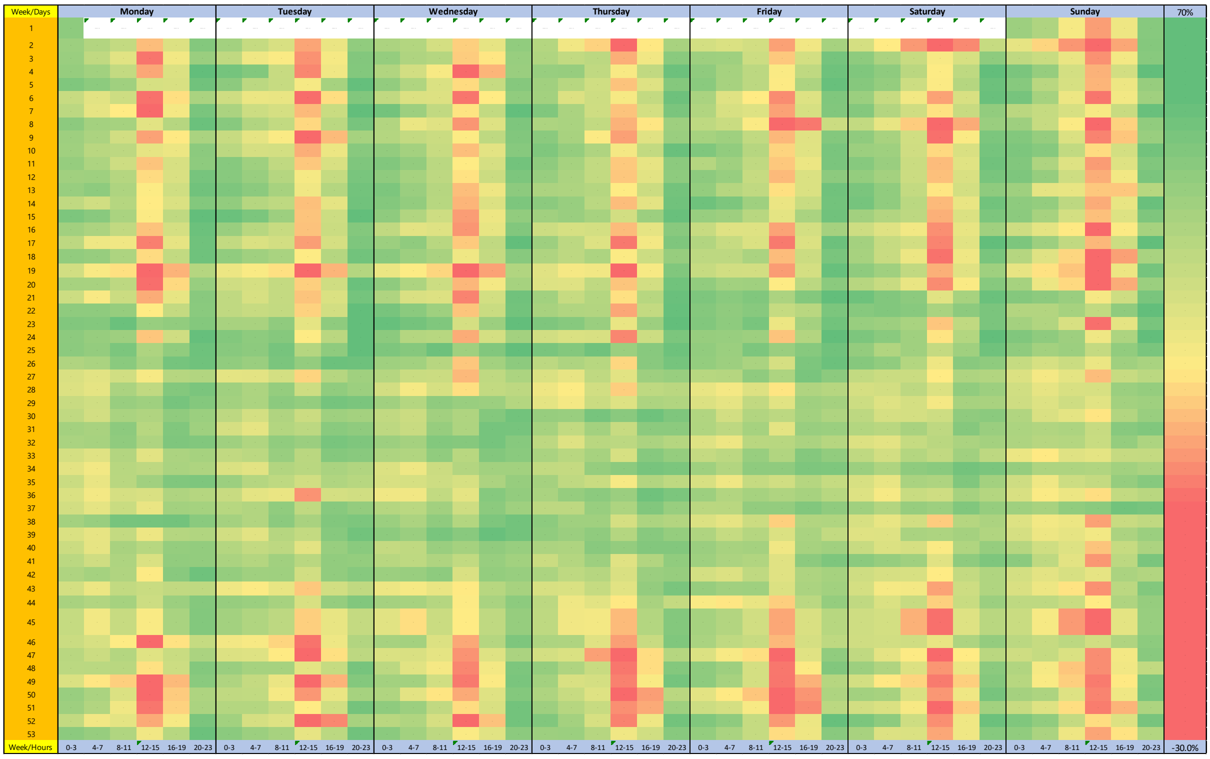
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Interconnected



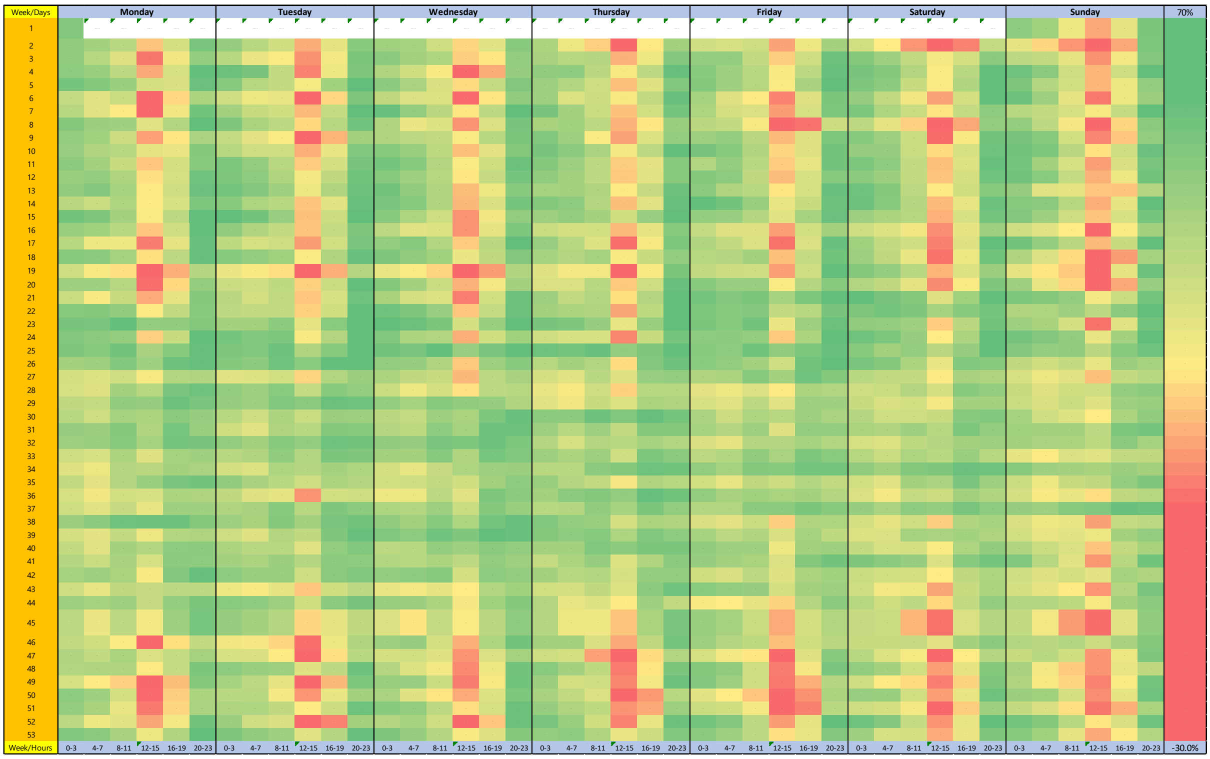
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Interconnected



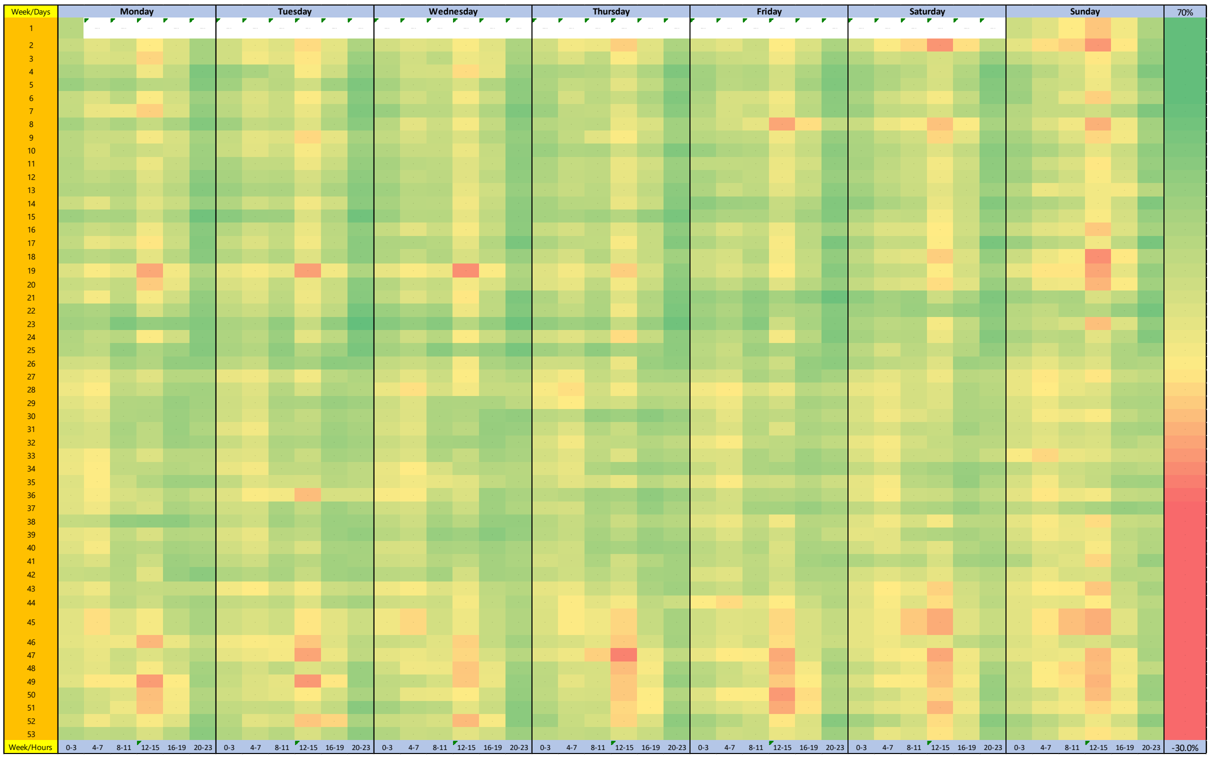
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Interconnected



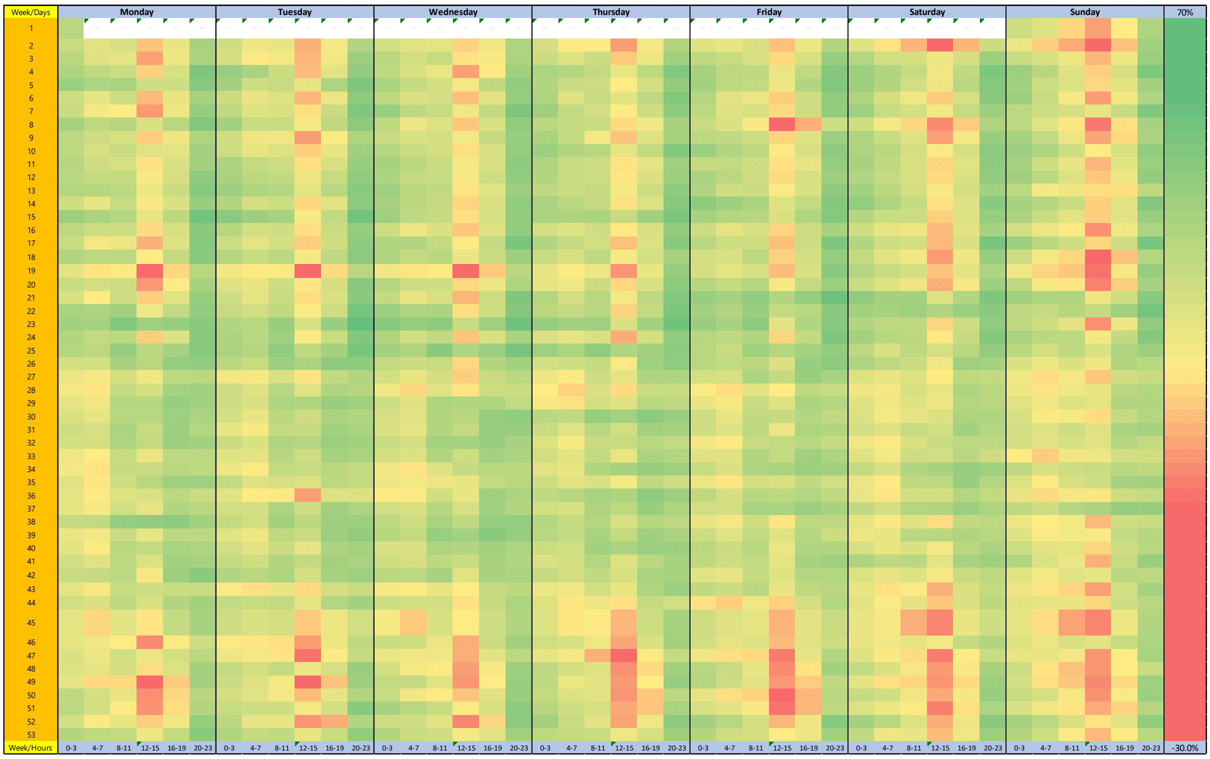
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Interconnected



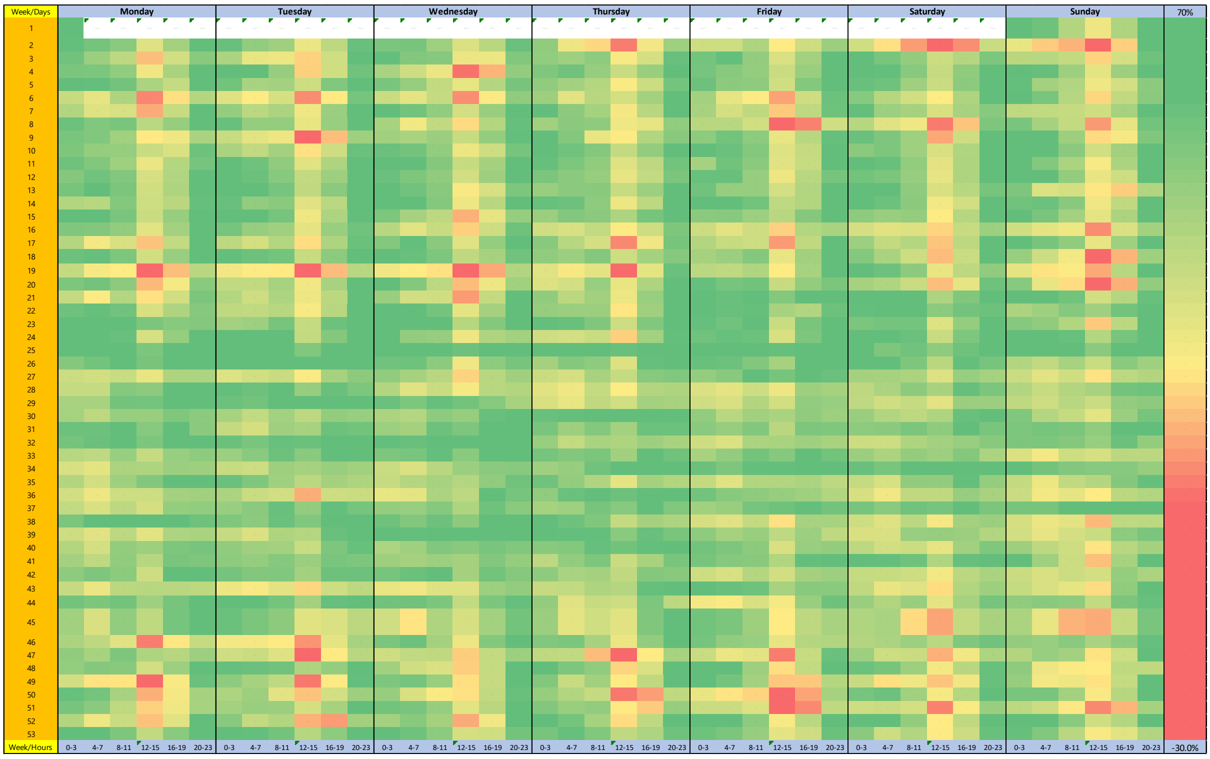
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Interconnected



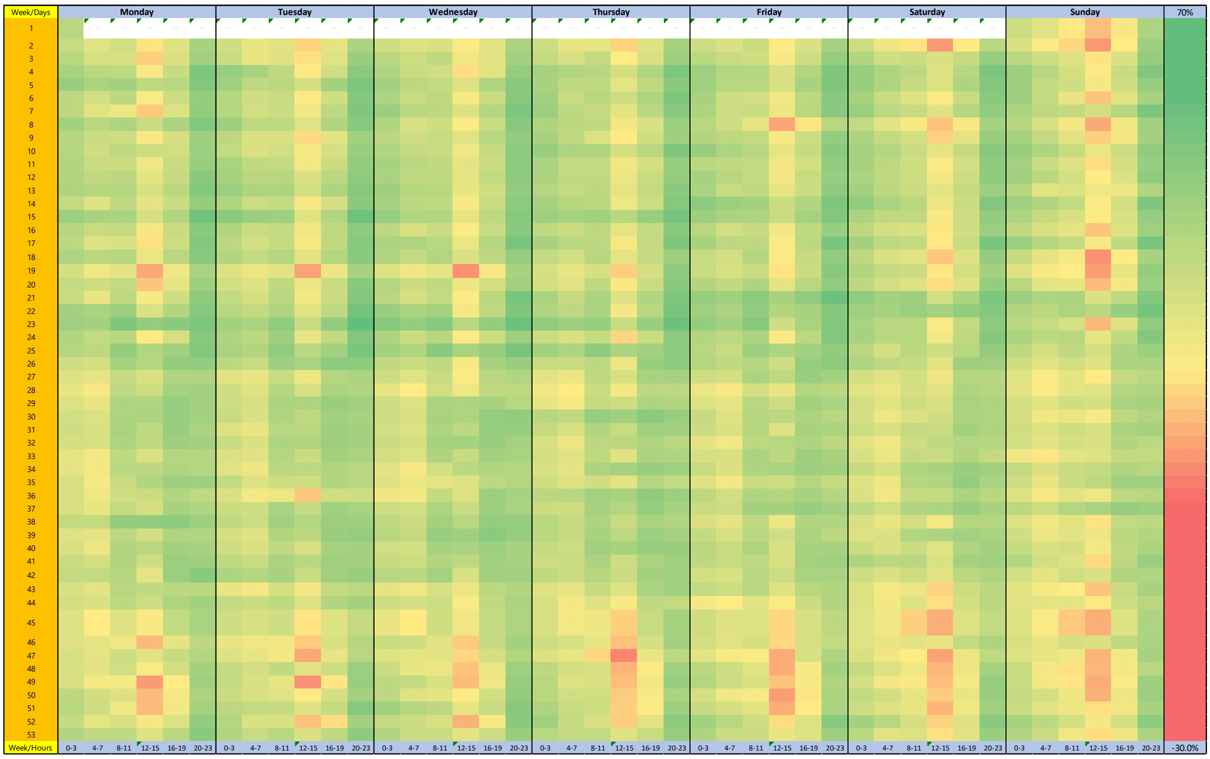
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Interconnected



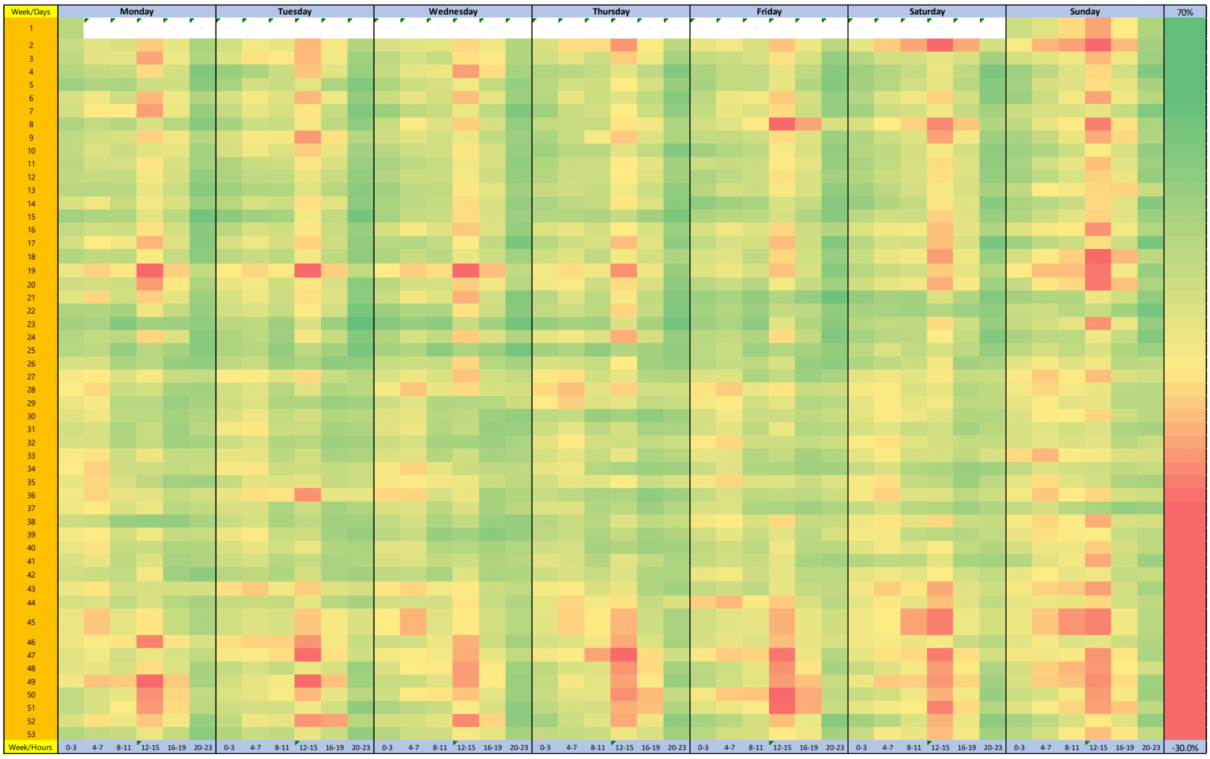
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Interconnected



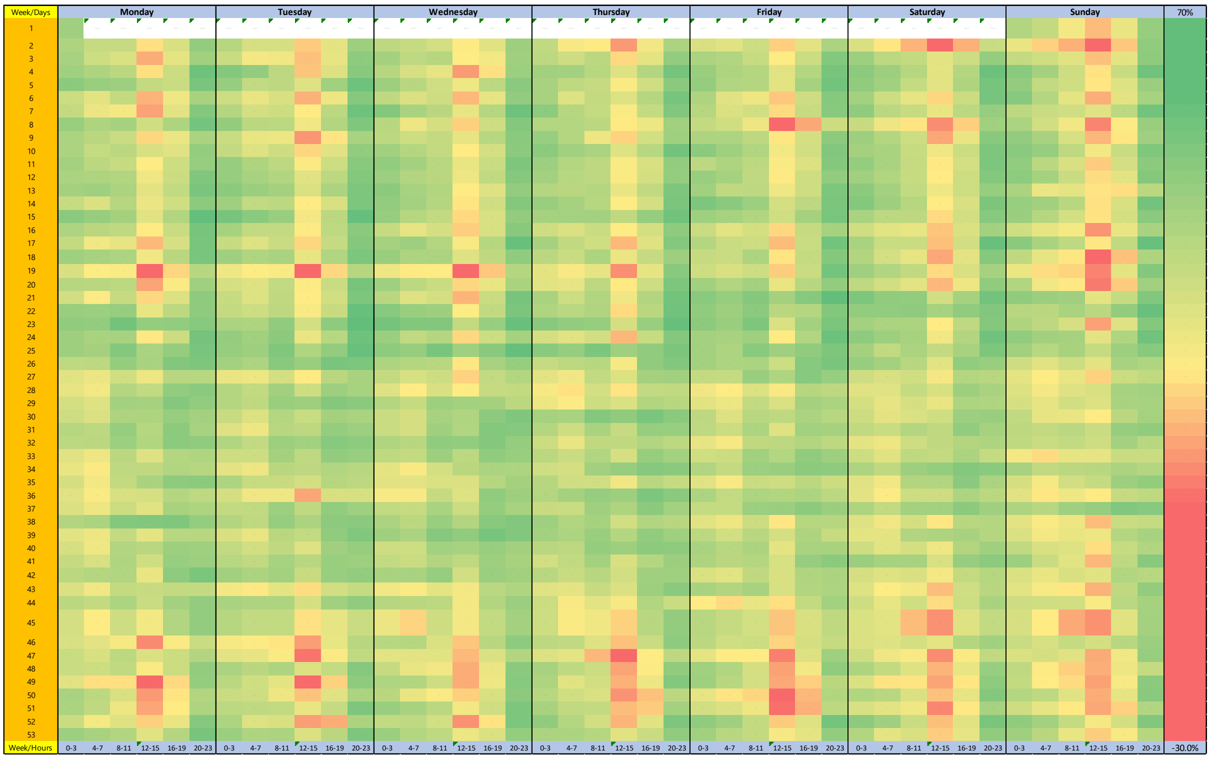
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Interconnected



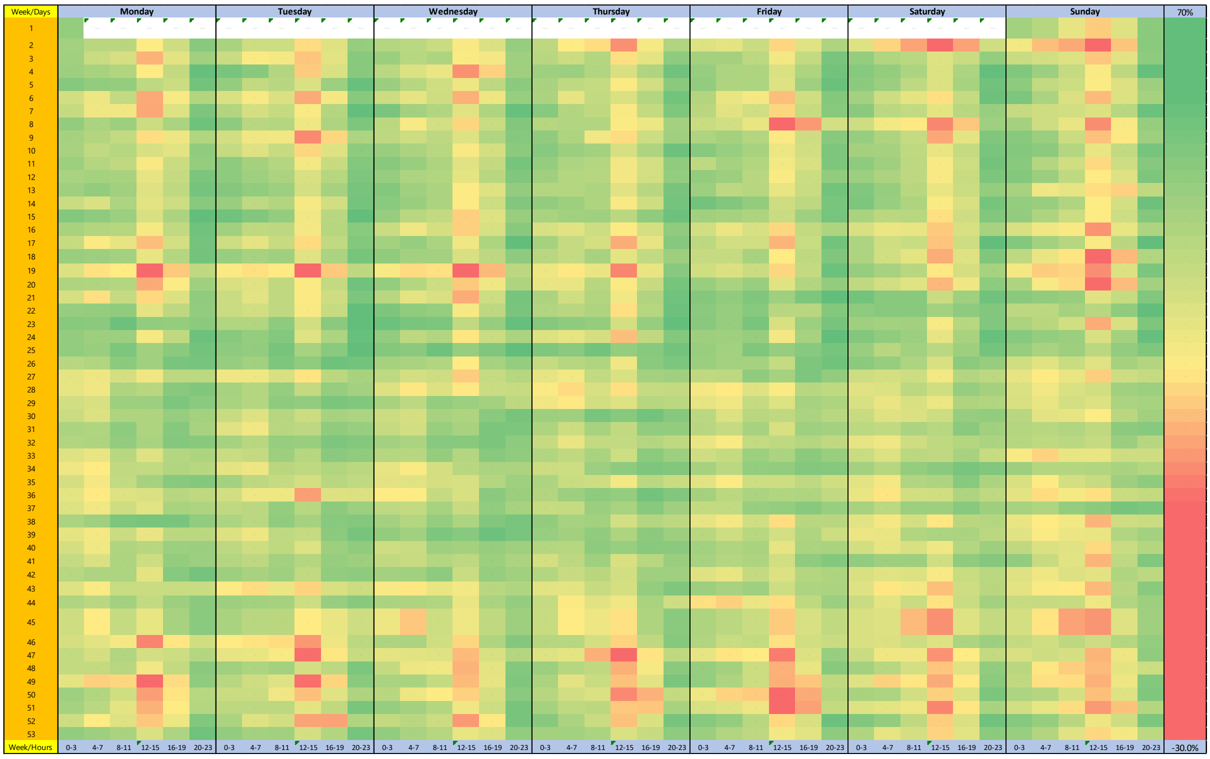
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Interconnected



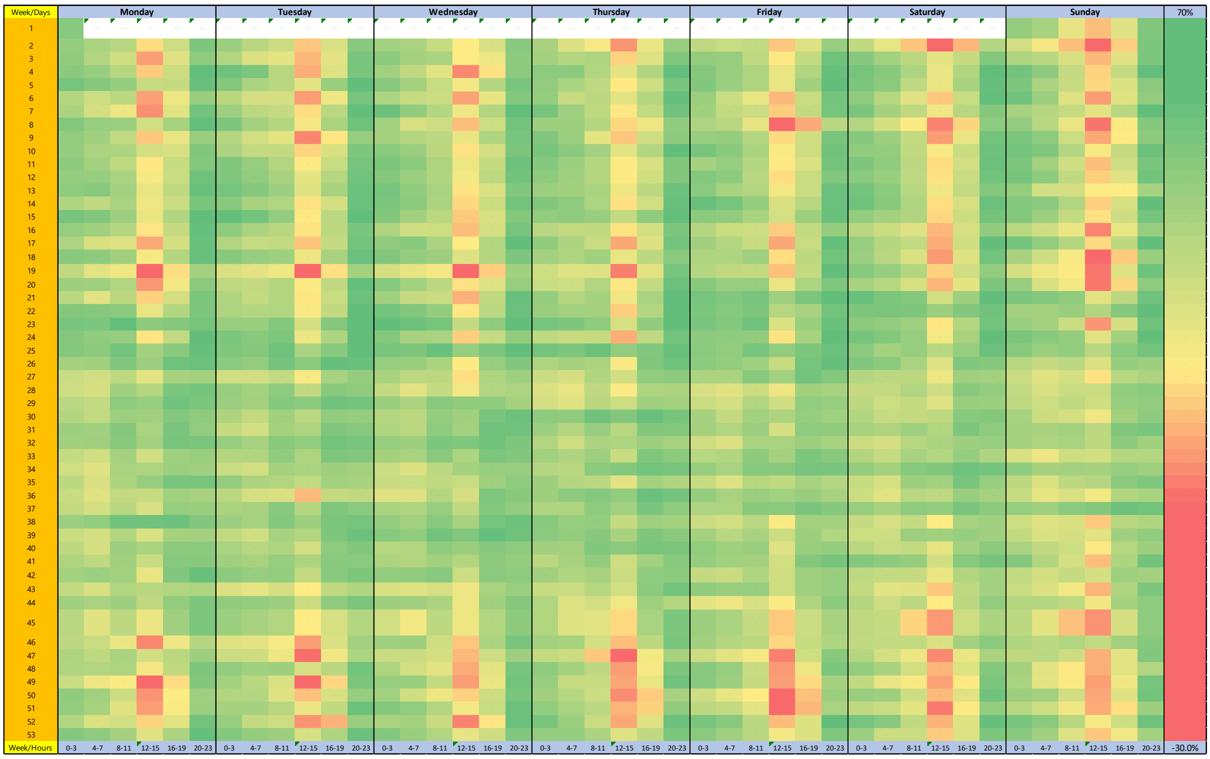
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Interconnected



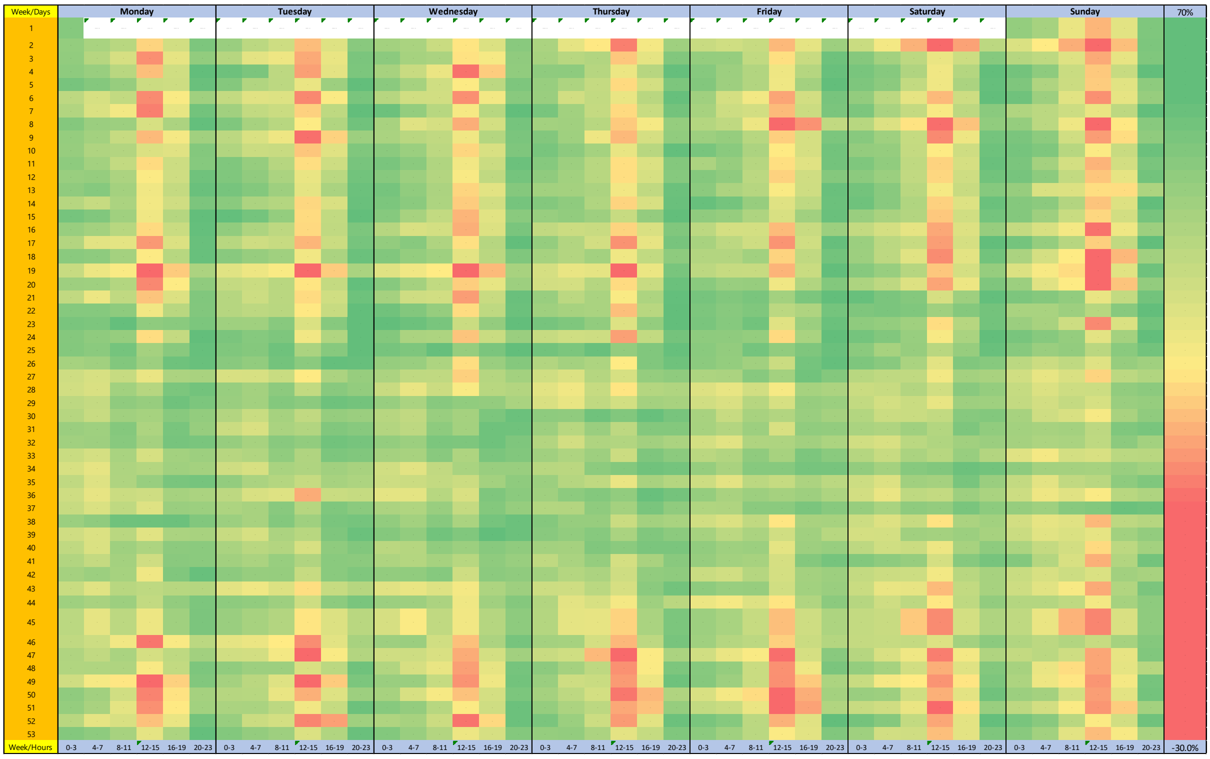
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Interconnected



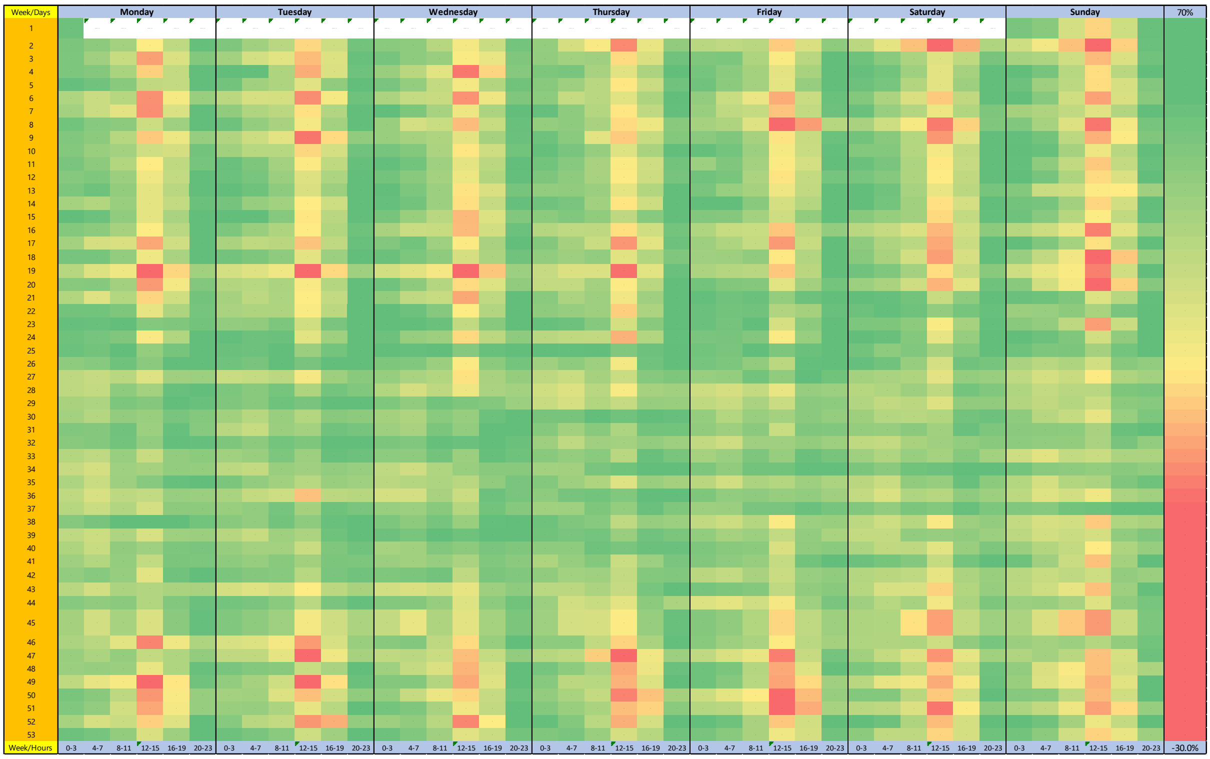
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Interconnected



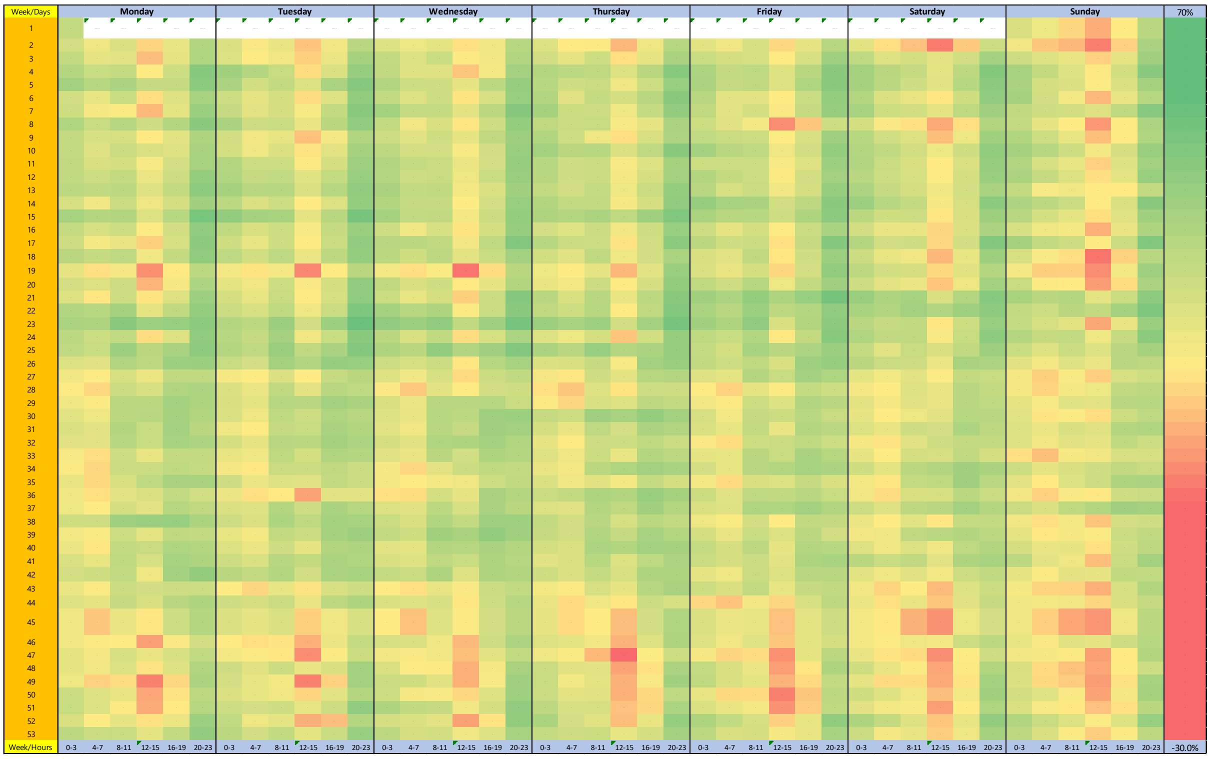
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Interconnected



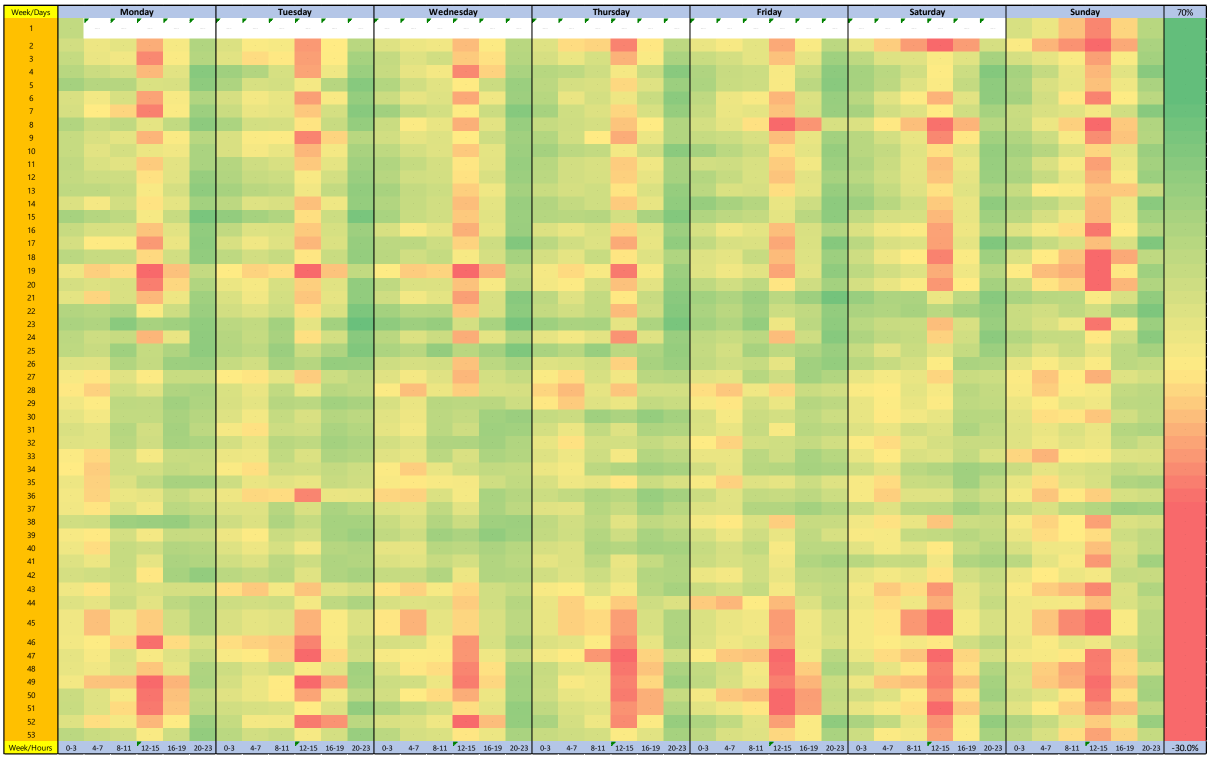
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Interconnected



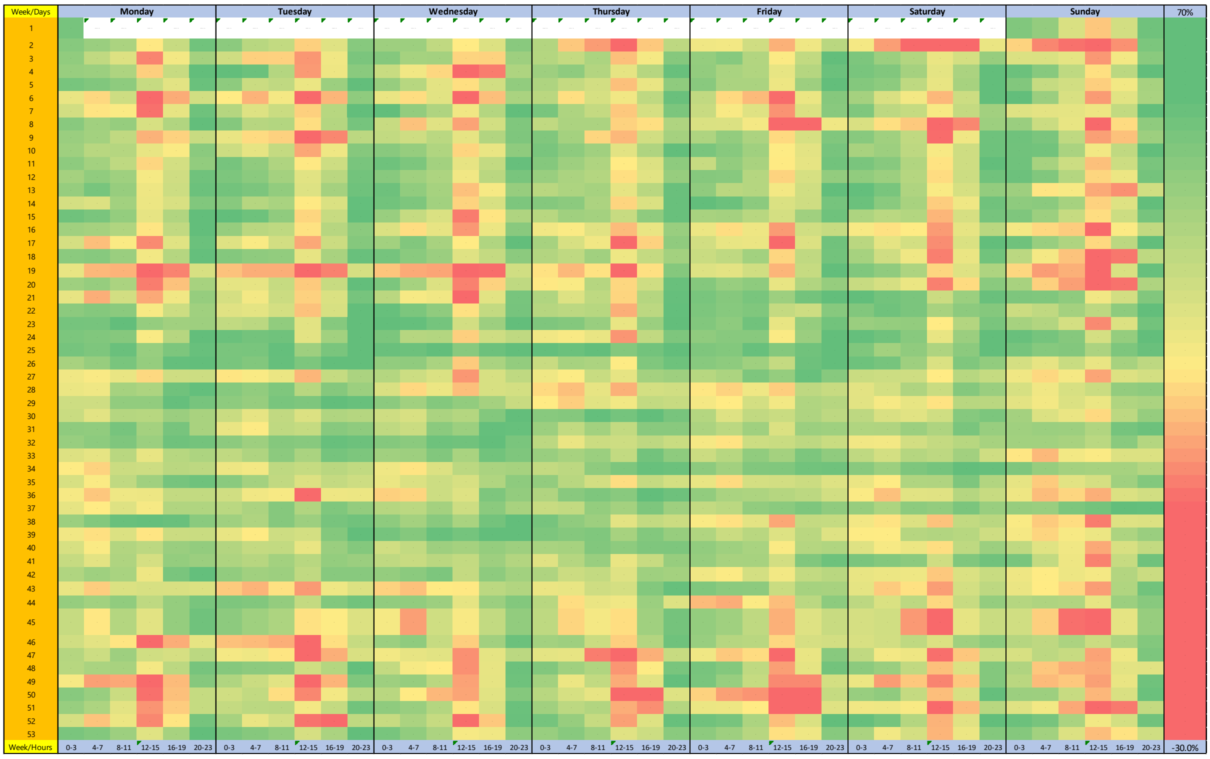
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,500 SPP=7,500 Isolated



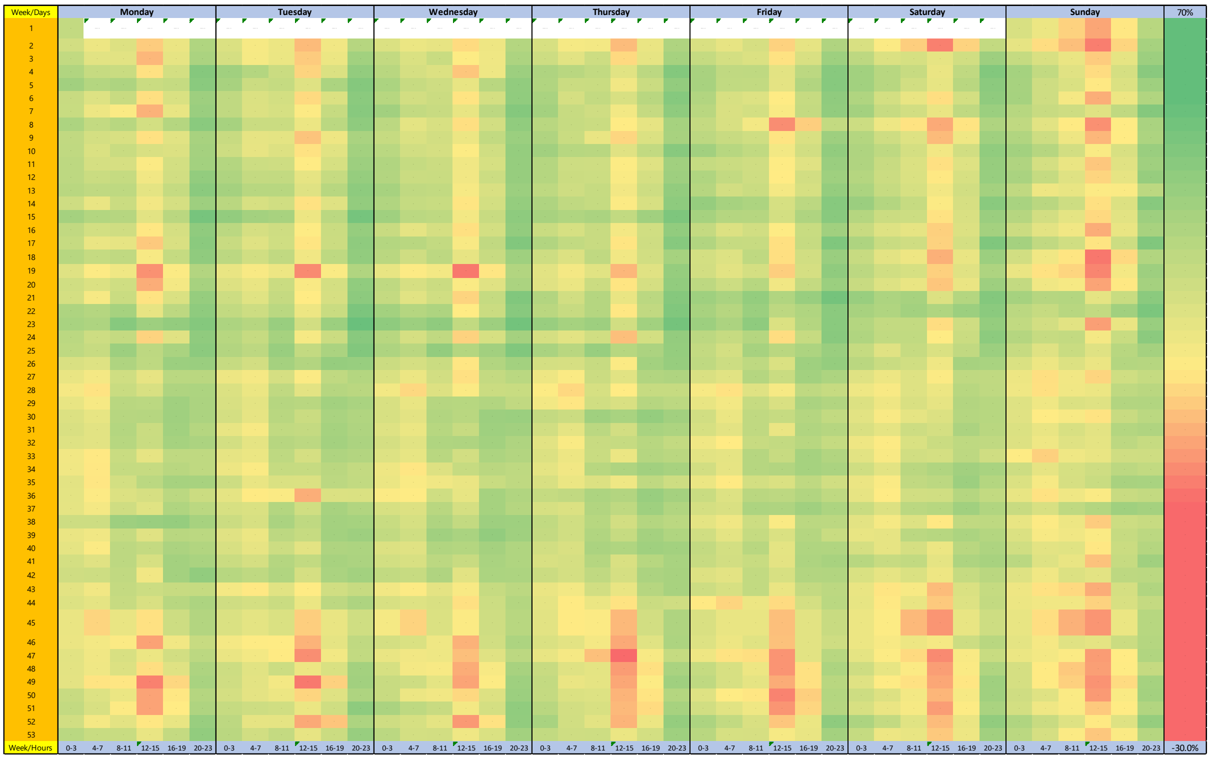
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,000 SPP=9,500 Isolated



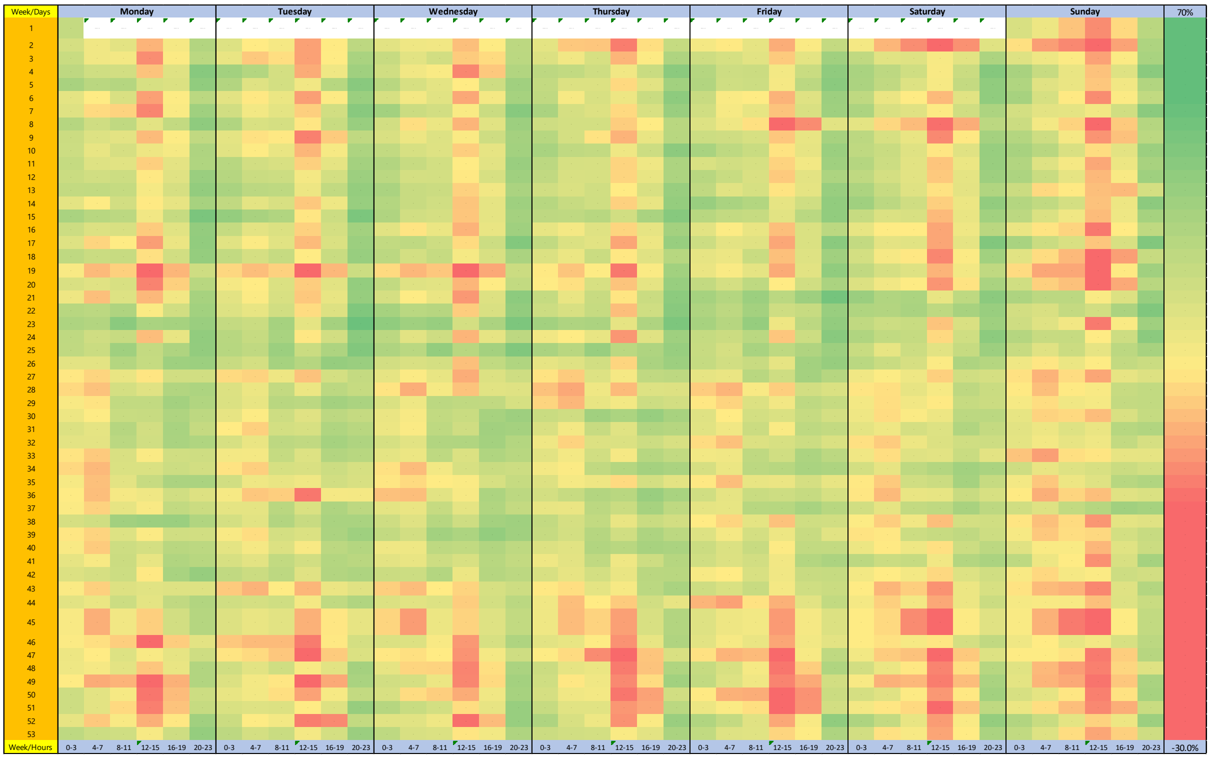
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=7,500 SPP=12,000 Isolated



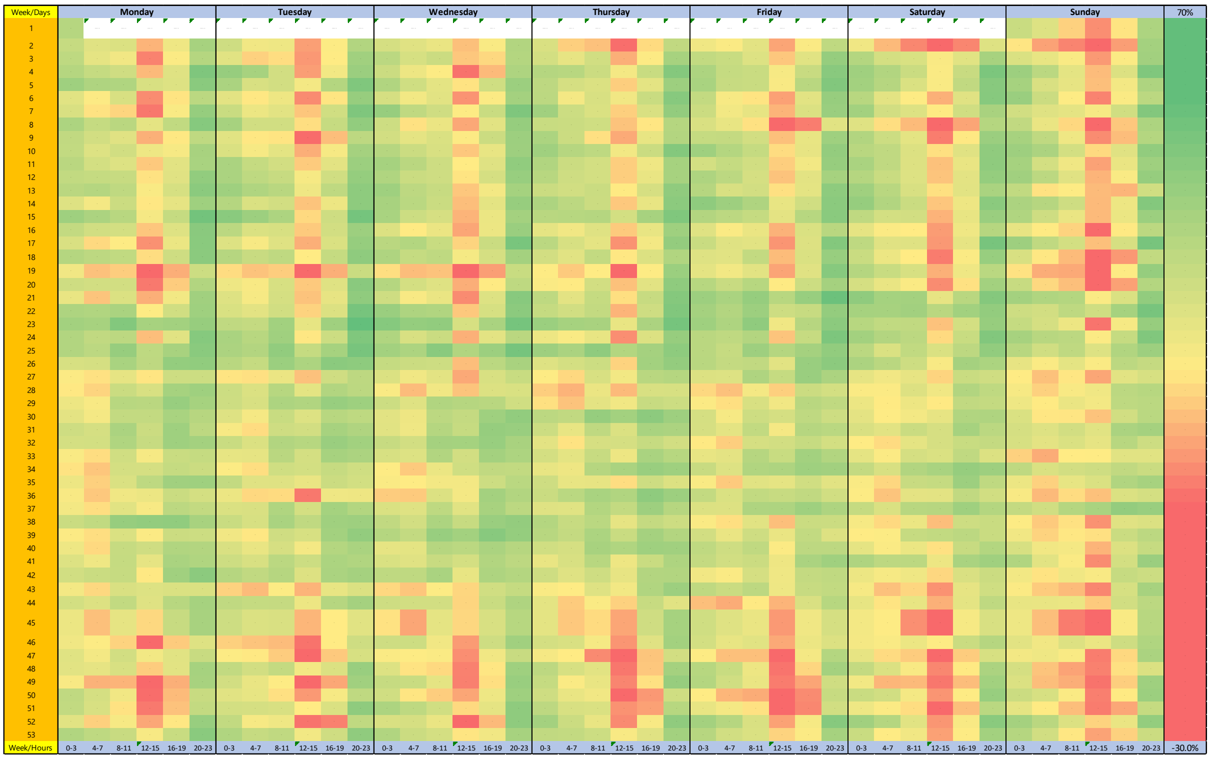
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=2,000 SPP=8,000 Isolated



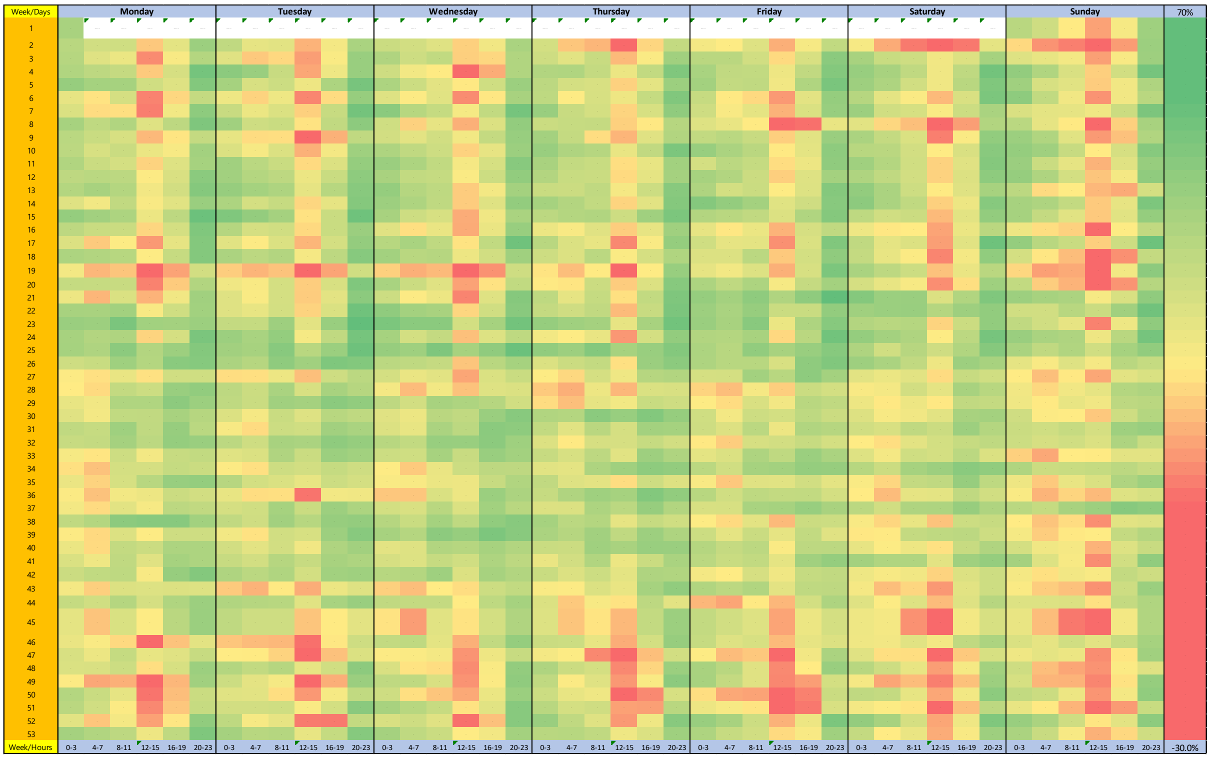
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=3,500 SPP=9,000 Isolated



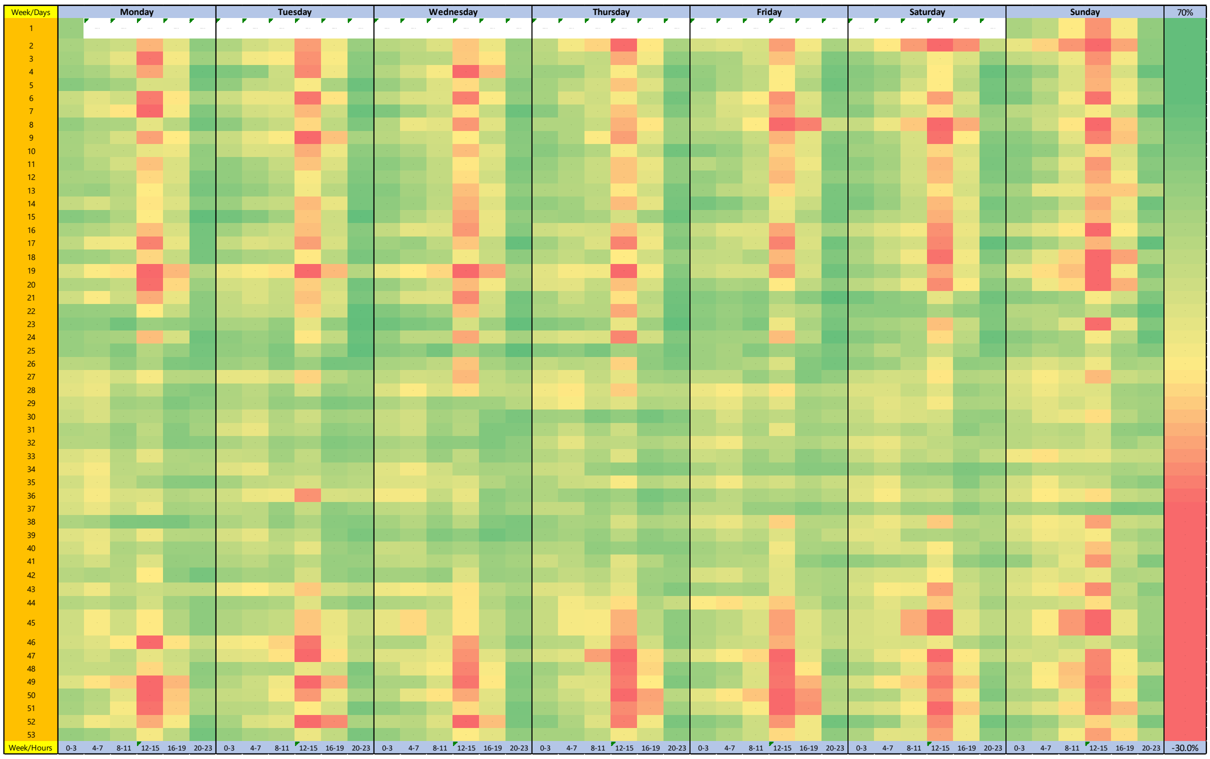
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=10,000 Isolated



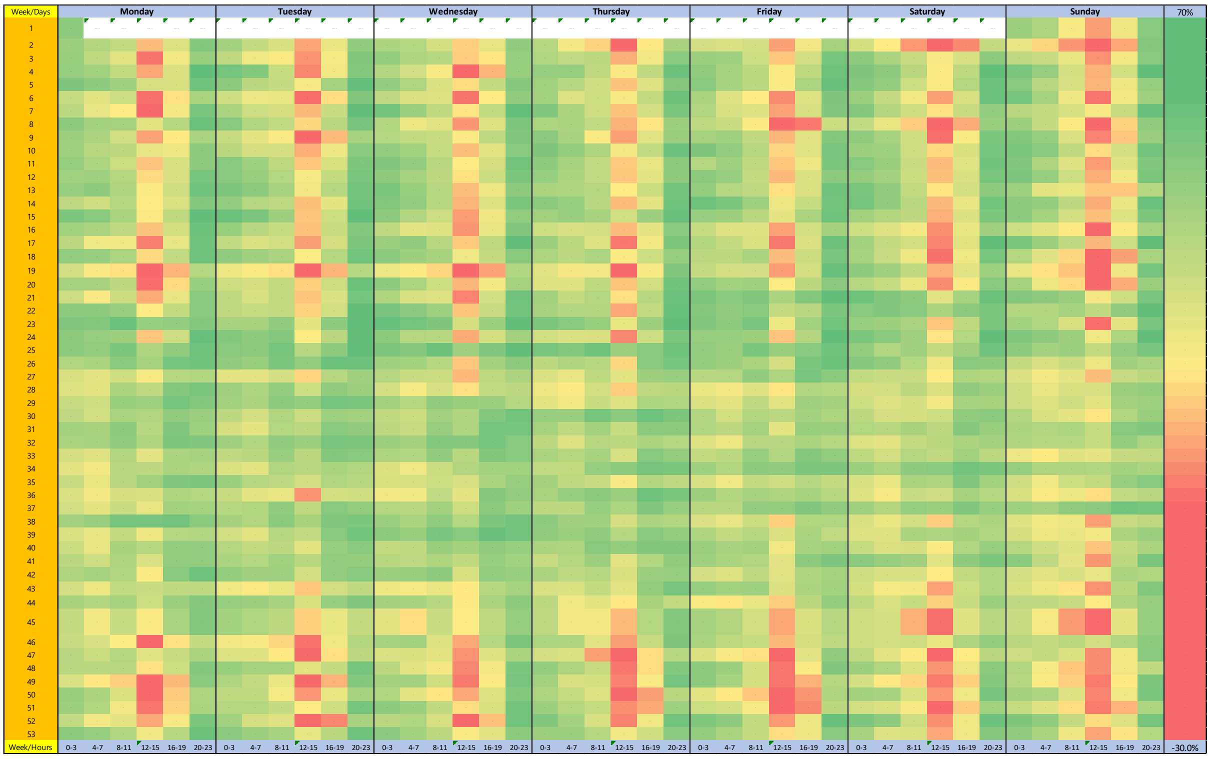
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=10,000 Isolated



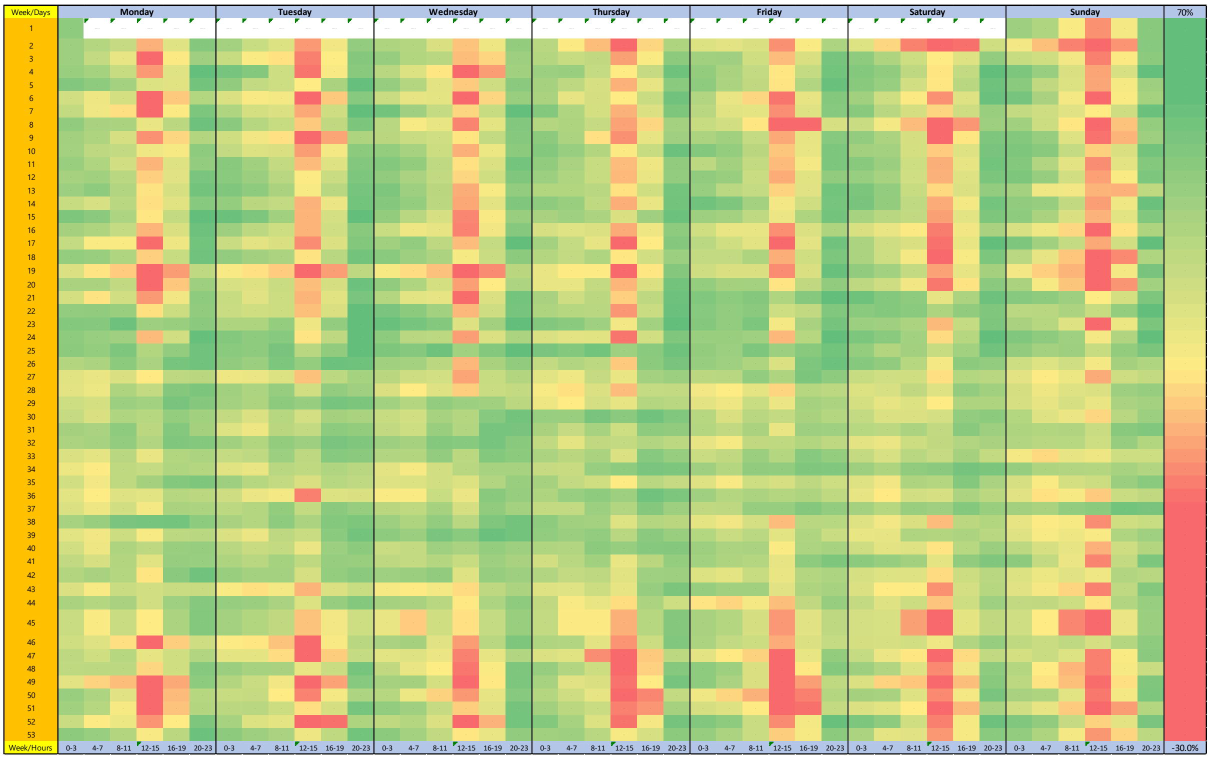
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,000 SPP=12,000 Isolated



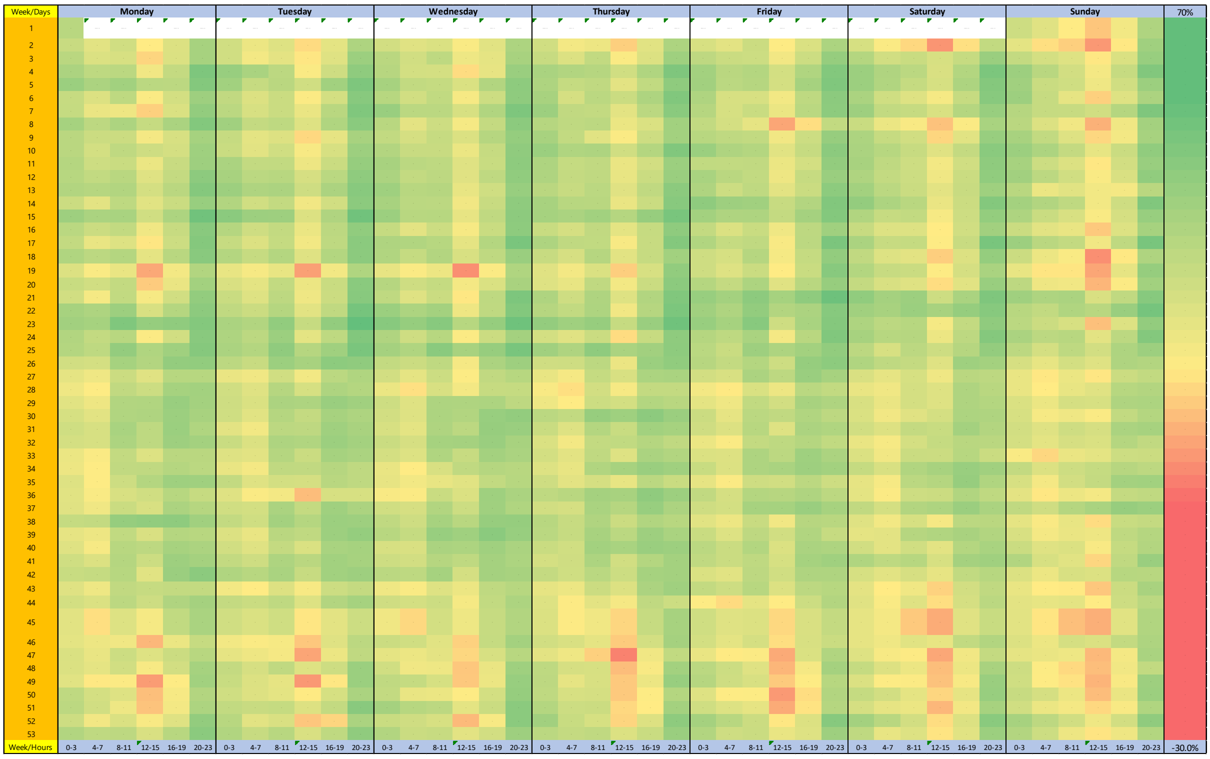
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=4,500 SPP=12,500 Isolated



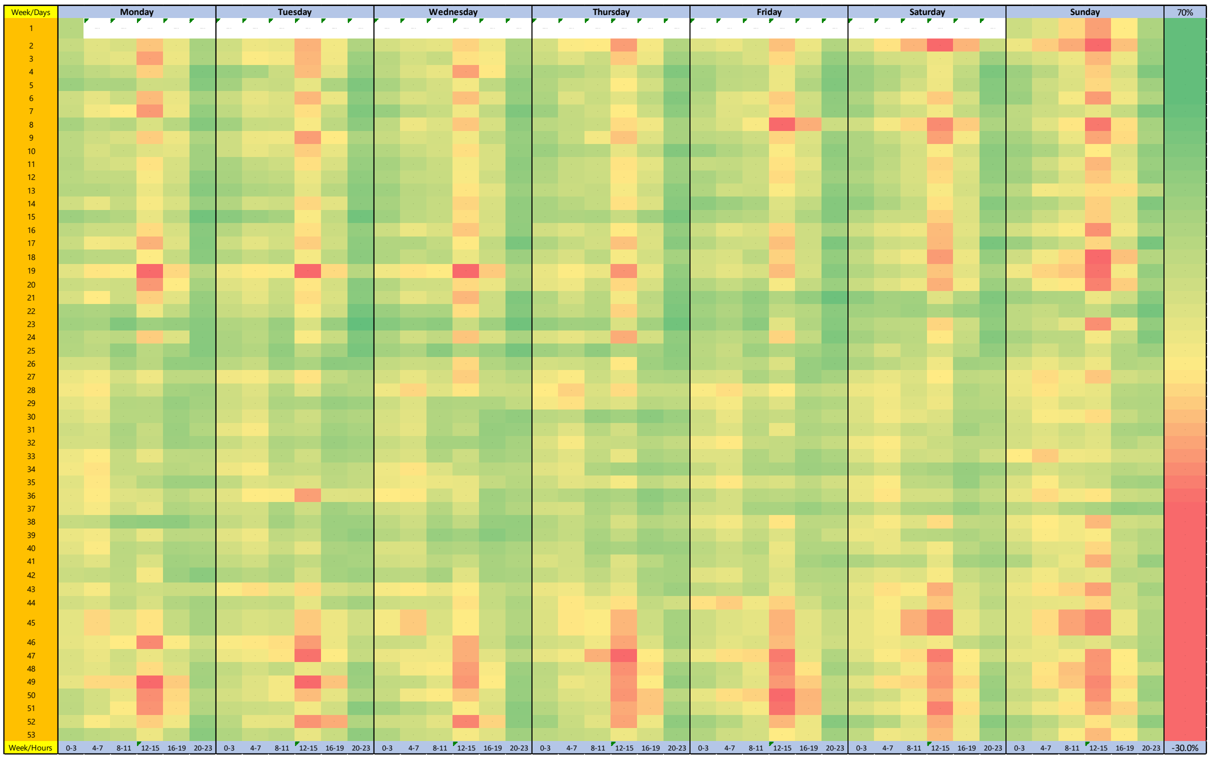
Scenario: Year 2025, Annual Load Growth 0.5%, WPP=5,000 SPP=13,000 Isolated



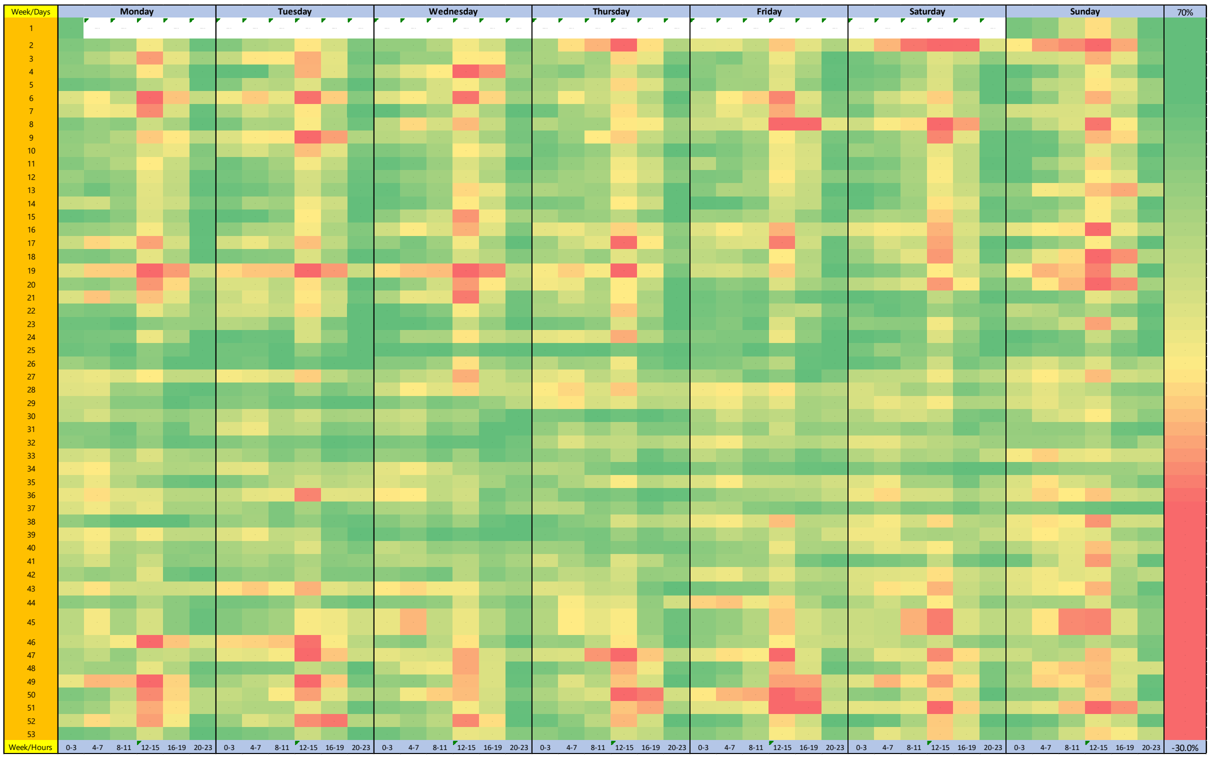
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,500 SPP=7,500 Isolated



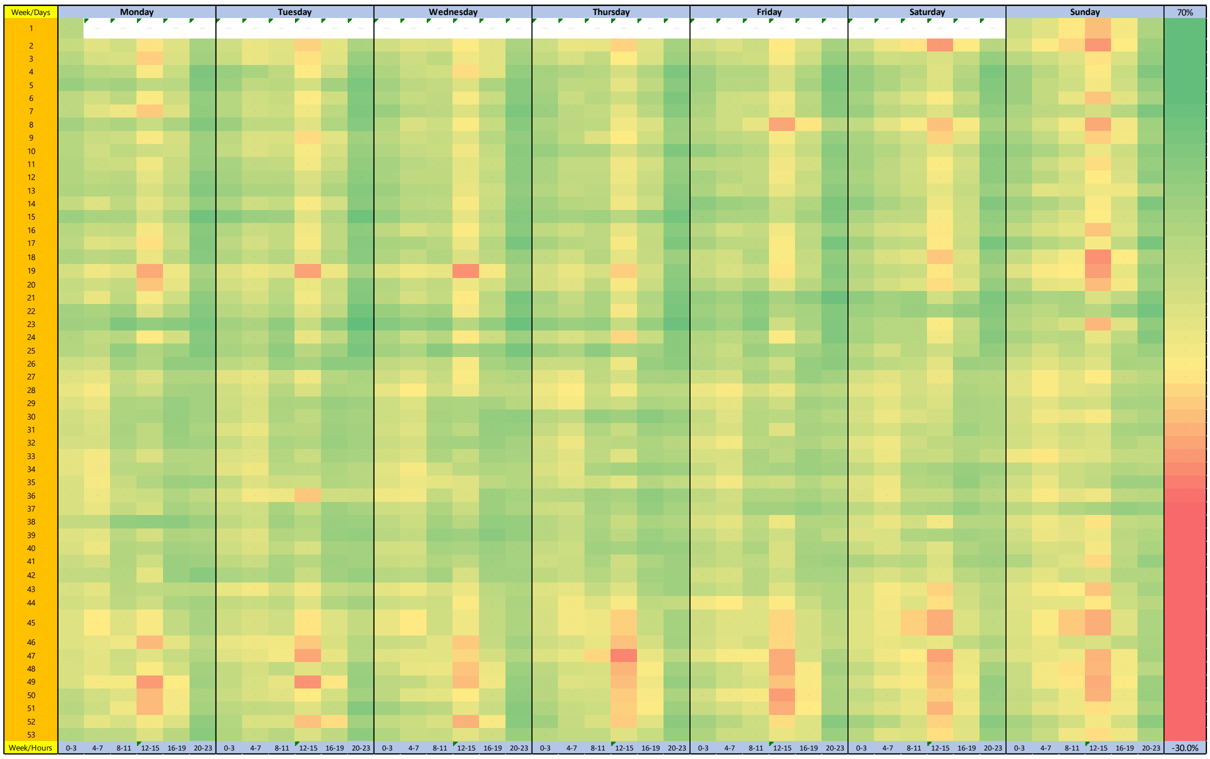
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,000 SPP=9,500 Isolated



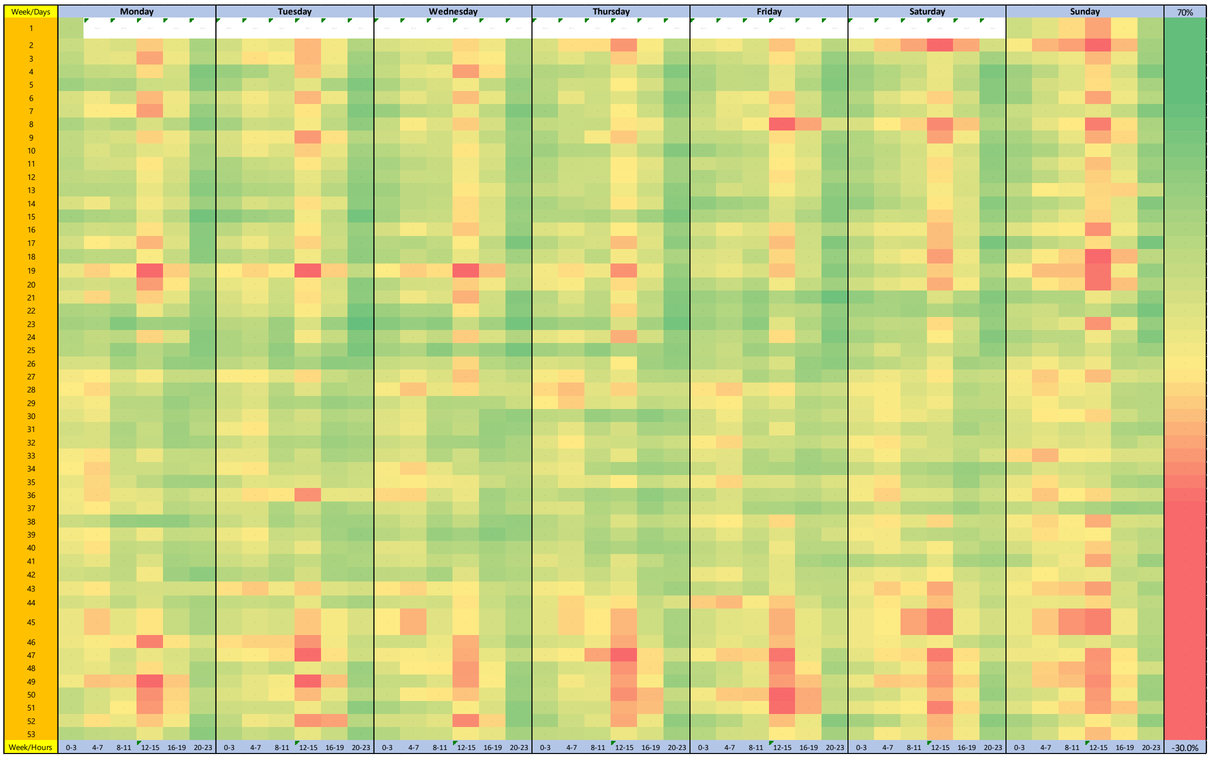
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=7,500 SPP=12,000 Isolated



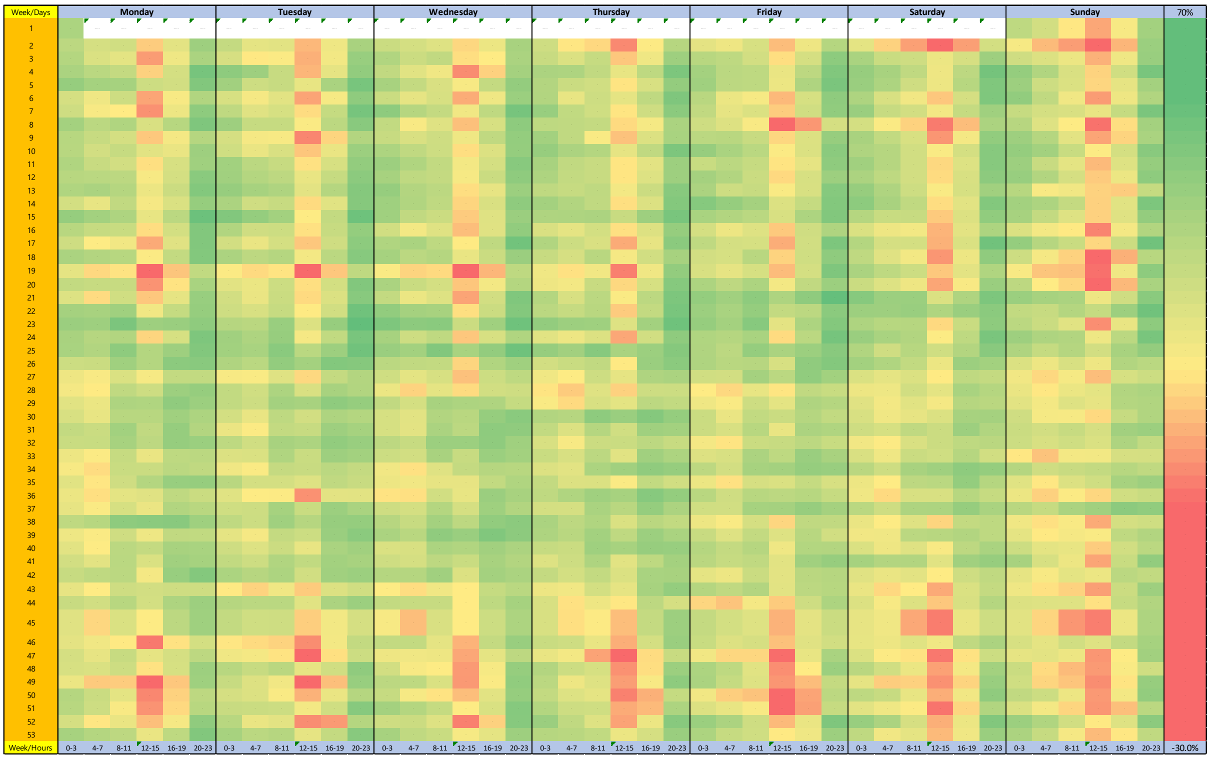
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=2,000 SPP=8,000 Isolated



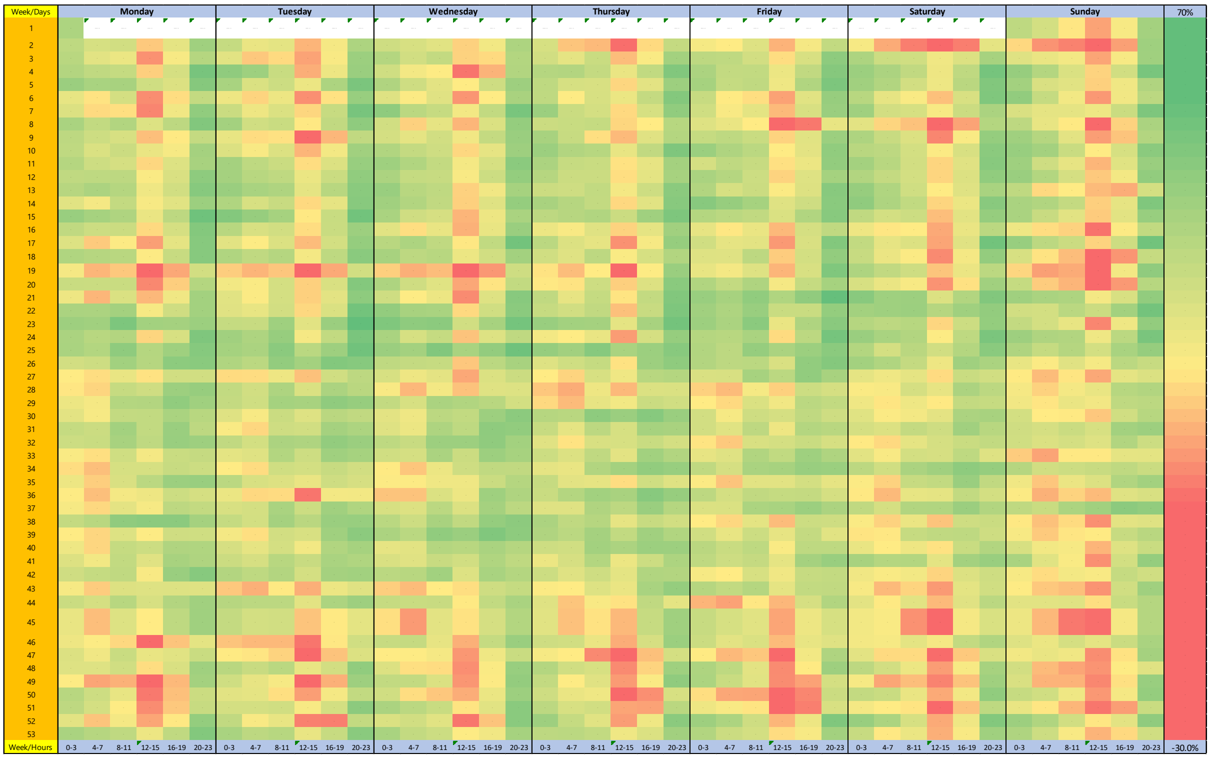
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=3,500 SPP=9,000 Isolated



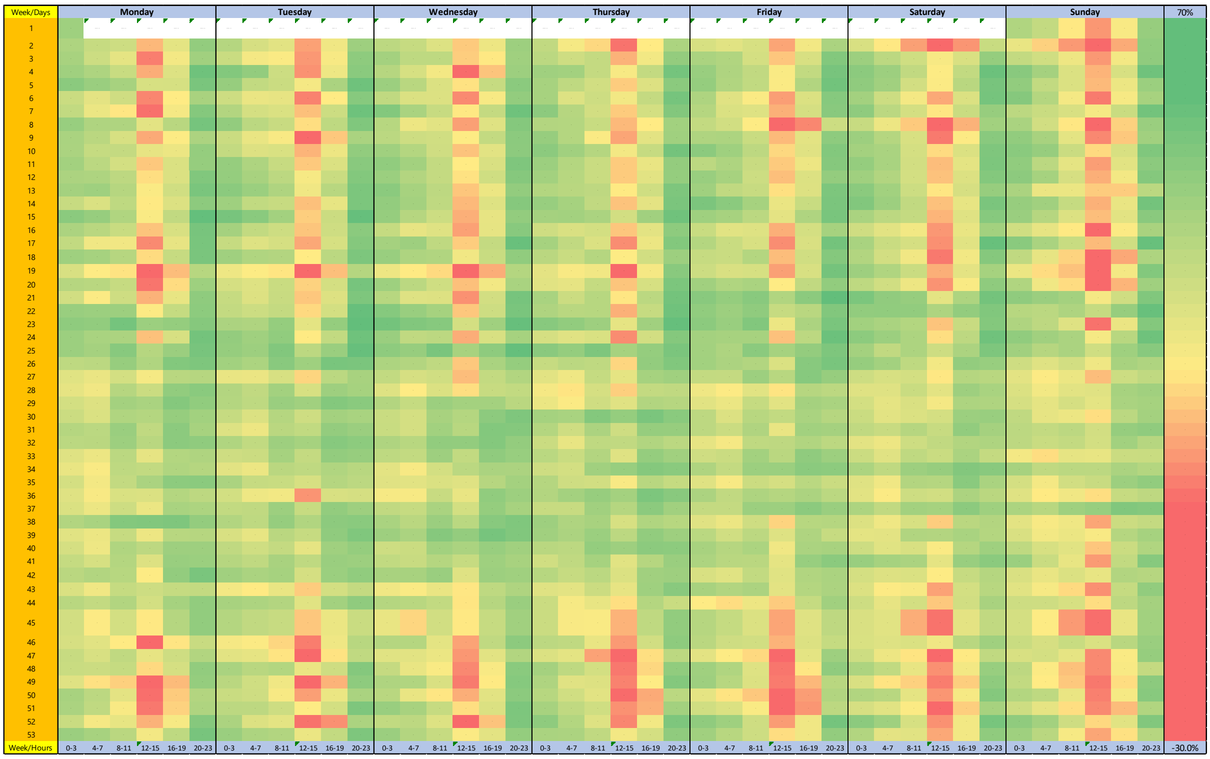
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=10,000 Isolated



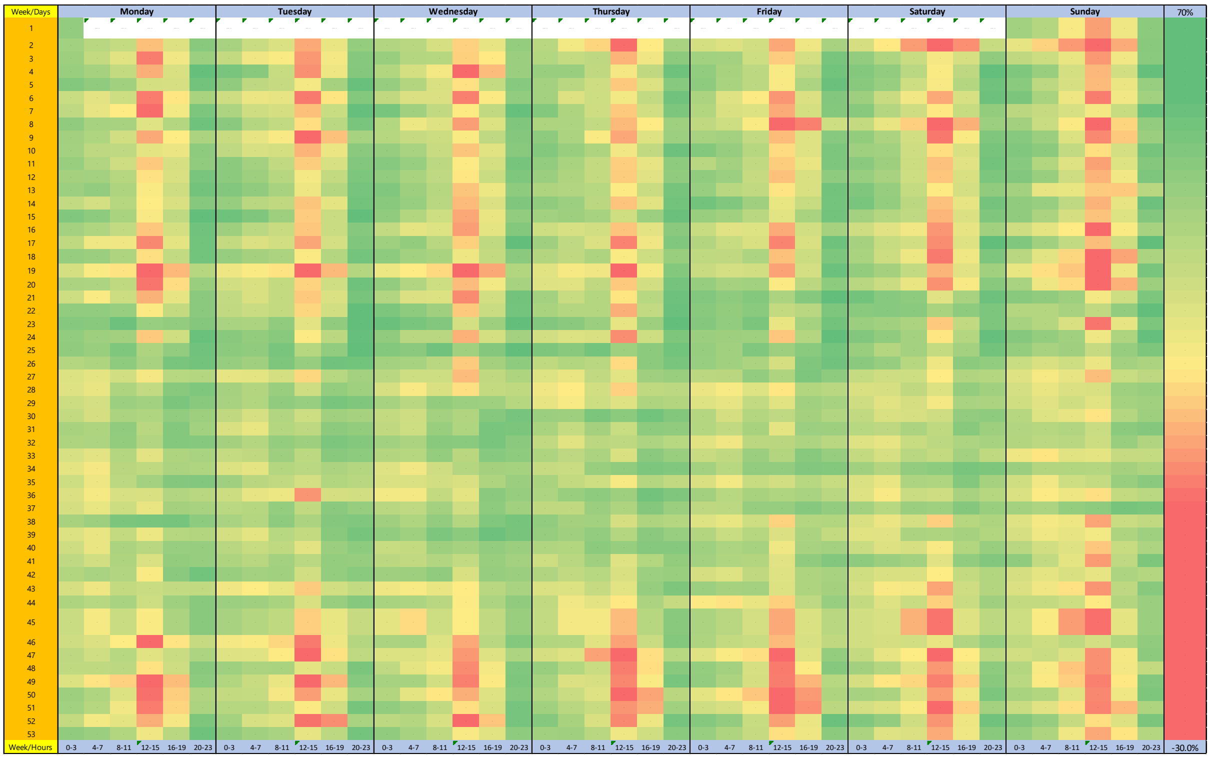
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=10,000 Isolated



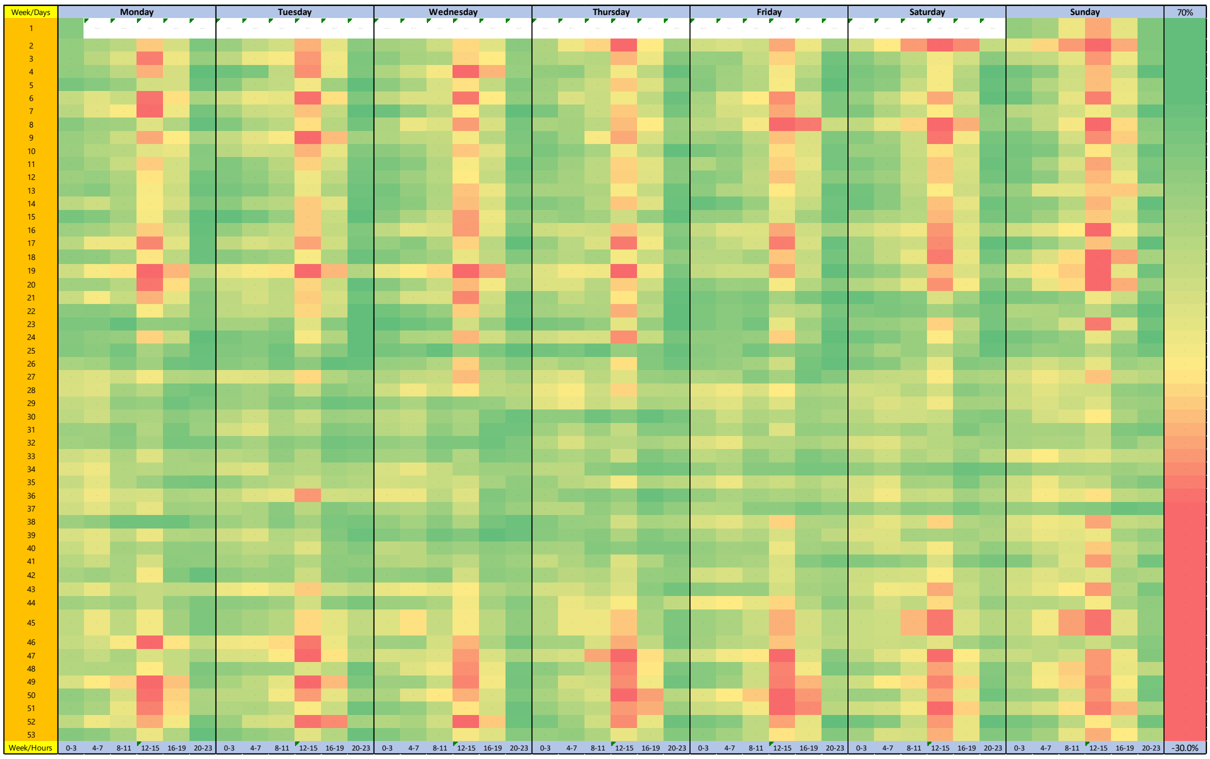
Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,000 SPP=12,000 Isolated



Scenario: Year 2025, Annual Load Growth 1.2%, WPP=4,500 SPP=12,500 Isolated

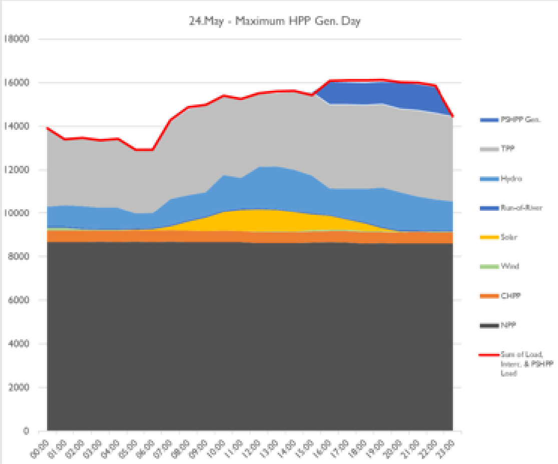


Scenario: Year 2025, Annual Load Growth 1.2%, WPP=5,000 SPP=13,000 Isolated



7.5. DAILY PROFILES - AS-IS AND SELECTED SCENARIOS FOR 2021 AND 2025

Day with Max HPP, May 24th: As-Is



24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8677	521	130	0	60	928	3566	0	13921
01:00	8673	525	135	0	55	1007	3064	0	13412
02:00	8662	524	84	0	52	1009	3157	0	13466
03:00	8682	518	34	0	54	983	3149	0	13374
04:00	8669	527	34	0	54	981	3168	0	13437
05:00	8680	529	18	21	54	694	2960	0	12922
06:00	8666	524	9	69	55	689	2981	0	12925
07:00	8691	525	13	167	56	1222	3556	0	14284
08:00	8670	528	5	416	58	1165	3969	0	14880
09:00	8658	522	1	617	59	1128	3993	0	14991
10:00	8667	525	3	869	60	1644	3628	0	15401
11:00	8664	512	7	986	60	1417	3551	0	15266
12:00	8631	506	23	1033	60	1900	3361	0	15516
13:00	8624	509	36	985	60	1950	3357	0	15606
14:00	8620	508	26	895	60	1893	3591	0	15637
15:00	8654	508	64	728	60	1732	3840	0	15424
16:00	8659	514	70	630	60	1223	3855	1040	16091
17:00	8652	513	81	449	60	1381	3858	1037	16123
18:00	8610	513	56	347	60	1556	3834	1037	16107
19:00	8621	513	37	132	60	1834	3817	1043	16138
20:00	8600	514	22	16	60	1764	3823	1208	16034
21:00	8612	537	17	-5	59	1561	3951	1208	16008
22:00	8593	524	32	-3	60	1450	3943	1208	15880
23:00	8605	519	34	0	60	1345	3883	0	14470

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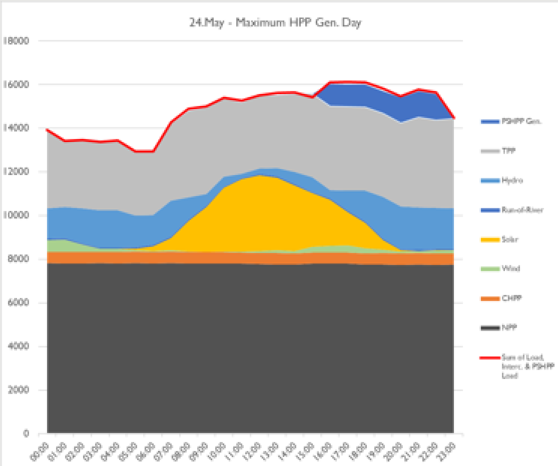
Figure 3: Day with Max HPP, May 24th: As-Is

May 24th: Scenario: 2021, 0,0% Yearly Growth, Intercon, 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

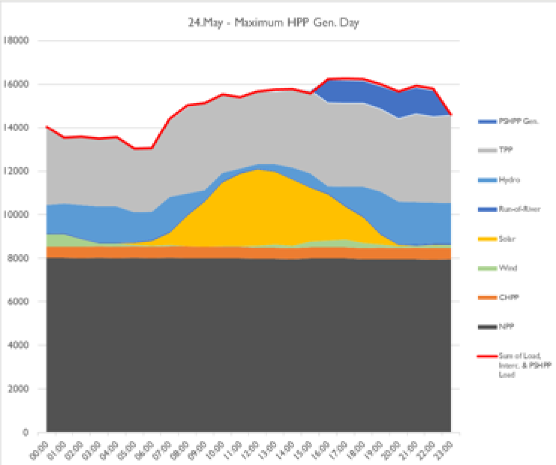


24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7809	521	551	0	60	1375	3566	0	13921
01:00	7806	525	569	0	55	1440	3064	0	13412
02:00	7796	524	355	0	52	1605	3157	0	13466
03:00	7814	518	142	0	54	1710	3182	0	13374
04:00	7802	527	145	0	54	1709	3196	0	13437
05:00	7812	529	75	71	54	1455	2960	0	12922
06:00	7799	524	38	233	55	1363	2981	0	12925
07:00	7822	525	56	563	56	1653	3556	0	14284
08:00	7803	528	21	1402	58	1030	3969	0	14880
09:00	7792	522	4	2080	59	528	3993	0	14991
10:00	7800	525	12	2929	60	442	3628	0	15401
11:00	7798	512	30	3323	60	190	3284	0	15266
12:00	7768	506	97	3482	60	240	3361	0	15516
13:00	7762	509	151	3320	60	362	3357	0	15606
14:00	7758	508	109	3017	60	550	3591	0	15637
15:00	7789	508	270	2454	60	665	3840	0	15424
16:00	7793	514	295	2123	60	370	3855	1040	16091
17:00	7787	513	341	1513	60	922	3858	1037	16123
18:00	7749	513	238	1170	60	1413	3834	1037	16107
19:00	7759	513	158	445	60	1929	3817	1043	15804
20:00	7740	514	95	54	60	1946	3823	1208	15467
21:00	7751	537	71	17	59	1930	4141	1208	15781
22:00	7734	524	137	10	60	1888	4014	1208	15648
23:00	7745	519	144	0	60	1849	4129	0	14470

2

Figure 4: May 24th: Scenario: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

May 24th: Scenario: 2021, 0,5% Yearly Growth, Interconnected, 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

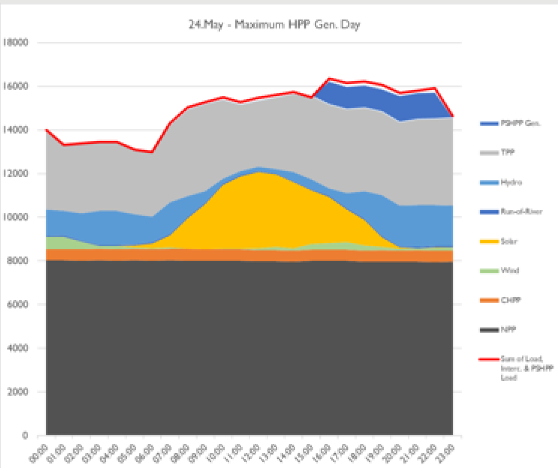


24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8026	521	551	0	60	1294	3566	0	14056
01:00	8023	525	569	0	55	1349	3064	0	13539
02:00	8012	524	355	0	52	1510	3157	0	13587
03:00	8031	518	142	0	54	1644	3149	0	13493
04:00	8019	527	145	0	54	1639	3168	0	13555
05:00	8029	529	75	71	54	1358	2960	0	13042
06:00	8016	524	38	233	55	1274	2981	0	13052
07:00	8039	525	56	563	56	1575	3556	0	14424
08:00	8020	528	21	1402	58	960	3969	0	15026
09:00	8009	522	4	2080	59	460	3993	0	15140
10:00	8017	525	12	2929	60	376	3628	0	15551
11:00	8014	512	30	3323	60	190	3217	0	15415
12:00	7984	506	97	3482	60	190	3346	0	15666
13:00	7977	509	151	3320	60	299	3357	0	15758
14:00	7974	508	109	3017	60	488	3591	0	15790
15:00	8005	508	270	2454	60	602	3840	0	15577
16:00	8010	514	295	2123	60	306	3855	1040	16243
17:00	8003	513	341	1513	60	855	3858	1037	16273
18:00	7964	513	238	1170	60	1348	3834	1037	16257
19:00	7974	513	158	445	60	1914	3817	1043	16005
20:00	7955	514	95	54	60	1930	3823	1208	15666
21:00	7966	537	71	17	59	1930	4079	1208	15935
22:00	7949	524	137	10	60	1888	3953	1208	15802
23:00	7960	519	144	0	60	1849	4057	0	14613

3

Figure 5: May 24th: Scenario: 2021, 0,5% Yearly Growth, Interconnected, 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

May 24th: Scenario: 2021, 0,5% Yearly Growth, Isolated, 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8026	521	551	0	60	1214	3566	0	13993
01:00	8023	525	569	0	55	1118	3064	0	13332
02:00	8012	524	355	0	52	1247	3157	0	13380
03:00	8031	518	142	0	54	1550	3149	0	13448
04:00	8019	527	145	0	54	1557	3168	0	13454
05:00	8029	529	75	71	54	1389	2960	0	13111
06:00	8016	524	38	233	55	1167	2981	0	12985
07:00	8039	525	56	563	56	1454	3556	0	14305
08:00	8020	528	21	1402	58	954	3969	0	15040
09:00	8009	522	4	2080	59	524	3993	0	15278
10:00	8017	525	12	2929	60	220	3628	0	15506
11:00	8014	512	30	3323	60	190	3044	0	15280
12:00	7984	506	97	3482	60	190	3036	0	15466
13:00	7977	509	151	3320	60	190	3300	0	15601
14:00	7974	508	109	3017	60	403	3591	0	15729
15:00	8005	508	270	2454	60	441	3840	0	15509
16:00	8010	514	295	2123	60	331	3855	1040	16361
17:00	8003	513	341	1513	60	676	3858	1037	16164
18:00	7964	513	238	1170	60	1248	3834	1037	16215
19:00	7974	513	158	445	60	1874	3817	1043	16059
20:00	7955	514	95	54	60	1866	3823	1208	15704
21:00	7966	537	71	17	59	1901	3951	1208	15815
22:00	7949	524	137	10	60	1888	3950	1208	15915
23:00	7960	519	144	0	60	1849	4028	0	14640

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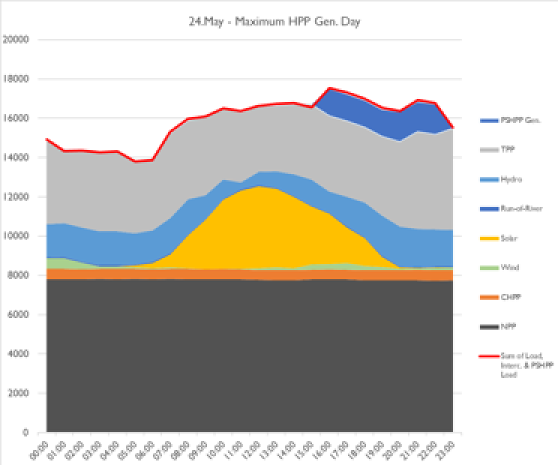
Figure 6: May 24th: Scenario: 2021, 0,5% Yearly Growth, Isolated, 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7809	521	533	0	60	1689	4271	0	14921
01:00	7806	525	550	0	55	1719	3737	0	14346
02:00	7796	524	343	0	52	1720	3952	0	14365
03:00	7814	518	137	0	54	1710	4064	0	14251
04:00	7802	527	140	0	54	1709	4079	0	14315
05:00	7812	529	72	85	54	1599	3688	0	13806
06:00	7799	524	37	279	55	1597	3644	0	13867
07:00	7822	525	54	676	56	1802	4329	0	15318
08:00	7803	528	20	1685	58	1780	4021	0	15964
09:00	7792	522	4	2499	59	1209	3993	0	16091
10:00	7800	525	12	3520	60	966	3628	0	16516
11:00	7798	512	29	3994	60	356	3551	0	16368
12:00	7768	506	94	4184	60	654	3361	0	16629
13:00	7762	509	146	3990	60	823	3357	0	16732
14:00	7758	508	106	3625	60	1083	3591	0	16774
15:00	7789	508	261	2949	60	1310	3840	0	16555
16:00	7793	514	286	2552	60	1077	3855	1371	17548
17:00	7787	513	330	1819	60	1493	3858	1366	17318
18:00	7749	513	230	1406	60	1751	3834	1366	17003
19:00	7759	513	153	535	60	2038	4017	1375	16530
20:00	7740	514	92	65	60	2011	4325	1532	16365
21:00	7751	537	68	20	59	1930	4955	1532	16920
22:00	7734	524	133	12	60	1888	4832	1532	16787
23:00	7745	519	139	0	60	1849	5191	0	15527

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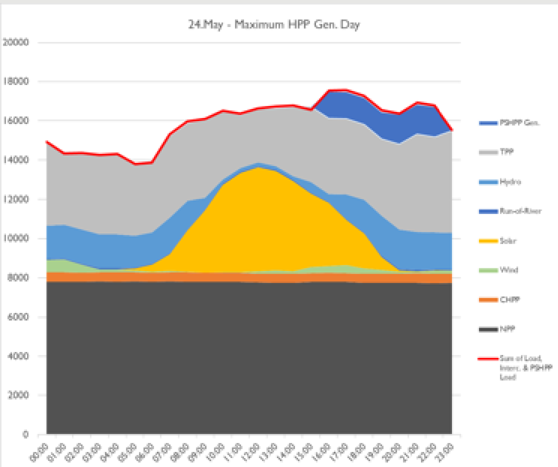
Figure 7: May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7809	469	639	0	60	1689	4217	0	14921
01:00	7806	473	660	0	55	1719	3680	0	14346
02:00	7796	472	411	0	52	1720	3936	0	14365
03:00	7814	466	165	0	54	1710	4088	0	14251
04:00	7802	474	168	0	54	1709	4103	0	14315
05:00	7812	476	87	108	54	1599	3704	0	13806
06:00	7799	472	44	354	55	1597	3614	0	13867
07:00	7822	473	65	857	56	1802	4190	0	15318
08:00	7803	475	24	2134	58	1432	3969	0	15964
09:00	7792	470	5	3166	59	594	3993	0	16091
10:00	7800	473	14	4458	60	190	3516	0	16516
11:00	7798	461	34	5059	60	190	2697	0	16368
12:00	7768	455	112	5300	60	190	2742	0	16629
13:00	7762	458	175	5054	60	190	2947	0	16732
14:00	7758	457	127	4592	60	190	3547	0	16774
15:00	7789	457	314	3735	60	522	3840	0	16555
16:00	7793	463	343	3232	60	391	3855	1371	17548
17:00	7787	462	395	2304	60	1237	3858	1366	17561
18:00	7749	462	276	1780	60	1654	3834	1366	17275
19:00	7759	462	183	677	60	2038	3895	1375	16530
20:00	7740	463	110	82	60	2011	4341	1532	16365
21:00	7751	483	82	26	59	1930	4989	1532	16920
22:00	7734	472	159	15	60	1888	4854	1532	16787
23:00	7745	467	167	0	60	1849	5215	0	15527

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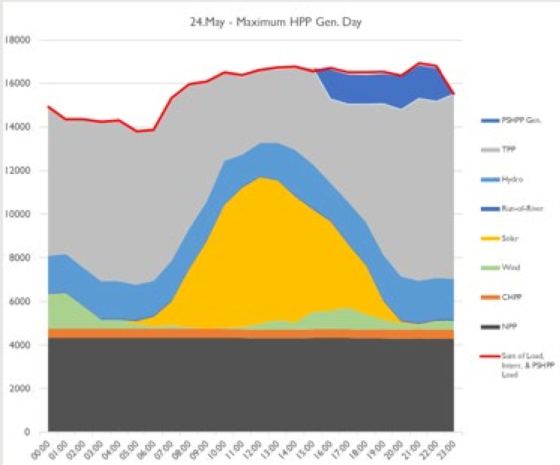
Figure 8: May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



24.05.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4339	417	1598	0	60	1689	6781	0	14921
01:00	4337	420	1651	0	55	1719	6211	0	14346
02:00	4331	419	1029	0	52	1720	6836	0	14365
03:00	4341	414	412	0	54	1710	7366	0	14251
04:00	4335	422	421	0	54	1709	7371	0	14315
05:00	4340	423	217	136	54	1599	7070	0	13806
06:00	4333	419	110	447	55	1597	6974	0	13867
07:00	4346	420	162	1082	56	1802	7396	0	15318
08:00	4335	422	60	2696	58	1780	6544	0	15964
09:00	4329	418	12	3999	59	1766	5497	0	16091
10:00	4334	420	35	5632	60	1964	4067	0	16516
11:00	4332	410	86	6390	60	1470	3551	0	16368
12:00	4316	405	281	6695	60	1510	3361	0	16629
13:00	4312	407	438	6384	60	1688	3357	0	16732
14:00	4310	406	317	5800	60	2060	3777	0	16774
15:00	4327	406	784	4718	60	1998	4423	0	16555
16:00	4330	411	857	4083	60	1692	3855	1371	16699
17:00	4326	410	989	2910	60	1863	4500	1366	16517
18:00	4305	410	691	2249	60	1931	5398	1366	16503
19:00	4311	410	459	855	60	2038	6942	1375	16530
20:00	4300	411	275	104	60	2011	7646	1532	16365
21:00	4306	430	205	32	59	1930	8358	1532	16920
22:00	4297	419	398	19	60	1888	8101	1532	16787
23:00	4303	415	418	0	60	1849	8458	0	15527

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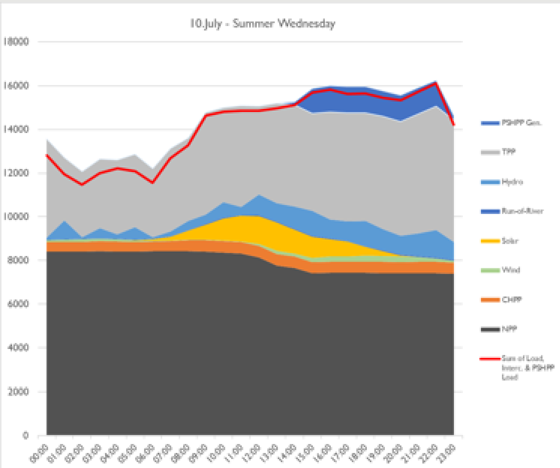
Figure 9: May 24th: Scenario: 2025, 1,2% Yearly Growth, Interconnected, 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

July 10th Summer Wednesday: As-Is



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8402	440	98	0	23	70	4536	0	12821
01:00	8399	444	109	0	22	851	2899	0	11967
02:00	8410	440	120	0	22	75	3003	0	11483
03:00	8426	455	114	0	22	474	3158	0	11995
04:00	8405	457	113	0	22	201	3413	0	12220
05:00	8399	445	61	21	22	572	3358	0	12089
06:00	8422	454	40	65	22	70	3136	0	11555
07:00	8418	465	38	168	22	227	3806	0	12688
08:00	8431	504	19	429	21	402	3819	0	13276
09:00	8394	529	22	686	41	416	4700	0	14639
10:00	8363	531	27	1002	42	709	4319	0	14824
11:00	8321	515	23	1186	42	370	4634	0	14860
12:00	8139	522	97	1275	42	938	4055	0	14859
13:00	7765	522	164	1297	42	832	4570	0	14961
14:00	7662	512	153	1100	42	999	4666	139	15122
15:00	7415	511	185	970	42	1155	4460	1153	15690
16:00	7434	512	249	786	42	857	4930	1208	15830
17:00	7429	519	242	666	42	902	4965	1208	15641
18:00	7430	511	282	391	42	1159	4953	1208	15644
19:00	7416	520	271	211	42	975	5171	1175	15452
20:00	7412	515	263	40	42	867	5235	1208	15334
21:00	7419	517	229	0	42	1044	5477	1208	15746
22:00	7419	531	153	0	42	1244	5670	1208	16114
23:00	7390	506	95	0	42	819	5582	201	14216

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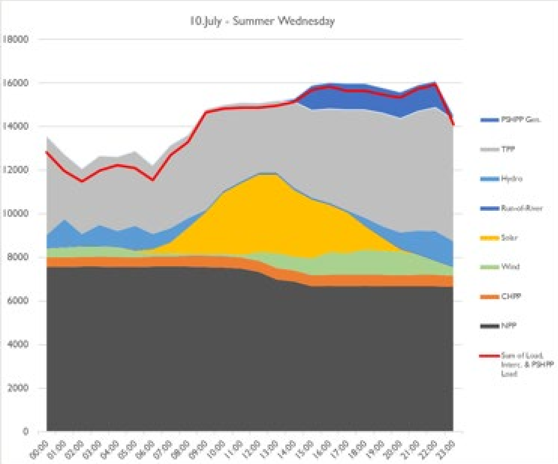
Figure 10: July 10th Summer Wednesday: As-Is

July 10th Summer Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7562	440	403	0	23	605	4536	0	12821
01:00	7559	444	448	0	22	1286	2965	0	11967
02:00	7569	440	493	0	22	543	3003	0	11483
03:00	7583	455	469	0	22	962	3158	0	11995
04:00	7565	457	465	0	22	690	3413	0	12220
05:00	7559	445	251	59	22	1111	3432	0	12089
06:00	7580	454	164	181	22	671	3136	0	11555
07:00	7576	465	156	469	22	650	3806	0	12688
08:00	7588	504	78	1197	21	418	3819	0	13276
09:00	7555	529	90	1914	41	50	4609	0	14639
10:00	7527	531	111	2795	42	50	3937	0	14824
11:00	7489	515	95	3309	42	50	3592	0	14860
12:00	7325	522	399	3557	42	50	3173	0	14859
13:00	6989	522	674	3618	42	50	3297	0	14961
14:00	6896	512	629	3069	42	50	3936	139	15122
15:00	6674	511	761	2706	42	50	3995	1153	15690
16:00	6691	512	1024	2193	42	50	4299	1208	15830
17:00	6686	519	995	1858	42	50	4615	1208	15641
18:00	6687	511	1160	1091	42	324	4953	1208	15644
19:00	6674	520	1114	589	42	495	5171	1175	15452
20:00	6671	515	1082	112	42	718	5235	1208	15334
21:00	6677	517	942	0	42	1054	5477	1208	15726
22:00	6677	531	629	0	42	1323	5670	1208	15927
23:00	6651	506	391	0	42	1153	5582	201	14107

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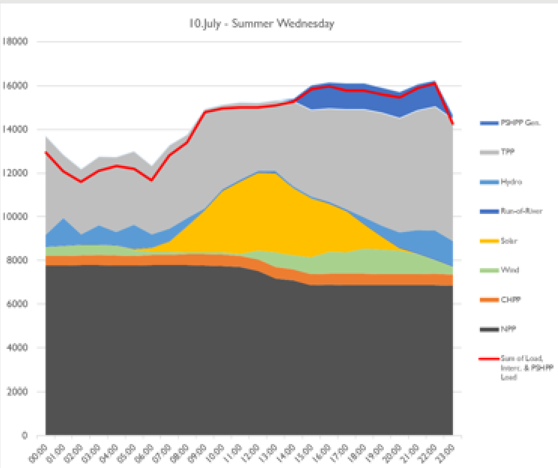
Figure 11: July 10th Summer Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 10th Summer Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7772	440	403	0	23	530	4536	0	12956
01:00	7769	444	448	0	22	1266	2899	0	12091
02:00	7779	440	493	0	22	453	3003	0	11604
03:00	7794	455	469	0	22	870	3158	0	12114
04:00	7775	457	465	0	22	599	3413	0	12339
05:00	7769	445	251	59	22	1093	3358	0	12208
06:00	7790	454	164	181	22	584	3136	0	11678
07:00	7787	465	156	469	22	573	3806	0	12822
08:00	7799	504	78	1197	21	347	3819	0	13416
09:00	7764	529	90	1914	41	50	4548	0	14788
10:00	7736	531	111	2795	42	50	3879	0	14975
11:00	7697	515	95	3309	42	50	3537	0	15014
12:00	7529	522	399	3557	42	50	3122	0	15012
13:00	7183	522	674	3618	42	50	3254	0	15112
14:00	7087	512	629	3069	42	50	3898	139	15275
15:00	6859	511	761	2706	42	50	3961	1153	15842
16:00	6876	512	1024	2193	42	50	4264	1208	15981
17:00	6872	519	995	1858	42	50	4579	1208	15791
18:00	6873	511	1160	1091	42	289	4953	1208	15793
19:00	6860	520	1114	589	42	460	5171	1175	15601
20:00	6856	515	1082	112	42	681	5235	1208	15482
21:00	6863	517	942	0	42	1040	5477	1208	15898
22:00	6863	531	629	0	42	1315	5670	1208	16104
23:00	6836	506	391	0	42	1123	5582	201	14262

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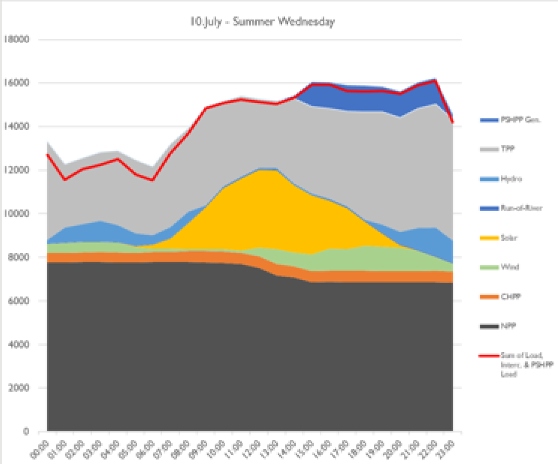
Figure 12: July 10th Summer Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 10th Summer Wednesday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7772	440	403	0	23	162	4536	0	12696
01:00	7769	444	448	0	22	691	2899	0	11560
02:00	7779	440	493	0	22	799	3032	0	12035
03:00	7794	455	469	0	22	932	3158	0	12244
04:00	7775	457	465	0	22	767	3413	0	12504
05:00	7769	445	251	59	22	565	3358	0	11804
06:00	7790	454	164	181	22	419	3136	0	11539
07:00	7787	465	156	469	22	502	3806	0	12771
08:00	7799	504	78	1197	21	497	3819	0	13662
09:00	7764	529	90	1914	41	50	4517	0	14839
10:00	7736	531	111	2795	42	50	3901	0	15079
11:00	7697	515	95	3309	42	50	3688	0	15240
12:00	7529	522	399	3557	42	50	3172	0	15131
13:00	7183	522	674	3618	42	50	3096	0	15041
14:00	7087	512	629	3069	42	50	3893	139	15315
15:00	6859	511	761	2706	42	50	3983	1153	15916
16:00	6876	512	1024	2193	42	50	4136	1208	15906
17:00	6872	519	995	1858	42	50	4354	1208	15624
18:00	6873	511	1160	1091	42	50	4952	1208	15611
19:00	6860	520	1114	589	42	371	5171	1175	15629
20:00	6856	515	1082	112	42	568	5235	1208	15489
21:00	6863	517	942	0	42	979	5477	1208	15888
22:00	6863	531	629	0	42	1297	5670	1208	16089
23:00	6836	506	391	0	42	997	5582	201	14198

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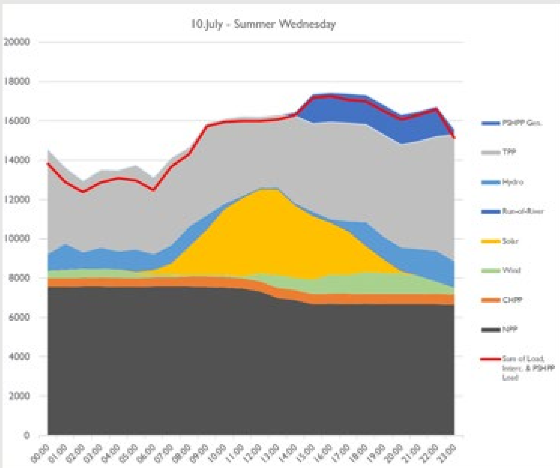
Figure 13: July 10th Summer Wednesday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7562	440	390	0	23	796	5355	0	13817
01:00	7559	444	434	0	22	1286	3901	0	12888
02:00	7569	440	477	0	22	799	3657	0	12377
03:00	7583	455	453	0	22	1049	3964	0	12873
04:00	7565	457	449	0	22	878	4121	0	13101
05:00	7559	445	243	70	22	1111	4307	0	12968
06:00	7580	454	159	218	22	796	3893	0	12468
07:00	7576	465	151	563	22	894	4460	0	13676
08:00	7588	504	76	1438	21	1004	4030	0	14312
09:00	7555	529	87	2300	41	675	4700	0	15738
10:00	7527	531	107	3359	42	228	4319	0	15944
11:00	7489	515	91	3976	42	50	4064	0	15997
12:00	7325	522	386	4275	42	50	3597	0	15988
13:00	6989	522	652	4348	42	50	3710	0	16082
14:00	6896	512	608	3688	42	50	4470	183	16298
15:00	6674	511	736	3252	42	189	4460	1519	17181
16:00	6691	512	990	2635	42	130	4930	1532	17274
17:00	6686	519	962	2233	42	471	4965	1532	17078
18:00	6687	511	1122	1311	42	1179	4953	1532	17004
19:00	6674	520	1078	707	42	1108	5171	1532	16503
20:00	6671	515	1046	134	42	1142	5235	1532	16068
21:00	6677	517	911	0	42	1344	5477	1532	16309
22:00	6677	531	608	0	42	1533	5824	1532	16594
23:00	6651	506	378	0	42	1266	6452	265	15141

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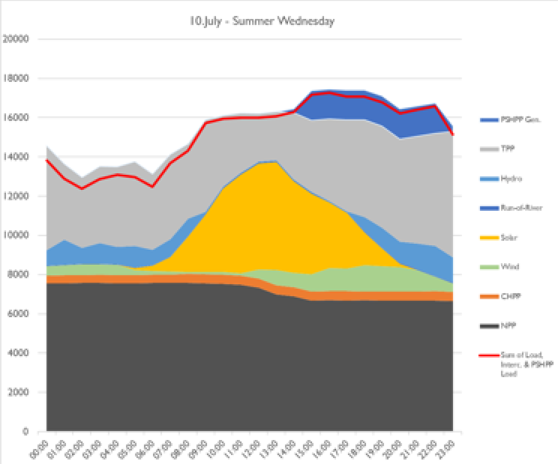
Figure 14: July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7562	396	468	0	23	796	5321	0	13817
01:00	7559	400	520	0	22	1286	3858	0	12888
02:00	7569	396	573	0	22	799	3605	0	12377
03:00	7583	410	544	0	22	1049	3919	0	12873
04:00	7565	411	539	0	22	878	4077	0	13101
05:00	7559	401	291	89	22	1111	4284	0	12968
06:00	7580	409	191	276	22	796	3849	0	12468
07:00	7576	419	181	713	22	894	4326	0	13676
08:00	7588	454	91	1822	21	867	3819	0	14312
09:00	7555	476	105	2913	41	97	4700	0	15738
10:00	7527	478	129	4255	42	50	3633	0	15944
11:00	7489	464	110	5037	42	50	3037	0	15997
12:00	7325	470	463	5415	42	50	2432	0	15988
13:00	6989	470	783	5508	42	50	2472	0	16082
14:00	6896	461	730	4671	42	50	3416	183	16298
15:00	6674	460	883	4119	42	50	3636	1519	17181
16:00	6691	461	1188	3338	42	50	4161	1532	17274
17:00	6686	467	1155	2828	42	50	4650	1532	17078
18:00	6687	460	1346	1660	42	730	4953	1532	17077
19:00	6674	468	1293	896	42	1022	5171	1532	16769
20:00	6671	464	1255	170	42	1087	5235	1532	16206
21:00	6677	465	1093	0	42	1311	5477	1532	16407
22:00	6677	478	730	0	42	1533	5755	1532	16594
23:00	6651	455	453	0	42	1266	6427	265	15141

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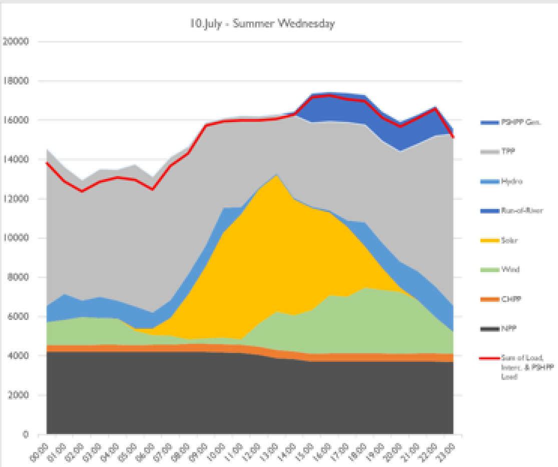
Figure 15: July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



10.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4201	352	1169	0	23	796	8024	0	13817
01:00	4200	355	1301	0	22	1286	6482	0	12888
02:00	4205	352	1432	0	22	799	6154	0	12377
03:00	4213	364	1360	0	22	1049	6519	0	12873
04:00	4203	366	1348	0	22	878	6675	0	13101
05:00	4200	356	728	113	22	1111	7228	0	12968
06:00	4211	363	477	349	22	796	6904	0	12468
07:00	4209	372	453	901	22	894	7280	0	13676
08:00	4216	403	227	2301	21	1004	6489	0	14312
09:00	4197	423	262	3680	41	1013	6271	0	15738
10:00	4182	425	322	5375	42	1197	4571	0	15944
11:00	4161	412	274	6362	42	343	4634	0	15997
12:00	4070	418	1157	6839	42	50	3621	0	15988
13:00	3883	418	1957	6958	42	50	3006	0	16082
14:00	3831	410	1825	5901	42	50	4207	183	16298
15:00	3708	409	2207	5203	42	50	4244	1519	17181
16:00	3717	410	2971	4216	42	50	4525	1532	17274
17:00	3715	415	2887	3573	42	282	4965	1532	17078
18:00	3715	409	3365	2097	42	1188	4953	1532	16969
19:00	3708	416	3233	1132	42	1227	5171	1532	16132
20:00	3706	412	3138	215	42	1296	5590	1532	15682
21:00	3710	414	2732	0	42	1407	6476	1532	16122
22:00	3710	425	1825	0	42	1533	7681	1532	16594
23:00	3695	405	1133	0	42	1266	8754	265	15141

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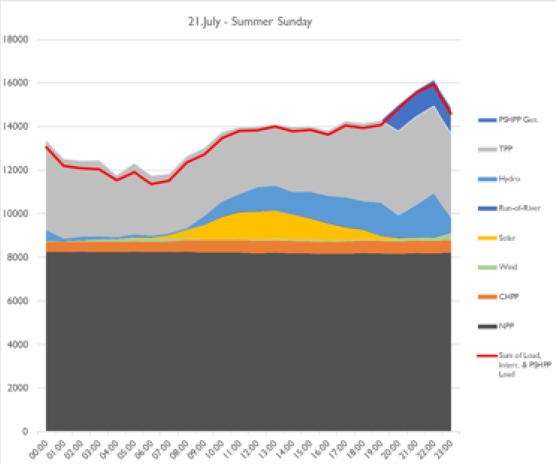
Figure 16: July 10th Summer Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

July 21st Summer Sunday: As-Is



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8248	457	55	0	20	472	4117	0	13046
01:00	8247	458	29	0	19	109	3656	0	12202
02:00	8273	451	62	0	19	160	3463	0	12090
03:00	8247	470	96	0	19	142	3472	0	12055
04:00	8252	468	118	0	19	70	2850	0	11532
05:00	8265	475	157	20	19	135	3251	0	11913
06:00	8245	470	141	59	19	70	2752	0	11366
07:00	8258	471	130	163	19	70	2734	0	11524
08:00	8282	529	60	384	18	70	3302	0	12353
09:00	8227	561	24	661	38	392	3125	0	12719
10:00	8230	552	40	1042	38	668	3175	0	13480
11:00	8235	558	33	1255	38	793	3056	0	13813
12:00	8195	566	54	1293	39	1082	2794	0	13823
13:00	8220	563	69	1280	36	1125	2811	0	13995
14:00	8188	558	77	1133	36	1004	2989	0	13785
15:00	8187	558	74	981	36	1176	2997	0	13843
16:00	8156	553	68	779	36	1222	3006	0	13619
17:00	8169	567	55	584	36	1347	3508	0	14046
18:00	8207	571	53	429	36	1278	3567	0	13935
19:00	8191	574	41	160	36	1519	3760	0	14060
20:00	8163	572	120	35	36	986	3888	1208	14844
21:00	8200	571	133	2	36	1468	4047	1208	15558
22:00	8188	575	145	0	38	1985	4005	1208	15932
23:00	8229	577	327	0	38	646	3850	1208	14597

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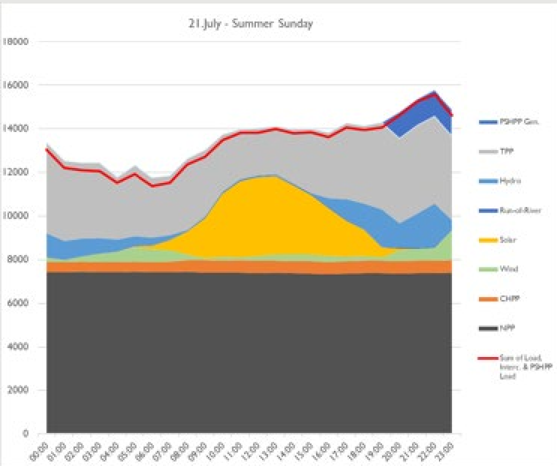
Figure 17: July 21st Summer Sunday: As-Is

July 21st Summer Sunday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7423	457	226	0	20	1081	4161	0	13046
01:00	7422	458	119	0	19	843	3656	0	12202
02:00	7446	451	255	0	19	794	3463	0	12090
03:00	7422	470	395	0	19	668	3472	0	12055
04:00	7427	468	485	0	19	528	2850	0	11532
05:00	7439	475	646	56	19	437	3251	0	11913
06:00	7421	470	580	165	19	350	2752	0	11366
07:00	7432	471	535	455	19	199	2734	0	11524
08:00	7454	529	247	1071	18	50	3276	0	12353
09:00	7404	561	99	1844	38	50	3032	0	12719
10:00	7407	552	164	2907	38	50	2626	0	13480
11:00	7412	558	136	3501	38	50	2273	0	13813
12:00	7376	566	222	3607	39	50	2163	0	13823
13:00	7398	563	284	3571	36	50	2202	0	13995
14:00	7369	558	317	3161	36	50	2494	0	13785
15:00	7368	558	304	2737	36	50	2956	0	13843
16:00	7340	553	280	2173	36	432	3006	0	13619
17:00	7352	567	226	1629	36	947	3508	0	14046
18:00	7386	571	218	1197	36	1166	3567	0	13935
19:00	7372	574	169	446	36	1716	3968	0	14060
20:00	7347	572	493	98	36	1120	3888	1208	14597
21:00	7380	571	547	6	36	1559	4047	1208	15246
22:00	7369	575	596	0	38	1992	4005	1208	15571
23:00	7406	577	1345	0	38	451	3850	1208	14597

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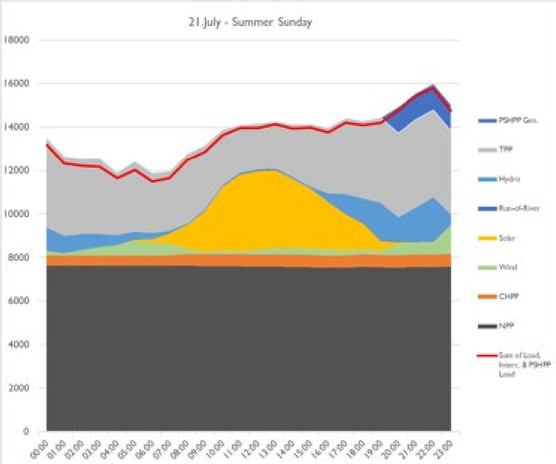
Figure 18: July 21st Summer Sunday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 21st Summer Sunday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7629	457	226	0	20	1055	4117	0	13182
01:00	7628	458	119	0	19	765	3656	0	12330
02:00	7653	451	255	0	19	708	3463	0	12210
03:00	7628	470	395	0	19	581	3472	0	12174
04:00	7633	468	485	0	19	440	2850	0	11650
05:00	7645	475	646	56	19	348	3251	0	12031
06:00	7627	470	580	165	19	264	2752	0	11486
07:00	7639	471	535	455	19	117	2734	0	11648
08:00	7661	529	247	1071	18	50	3198	0	12482
09:00	7610	561	99	1844	38	50	2963	0	12856
10:00	7613	552	164	2907	38	50	2563	0	13622
11:00	7617	558	136	3501	38	50	2211	0	13956
12:00	7580	566	222	3607	39	50	2102	0	13967
13:00	7604	563	284	3571	36	50	2140	0	14138
14:00	7574	558	317	3161	36	50	2433	0	13928
15:00	7573	558	304	2737	36	50	2893	0	13985
16:00	7544	553	280	2173	36	371	3006	0	13762
17:00	7556	567	226	1629	36	888	3508	0	14191
18:00	7591	571	218	1197	36	1106	3567	0	14081
19:00	7577	574	169	446	36	1716	3909	0	14205
20:00	7551	572	493	98	36	1099	3888	1208	14781
21:00	7585	571	547	6	36	1546	4047	1208	15438
22:00	7574	575	596	0	38	1991	4005	1208	15775
23:00	7612	577	1345	0	38	389	3850	1208	14740

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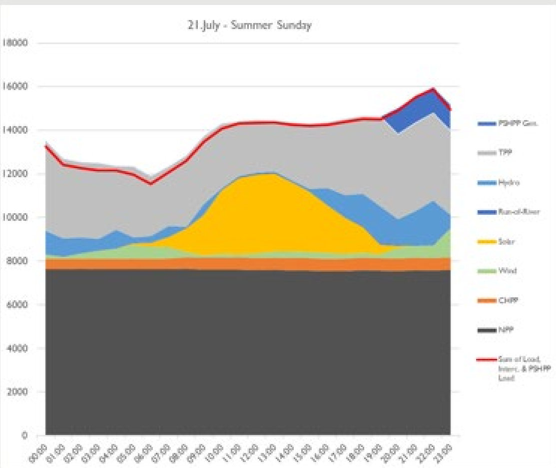
Figure 19: July 21st Summer Sunday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 21st Summer Sunday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7629	457	226	0	20	1069	4117	0	13255
01:00	7628	458	119	0	19	820	3656	0	12418
02:00	7653	451	255	0	19	699	3463	0	12260
03:00	7628	470	395	0	19	514	3472	0	12158
04:00	7633	468	485	0	19	838	2912	0	12150
05:00	7645	475	646	56	19	245	3251	0	11954
06:00	7627	470	580	165	19	295	2752	0	11549
07:00	7639	471	535	455	19	490	2734	0	12070
08:00	7661	529	247	1071	18	50	3274	0	12603
09:00	7610	561	99	1844	38	448	3125	0	13468
10:00	7613	552	164	2907	38	50	2965	0	14077
11:00	7617	558	136	3501	38	50	2503	0	14312
12:00	7580	566	222	3607	39	50	2403	0	14331
13:00	7604	563	284	3571	36	50	2296	0	14356
14:00	7574	558	317	3161	36	50	2678	0	14244
15:00	7573	558	304	2737	36	93	2997	0	14201
16:00	7544	553	280	2173	36	771	3006	0	14234
17:00	7556	567	226	1629	36	1002	3508	0	14374
18:00	7591	571	218	1197	36	1480	3567	0	14511
19:00	7577	574	169	446	36	1716	4113	0	14479
20:00	7551	572	493	98	36	1172	3888	1208	14897
21:00	7585	571	547	6	36	1561	4047	1208	15518
22:00	7574	575	596	0	38	1989	4005	1208	15882
23:00	7612	577	1345	0	38	553	3850	1208	14948

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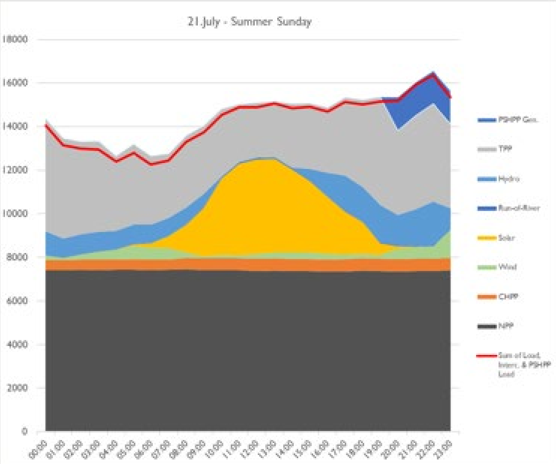
Figure 20: July 21st Summer Sunday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7423	457	219	0	20	1081	5174	0	14052
01:00	7422	458	115	0	19	861	4589	0	13149
02:00	7446	451	247	0	19	892	4265	0	12982
03:00	7422	470	382	0	19	881	4154	0	12938
04:00	7427	468	469	0	19	838	3429	0	12405
05:00	7439	475	624	67	19	877	3692	0	12784
06:00	7421	470	561	198	19	838	3140	0	12255
07:00	7432	471	517	546	19	838	2942	0	12444
08:00	7454	529	239	1287	18	769	3302	0	13306
09:00	7404	561	95	2216	38	599	3125	0	13729
10:00	7407	552	159	3494	38	50	3098	0	14533
11:00	7412	558	131	4208	38	50	2631	0	14873
12:00	7376	566	215	4335	39	50	2509	0	14889
13:00	7398	563	274	4291	36	50	2552	0	15056
14:00	7369	558	306	3799	36	50	2926	0	14844
15:00	7368	558	294	3289	36	520	2997	0	14896
16:00	7340	553	270	2612	36	1061	3006	0	14677
17:00	7352	567	219	1958	36	1612	3592	0	15116
18:00	7386	571	211	1438	36	1570	4007	0	15013
19:00	7372	574	163	536	36	1716	4960	0	15136
20:00	7347	572	477	117	36	1386	3888	1532	15191
21:00	7380	571	529	7	36	1685	4293	1532	15925
22:00	7369	575	577	0	38	1998	4487	1532	16364
23:00	7406	577	1301	0	38	927	3850	1532	15352

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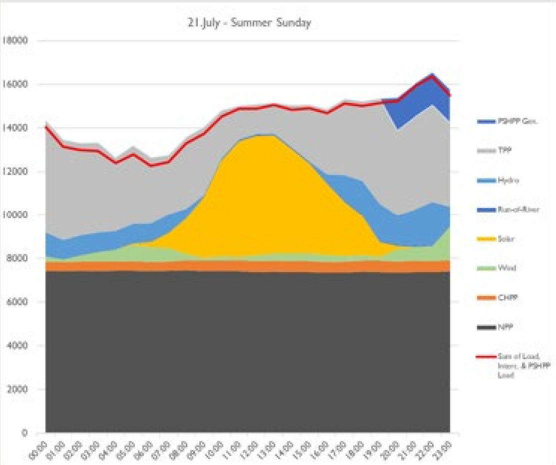
Figure 21: July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7423	411	262	0	20	1081	5176	0	14052
01:00	7422	412	138	0	19	861	4612	0	13149
02:00	7446	406	296	0	19	892	4261	0	12982
03:00	7422	423	458	0	19	881	4125	0	12938
04:00	7427	421	563	0	19	838	3382	0	12405
05:00	7439	428	749	85	19	877	3596	0	12784
06:00	7421	423	673	251	19	838	3022	0	12255
07:00	7432	424	620	692	19	838	2740	0	12444
08:00	7454	476	286	1631	18	431	3302	0	13306
09:00	7404	505	115	2807	38	50	3120	0	13729
10:00	7407	497	191	4425	38	50	2190	0	14533
11:00	7412	502	157	5330	38	50	1539	0	14873
12:00	7376	509	258	5491	39	50	1366	0	14889
13:00	7398	507	329	5436	36	50	1409	0	15056
14:00	7369	502	367	4812	36	50	1907	0	14844
15:00	7368	502	353	4166	36	50	2586	0	14896
16:00	7340	498	325	3308	36	366	3006	0	14677
17:00	7352	510	262	2480	36	1187	3508	0	15116
18:00	7386	514	253	1822	36	1570	3639	0	15013
19:00	7372	517	196	679	36	1716	4842	0	15136
20:00	7347	515	573	149	36	1367	3888	1532	15241
21:00	7380	514	635	8	36	1685	4243	1532	15925
22:00	7369	518	692	0	38	1998	4429	1532	16364
23:00	7406	519	1561	0	38	865	3850	1532	15492

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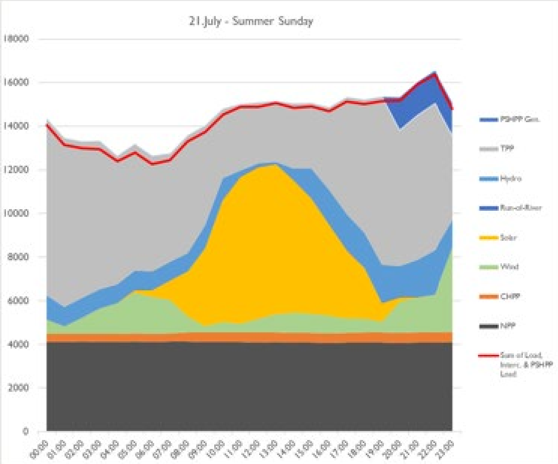
Figure 22: July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



21.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4124	366	656	0	20	1081	8127	0	14052
01:00	4124	366	346	0	19	861	7749	0	13149
02:00	4137	361	740	0	19	892	7171	0	12982
03:00	4124	376	1145	0	19	881	6783	0	12938
04:00	4126	374	1408	0	19	838	5885	0	12405
05:00	4133	380	1873	107	19	877	5804	0	12784
06:00	4123	376	1682	316	19	838	5291	0	12255
07:00	4129	377	1551	874	19	838	4977	0	12444
08:00	4141	423	716	2060	18	838	5402	0	13306
09:00	4114	449	286	3546	38	1033	4573	0	13729
10:00	4115	442	477	5590	38	962	3175	0	14533
11:00	4118	446	394	6732	38	244	3056	0	14873
12:00	4098	453	644	6936	39	125	2794	0	14889
13:00	4110	450	823	6866	36	68	2811	0	15056
14:00	4094	446	919	6078	36	482	2989	0	14844
15:00	4094	446	883	5262	36	1344	2997	0	14896
16:00	4078	442	811	4179	36	1536	3796	0	14677
17:00	4085	454	656	3133	36	1612	5361	0	15116
18:00	4104	457	632	2301	36	1570	6120	0	15013
19:00	4096	459	489	858	36	1716	7703	0	15136
20:00	4082	458	1432	188	36	1393	6218	1532	15173
21:00	4100	457	1587	11	36	1685	6626	1532	15925
22:00	4094	460	1730	0	38	1998	6724	1532	16364
23:00	4115	462	3902	0	38	1177	3850	1532	14796

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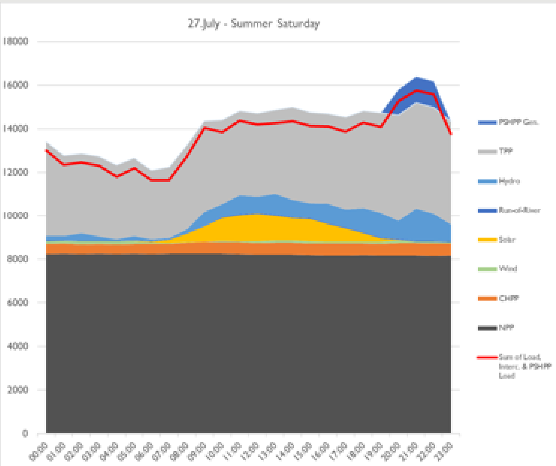
Figure 23: July 21st Summer Sunday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

July 27th Summer Saturday: As-Is



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8229	452	152	0	24	198	4371	0	13019
01:00	8247	459	139	0	22	206	3698	0	12359
02:00	8231	444	145	0	23	361	3671	0	12468
03:00	8242	447	131	0	23	204	3690	0	12304
04:00	8220	455	150	0	23	72	3425	0	11796
05:00	8240	456	122	19	23	205	3604	0	12195
06:00	8231	455	69	54	23	73	3204	0	11643
07:00	8240	460	37	154	23	72	3257	0	11656
08:00	8251	516	6	394	22	193	3883	0	12722
09:00	8246	545	14	690	42	645	4175	0	14039
10:00	8245	542	56	1050	42	608	3868	0	13838
11:00	8224	548	51	1215	42	884	3853	0	14377
12:00	8206	539	84	1261	43	754	3825	0	14194
13:00	8208	547	108	1147	40	975	3853	0	14258
14:00	8203	547	113	1042	40	798	4251	0	14354
15:00	8175	543	111	1022	40	688	4184	0	14133
16:00	8163	544	101	804	40	918	4134	0	14117
17:00	8158	545	108	602	40	834	4260	0	13868
18:00	8181	540	80	389	40	1125	4480	0	14291
19:00	8155	545	110	149	40	1152	4591	0	14081
20:00	8172	566	130	31	40	830	4850	1208	15271
21:00	8173	565	68	0	40	1497	4851	1208	15768
22:00	8146	558	99	0	42	1254	4883	1208	15583
23:00	8169	539	68	0	42	775	4742	0	13762

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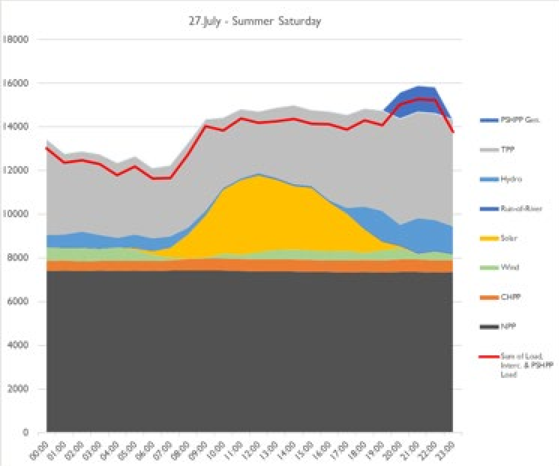
Figure 24: July 27th Summer Saturday: As-Is

July 27th Summer Saturday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7406	452	625	0	24	548	4371	0	13019
01:00	7422	459	572	0	22	598	3698	0	12359
02:00	7408	444	596	0	23	733	3671	0	12468
03:00	7418	447	539	0	23	620	3690	0	12304
04:00	7398	455	617	0	23	427	3425	0	11796
05:00	7416	456	502	53	23	615	3604	0	12195
06:00	7408	455	284	151	23	585	3204	0	11643
07:00	7416	460	152	430	23	505	3257	0	11656
08:00	7426	516	25	1099	22	294	3883	0	12722
09:00	7421	545	58	1925	42	191	4175	0	14039
10:00	7421	542	230	2929	42	50	3197	0	13838
11:00	7402	548	210	3390	42	50	3176	0	14377
12:00	7385	539	345	3518	43	50	2831	0	14194
13:00	7387	547	444	3200	40	50	3210	0	14258
14:00	7383	547	465	2907	40	50	3603	0	14354
15:00	7358	543	456	2851	40	50	3465	0	14133
16:00	7347	544	415	2243	40	50	4065	0	14117
17:00	7342	545	444	1680	40	236	4260	0	13868
18:00	7363	540	329	1085	40	998	4480	0	14291
19:00	7340	545	452	416	40	1358	4591	0	14081
20:00	7355	566	535	86	40	936	4850	1208	15020
21:00	7356	565	280	0	40	1591	4851	1208	15256
22:00	7331	558	407	0	42	1393	4883	1208	15215
23:00	7352	539	280	0	42	1226	4897	0	13762

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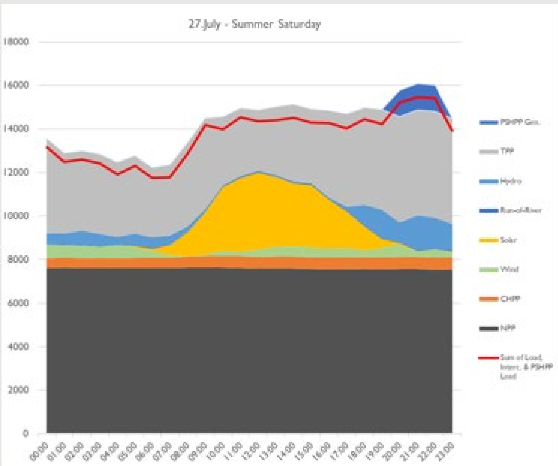
Figure 25: July 27th Summer Saturday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 27th Summer Saturday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7612	452	625	0	24	479	4371	0	13156
01:00	7628	459	572	0	22	522	3698	0	12489
02:00	7614	444	596	0	23	651	3671	0	12592
03:00	7624	447	539	0	23	536	3690	0	12425
04:00	7604	455	617	0	23	344	3425	0	11918
05:00	7622	456	502	53	23	530	3604	0	12316
06:00	7614	455	284	151	23	502	3204	0	11766
07:00	7622	460	152	430	23	427	3257	0	11784
08:00	7632	516	25	1099	22	223	3883	0	12857
09:00	7628	545	58	1925	42	129	4175	0	14183
10:00	7627	542	230	2929	42	50	3141	0	13988
11:00	7607	548	210	3390	42	50	3120	0	14526
12:00	7591	539	345	3518	43	50	2776	0	14344
13:00	7592	547	444	3200	40	50	3156	0	14409
14:00	7588	547	465	2907	40	50	3549	0	14506
15:00	7562	543	456	2851	40	50	3411	0	14284
16:00	7551	544	415	2243	40	50	4011	0	14267
17:00	7546	545	444	1680	40	182	4260	0	14018
18:00	7567	540	329	1085	40	945	4480	0	14442
19:00	7543	545	452	416	40	1305	4591	0	14232
20:00	7559	566	535	86	40	920	4850	1208	15208
21:00	7560	565	280	0	40	1583	4851	1208	15452
22:00	7535	558	407	0	42	1380	4883	1208	15406
23:00	7556	539	280	0	42	1226	4841	0	13911

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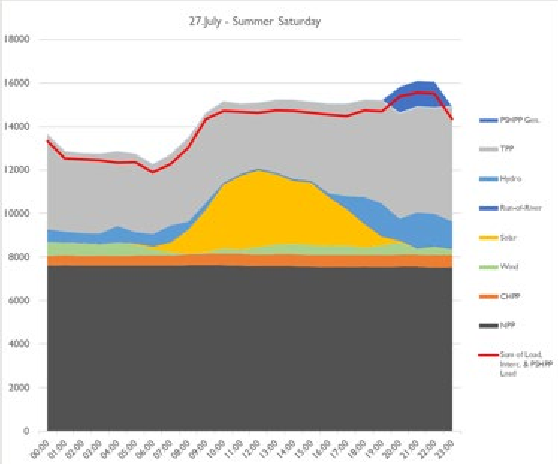
Figure 26: July 27th Summer Saturday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 27th Summer Saturday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7612	452	625	0	24	576	4371	0	13315
01:00	7628	459	572	0	22	494	3698	0	12529
02:00	7614	444	596	0	23	432	3671	0	12480
03:00	7624	447	539	0	23	447	3690	0	12433
04:00	7604	455	617	0	23	740	3425	0	12339
05:00	7622	456	502	53	23	490	3604	0	12347
06:00	7614	455	284	151	23	543	3204	0	11899
07:00	7622	460	152	430	23	777	3267	0	12254
08:00	7632	516	25	1099	22	340	3883	0	13021
09:00	7628	545	58	1925	42	287	4175	0	14349
10:00	7627	542	230	2929	42	50	3763	0	14727
11:00	7607	548	210	3390	42	50	3229	0	14693
12:00	7591	539	345	3518	43	50	3017	0	14636
13:00	7592	547	444	3200	40	50	3364	0	14751
14:00	7588	547	465	2907	40	50	3647	0	14730
15:00	7562	543	456	2851	40	50	3660	0	14638
16:00	7551	544	415	2243	40	143	4134	0	14561
17:00	7546	545	444	1680	40	550	4260	0	14482
18:00	7567	540	329	1085	40	1206	4480	0	14746
19:00	7543	545	452	416	40	1466	4769	0	14699
20:00	7559	566	535	86	40	991	4850	1208	15399
21:00	7560	565	280	0	40	1619	4851	1208	15570
22:00	7535	558	407	0	42	1451	4883	1208	15530
23:00	7556	539	280	0	42	1226	5286	0	14363

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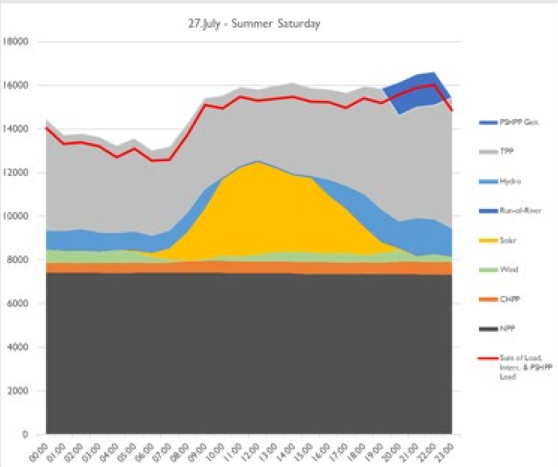
Figure 27: July 27th Summer Saturday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7406	452	605	0	24	857	5099	0	14036
01:00	7422	459	553	0	22	863	4411	0	13318
02:00	7408	444	577	0	23	961	4381	0	13387
03:00	7418	447	521	0	23	861	4366	0	13203
04:00	7398	455	597	0	23	777	4000	0	12701
05:00	7416	456	485	64	23	862	4259	0	13091
06:00	7408	455	274	181	23	778	3900	0	12553
07:00	7416	460	147	516	23	777	3850	0	12603
08:00	7426	516	24	1321	22	854	4099	0	13719
09:00	7421	545	56	2313	42	873	4175	0	15108
10:00	7421	542	223	3520	42	50	3723	0	14947
11:00	7402	548	203	4074	42	50	3603	0	15481
12:00	7385	539	334	4228	43	50	3243	0	15304
13:00	7387	547	430	3846	40	50	3699	0	15378
14:00	7383	547	449	3494	40	50	4153	0	15476
15:00	7358	543	441	3426	40	50	4019	0	15248
16:00	7347	544	402	2696	40	652	4134	0	15227
17:00	7342	545	430	2018	40	1022	4260	0	14978
18:00	7363	540	318	1304	40	1449	4942	0	15412
19:00	7340	545	437	500	40	1466	5531	0	15198
20:00	7355	566	517	104	40	1187	4850	1532	15594
21:00	7356	565	270	0	40	1686	5076	1532	15891
22:00	7331	558	394	0	42	1531	5235	1532	16016
23:00	7352	539	270	0	42	1226	6006	0	14863

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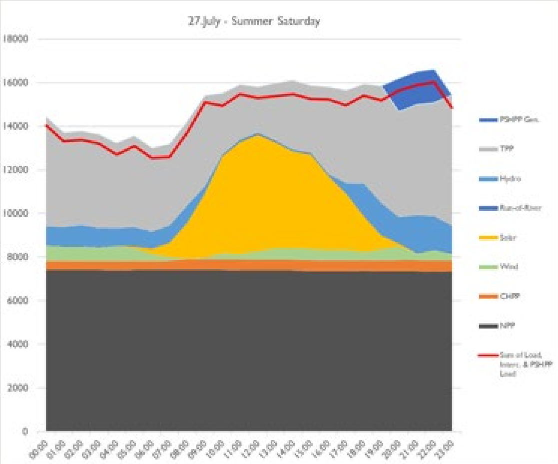
Figure 28: July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7406	407	725	0	24	857	5023	0	14036
01:00	7422	413	663	0	22	863	4347	0	13318
02:00	7408	400	692	0	23	961	4310	0	13387
03:00	7418	402	625	0	23	861	4306	0	13203
04:00	7398	410	716	0	23	777	3927	0	12701
05:00	7416	410	582	81	23	862	4191	0	13091
06:00	7408	410	329	229	23	778	3843	0	12553
07:00	7416	414	177	654	23	777	3729	0	12603
08:00	7426	464	29	1673	22	765	3883	0	13719
09:00	7421	491	67	2930	42	300	4175	0	15108
10:00	7421	488	267	4459	42	50	2794	0	14947
11:00	7402	493	243	5160	42	50	2531	0	15481
12:00	7385	485	401	5355	43	50	2103	0	15304
13:00	7387	492	515	4871	40	50	2642	0	15378
14:00	7383	492	539	4425	40	50	3186	0	15476
15:00	7358	489	530	4340	40	50	3071	0	15248
16:00	7347	490	482	3414	40	50	3991	0	15227
17:00	7342	491	515	2557	40	453	4260	0	14978
18:00	7363	486	382	1652	40	1449	4584	0	15412
19:00	7340	491	525	633	40	1466	5365	0	15198
20:00	7355	509	620	132	40	1169	4850	1532	15650
21:00	7356	509	325	0	40	1686	5078	1532	15891
22:00	7331	502	472	0	42	1531	5212	1532	16016
23:00	7352	485	325	0	42	1226	6006	0	14863

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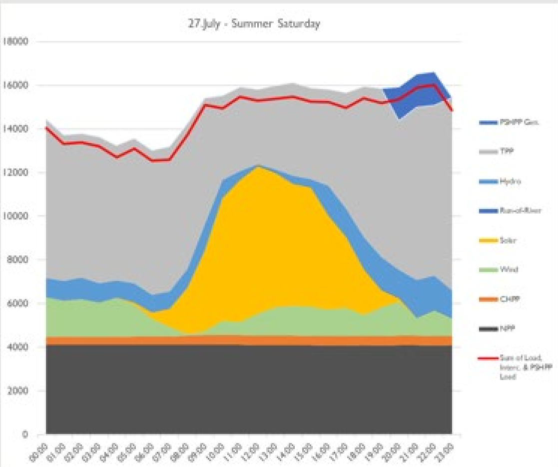
Figure 29: July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



27.07.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4115	362	1814	0	24	857	7272	0	14036
01:00	4124	367	1658	0	22	863	6696	0	13318
02:00	4116	355	1730	0	23	961	6608	0	13387
03:00	4121	358	1563	0	23	861	6710	0	13203
04:00	4110	364	1790	0	23	777	6186	0	12701
05:00	4120	365	1456	102	23	862	6638	0	13091
06:00	4116	364	823	290	23	778	6626	0	12553
07:00	4120	368	441	826	23	777	6634	0	12603
08:00	4126	413	72	2114	22	854	6662	0	13719
09:00	4123	436	167	3701	42	1143	5814	0	15108
10:00	4123	434	668	5633	42	754	3868	0	14947
11:00	4112	438	608	6518	42	349	3853	0	15481
12:00	4103	431	1002	6764	43	50	3429	0	15304
13:00	4104	438	1289	6153	40	122	3853	0	15378
14:00	4102	438	1348	5590	40	348	4251	0	15476
15:00	4088	434	1324	5482	40	325	4184	0	15248
16:00	4082	435	1205	4313	40	1317	4423	0	15227
17:00	4079	436	1289	3229	40	1263	5321	0	14978
18:00	4091	432	955	2087	40	1449	6903	0	15412
19:00	4078	436	1312	799	40	1466	7727	0	15198
20:00	4086	453	1551	166	40	1261	6831	1532	15363
21:00	4087	452	811	0	40	1686	7917	1532	15891
22:00	4073	446	1181	0	42	1531	7818	1532	16016
23:00	4085	431	811	0	42	1226	8841	0	14863

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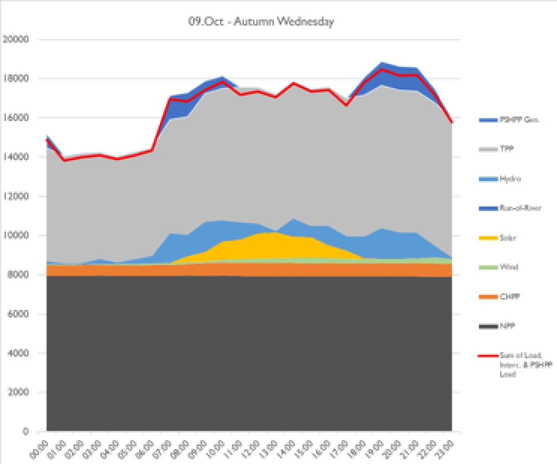
Figure 30: July 27th Summer Saturday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Oct 9th Autumn Wednesday: As-Is



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7951	546	46	0	12	139	5769	714	14864
01:00	7938	544	43	0	11	46	5484	0	13821
02:00	7956	544	37	0	11	48	5614	0	14000
03:00	7958	544	55	0	12	250	5433	0	14095
04:00	7946	543	69	0	12	48	5416	0	13889
05:00	7934	544	71	0	12	249	5461	0	14083
06:00	7957	546	73	0	12	390	5493	0	14330
07:00	7957	544	79	30	12	1503	5791	1208	16950
08:00	7961	590	95	300	13	1079	6027	1208	16818
09:00	7940	677	72	489	23	1507	6535	614	17408
10:00	7964	674	143	928	24	1057	6710	627	17821
11:00	7938	678	183	1015	25	847	6856	0	17176
12:00	7932	676	228	1293	24	466	6928	0	17353
13:00	7918	677	246	1319	25	48	6964	0	17041
14:00	7924	675	274	1066	28	923	6980	0	17764
15:00	7913	670	303	1034	28	545	6982	0	17339
16:00	7920	675	276	635	27	961	7075	0	17425
17:00	7913	676	240	409	25	706	7026	0	16634
18:00	7913	678	207	60	24	1077	7202	890	17791
19:00	7929	678	220	0	25	1542	7258	1208	18477
20:00	7918	675	226	0	25	1334	7235	1208	18158
21:00	7922	676	257	0	25	1267	7211	1208	18163
22:00	7897	678	313	0	25	579	7283	703	17196
23:00	7913	655	260	0	16	48	7062	0	15770

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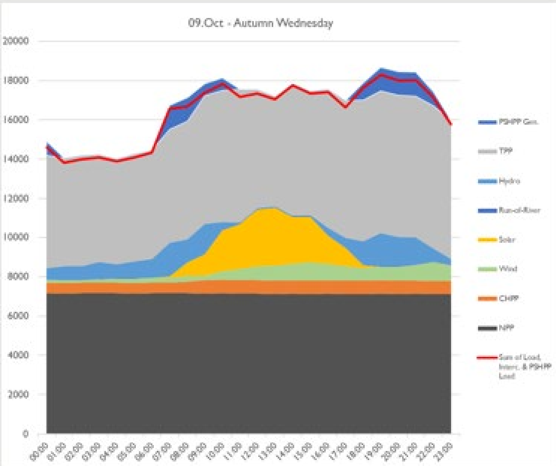
Figure 31: Oct 9th Autumn Wednesday: As-Is

Oct 9th Autumn Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7156	546	143	0	12	571	5769	714	14598
01:00	7144	544	134	0	11	703	5530	0	13821
02:00	7160	544	115	0	11	705	5675	0	14000
03:00	7162	544	171	0	12	858	5505	0	14095
04:00	7151	543	214	0	12	697	5416	0	13889
05:00	7141	544	221	0	12	857	5497	0	14083
06:00	7161	546	227	0	12	964	5561	0	14330
07:00	7161	544	246	67	12	1710	5791	1208	16565
08:00	7165	590	295	674	13	1172	6027	1208	16689
09:00	7146	677	224	1099	23	1522	6535	614	17391
10:00	7168	674	444	2086	24	394	6710	627	17821
11:00	7144	678	569	2282	25	50	6794	0	17176
12:00	7139	676	709	2906	24	50	6043	0	17353
13:00	7126	677	765	2965	25	48	5591	0	17041
14:00	7132	675	852	2396	28	50	6738	0	17764
15:00	7122	670	942	2324	28	50	6339	0	17339
16:00	7128	675	858	1427	27	379	7075	0	17425
17:00	7122	676	746	919	25	481	7026	0	16634
18:00	7122	678	643	135	24	1204	7202	890	17639
19:00	7136	678	684	0	25	1693	7258	1208	18298
20:00	7126	675	702	0	25	1494	7235	1208	18002
21:00	7130	676	799	0	25	1376	7211	1208	18021
22:00	7107	678	973	0	25	654	7283	703	17141
23:00	7122	655	808	0	16	291	7062	0	15770

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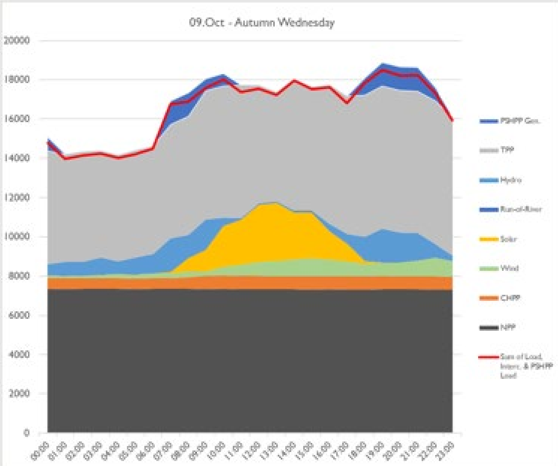
Figure 32: Oct 9th Autumn Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 9th Autumn Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7355	546	143	0	12	543	5769	714	14769
01:00	7343	544	134	0	11	695	5484	0	13965
02:00	7359	544	115	0	11	703	5614	0	14137
03:00	7361	544	171	0	12	858	5443	0	14232
04:00	7350	543	214	0	12	635	5416	0	14026
05:00	7339	544	221	0	12	833	5461	0	14222
06:00	7360	546	227	0	12	964	5509	0	14477
07:00	7360	544	246	67	12	1698	5791	1208	16752
08:00	7364	590	295	674	13	1161	6027	1208	16877
09:00	7345	677	224	1099	23	1514	6535	614	17581
10:00	7367	674	444	2086	24	377	6710	627	18003
11:00	7343	678	569	2282	25	50	6775	0	17355
12:00	7337	676	709	2906	24	50	6023	0	17531
13:00	7324	677	765	2965	25	48	5569	0	17217
14:00	7330	675	852	2396	28	50	6718	0	17943
15:00	7320	670	942	2324	28	50	6317	0	17514
16:00	7326	675	858	1427	27	357	7075	0	17601
17:00	7320	676	746	919	25	459	7026	0	16810
18:00	7320	678	643	135	24	1196	7202	890	17828
19:00	7334	678	684	0	25	1690	7258	1208	18493
20:00	7324	675	702	0	25	1490	7235	1208	18196
21:00	7328	676	799	0	25	1371	7211	1208	18214
22:00	7305	678	973	0	25	642	7283	703	17326
23:00	7320	655	808	0	16	257	7062	0	15934

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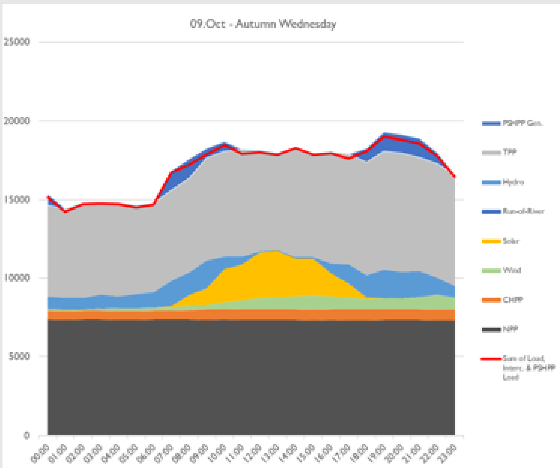
Figure 33: Oct 9th Autumn Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 9th Autumn Wednesday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7355	546	143	0	12	774	5812	714	15127
01:00	7343	544	134	0	11	703	5674	0	14234
02:00	7359	544	115	0	11	705	6101	0	14702
03:00	7361	544	171	0	12	858	5916	0	14753
04:00	7350	543	214	0	12	705	5984	0	14723
05:00	7339	544	221	0	12	857	5663	0	14504
06:00	7360	546	227	0	12	964	5673	0	14673
07:00	7360	544	246	67	12	1603	5791	1208	16730
08:00	7364	590	295	674	13	1427	6027	1208	17212
09:00	7345	677	224	1099	23	1751	6535	614	17894
10:00	7367	674	444	2086	24	777	6710	627	18474
11:00	7343	678	569	2282	25	466	6856	0	17915
12:00	7337	676	709	2906	24	50	6449	0	17999
13:00	7324	677	765	2965	25	48	6166	0	17867
14:00	7330	675	852	2396	28	50	6960	0	18277
15:00	7320	670	942	2324	28	50	6586	0	17861
16:00	7326	675	858	1427	27	641	7075	0	17964
17:00	7320	676	746	919	25	1203	7029	0	17613
18:00	7320	678	643	135	24	1381	7202	890	18064
19:00	7334	678	684	0	25	1836	7539	1208	19025
20:00	7324	675	702	0	25	1679	7553	1208	18801
21:00	7328	676	799	0	25	1628	7241	1208	18570
22:00	7305	678	973	0	25	1030	7283	703	17804
23:00	7320	655	808	0	16	698	7062	0	16445

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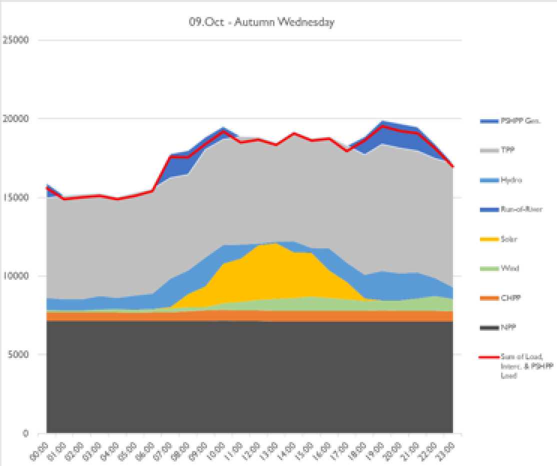
Figure 34: Oct 9th Autumn Wednesday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7156	546	138	0	12	774	6358	940	15611
01:00	7144	544	129	0	11	703	6602	0	14888
02:00	7160	544	111	0	11	705	6691	0	15012
03:00	7162	544	165	0	12	858	6526	0	15110
04:00	7151	543	207	0	12	705	6426	0	14900
05:00	7141	544	213	0	12	857	6532	0	15111
06:00	7161	546	219	0	12	964	6657	0	15418
07:00	7161	544	237	81	12	1807	6399	1532	17599
08:00	7165	590	286	810	13	1486	6117	1532	17543
09:00	7146	677	216	1321	23	1810	6853	809	18407
10:00	7168	674	430	2507	24	1176	6710	827	19209
11:00	7144	678	550	2742	25	875	6856	0	18504
12:00	7139	676	685	3493	24	50	6799	0	18672
13:00	7126	677	739	3563	25	48	6321	0	18344
14:00	7132	675	824	2880	28	676	6980	0	19088
15:00	7122	670	911	2793	28	266	6982	0	18636
16:00	7128	675	830	1715	27	1396	7104	0	18731
17:00	7122	676	721	1105	25	1203	7445	0	17936
18:00	7122	678	622	162	24	1484	7624	1173	18630
19:00	7136	678	661	0	25	1836	8057	1532	19542
20:00	7126	675	679	0	25	1679	7977	1532	19230
21:00	7130	676	773	0	25	1628	7722	1532	19082
22:00	7107	678	941	0	25	1107	7620	926	18122
23:00	7122	655	782	0	16	705	7886	0	16981

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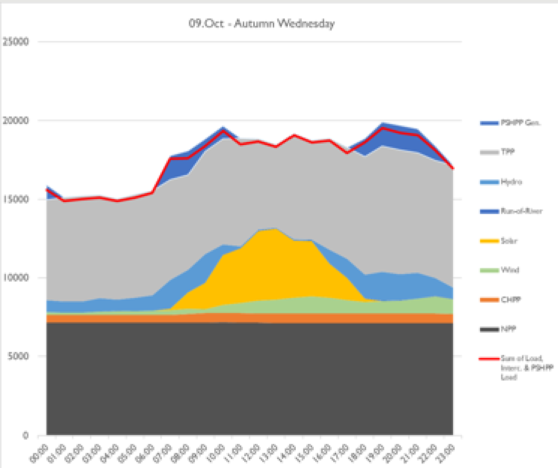
Figure 35: Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7156	491	166	0	12	774	6385	940	15611
01:00	7144	490	155	0	11	703	6630	0	14888
02:00	7160	490	133	0	11	705	6723	0	15012
03:00	7162	490	198	0	12	858	6547	0	15110
04:00	7151	489	249	0	12	705	6439	0	14900
05:00	7141	490	256	0	12	857	6544	0	15111
06:00	7161	491	263	0	12	964	6667	0	15418
07:00	7161	490	285	103	12	1807	6384	1532	17599
08:00	7165	531	343	1026	13	1446	6027	1532	17628
09:00	7146	609	260	1673	23	1806	6535	809	18413
10:00	7168	607	516	3175	24	646	6710	827	19366
11:00	7144	610	660	3473	25	102	6856	0	18504
12:00	7139	608	822	4424	24	50	5798	0	18672
13:00	7126	609	887	4513	25	48	5291	0	18344
14:00	7132	608	988	3647	28	50	6741	0	19088
15:00	7122	603	1093	3538	28	50	6338	0	18636
16:00	7128	608	996	2173	27	869	7075	0	18731
17:00	7122	608	866	1399	25	1203	7074	0	17936
18:00	7122	610	747	205	24	1484	7524	1173	18630
19:00	7136	610	794	0	25	1836	7992	1532	19542
20:00	7126	608	815	0	25	1679	7908	1532	19230
21:00	7130	608	927	0	25	1628	7635	1532	19082
22:00	7107	610	1129	0	25	1107	7500	926	18122
23:00	7122	590	938	0	16	705	7795	0	16981

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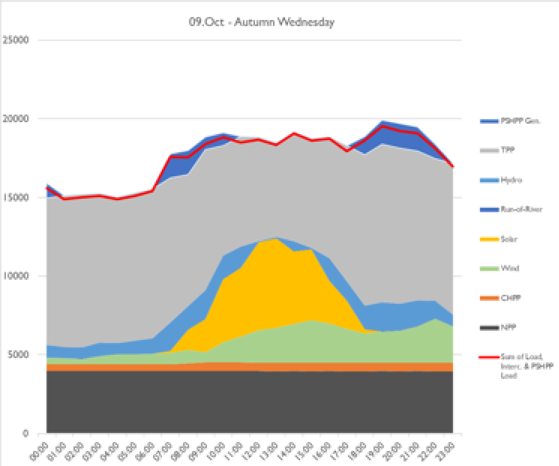
Figure 36: Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



09.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	3976	437	415	0	12	774	9371	940	15611
01:00	3969	435	388	0	11	703	9627	0	14888
02:00	3978	435	334	0	11	705	9760	0	15012
03:00	3979	435	496	0	12	858	9487	0	15110
04:00	3973	434	622	0	12	705	9298	0	14900
05:00	3967	435	640	0	12	857	9387	0	15111
06:00	3979	437	658	0	12	964	9510	0	15418
07:00	3979	435	712	130	12	1807	9167	1532	17599
08:00	3981	472	857	1297	13	1486	8362	1532	17543
09:00	3970	542	649	2113	23	1810	8939	809	18407
10:00	3982	539	1290	4011	24	1469	6988	827	18823
11:00	3969	542	1650	4387	25	1310	6987	0	18504
12:00	3966	541	2056	5588	24	50	6641	0	18672
13:00	3959	542	2218	5701	25	48	6007	0	18344
14:00	3962	540	2471	4607	28	606	6980	0	19088
15:00	3957	536	2732	4469	28	68	6982	0	18636
16:00	3960	540	2489	2744	27	1396	7718	0	18731
17:00	3957	541	2164	1768	25	1203	8640	0	17936
18:00	3957	542	1867	259	24	1484	9583	1173	18630
19:00	3965	542	1984	0	25	1836	10041	1532	19542
20:00	3959	540	2038	0	25	1679	9920	1532	19230
21:00	3961	541	2318	0	25	1628	9481	1532	19082
22:00	3949	542	2823	0	25	1107	9033	926	18122
23:00	3957	524	2345	0	16	705	9619	0	16981

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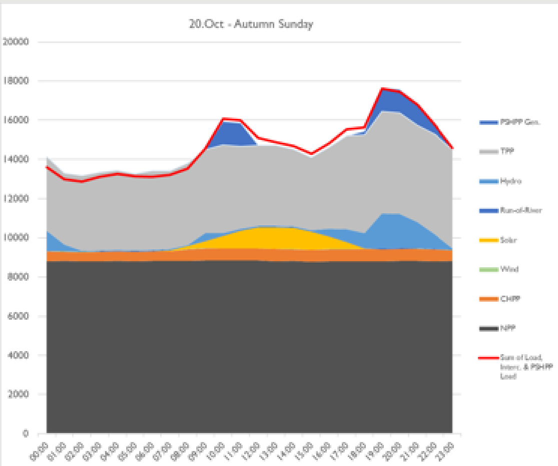
Figure 37: Oct 9th Autumn Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Oct 20th Autumn Sunday: As-Is



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8802	506	5	0	18	1044	3783	0	13592
01:00	8821	475	7	0	18	344	3643	0	12995
02:00	8793	483	5	0	18	46	3820	0	12863
03:00	8808	474	7	0	18	48	3993	0	13117
04:00	8832	472	12	0	18	46	4072	0	13271
05:00	8808	478	8	0	18	48	3921	0	13128
06:00	8829	475	13	0	18	46	4048	0	13123
07:00	8830	483	11	44	18	48	3997	0	13205
08:00	8835	583	13	142	19	48	4167	0	13529
09:00	8849	619	8	350	26	399	4244	0	14565
10:00	8845	617	10	633	27	117	4482	1208	16065
11:00	8845	611	13	888	28	69	4206	1208	15996
12:00	8840	610	8	1076	27	48	4106	0	15099
13:00	8810	620	4	1107	27	48	4108	0	14881
14:00	8816	606	4	1078	27	48	3932	0	14681
15:00	8779	606	9	916	27	48	3717	0	14288
16:00	8797	621	10	643	27	368	4156	0	14832
17:00	8802	615	10	340	27	634	4788	0	15526
18:00	8807	619	6	34	27	759	4997	199	15621
19:00	8803	614	2	4	28	1782	5223	1208	17610
20:00	8817	618	8	2	37	1731	5152	1208	17429
21:00	8822	621	6	2	28	1316	4938	1135	16773
22:00	8790	617	6	1	28	719	5124	439	15757
23:00	8814	553	9	1	27	48	5043	199	14576

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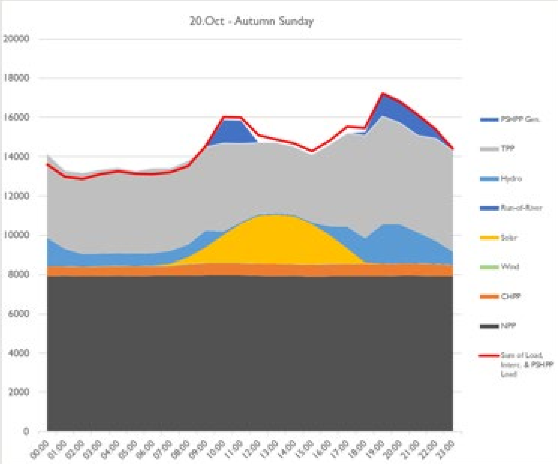
Figure 38: Oct 20th Autumn Sunday: As-Is

Oct 20th Autumn Sunday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	7922	506	16	0	18	1409	4288	0	13592
01:00	7939	475	22	0	18	858	3996	0	12995
02:00	7914	483	16	0	18	624	4111	0	12863
03:00	7927	474	22	0	18	625	4282	0	13117
04:00	7949	472	37	0	18	624	4352	0	13271
05:00	7927	478	25	0	18	625	4208	0	13128
06:00	7946	475	40	0	18	624	4326	0	13123
07:00	7947	483	34	99	18	625	4225	0	13205
08:00	7952	583	40	319	19	625	4269	0	13529
09:00	7964	619	25	787	26	830	4244	0	14565
10:00	7961	617	31	1423	27	145	4482	1208	16019
11:00	7961	611	40	1996	28	50	3974	1208	15996
12:00	7956	610	25	2419	27	48	3630	0	15099
13:00	7929	620	12	2488	27	48	3599	0	14881
14:00	7934	606	12	2423	27	48	3460	0	14681
15:00	7901	606	28	2059	27	48	3433	0	14288
16:00	7917	621	31	1445	27	424	4156	0	14832
17:00	7922	615	31	764	27	1069	4788	0	15526
18:00	7926	619	19	76	27	1185	5236	199	15460
19:00	7923	614	6	9	28	1990	5498	1208	17221
20:00	7935	618	25	4	37	1938	5152	1208	16773
21:00	7940	621	19	4	28	1533	4938	1135	16123
22:00	7911	617	19	2	28	1153	5200	439	15402
23:00	7933	553	28	2	27	625	5166	199	14415

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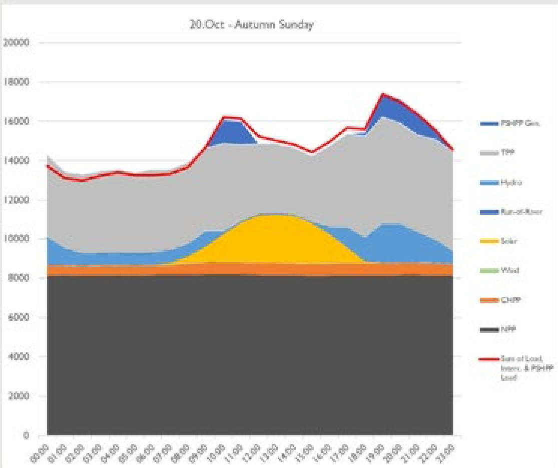
Figure 39: Oct 20th Autumn Sunday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 20th Autumn Sunday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	8142	506	16	0	18	1409	4206	0	13731
01:00	8159	475	22	0	18	858	3907	0	13127
02:00	8134	483	16	0	18	624	4018	0	12989
03:00	8147	474	22	0	18	625	4187	0	13242
04:00	8170	472	37	0	18	624	4257	0	13396
05:00	8147	478	25	0	18	625	4113	0	13253
06:00	8167	475	40	0	18	624	4233	0	13251
07:00	8168	483	34	99	18	625	4137	0	13338
08:00	8172	583	40	319	19	625	4185	0	13667
09:00	8185	619	25	787	26	754	4244	0	14710
10:00	8182	617	31	1423	27	119	4482	1208	16214
11:00	8182	611	40	1996	28	50	3902	1208	16145
12:00	8177	610	25	2419	27	48	3557	0	15246
13:00	8149	620	12	2488	27	48	3524	0	15026
14:00	8155	606	12	2423	27	48	3383	0	14825
15:00	8121	606	28	2059	27	48	3356	0	14431
16:00	8137	621	31	1445	27	348	4156	0	14976
17:00	8142	615	31	764	27	998	4788	0	15675
18:00	8146	619	19	76	27	1185	5172	199	15616
19:00	8143	614	6	9	28	1990	5447	1208	17390
20:00	8156	618	25	4	37	1926	5152	1208	16981
21:00	8160	621	19	4	28	1520	4938	1135	16330
22:00	8131	617	19	2	28	1153	5138	439	15560
23:00	8153	553	28	2	27	625	5092	199	14562

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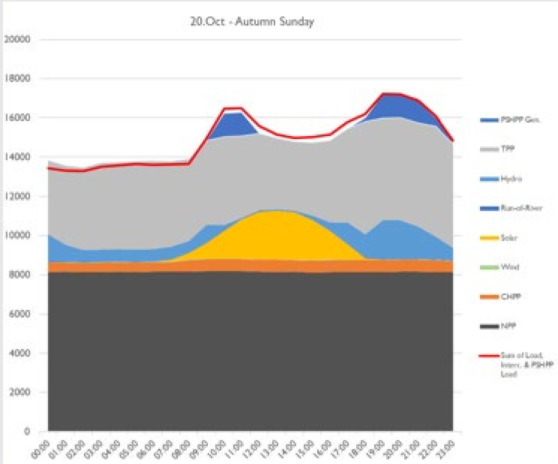
Figure 40: Oct 20th Autumn Sunday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 20th Autumn Sunday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8142	506	16	0	18	1382	3783	0	13424
01:00	8159	475	22	0	18	858	4044	0	13305
02:00	8134	483	16	0	18	624	4185	0	13282
03:00	8147	474	22	0	18	625	4424	0	13509
04:00	8170	472	37	0	18	624	4423	0	13582
05:00	8147	478	25	0	18	625	4493	0	13644
06:00	8167	475	40	0	18	624	4479	0	13607
07:00	8168	483	34	99	18	625	4354	0	13626
08:00	8172	583	40	319	19	605	4167	0	13648
09:00	8185	619	25	787	26	901	4297	0	14950
10:00	8182	617	31	1423	27	264	4482	1208	16468
11:00	8182	611	40	1996	28	50	4170	1208	16490
12:00	8177	610	25	2419	27	48	3902	0	15594
13:00	8149	620	12	2488	27	48	3608	0	15138
14:00	8155	606	12	2423	27	48	3519	0	14975
15:00	8121	606	28	2059	27	177	3717	0	15030
16:00	8137	621	31	1445	27	424	4156	0	15154
17:00	8142	615	31	764	27	1083	4788	0	15784
18:00	8146	619	19	76	27	1185	5745	199	16201
19:00	8143	614	6	9	28	1975	5223	1208	17221
20:00	8156	618	25	4	37	1950	5232	1208	17186
21:00	8160	621	19	4	28	1623	5282	1135	16876
22:00	8131	617	19	2	28	1153	5627	439	16102
23:00	8153	553	28	2	27	625	5267	199	14842

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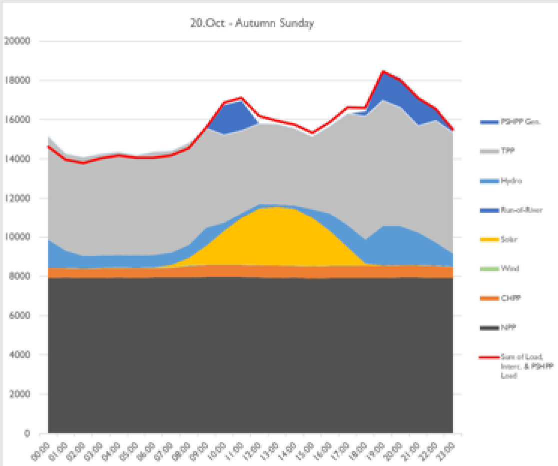
Figure 41: Oct 20th Autumn Sunday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7922	506	15	0	18	1409	5316	0	14619
01:00	7939	475	21	0	18	858	4971	0	13969
02:00	7914	483	15	0	18	624	5048	0	13799
03:00	7927	474	21	0	18	625	5208	0	14042
04:00	7949	472	36	0	18	624	5279	0	14197
05:00	7927	478	24	0	18	625	5137	0	14057
06:00	7946	475	39	0	18	624	5278	0	14074
07:00	7947	483	33	119	18	625	5190	0	14189
08:00	7952	583	39	384	19	625	5224	0	14548
09:00	7964	619	24	945	26	901	5090	0	15640
10:00	7961	617	30	1710	27	399	4482	1532	16883
11:00	7961	611	39	2399	28	211	4206	1532	17114
12:00	7956	610	24	2907	27	174	4106	0	16188
13:00	7929	620	12	2990	27	113	4108	0	15956
14:00	7934	606	12	2912	27	151	3932	0	15745
15:00	7901	606	27	2474	27	406	3717	0	15345
16:00	7917	621	30	1737	27	877	4476	0	15895
17:00	7922	615	30	918	27	1086	5723	0	16632
18:00	7926	619	18	92	27	1185	6315	262	16617
19:00	7923	614	6	11	28	1990	6421	1532	18470
20:00	7935	618	24	5	37	1950	6041	1532	17997
21:00	7940	621	18	5	28	1623	5455	1496	17091
22:00	7911	617	18	3	28	1153	6228	579	16570
23:00	7933	553	27	3	27	625	6188	262	15500

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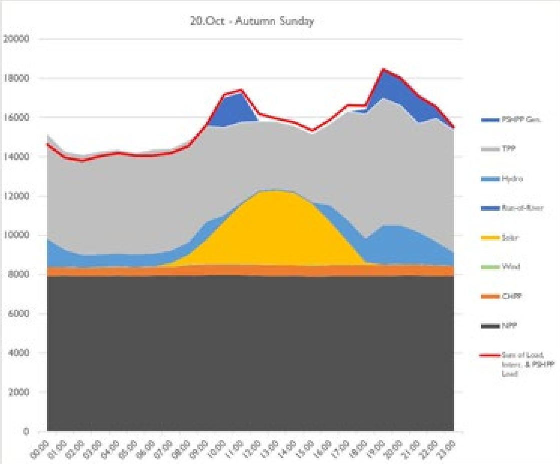
Figure 42: Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7922	455	18	0	18	1409	5363	0	14619
01:00	7939	428	25	0	18	858	5014	0	13969
02:00	7914	435	18	0	18	624	5093	0	13799
03:00	7927	427	25	0	18	625	5251	0	14042
04:00	7949	425	43	0	18	624	5319	0	14197
05:00	7927	430	29	0	18	625	5180	0	14057
06:00	7946	428	47	0	18	624	5317	0	14074
07:00	7947	435	40	151	18	625	5200	0	14189
08:00	7952	525	47	486	19	625	5172	0	14548
09:00	7964	557	29	1198	26	901	4895	0	15640
10:00	7961	555	36	2166	27	275	4482	1532	17160
11:00	7961	550	47	3038	28	50	4092	1532	17425
12:00	7956	549	29	3682	27	48	3513	0	16188
13:00	7929	558	14	3788	27	48	3435	0	15956
14:00	7934	545	14	3689	27	48	3317	0	15745
15:00	7901	545	32	3134	27	48	3471	0	15345
16:00	7917	559	36	2200	27	790	4156	0	15895
17:00	7922	554	36	1163	27	1086	5534	0	16632
18:00	7926	557	22	116	27	1185	6349	262	16617
19:00	7923	553	7	14	28	1990	6478	1532	18470
20:00	7935	556	29	7	37	1950	6096	1532	17997
21:00	7940	559	22	7	28	1623	5512	1496	17091
22:00	7911	555	22	3	28	1153	6285	579	16570
23:00	7933	498	32	3	27	625	6237	262	15500

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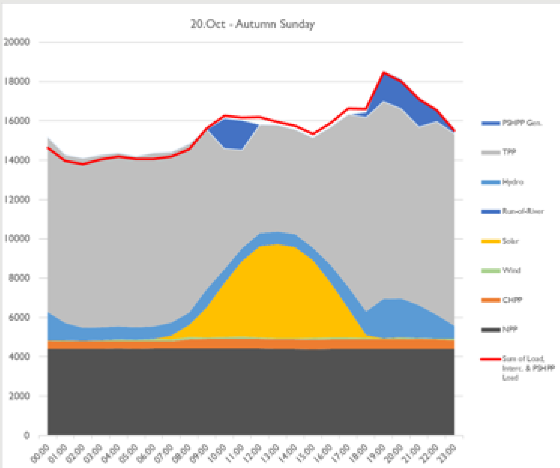
Figure 43: Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



20.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4401	405	45	0	18	1409	8907	0	14619
01:00	4411	380	63	0	18	858	8552	0	13969
02:00	4397	386	45	0	18	624	8631	0	13799
03:00	4404	379	63	0	18	625	8784	0	14042
04:00	4416	378	108	0	18	624	8834	0	14197
05:00	4404	382	72	0	18	625	8708	0	14057
06:00	4415	380	117	0	18	624	8826	0	14074
07:00	4415	386	99	190	18	625	8681	0	14189
08:00	4418	466	117	614	19	625	8566	0	14548
09:00	4425	495	72	1513	26	901	8138	0	15640
10:00	4423	494	90	2736	27	680	6153	1532	16259
11:00	4423	489	117	3838	28	642	4976	1532	16172
12:00	4420	488	72	4651	27	625	5521	0	16188
13:00	4405	496	36	4785	27	625	5426	0	15956
14:00	4408	485	36	4659	27	625	5334	0	15745
15:00	4390	485	81	3959	27	625	5592	0	15345
16:00	4399	497	90	2779	27	877	7016	0	15895
17:00	4401	492	90	1469	27	1086	8756	0	16632
18:00	4404	495	54	147	27	1185	9871	262	16617
19:00	4402	491	18	17	28	1990	10046	1532	18470
20:00	4409	494	72	9	37	1950	9640	1532	17997
21:00	4411	497	54	9	28	1623	9069	1496	17091
22:00	4395	494	54	4	28	1153	9830	579	16570
23:00	4407	442	81	4	27	625	9769	262	15500

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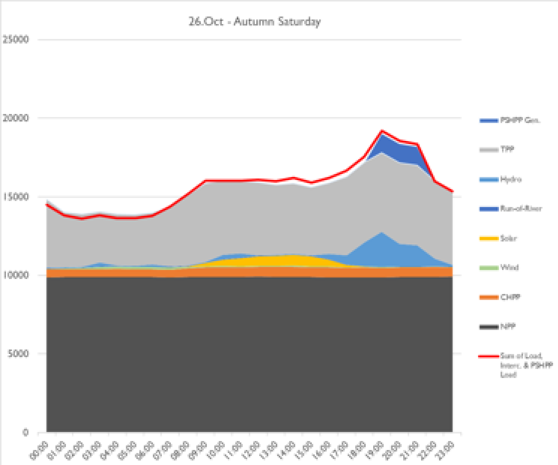
Figure 44: Oct 20th Autumn Sunday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Oct 26th Autumn Saturday: As-Is



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9877	514	42	0	16	46	4360	0	14506
01:00	9887	489	63	0	16	48	3514	0	13822
02:00	9895	489	101	0	16	48	3352	0	13604
03:00	9903	502	144	0	16	249	3246	0	13814
04:00	9916	500	158	0	16	48	3264	0	13656
05:00	9896	499	142	0	16	48	3286	0	13635
06:00	9896	506	136	0	16	150	3304	0	13791
07:00	9882	489	141	0	16	48	3787	0	14376
08:00	9909	529	94	51	16	48	4487	0	15172
09:00	9906	598	84	190	18	48	5008	0	16035
10:00	9911	601	105	395	18	268	4755	0	16014
11:00	9909	608	70	504	20	287	4592	0	16039
12:00	9918	634	37	634	17	48	4645	0	16090
13:00	9910	636	46	644	17	46	4462	0	15996
14:00	9904	635	89	674	17	48	4483	0	16196
15:00	9890	627	66	634	17	48	4338	0	15909
16:00	9879	624	68	443	17	350	4495	0	16210
17:00	9875	595	51	147	17	606	4983	0	16656
18:00	9872	626	56	6	17	1525	5093	0	17547
19:00	9864	627	42	0	19	2209	5062	1208	19207
20:00	9896	625	20	0	19	1453	5160	1208	18549
21:00	9898	623	34	0	19	1332	5112	1208	18336
22:00	9913	622	25	0	19	473	4950	0	15996
23:00	9917	605	19	0	19	105	4679	0	15358

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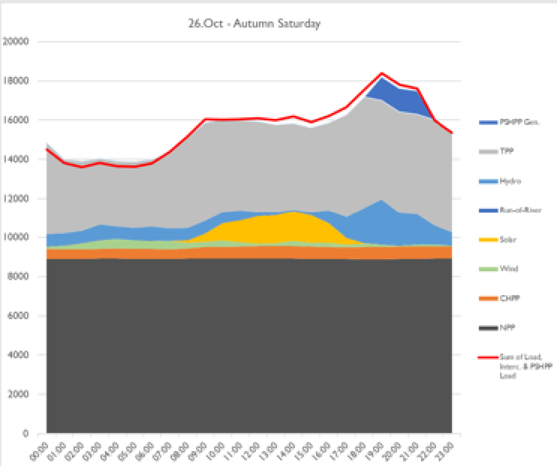
Figure 45: Oct 26th Autumn Saturday: As-Is

Oct 26th Autumn Saturday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8889	514	131	0	16	621	4684	0	14506
01:00	8898	489	196	0	16	622	3795	0	13822
02:00	8906	489	314	0	16	622	3554	0	13604
03:00	8913	502	448	0	16	781	3401	0	13814
04:00	8924	500	491	0	16	622	3348	0	13656
05:00	8906	499	441	0	16	622	3402	0	13635
06:00	8906	506	423	0	16	703	3454	0	13791
07:00	8894	489	438	0	16	622	3903	0	14376
08:00	8918	529	292	115	16	622	4642	0	15172
09:00	8915	598	261	427	18	622	5010	0	16035
10:00	8920	601	326	888	18	545	4755	0	16014
11:00	8918	608	218	1133	20	501	4592	0	16039
12:00	8926	634	115	1425	17	171	4645	0	16090
13:00	8919	636	143	1448	17	136	4462	0	15996
14:00	8914	635	277	1515	17	48	4445	0	16196
15:00	8901	627	205	1425	17	107	4338	0	15909
16:00	8891	624	211	996	17	642	4495	0	16210
17:00	8888	595	159	330	17	1062	5223	0	16656
18:00	8885	626	174	13	17	1786	5694	0	17547
19:00	8878	627	131	0	19	2298	5062	1208	18397
20:00	8906	625	62	0	19	1647	5160	1208	17796
21:00	8908	623	106	0	19	1536	5112	1208	17622
22:00	8922	622	78	0	19	957	5404	0	15996
23:00	8925	605	59	0	19	667	5068	0	15358

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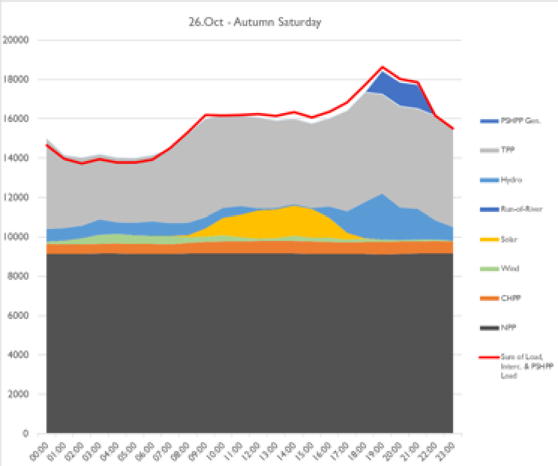
Figure 46: Oct 26th Autumn Saturday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 26th Autumn Saturday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9136	514	131	0	16	621	4585	0	14653
01:00	9145	489	196	0	16	622	3687	0	13961
02:00	9153	489	314	0	16	622	3440	0	13737
03:00	9160	502	448	0	16	781	3286	0	13947
04:00	9172	500	491	0	16	589	3264	0	13786
05:00	9154	499	441	0	16	622	3286	0	13767
06:00	9154	506	423	0	16	703	3342	0	13927
07:00	9141	489	438	0	16	622	3796	0	14516
08:00	9166	529	292	115	16	622	4541	0	15319
09:00	9163	598	261	427	18	536	5008	0	16194
10:00	9168	601	326	888	18	460	4755	0	16177
11:00	9166	608	218	1133	20	416	4592	0	16201
12:00	9174	634	115	1425	17	82	4645	0	16250
13:00	9167	636	143	1448	17	46	4462	0	16153
14:00	9161	635	277	1515	17	48	4354	0	16353
15:00	9148	627	205	1425	17	48	4306	0	16065
16:00	9138	624	211	996	17	552	4495	0	16367
17:00	9134	595	159	330	17	1062	5138	0	16817
18:00	9132	626	174	13	17	1786	5617	0	17717
19:00	9124	627	131	0	19	2291	5062	1208	18637
20:00	9154	625	62	0	19	1633	5160	1208	18028
21:00	9156	623	106	0	19	1519	5112	1208	17852
22:00	9170	622	78	0	19	957	5320	0	16160
23:00	9173	605	59	0	19	667	4975	0	15513

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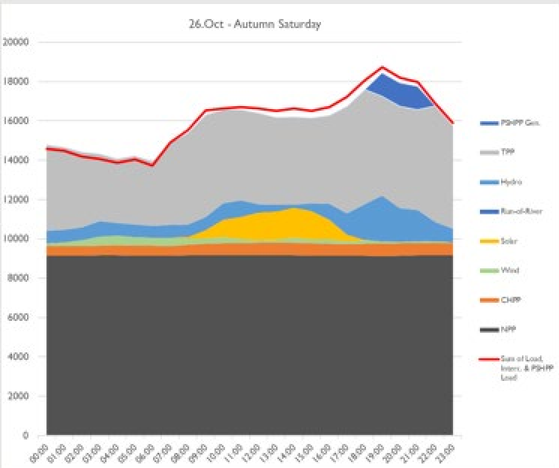
Figure 47: Oct 26th Autumn Saturday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 26th Autumn Saturday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9136	514	131	0	16	621	4364	0	14575
01:00	9145	489	196	0	16	622	4204	0	14490
02:00	9153	489	314	0	16	622	3819	0	14190
03:00	9160	502	448	0	16	781	3407	0	14062
04:00	9172	500	491	0	16	622	3269	0	13878
05:00	9154	499	441	0	16	622	3485	0	14032
06:00	9154	506	423	0	16	565	3304	0	13734
07:00	9141	489	438	0	16	622	4182	0	14888
08:00	9166	529	292	115	16	622	4669	0	15544
09:00	9163	598	261	427	18	622	5223	0	16548
10:00	9168	601	326	888	18	796	4785	0	16627
11:00	9166	608	218	1133	20	811	4619	0	16707
12:00	9174	634	115	1425	17	382	4645	0	16632
13:00	9167	636	143	1448	17	316	4462	0	16509
14:00	9161	635	277	1515	17	122	4483	0	16630
15:00	9148	627	205	1425	17	387	4338	0	16521
16:00	9138	624	211	996	17	796	4495	0	16701
17:00	9134	595	159	330	17	1062	5440	0	17209
18:00	9132	626	174	13	17	1786	5848	0	18056
19:00	9124	627	131	0	19	2294	5062	1208	18735
20:00	9154	625	62	0	19	1712	5160	1208	18192
21:00	9156	623	106	0	19	1557	5112	1208	17984
22:00	9170	622	78	0	19	957	5928	0	16897
23:00	9173	605	59	0	19	667	5244	0	15910

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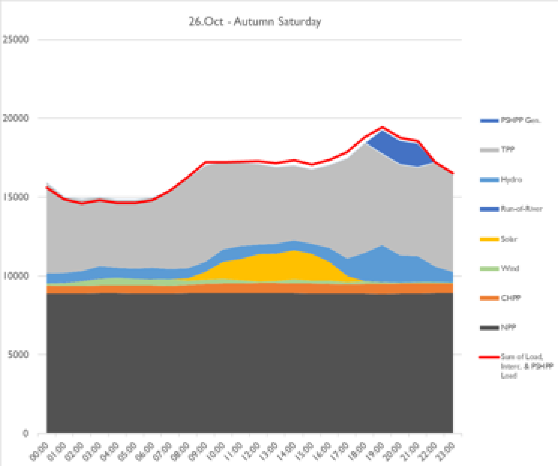
Figure 48: Oct 26th Autumn Saturday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8889	514	126	0	16	621	5779	0	15597
01:00	8898	489	189	0	16	622	4832	0	14852
02:00	8906	489	304	0	16	622	4552	0	14592
03:00	8913	502	433	0	16	781	4396	0	14795
04:00	8924	500	475	0	16	622	4326	0	14618
05:00	8906	499	427	0	16	622	4390	0	14609
06:00	8906	506	409	0	16	703	4472	0	14795
07:00	8894	489	424	0	16	622	4953	0	15411
08:00	8918	529	283	138	16	622	5719	0	16263
09:00	8915	598	252	513	18	622	6110	0	17213
10:00	8920	601	316	1067	18	796	5542	0	17221
11:00	8918	608	210	1361	20	811	5261	0	17239
12:00	8926	634	111	1713	17	622	5092	0	17272
13:00	8919	636	138	1740	17	621	4854	0	17160
14:00	8914	635	268	1821	17	622	4733	0	17355
15:00	8901	627	198	1713	17	622	4697	0	17064
16:00	8891	624	204	1197	17	860	5245	0	17372
17:00	8888	595	153	397	17	1062	6354	0	17848
18:00	8885	626	168	16	17	1786	6955	0	18806
19:00	8878	627	126	0	19	2325	5777	1532	19459
20:00	8906	625	60	0	19	1729	5731	1532	18771
21:00	8908	623	102	0	19	1634	5620	1532	18548
22:00	8922	622	75	0	19	957	6619	0	17208
23:00	8925	605	57	0	19	667	6214	0	16502

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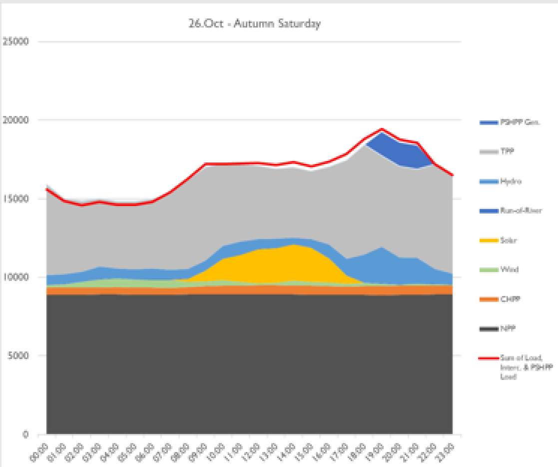
Figure 49: Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8889	463	151	0	16	621	5805	0	15597
01:00	8898	440	227	0	16	622	4843	0	14852
02:00	8906	440	364	0	16	622	4540	0	14592
03:00	8913	452	519	0	16	781	4360	0	14795
04:00	8924	450	570	0	16	622	4281	0	14618
05:00	8906	449	512	0	16	622	4354	0	14609
06:00	8906	455	491	0	16	703	4440	0	14795
07:00	8894	440	509	0	16	622	4917	0	15411
08:00	8918	476	339	175	16	622	5678	0	16263
09:00	8915	538	303	650	18	622	5982	0	17213
10:00	8920	541	379	1352	18	796	5255	0	17221
11:00	8918	547	252	1724	20	811	4917	0	17239
12:00	8926	571	133	2169	17	622	4676	0	17272
13:00	8919	572	166	2204	17	585	4462	0	17160
14:00	8914	572	321	2306	17	397	4483	0	17355
15:00	8901	564	238	2169	17	547	4338	0	17064
16:00	8891	562	245	1516	17	860	4947	0	17372
17:00	8888	536	184	503	17	1062	6277	0	17848
18:00	8885	563	202	21	17	1786	6980	0	18806
19:00	8878	564	151	0	19	2325	5814	1532	19459
20:00	8906	563	72	0	19	1729	5782	1532	18771
21:00	8908	561	123	0	19	1634	5662	1532	18548
22:00	8922	560	90	0	19	957	6666	0	17208
23:00	8925	545	69	0	19	667	6264	0	16502

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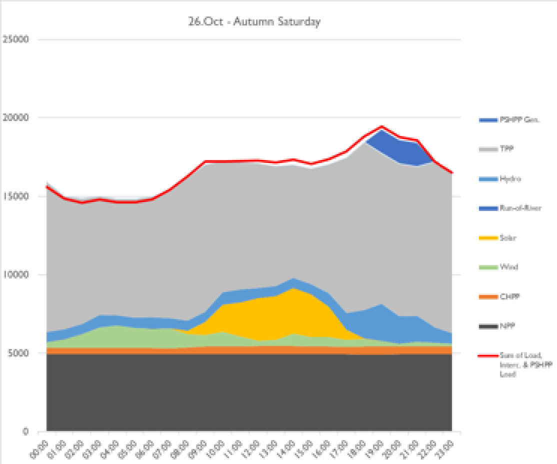
Figure 50: Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



26.10.2019	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4939	411	379	0	16	621	9580	0	15597
01:00	4944	391	568	0	16	622	8506	0	14852
02:00	4948	391	911	0	16	622	8001	0	14592
03:00	4952	402	1299	0	16	781	7592	0	14795
04:00	4958	400	1425	0	16	622	7443	0	14618
05:00	4948	399	1281	0	16	622	7594	0	14609
06:00	4948	405	1226	0	16	703	7714	0	14795
07:00	4941	391	1271	0	16	622	8156	0	15411
08:00	4955	423	848	220	16	622	9140	0	16263
09:00	4953	478	757	821	18	622	9379	0	17213
10:00	4956	481	947	1707	18	796	8356	0	17221
11:00	4955	486	631	2178	20	811	8108	0	17239
12:00	4959	507	334	2740	17	622	7936	0	17272
13:00	4955	509	415	2783	17	621	7625	0	17160
14:00	4952	508	803	2913	17	622	7194	0	17355
15:00	4945	502	595	2740	17	622	7354	0	17064
16:00	4940	499	613	1915	17	860	8194	0	17372
17:00	4938	476	460	635	17	1062	9878	0	17848
18:00	4936	501	505	26	17	1786	10683	0	18806
19:00	4932	502	379	0	19	2325	9595	1532	19459
20:00	4948	500	180	0	19	1729	9694	1532	18771
21:00	4949	498	307	0	19	1634	9500	1532	18548
22:00	4957	498	225	0	19	957	10558	0	17208
23:00	4959	484	171	0	19	667	10188	0	16502

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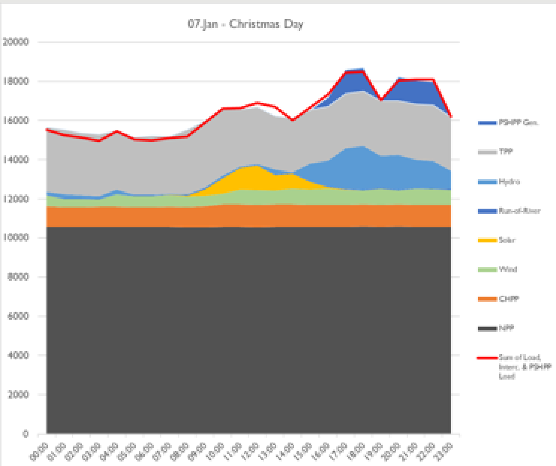
Figure 51: Oct 26th Autumn Saturday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Jan 7th Christmas Day: As-Is



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	10571	1063	559	0	23	145	3308	0	15525
01:00	10564	1032	402	0	22	235	3290	0	15262
02:00	10554	1044	416	0	22	166	3176	0	15151
03:00	10553	1047	388	0	22	138	3151	0	14960
04:00	10562	1047	626	0	22	240	3007	0	15470
05:00	10554	1041	559	0	22	46	2937	0	15040
06:00	10555	1036	564	0	22	48	3006	0	14985
07:00	10559	1044	598	11	22	48	2930	0	15123
08:00	10542	1052	530	51	23	38	3315	0	15202
09:00	10542	1093	541	325	31	47	3416	0	15907
10:00	10571	1163	542	774	32	117	3417	0	16611
11:00	10568	1163	759	1099	32	48	2903	0	16635
12:00	10548	1161	758	1240	29	49	2918	0	16912
13:00	10564	1158	729	767	29	270	2718	0	16702
14:00	10568	1164	801	767	31	48	2757	0	16026
15:00	10553	1153	793	378	30	899	2746	0	16673
16:00	10562	1157	832	64	29	1314	2751	480	17346
17:00	10551	1157	771	1	29	2076	2797	1208	18436
18:00	10576	1155	716	0	32	2242	2781	1208	18489
19:00	10567	1152	831	0	32	1630	2799	0	17056
20:00	10584	1158	702	0	32	1768	2778	1208	18052
21:00	10563	1156	822	0	33	1426	2851	1208	18095
22:00	10558	1162	796	0	33	1392	2852	1208	18091
23:00	10553	1151	774	0	29	936	2745	0	16228

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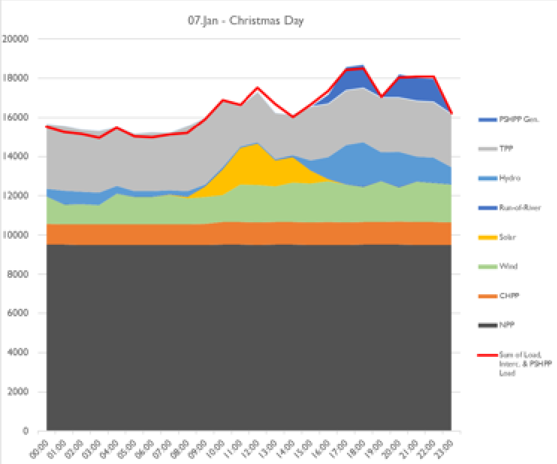
Figure 52: Jan 7th Christmas Day: As-Is

Jan 7th Christmas Day: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9514	1063	1394	0	23	367	3308	0	15525
01:00	9508	1032	1003	0	22	691	3290	0	15262
02:00	9499	1044	1037	0	22	600	3176	0	15151
03:00	9498	1047	968	0	22	614	3151	0	14960
04:00	9506	1047	1561	0	22	361	3007	0	15470
05:00	9499	1041	1394	0	22	266	2937	0	15040
06:00	9500	1036	1407	0	22	261	3006	0	14985
07:00	9503	1044	1491	19	22	203	2930	0	15123
08:00	9488	1052	1322	87	23	265	3315	0	15202
09:00	9488	1093	1349	552	31	66	3416	0	15907
10:00	9514	1163	1352	1315	32	88	3417	0	16876
11:00	9511	1163	1893	1867	32	48	2058	0	16635
12:00	9493	1161	1890	2106	29	49	2595	0	17533
13:00	9508	1158	1818	1303	29	50	2369	0	16702
14:00	9511	1164	1998	1303	31	48	2081	0	16026
15:00	9498	1153	1978	642	30	505	2746	0	16673
16:00	9506	1157	2075	109	29	1083	2751	480	17346
17:00	9496	1157	1923	2	29	1979	2797	1208	18436
18:00	9518	1155	1786	0	32	2230	2781	1208	18489
19:00	9510	1152	2072	0	32	1445	2799	0	17056
20:00	9526	1158	1751	0	32	1771	2778	1208	18044
21:00	9507	1156	2050	0	33	1254	2851	1208	18095
22:00	9502	1162	1985	0	33	1259	2852	1208	18091
23:00	9498	1151	1930	0	29	835	2745	0	16228

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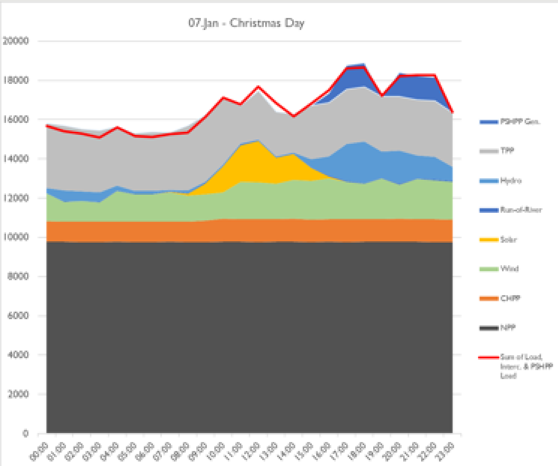
Figure 53: Jan 7th Christmas Day: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 7th Christmas Day: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9778	1063	1394	0	23	259	3308	0	15681
01:00	9772	1032	1003	0	22	577	3290	0	15412
02:00	9762	1044	1037	0	22	480	3176	0	15295
03:00	9762	1047	968	0	22	489	3151	0	15099
04:00	9770	1047	1561	0	22	239	3007	0	15613
05:00	9762	1041	1394	0	22	141	2937	0	15179
06:00	9763	1036	1407	0	22	141	3006	0	15129
07:00	9767	1044	1491	19	22	85	2930	0	15270
08:00	9751	1052	1322	87	23	149	3315	0	15350
09:00	9751	1093	1349	552	31	47	3416	0	16152
10:00	9778	1163	1352	1315	32	78	3417	0	17130
11:00	9775	1163	1893	1867	32	48	1951	0	16792
12:00	9757	1161	1890	2106	29	49	2487	0	17688
13:00	9772	1158	1818	1303	29	50	2262	0	16859
14:00	9775	1164	1998	1303	31	48	1970	0	16179
15:00	9762	1153	1978	642	30	407	2746	0	16838
16:00	9770	1157	2075	109	29	985	2751	480	17513
17:00	9760	1157	1923	2	29	1894	2797	1208	18615
18:00	9783	1155	1786	0	32	2142	2781	1208	18665
19:00	9774	1152	2072	0	32	1347	2799	0	17222
20:00	9790	1158	1751	0	32	1686	2778	1208	18224
21:00	9771	1156	2050	0	33	1158	2851	1208	18262
22:00	9766	1162	1985	0	33	1164	2852	1208	18260
23:00	9762	1151	1930	0	29	729	2745	0	16385

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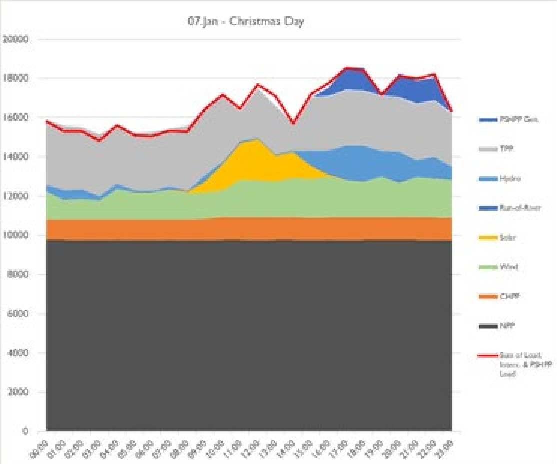
Figure 54: Jan 7th Christmas Day: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 7th Christmas Day: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9778	1063	1394	0	23	337	3308	0	15796
01:00	9772	1032	1003	0	22	473	3290	0	15324
02:00	9762	1044	1037	0	22	479	3176	0	15316
03:00	9762	1047	968	0	22	214	3151	0	14829
04:00	9770	1047	1561	0	22	231	3007	0	15598
05:00	9762	1041	1394	0	22	70	2937	0	15106
06:00	9763	1036	1407	0	22	48	3006	0	15053
07:00	9767	1044	1491	19	22	146	2930	0	15348
08:00	9751	1052	1322	87	23	38	3315	0	15300
09:00	9751	1093	1349	552	31	279	3416	0	16440
10:00	9778	1163	1352	1315	32	98	3417	0	17182
11:00	9775	1163	1893	1867	32	48	1587	0	16474
12:00	9757	1161	1890	2106	29	49	2517	0	17696
13:00	9772	1158	1818	1303	29	50	2462	0	17095
14:00	9775	1164	1998	1303	31	48	1447	0	15699
15:00	9762	1153	1978	642	30	727	2746	0	17205
16:00	9770	1157	2075	109	29	1184	2751	480	17765
17:00	9760	1157	1923	2	29	1727	2797	1208	18528
18:00	9783	1155	1786	0	32	1810	2781	1208	18388
19:00	9774	1152	2072	0	32	1277	2799	0	17182
20:00	9790	1158	1751	0	32	1531	2778	1208	18128
21:00	9771	1156	2050	0	33	836	2851	1208	17981
22:00	9766	1162	1985	0	33	1069	2852	1208	18201
23:00	9762	1151	1930	0	29	623	2745	0	16346

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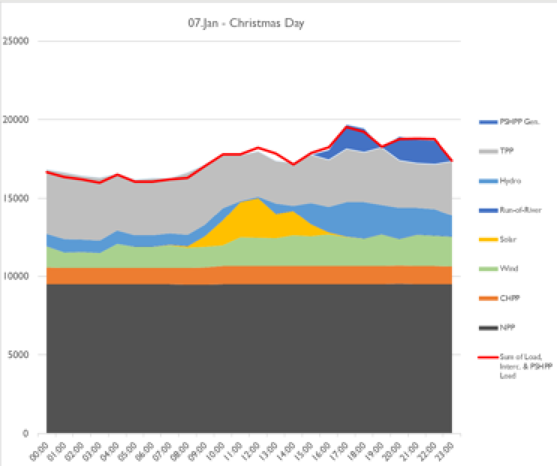
Figure 55: Jan 7th Christmas Day: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9514	1063	1348	0	23	774	4101	0	16680
01:00	9508	1032	970	0	22	841	4286	0	16375
02:00	9499	1044	1003	0	22	790	4087	0	16218
03:00	9498	1047	936	0	22	769	4059	0	15992
04:00	9506	1047	1510	0	22	844	3624	0	16519
05:00	9499	1041	1348	0	22	701	3574	0	16066
06:00	9500	1036	1360	0	22	703	3675	0	16049
07:00	9503	1044	1442	22	22	703	3560	0	16207
08:00	9488	1052	1278	104	23	695	4007	0	16298
09:00	9488	1093	1305	663	31	702	3860	0	17054
10:00	9514	1163	1307	1580	32	754	3441	0	17786
11:00	9511	1163	1831	2243	32	54	2903	0	17800
12:00	9493	1161	1828	2531	29	49	2918	0	18219
13:00	9508	1158	1758	1566	29	659	2718	0	17863
14:00	9511	1164	1932	1566	31	306	2757	0	17157
15:00	9498	1153	1913	772	30	1331	3077	0	17894
16:00	9506	1157	2007	131	29	1638	2992	633	18249
17:00	9496	1157	1860	2	29	2201	3419	1532	19542
18:00	9518	1155	1727	0	32	2324	3179	1532	19246
19:00	9510	1152	2004	0	32	1872	3670	0	18285
20:00	9526	1158	1693	0	32	1974	3031	1532	18767
21:00	9507	1156	1983	0	33	1708	2851	1532	18805
22:00	9502	1162	1920	0	33	1694	2852	1532	18785
23:00	9498	1151	1867	0	29	1359	3449	0	17393

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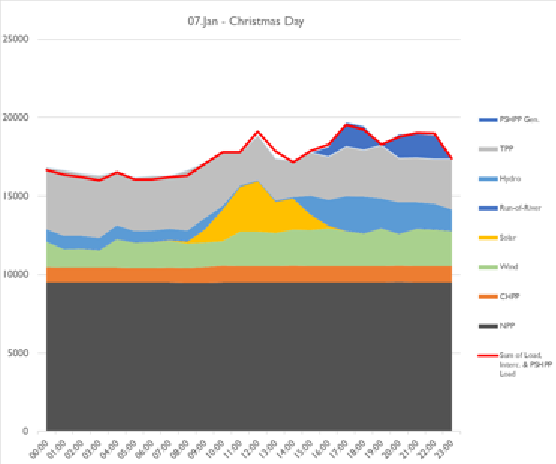
Figure 56: Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9514	957	1618	0	23	774	3938	0	16680
01:00	9508	929	1164	0	22	841	4196	0	16375
02:00	9499	940	1204	0	22	790	3991	0	16218
03:00	9498	942	1123	0	22	769	3977	0	15992
04:00	9506	942	1812	0	22	844	3427	0	16519
05:00	9499	937	1618	0	22	701	3408	0	16066
06:00	9500	932	1632	0	22	703	3506	0	16049
07:00	9503	940	1731	28	22	703	3370	0	16207
08:00	9488	947	1534	132	23	695	3828	0	16298
09:00	9488	984	1566	840	31	702	3532	0	17054
10:00	9514	1047	1569	2001	32	211	3417	0	17786
11:00	9511	1047	2197	2842	32	48	2061	0	17800
12:00	9493	1045	2194	3206	29	49	2880	0	19106
13:00	9508	1042	2110	1983	29	50	2674	0	17863
14:00	9511	1048	2318	1983	31	48	2328	0	17157
15:00	9498	1038	2295	977	30	1189	2746	0	17894
16:00	9506	1041	2408	165	29	1606	2751	633	18297
17:00	9496	1041	2232	3	29	2201	3162	1532	19542
18:00	9518	1040	2072	0	32	2324	2949	1532	19246
19:00	9510	1037	2405	0	32	1872	3384	0	18285
20:00	9526	1042	2032	0	32	1974	2808	1532	18767
21:00	9507	1040	2379	0	33	1639	2851	1532	19016
22:00	9502	1046	2304	0	33	1626	2852	1532	18984
23:00	9498	1036	2240	0	29	1359	3191	0	17393

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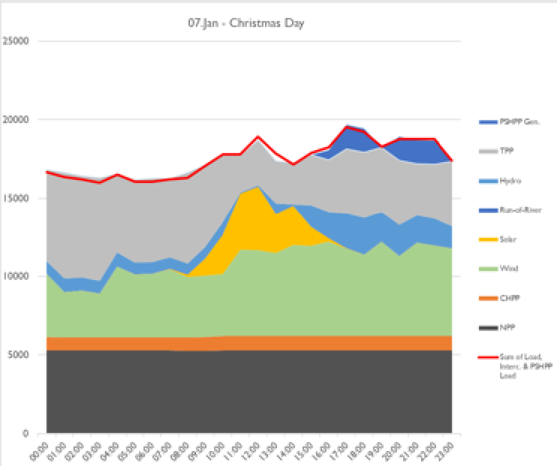
Figure 57: Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



07.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	5286	850	4045	0	23	774	5846	0	16680
01:00	5282	826	2909	0	22	841	6779	0	16375
02:00	5277	835	3010	0	22	790	6511	0	16218
03:00	5277	838	2808	0	22	769	6618	0	15992
04:00	5281	838	4530	0	22	844	5039	0	16519
05:00	5277	833	4045	0	22	701	5307	0	16066
06:00	5278	829	4081	0	22	703	5383	0	16049
07:00	5280	835	4327	36	22	703	5094	0	16207
08:00	5271	842	3835	167	23	695	5815	0	16298
09:00	5271	874	3915	1061	31	702	5288	0	17054
10:00	5286	930	3922	2528	32	754	4339	0	17786
11:00	5284	930	5492	3589	32	48	2361	0	17800
12:00	5274	929	5485	4050	29	49	2918	0	18943
13:00	5282	926	5275	2505	29	661	2718	0	17863
14:00	5284	931	5796	2505	31	48	2672	0	17157
15:00	5277	922	5738	1235	30	1331	3240	0	17894
16:00	5281	926	6020	209	29	1638	3356	633	18249
17:00	5276	926	5579	3	29	2201	4151	1532	19542
18:00	5288	924	5181	0	32	2324	4186	1532	19246
19:00	5284	922	6013	0	32	1872	4118	0	18285
20:00	5292	926	5080	0	32	1974	4109	1532	18767
21:00	5282	925	5948	0	33	1721	3292	1532	18767
22:00	5279	930	5760	0	33	1696	3461	1532	18779
23:00	5277	921	5601	0	29	1359	4167	0	17393

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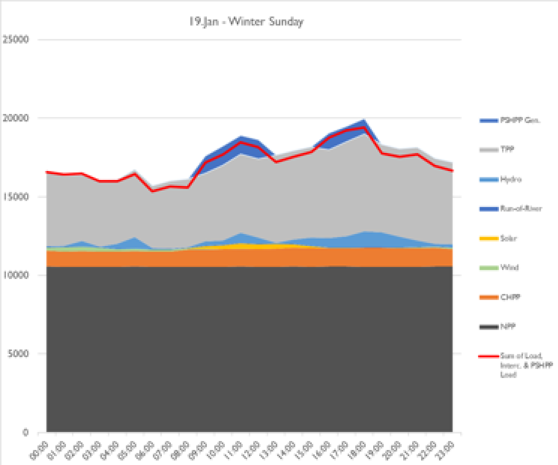
Figure 58: Jan 7th Christmas Day: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Jan 19th Winter Sunday: As-Is



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	10559	1036	184	0	21	46	4817	0	16566
01:00	10531	990	287	0	22	46	4485	0	16419
02:00	10552	992	271	0	22	359	4215	0	16482
03:00	10557	978	230	0	21	48	4217	0	15982
04:00	10534	975	161	0	21	312	4077	0	15989
05:00	10577	980	141	0	21	715	4306	0	16464
06:00	10538	977	141	0	17	48	3996	0	15360
07:00	10539	982	109	13	18	48	4309	0	15667
08:00	10557	1071	80	31	19	40	4327	0	15613
09:00	10546	1106	60	135	27	281	4339	1094	17185
10:00	10549	1110	15	234	28	285	4809	1208	17715
11:00	10559	1124	12	354	28	631	5013	1208	18468
12:00	10553	1117	8	295	27	419	5005	1208	18180
13:00	10551	1150	4	291	27	46	5586	0	17208
14:00	10561	1193	8	220	29	272	5667	0	17553
15:00	10545	1185	12	110	29	519	5787	0	17854
16:00	10559	1185	8	14	29	577	5638	1052	18771
17:00	10564	1182	8	0	29	723	6021	954	19232
18:00	10557	1205	7	0	30	990	6231	954	19429
19:00	10553	1201	17	0	30	941	5583	0	17781
20:00	10532	1204	43	0	30	669	5582	0	17554
21:00	10551	1195	59	0	30	391	5922	0	17701
22:00	10572	1187	77	0	30	132	5453	0	16986
23:00	10559	1113	95	0	27	191	5232	0	16672

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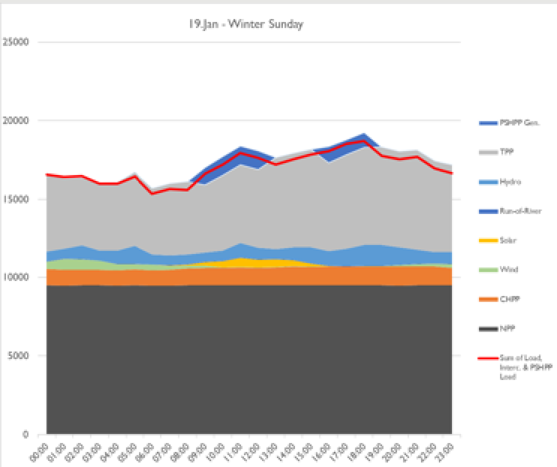
Figure 59: Jan 19th Winter Sunday: As-Is

Jan 19th Winter Sunday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9503	1036	459	0	21	618	5026	0	16566
01:00	9478	990	716	0	22	618	4537	0	16419
02:00	9497	992	676	0	22	860	4364	0	16482
03:00	9501	978	574	0	21	620	4357	0	15982
04:00	9481	975	402	0	21	824	4378	0	15989
05:00	9519	980	352	0	21	1135	4733	0	16464
06:00	9484	977	352	0	17	620	4267	0	15360
07:00	9485	982	272	22	18	620	4619	0	15667
08:00	9501	1071	200	53	19	614	4668	0	15613
09:00	9491	1106	150	229	27	591	4339	1094	16624
10:00	9494	1110	37	397	28	645	4809	1208	17206
11:00	9503	1124	30	601	28	893	5013	1208	17939
12:00	9498	1117	20	501	27	716	5005	1208	17639
13:00	9496	1150	10	494	27	618	5859	0	17208
14:00	9505	1193	20	374	29	793	6037	0	17553
15:00	9491	1185	30	187	29	984	6282	0	17854
16:00	9503	1185	20	24	29	922	5638	1052	18082
17:00	9508	1182	20	0	29	1076	6021	954	18541
18:00	9501	1205	17	0	30	1308	6231	954	18702
19:00	9498	1201	42	0	30	1309	6245	0	17781
20:00	9479	1204	107	0	30	1099	6141	0	17554
21:00	9496	1195	147	0	30	885	6395	0	17701
22:00	9515	1187	192	0	30	685	5842	0	16986
23:00	9503	1113	237	0	27	730	5607	0	16672

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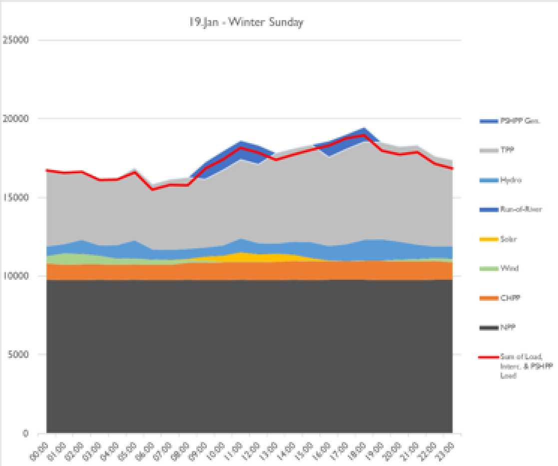
Figure 60: Jan 19th Winter Sunday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 19th Winter Sunday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9767	1036	459	0	21	618	4926	0	16730
01:00	9741	990	716	0	22	567	4485	0	16579
02:00	9761	992	676	0	22	860	4257	0	16638
03:00	9765	978	574	0	21	620	4241	0	16129
04:00	9744	975	402	0	21	824	4267	0	16141
05:00	9784	980	352	0	21	1135	4624	0	16619
06:00	9748	977	352	0	17	620	4152	0	15508
07:00	9749	982	272	22	18	620	4513	0	15824
08:00	9765	1071	200	53	19	614	4565	0	15774
09:00	9755	1106	150	229	27	560	4339	1094	16856
10:00	9758	1110	37	397	28	610	4809	1208	17434
11:00	9767	1124	30	601	28	867	5013	1208	18177
12:00	9762	1117	20	501	27	686	5005	1208	17873
13:00	9760	1150	10	494	27	618	5774	0	17387
14:00	9769	1193	20	374	29	793	5956	0	17736
15:00	9754	1185	30	187	29	984	6202	0	18037
16:00	9767	1185	20	24	29	896	5638	1052	18319
17:00	9772	1182	20	0	29	1052	6021	954	18781
18:00	9765	1205	17	0	30	1287	6231	954	18945
19:00	9762	1201	42	0	30	1309	6172	0	17972
20:00	9742	1204	107	0	30	1099	6064	0	17741
21:00	9760	1195	147	0	30	885	6316	0	17886
22:00	9779	1187	192	0	30	685	5758	0	17166
23:00	9767	1113	237	0	27	730	5516	0	16845

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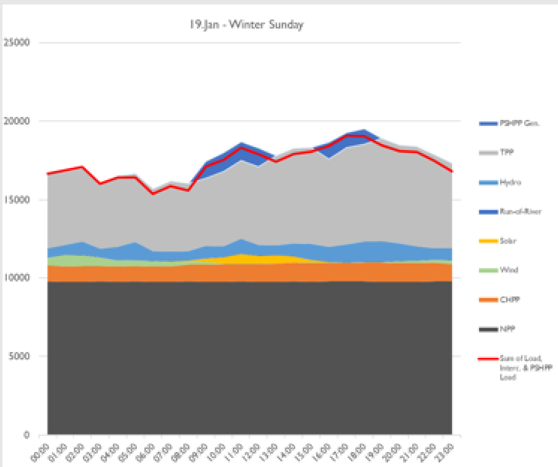
Figure 61: Jan 19th Winter Sunday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 19th Winter Sunday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9767	1036	459	0	21	611	4817	0	16676
01:00	9741	990	716	0	22	618	4706	0	16872
02:00	9761	992	676	0	22	860	4694	0	17104
03:00	9765	978	574	0	21	515	4217	0	16022
04:00	9744	975	402	0	21	824	4528	0	16412
05:00	9784	980	352	0	21	1135	4419	0	16434
06:00	9748	977	352	0	17	617	3996	0	15389
07:00	9749	982	272	22	18	620	4521	0	15879
08:00	9765	1071	200	53	19	603	4327	0	15609
09:00	9755	1106	150	229	27	761	4339	1094	17132
10:00	9758	1110	37	397	28	665	4809	1208	17562
11:00	9767	1124	30	601	28	943	5013	1208	18326
12:00	9762	1117	20	501	27	670	5005	1208	17925
13:00	9760	1150	10	494	27	618	5757	0	17439
14:00	9769	1193	20	374	29	793	6085	0	17928
15:00	9754	1185	30	187	29	984	6169	0	18067
16:00	9767	1185	20	24	29	946	5638	1052	18439
17:00	9772	1182	20	0	29	1141	6182	954	19096
18:00	9765	1205	17	0	30	1310	6231	954	19042
19:00	9762	1201	42	0	30	1309	6571	0	18470
20:00	9742	1204	107	0	30	1099	6315	0	18099
21:00	9760	1195	147	0	30	885	6380	0	18029
22:00	9779	1187	192	0	30	685	5995	0	17489
23:00	9767	1113	237	0	27	730	5440	0	16831

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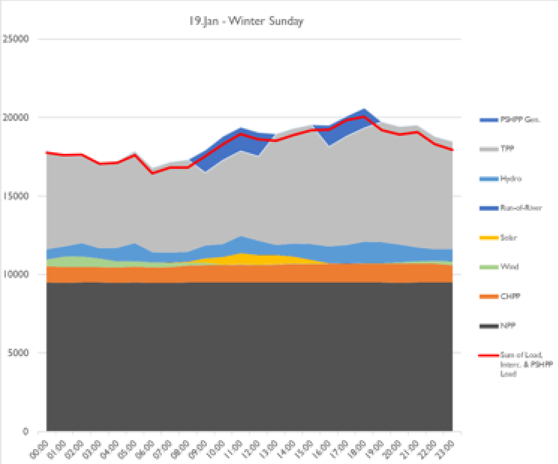
Figure 62: Jan 19th Winter Sunday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	9503	1036	444	0	21	618	6256	0	17781
01:00	9478	990	692	0	22	618	5743	0	17601
02:00	9497	992	654	0	22	860	5543	0	17639
03:00	9501	978	555	0	21	620	5467	0	17073
04:00	9481	975	388	0	21	824	5518	0	17116
05:00	9519	980	340	0	21	1135	5894	0	17613
06:00	9484	977	340	0	17	620	5375	0	16457
07:00	9485	982	263	27	18	620	5788	0	16831
08:00	9501	1071	193	63	19	614	5857	0	16806
09:00	9491	1106	145	276	27	800	4659	1441	17542
10:00	9494	1110	36	478	28	803	5353	1532	18310
11:00	9503	1124	29	723	28	1070	5406	1532	18954
12:00	9498	1117	19	602	27	906	5371	1532	18620
13:00	9496	1150	10	594	27	618	7083	0	18531
14:00	9505	1193	19	449	29	793	7318	0	18909
15:00	9491	1185	29	225	29	984	7603	0	19211
16:00	9503	1185	19	29	29	1028	6349	1386	19237
17:00	9508	1182	19	0	29	1141	6957	1258	19845
18:00	9501	1205	17	0	30	1347	7253	1258	20066
19:00	9498	1201	41	0	30	1309	7662	0	19197
20:00	9479	1204	104	0	30	1099	7526	0	18936
21:00	9496	1195	142	0	30	885	7769	0	19070
22:00	9515	1187	186	0	30	685	7179	0	18316
23:00	9503	1113	229	0	27	730	6898	0	17956

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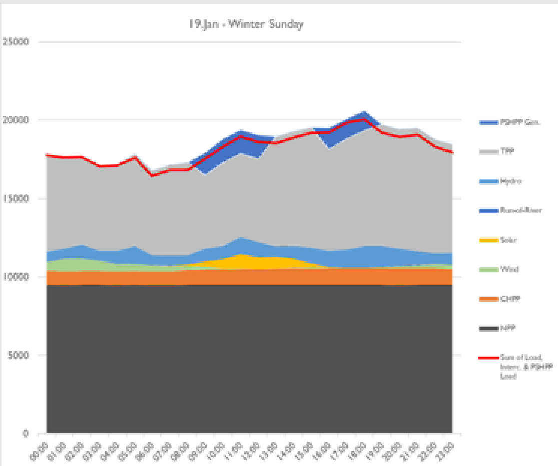
Figure 63: Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	9503	932	533	0	21	618	6271	0	17781
01:00	9478	891	831	0	22	618	5703	0	17601
02:00	9497	893	784	0	22	860	5512	0	17639
03:00	9501	880	666	0	21	620	5454	0	17073
04:00	9481	878	466	0	21	824	5538	0	17116
05:00	9519	882	408	0	21	1135	5924	0	17613
06:00	9484	879	408	0	17	620	5405	0	16457
07:00	9485	884	315	34	18	620	5826	0	16831
08:00	9501	964	232	80	19	614	5909	0	16806
09:00	9491	995	174	349	27	800	4667	1441	17542
10:00	9494	999	43	605	28	803	5329	1532	18310
11:00	9503	1012	35	915	28	1070	5320	1532	18954
12:00	9498	1005	23	763	27	906	5318	1532	18620
13:00	9496	1035	12	752	27	618	7037	0	18531
14:00	9505	1074	23	569	29	793	7313	0	18909
15:00	9491	1067	35	284	29	984	7655	0	19211
16:00	9503	1067	23	36	29	1028	6456	1386	19237
17:00	9508	1064	23	0	29	1141	7071	1258	19845
18:00	9501	1085	20	0	30	1347	7370	1258	20066
19:00	9498	1081	49	0	30	1309	7774	0	19197
20:00	9479	1084	124	0	30	1099	7626	0	18936
21:00	9496	1076	171	0	30	885	7860	0	19070
22:00	9515	1068	223	0	30	685	7260	0	18316
23:00	9503	1002	275	0	27	730	6964	0	17956

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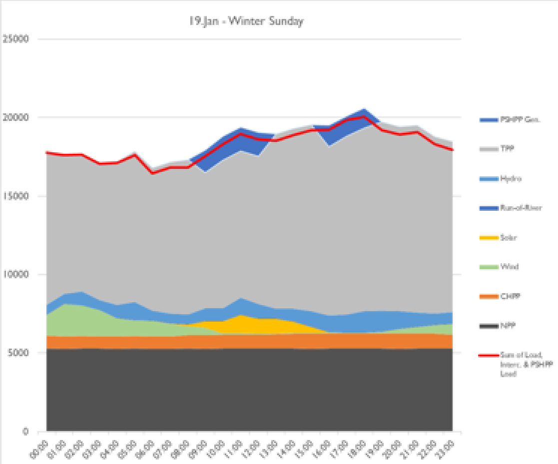
Figure 64: Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



19.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	5280	829	1331	0	21	618	9799	0	17781
01:00	5266	792	2077	0	22	618	8769	0	17601
02:00	5276	794	1961	0	22	860	8655	0	17639
03:00	5279	782	1664	0	21	620	8776	0	17073
04:00	5267	780	1165	0	21	824	9150	0	17116
05:00	5289	784	1020	0	21	1135	9641	0	17613
06:00	5269	782	1020	0	17	620	9106	0	16457
07:00	5270	786	789	42	18	620	9658	0	16831
08:00	5279	857	579	101	19	614	9870	0	16806
09:00	5273	885	434	441	27	800	8644	1441	17542
10:00	5275	888	109	764	28	803	9436	1532	18310
11:00	5280	899	87	1156	28	1070	9363	1532	18954
12:00	5277	894	58	964	27	906	9416	1532	18620
13:00	5276	920	29	950	27	618	11157	0	18531
14:00	5281	954	58	719	29	793	11473	0	18909
15:00	5273	948	87	359	29	984	11865	0	19211
16:00	5280	948	58	46	29	1028	10753	1386	19237
17:00	5282	946	58	0	29	1141	11380	1258	19845
18:00	5279	964	51	0	30	1347	11683	1258	20066
19:00	5277	961	123	0	30	1309	12042	0	19197
20:00	5266	963	311	0	30	1099	11772	0	18936
21:00	5276	956	427	0	30	885	11943	0	19070
22:00	5286	950	557	0	30	685	11273	0	18316
23:00	5280	890	687	0	27	730	10886	0	17956

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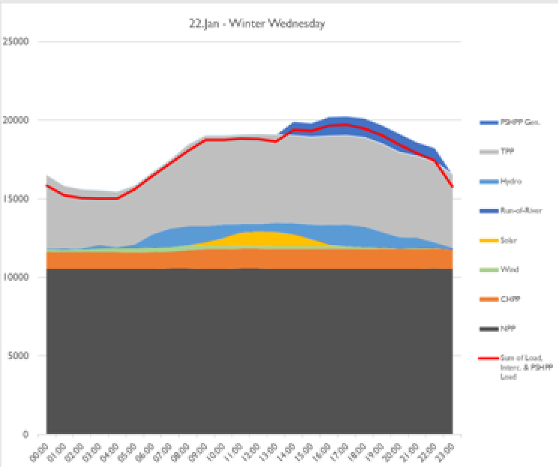
Figure 65: Jan 19th Winter Sunday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Jan 22nd Winter Wednesday: As-Is



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	10552	1099	143	0	16	46	4668	0	15842
01:00	10542	1060	171	0	17	48	3984	0	15235
02:00	10544	1068	188	0	17	48	3750	0	15047
03:00	10555	1056	205	0	16	240	3466	0	15023
04:00	10557	1062	242	0	16	48	3543	0	15025
05:00	10531	1059	266	0	16	239	3745	0	15637
06:00	10551	1060	288	0	16	822	3984	0	16457
07:00	10565	1065	274	9	16	1188	4400	0	17234
08:00	10560	1185	258	30	17	1204	5195	0	18033
09:00	10557	1237	259	173	36	999	5777	0	18734
10:00	10549	1260	235	462	37	797	5705	0	18743
11:00	10561	1268	238	804	37	462	5717	0	18847
12:00	10565	1266	219	877	35	418	5739	0	18793
13:00	10541	1243	236	871	17	553	5645	0	18656
14:00	10556	1238	205	756	19	666	5607	881	19377
15:00	10544	1243	230	421	37	874	5592	878	19324
16:00	10552	1248	222	89	37	1170	5692	1208	19668
17:00	10549	1249	181	0	37	1324	5702	1208	19716
18:00	10539	1246	136	0	39	1257	5709	1208	19493
19:00	10557	1254	82	0	39	964	5612	1208	19060
20:00	10531	1251	44	0	39	709	5379	1208	18427
21:00	10556	1252	46	0	39	642	5194	888	17878
22:00	10565	1251	44	0	39	325	5124	881	17426
23:00	10549	1206	22	0	34	65	4689	0	15790

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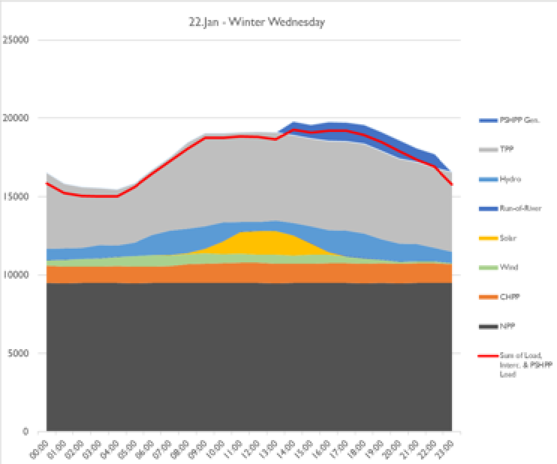
Figure 66: Jan 22nd Winter Wednesday: As-Is

Jan 22nd Winter Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9497	1099	357	0	16	697	4858	0	15842
01:00	9488	1060	426	0	17	699	4132	0	15235
02:00	9490	1068	469	0	17	699	3873	0	15047
03:00	9500	1056	511	0	16	841	3614	0	15023
04:00	9501	1062	604	0	16	699	3586	0	15025
05:00	9478	1059	663	0	16	840	3799	0	15637
06:00	9496	1060	718	0	16	1272	4159	0	16457
07:00	9509	1065	683	15	16	1543	4686	0	17234
08:00	9504	1185	643	51	17	1555	5494	0	18033
09:00	9501	1237	646	294	36	1403	5921	0	18734
10:00	9494	1260	586	785	37	1178	5705	0	18743
11:00	9505	1268	594	1366	37	601	5717	0	18847
12:00	9509	1266	546	1490	35	535	5739	0	18793
13:00	9487	1243	589	1480	17	646	5645	0	18656
14:00	9500	1238	511	1284	19	766	5607	881	19256
15:00	9490	1243	574	715	37	1050	5592	878	19084
16:00	9497	1248	554	151	37	1379	5692	1208	19216
17:00	9494	1249	451	0	37	1592	5702	1208	19199
18:00	9485	1246	339	0	39	1552	5709	1208	18937
19:00	9501	1254	205	0	39	1297	5612	1208	18460
20:00	9478	1251	110	0	39	1146	5379	1208	17876
21:00	9500	1252	115	0	39	1087	5194	888	17336
22:00	9509	1251	110	0	39	812	5124	881	16923
23:00	9494	1206	55	0	34	712	5065	0	15790

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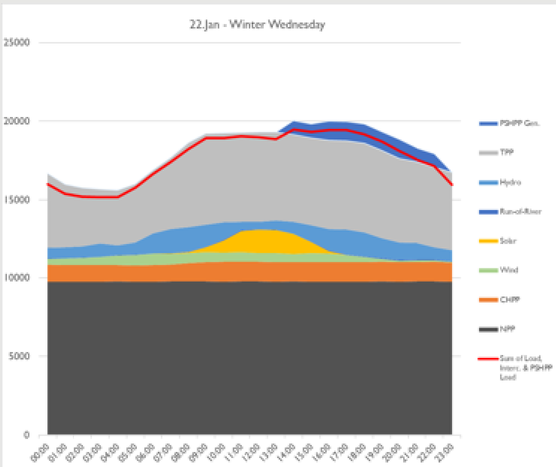
Figure 67: Jan 22nd Winter Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 22nd Winter Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9761	1099	357	0	16	697	4760	0	16007
01:00	9751	1060	426	0	17	699	4026	0	15392
02:00	9753	1068	469	0	17	699	3760	0	15198
03:00	9763	1056	511	0	16	841	3502	0	15175
04:00	9765	1062	604	0	16	626	3543	0	15173
05:00	9741	1059	663	0	16	786	3745	0	15791
06:00	9760	1060	718	0	16	1272	4062	0	16624
07:00	9773	1065	683	15	16	1543	4603	0	17415
08:00	9768	1185	643	51	17	1555	5418	0	18221
09:00	9765	1237	646	294	36	1403	5851	0	18928
10:00	9758	1260	586	785	37	1111	5705	0	18939
11:00	9769	1268	594	1366	37	531	5717	0	19041
12:00	9773	1266	546	1490	35	464	5739	0	18987
13:00	9750	1243	589	1480	17	580	5645	0	18854
14:00	9764	1238	511	1284	19	737	5607	881	19491
15:00	9753	1243	574	715	37	1022	5592	878	19320
16:00	9761	1248	554	151	37	1360	5692	1208	19460
17:00	9758	1249	451	0	37	1571	5702	1208	19442
18:00	9749	1246	339	0	39	1532	5709	1208	19180
19:00	9765	1254	205	0	39	1274	5612	1208	18700
20:00	9741	1251	110	0	39	1115	5379	1208	18109
21:00	9764	1252	115	0	39	1055	5194	888	17568
22:00	9773	1251	110	0	39	773	5124	881	17147
23:00	9758	1206	55	0	34	712	4974	0	15963

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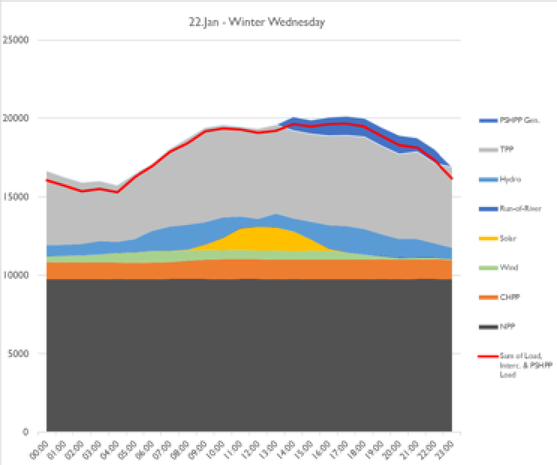
Figure 68: Jan 22nd Winter Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 22nd Winter Wednesday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9761	1099	357	0	16	697	4733	0	16044
01:00	9751	1060	426	0	17	699	4307	0	15712
02:00	9753	1068	469	0	17	699	3903	0	15361
03:00	9763	1056	511	0	16	841	3825	0	15511
04:00	9765	1062	604	0	16	699	3597	0	15307
05:00	9741	1059	663	0	16	840	4157	0	16277
06:00	9760	1060	718	0	16	1272	4289	0	16933
07:00	9773	1065	683	15	16	1543	4955	0	17866
08:00	9768	1185	643	51	17	1555	5517	0	18410
09:00	9765	1237	646	294	36	1403	6018	0	19180
10:00	9758	1260	586	785	37	1254	5897	0	19361
11:00	9769	1268	594	1366	37	718	5717	0	19309
12:00	9773	1266	546	1490	35	496	5739	0	19092
13:00	9750	1243	589	1480	17	860	5645	0	19195
14:00	9764	1238	511	1284	19	800	5607	881	19638
15:00	9753	1243	574	715	37	1097	5592	878	19478
16:00	9761	1248	554	151	37	1439	5692	1208	19632
17:00	9758	1249	451	0	37	1644	5785	1208	19664
18:00	9749	1246	339	0	39	1594	5846	1208	19464
19:00	9765	1254	205	0	39	1353	5612	1208	18874
20:00	9741	1251	110	0	39	1188	5386	1208	18296
21:00	9764	1252	115	0	39	1139	5560	888	18126
22:00	9773	1251	110	0	39	860	5124	881	17340
23:00	9758	1206	55	0	34	712	5126	0	16166

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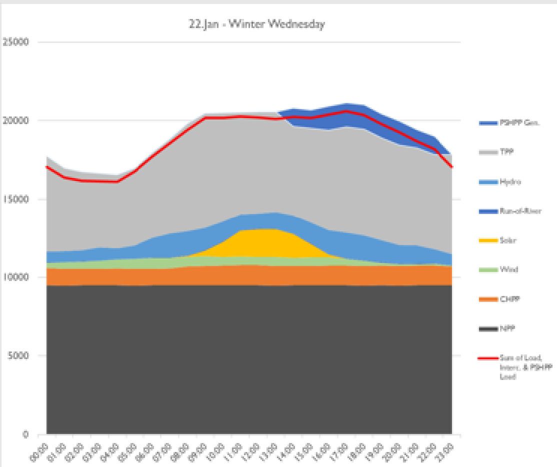
Figure 69: Jan 22nd Winter Wednesday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9497	1099	345	0	16	697	6094	0	17066
01:00	9488	1060	412	0	17	699	5311	0	16400
02:00	9490	1068	453	0	17	699	5009	0	16168
03:00	9500	1056	494	0	16	841	4757	0	16149
04:00	9501	1062	584	0	16	699	4702	0	16121
05:00	9478	1059	642	0	16	840	4963	0	16779
06:00	9496	1060	695	0	16	1272	5417	0	17692
07:00	9509	1065	661	18	16	1543	6044	0	18572
08:00	9504	1185	622	61	17	1555	6899	0	19428
09:00	9501	1237	625	353	36	1403	7322	0	20173
10:00	9494	1260	567	943	37	1254	6944	0	20196
11:00	9505	1268	574	1641	37	1005	6495	0	20286
12:00	9509	1266	528	1790	35	973	6451	0	20226
13:00	9487	1243	569	1778	17	1073	6404	0	20121
14:00	9500	1238	494	1543	19	1157	5694	1162	20256
15:00	9490	1243	555	859	37	1311	6040	1158	20196
16:00	9497	1248	535	182	37	1530	6372	1532	20382
17:00	9494	1249	437	0	37	1644	6752	1532	20610
18:00	9485	1246	328	0	39	1594	6785	1532	20367
19:00	9501	1254	198	0	39	1377	6537	1532	19782
20:00	9478	1251	106	0	39	1188	6398	1532	19258
21:00	9500	1252	111	0	39	1139	6225	1170	18697
22:00	9509	1251	106	0	39	904	6024	1162	18191
23:00	9494	1206	53	0	34	712	6346	0	17069

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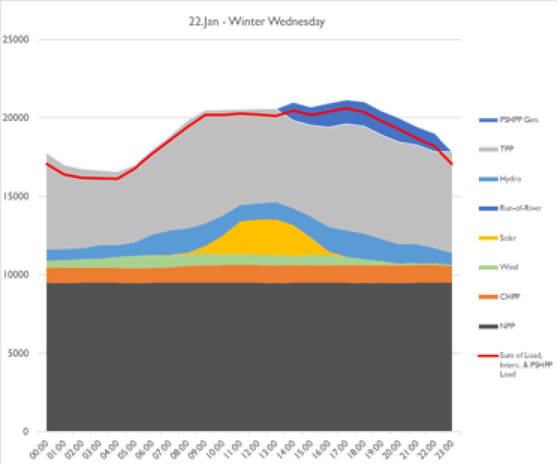
Figure 70: Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	9497	989	414	0	16	697	6135	0	17066
01:00	9488	954	495	0	17	699	5334	0	16400
02:00	9490	961	544	0	17	699	5025	0	16168
03:00	9500	950	593	0	16	841	4763	0	16149
04:00	9501	956	700	0	16	699	4691	0	16121
05:00	9478	953	770	0	16	840	4941	0	16779
06:00	9496	954	834	0	16	1272	5384	0	17692
07:00	9509	959	793	23	16	1543	6013	0	18572
08:00	9504	1067	747	78	17	1555	6877	0	19428
09:00	9501	1113	750	447	36	1403	7226	0	20173
10:00	9494	1134	680	1195	37	1254	6705	0	20196
11:00	9505	1141	689	2079	37	1005	6069	0	20286
12:00	9509	1139	634	2268	35	973	5995	0	20226
13:00	9487	1119	683	2252	17	1073	5941	0	20121
14:00	9500	1114	593	1955	19	1049	5607	1162	20449
15:00	9490	1119	666	1089	37	1311	5824	1158	20196
16:00	9497	1123	643	230	37	1530	6341	1532	20382
17:00	9494	1124	524	0	37	1644	6790	1532	20610
18:00	9485	1121	394	0	39	1594	6844	1532	20367
19:00	9501	1129	237	0	39	1377	6623	1532	19782
20:00	9478	1126	127	0	39	1188	6502	1532	19258
21:00	9500	1127	133	0	39	1139	6328	1170	18697
22:00	9509	1126	127	0	39	904	6127	1162	18191
23:00	9494	1085	64	0	34	712	6456	0	17069

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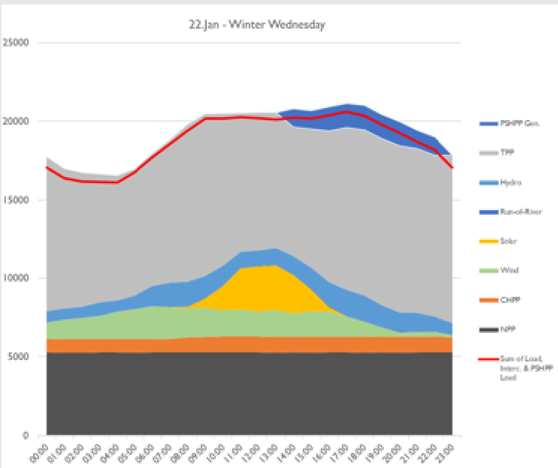
Figure 71: Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



22.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	5276	879	1035	0	16	697	9845	0	17066
01:00	5271	848	1237	0	17	699	8915	0	16400
02:00	5272	854	1360	0	17	699	8533	0	16168
03:00	5278	845	1483	0	16	841	8201	0	16149
04:00	5279	850	1751	0	16	699	7970	0	16121
05:00	5266	847	1925	0	16	840	8104	0	16779
06:00	5276	848	2084	0	16	1272	8460	0	17692
07:00	5283	852	1983	29	16	1543	9150	0	18572
08:00	5280	948	1867	98	17	1555	10079	0	19428
09:00	5279	990	1874	565	36	1403	10331	0	20173
10:00	5275	1008	1700	1509	37	1254	9716	0	20196
11:00	5281	1014	1722	2626	37	1005	8840	0	20286
12:00	5283	1013	1585	2864	35	973	8800	0	20226
13:00	5271	994	1708	2845	17	1073	8664	0	20121
14:00	5278	990	1483	2469	19	1157	8249	1162	20256
15:00	5272	994	1664	1375	37	1311	8881	1158	20196
16:00	5276	998	1606	291	37	1530	9662	1532	20382
17:00	5275	999	1310	0	37	1644	10349	1532	20610
18:00	5270	997	984	0	39	1594	10593	1532	20367
19:00	5279	1003	593	0	39	1377	10615	1532	19782
20:00	5266	1001	318	0	39	1188	10649	1532	19258
21:00	5278	1002	333	0	39	1139	10476	1170	18697
22:00	5283	1001	318	0	39	904	10288	1162	18191
23:00	5275	965	159	0	34	712	10700	0	17069

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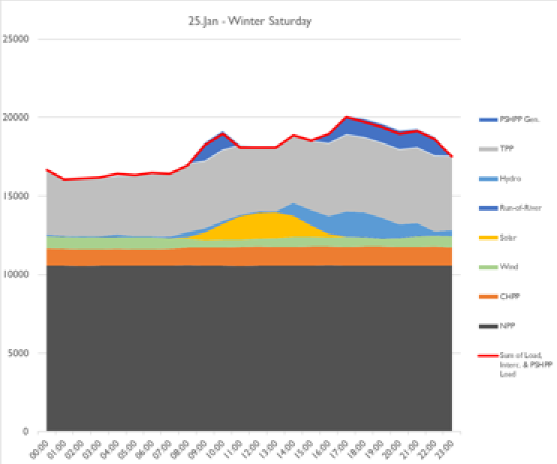
Figure 72: Jan 22nd Winter Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Jan 25th Winter Saturday: As-Is



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	10574	1105	759	0	18	108	4168	0	16667
01:00	10577	1070	760	0	16	48	3635	0	16059
02:00	10558	1052	763	0	16	46	3635	0	16118
03:00	10569	1044	763	0	18	46	3689	0	16192
04:00	10584	1048	752	0	18	142	3748	0	16413
05:00	10574	1043	746	0	18	46	3879	0	16347
06:00	10577	1048	736	0	18	46	3990	0	16498
07:00	10584	1053	677	15	18	46	4079	0	16428
08:00	10594	1126	572	72	19	340	4314	0	16943
09:00	10560	1165	470	478	28	257	4273	1208	18260
10:00	10559	1183	482	1012	28	164	4510	1208	18946
11:00	10552	1217	468	1497	28	46	4421	0	18087
12:00	10585	1205	487	1667	26	48	4139	0	18077
13:00	10583	1197	548	1628	25	48	4161	0	18065
14:00	10573	1196	641	1343	27	809	4290	0	18872
15:00	10585	1205	623	739	27	948	4375	0	18523
16:00	10590	1207	582	215	27	1111	4627	615	18960
17:00	10574	1202	629	3	27	1589	4891	1198	20014
18:00	10575	1209	593	-1	29	1551	4773	1208	19714
19:00	10582	1200	509	-1	29	1309	4777	1208	19372
20:00	10571	1205	539	-1	29	849	4785	1208	18951
21:00	10569	1206	664	-1	29	817	4791	1208	19144
22:00	10583	1210	683	-1	29	248	4813	1208	18626
23:00	10570	1159	696	-1	26	369	4705	0	17516

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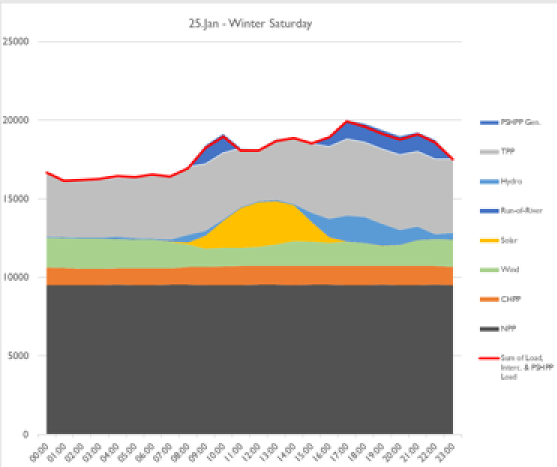
Figure 73: Jan 25th Winter Saturday: As-Is

Jan 25th Winter Saturday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9517	1105	1893	0	18	50	4149	0	16667
01:00	9519	1070	1895	0	16	48	3635	0	16137
02:00	9502	1052	1903	0	16	46	3635	0	16202
03:00	9512	1044	1903	0	18	46	3689	0	16275
04:00	9526	1048	1875	0	18	126	3748	0	16462
05:00	9517	1043	1861	0	18	46	3879	0	16404
06:00	9519	1048	1836	0	18	46	3990	0	16540
07:00	9526	1053	1688	25	18	83	4079	0	16428
08:00	9535	1126	1427	122	19	495	4314	0	16943
09:00	9504	1165	1172	812	28	265	4273	1208	18247
10:00	9503	1183	1202	1719	28	50	4253	1208	18946
11:00	9497	1217	1167	2543	28	46	3731	0	18087
12:00	9527	1205	1215	2832	26	48	3305	0	18077
13:00	9525	1197	1367	2765	25	48	3891	0	18693
14:00	9516	1196	1599	2281	27	50	4210	0	18872
15:00	9527	1205	1554	1255	27	559	4375	0	18523
16:00	9531	1207	1451	365	27	1128	4627	615	18938
17:00	9517	1202	1569	5	27	1613	4891	1198	19922
18:00	9518	1209	1479	2	29	1595	4773	1208	19589
19:00	9524	1200	1269	2	29	1383	4777	1208	19151
20:00	9514	1205	1344	2	29	927	4785	1208	18780
21:00	9512	1206	1656	2	29	837	4791	1208	19102
22:00	9525	1210	1703	2	29	261	4813	1208	18605
23:00	9513	1159	1736	2	26	383	4705	0	17516

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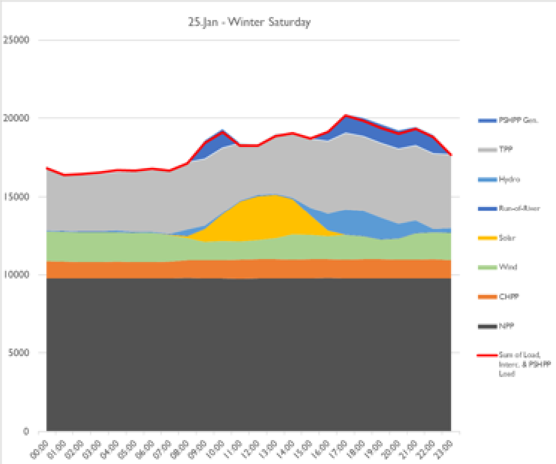
Figure 74: Jan 25th Winter Saturday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 25th Winter Saturday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9781	1105	1893	0	18	50	4050	0	16832
01:00	9784	1070	1895	0	16	48	3635	0	16401
02:00	9766	1052	1903	0	16	46	3635	0	16466
03:00	9776	1044	1903	0	18	46	3689	0	16539
04:00	9790	1048	1875	0	18	99	3748	0	16700
05:00	9781	1043	1861	0	18	46	3879	0	16668
06:00	9784	1048	1836	0	18	46	3990	0	16804
07:00	9790	1053	1688	25	18	46	4079	0	16656
08:00	9799	1126	1427	122	19	399	4314	0	17113
09:00	9768	1165	1172	812	28	190	4273	1208	18437
10:00	9767	1183	1202	1719	28	50	4170	1208	19127
11:00	9761	1217	1167	2543	28	46	3649	0	18269
12:00	9791	1205	1215	2832	26	48	3223	0	18259
13:00	9789	1197	1367	2765	25	48	3807	0	18873
14:00	9780	1196	1599	2281	27	50	4134	0	19060
15:00	9791	1205	1554	1255	27	478	4375	0	18706
16:00	9796	1207	1451	365	27	1072	4627	615	19147
17:00	9781	1202	1569	5	27	1599	4891	1198	20172
18:00	9782	1209	1479	2	29	1577	4773	1208	19836
19:00	9788	1200	1269	2	29	1364	4777	1208	19397
20:00	9778	1205	1344	2	29	902	4785	1208	19019
21:00	9776	1206	1656	2	29	801	4791	1208	19331
22:00	9789	1210	1703	2	29	194	4813	1208	18802
23:00	9777	1159	1736	2	26	292	4705	0	17689

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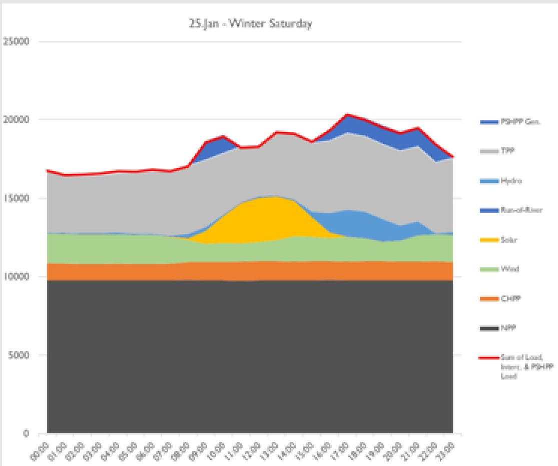
Figure 75: Jan 25th Winter Saturday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 25th Winter Saturday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9781	1105	1893	0	18	50	3906	0	16758
01:00	9784	1070	1895	0	16	48	3635	0	16482
02:00	9766	1052	1903	0	16	46	3635	0	16521
03:00	9776	1044	1903	0	18	46	3689	0	16573
04:00	9790	1048	1875	0	18	107	3748	0	16742
05:00	9781	1043	1861	0	18	46	3879	0	16713
06:00	9784	1048	1836	0	18	46	3990	0	16832
07:00	9790	1053	1688	25	18	46	4079	0	16726
08:00	9799	1126	1427	122	19	262	4314	0	17024
09:00	9768	1165	1172	812	28	239	4273	1208	18564
10:00	9767	1183	1202	1719	28	50	3920	1208	18929
11:00	9761	1217	1167	2543	28	46	3527	0	18213
12:00	9791	1205	1215	2832	26	48	3208	0	18292
13:00	9789	1197	1367	2765	25	48	4074	0	19205
14:00	9780	1196	1599	2281	27	50	4133	0	19113
15:00	9791	1205	1554	1255	27	318	4375	0	18590
16:00	9796	1207	1451	365	27	1196	4627	615	19329
17:00	9781	1202	1569	5	27	1691	4891	1198	20345
18:00	9782	1209	1479	2	29	1659	4773	1208	20001
19:00	9788	1200	1269	2	29	1398	4777	1208	19510
20:00	9778	1205	1344	2	29	898	4785	1208	19142
21:00	9776	1206	1656	2	29	855	4791	1208	19477
22:00	9789	1210	1703	2	29	50	4509	1208	18443
23:00	9777	1159	1736	2	26	157	4705	0	17638

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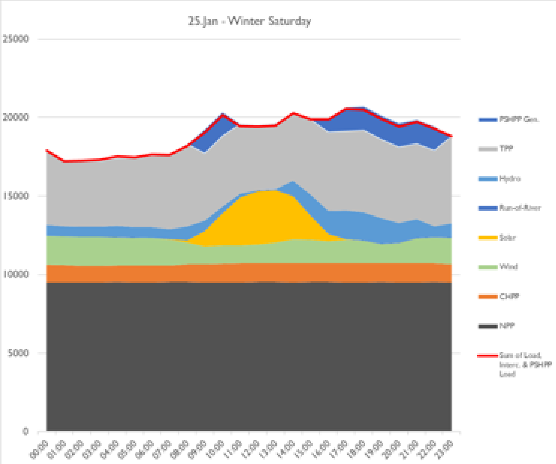
Figure 76: Jan 25th Winter Saturday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9517	1105	1831	0	18	692	4792	0	17889
01:00	9519	1070	1833	0	16	646	4176	0	17213
02:00	9502	1052	1840	0	16	645	4142	0	17245
03:00	9512	1044	1840	0	18	645	4175	0	17297
04:00	9526	1048	1814	0	18	718	4286	0	17530
05:00	9517	1043	1799	0	18	645	4395	0	17458
06:00	9519	1048	1775	0	18	645	4553	0	17641
07:00	9526	1053	1633	31	18	645	4752	0	17613
08:00	9535	1126	1380	147	19	868	5219	0	18200
09:00	9504	1165	1134	976	28	634	4273	1532	19065
10:00	9503	1183	1163	2066	28	376	4510	1532	20160
11:00	9497	1217	1129	3056	28	229	4421	0	19435
12:00	9527	1205	1175	3403	26	48	4120	0	19423
13:00	9525	1197	1322	3323	25	48	4161	0	19476
14:00	9516	1196	1546	2742	27	957	4290	0	20266
15:00	9527	1205	1503	1509	27	1331	4754	0	19876
16:00	9531	1207	1404	439	27	1456	5017	811	19876
17:00	9517	1202	1517	6	27	1820	5038	1532	20559
18:00	9518	1209	1430	2	29	1790	5201	1532	20488
19:00	9524	1200	1228	2	29	1606	5017	1532	19896
20:00	9514	1205	1300	2	29	1255	4823	1532	19427
21:00	9512	1206	1602	2	29	1197	4791	1532	19732
22:00	9525	1210	1647	2	29	679	4813	1532	19291
23:00	9513	1159	1679	2	26	889	5536	0	18796

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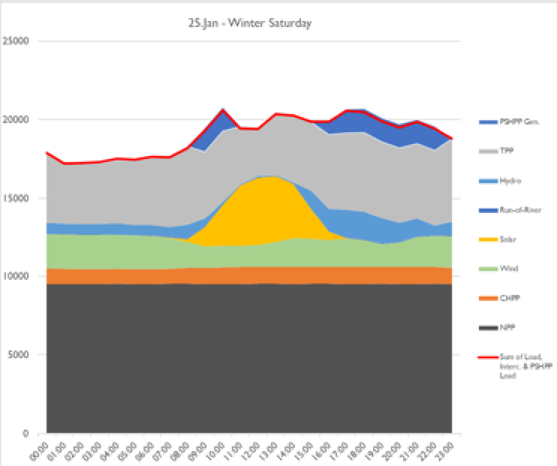
Figure 77: Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9517	995	2197	0	18	692	4537	0	17889
01:00	9519	963	2200	0	16	646	3916	0	17213
02:00	9502	947	2208	0	16	645	3879	0	17245
03:00	9512	940	2208	0	18	645	3912	0	17297
04:00	9526	943	2177	0	18	718	4028	0	17530
05:00	9517	939	2159	0	18	645	4140	0	17458
06:00	9519	943	2130	0	18	645	4303	0	17641
07:00	9526	948	1959	39	18	645	4523	0	17613
08:00	9535	1013	1656	186	19	868	5016	0	18200
09:00	9504	1049	1360	1236	28	518	4273	1532	19320
10:00	9503	1065	1395	2617	28	161	4510	1532	20610
11:00	9497	1095	1355	3871	28	46	3686	0	19435
12:00	9527	1085	1410	4310	26	48	3099	0	19423
13:00	9525	1077	1586	4210	25	48	4008	0	20354
14:00	9516	1076	1855	3473	27	50	4276	0	20266
15:00	9527	1085	1803	1911	27	1128	4375	0	19876
16:00	9531	1086	1685	556	27	1456	4740	811	19876
17:00	9517	1082	1821	8	27	1814	4891	1532	20591
18:00	9518	1088	1716	3	29	1790	5035	1532	20488
19:00	9524	1080	1473	3	29	1606	4891	1532	19896
20:00	9514	1085	1560	3	29	1230	4785	1532	19503
21:00	9512	1085	1922	3	29	1146	4791	1532	19881
22:00	9525	1089	1977	3	29	614	4813	1532	19435
23:00	9513	1043	2014	3	26	889	5316	0	18796

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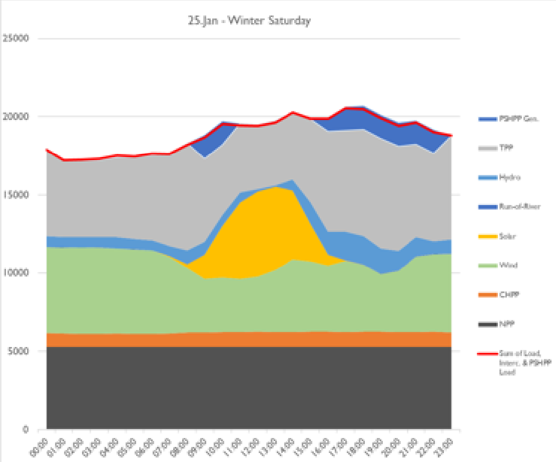
Figure 78: Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



25.01.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	5287	884	5492	0	18	692	5582	0	17889
01:00	5289	856	5499	0	16	646	4954	0	17213
02:00	5279	842	5521	0	16	645	4895	0	17245
03:00	5285	835	5521	0	18	645	4931	0	17297
04:00	5292	838	5441	0	18	718	5102	0	17530
05:00	5287	834	5398	0	18	645	5235	0	17458
06:00	5289	838	5326	0	18	645	5443	0	17641
07:00	5292	842	4899	49	18	645	5912	0	17613
08:00	5297	901	4139	235	19	868	6834	0	18200
09:00	5280	932	3401	1561	28	805	5327	1532	18687
10:00	5280	946	3488	3305	28	663	4510	1532	19552
11:00	5276	974	3386	4889	28	603	4421	0	19435
12:00	5293	964	3524	5445	26	113	4139	0	19423
13:00	5292	958	3965	5317	25	48	4161	0	19641
14:00	5287	957	4638	4386	27	688	4290	0	20266
15:00	5293	964	4508	2414	27	1331	5319	0	19876
16:00	5295	966	4211	702	27	1456	6423	811	19876
17:00	5287	962	4551	10	27	1820	6470	1532	20559
18:00	5288	967	4291	3	29	1790	6811	1532	20488
19:00	5291	960	3683	3	29	1606	7033	1532	19896
20:00	5286	964	3900	3	29	1255	6691	1532	19427
21:00	5285	965	4805	3	29	1231	5922	1532	19632
22:00	5292	968	4942	3	29	798	5614	1532	19031
23:00	5285	927	5036	3	26	889	6637	0	18796

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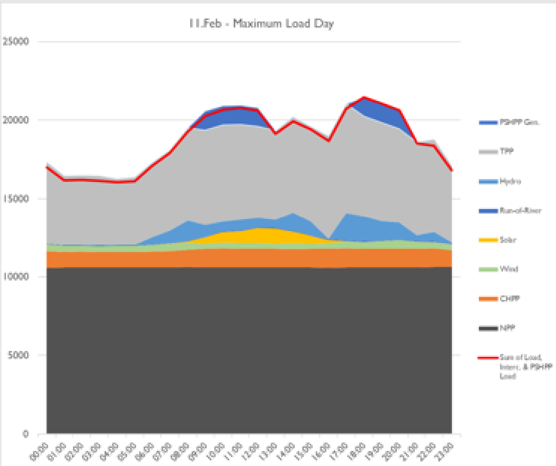
Figure 79: Jan 25th Winter Saturday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Feb 11st Maximum Load Day: As-Is



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	10573	1068	423	0	29	46	5226	0	17017
01:00	10593	991	386	0	27	48	4421	0	16179
02:00	10600	1001	377	0	28	46	4450	0	16221
03:00	10596	991	370	0	28	46	4433	0	16139
04:00	10591	993	394	0	28	48	4238	0	16057
05:00	10600	984	396	0	28	46	4328	0	16112
06:00	10610	995	426	0	28	478	4798	0	17081
07:00	10602	1033	466	37	28	785	5173	0	17925
08:00	10621	1102	457	85	28	1307	5927	0	19278
09:00	10600	1201	344	373	44	769	6054	1208	20269
10:00	10600	1220	367	692	46	597	6188	1208	20664
11:00	10604	1197	373	760	46	669	6102	1208	20805
12:00	10596	1190	376	935	46	650	5808	1208	20604
13:00	10605	1183	355	941	46	535	5677	0	19133
14:00	10596	1182	386	742	48	1176	6110	0	19940
15:00	10602	1186	355	468	48	878	6091	0	19423
16:00	10578	1207	383	179	48	46	6573	0	18681
17:00	10598	1213	477	10	48	1731	6973	0	20731
18:00	10599	1185	439	0	48	1605	6379	1208	21463
19:00	10600	1187	494	0	48	1238	6304	1208	21068
20:00	10595	1201	535	0	48	1103	5974	1208	20630
21:00	10597	1193	463	0	48	345	5972	0	18517
22:00	10622	1203	405	0	48	588	5912	0	18365
23:00	10622	1097	386	0	45	55	4898	0	16817

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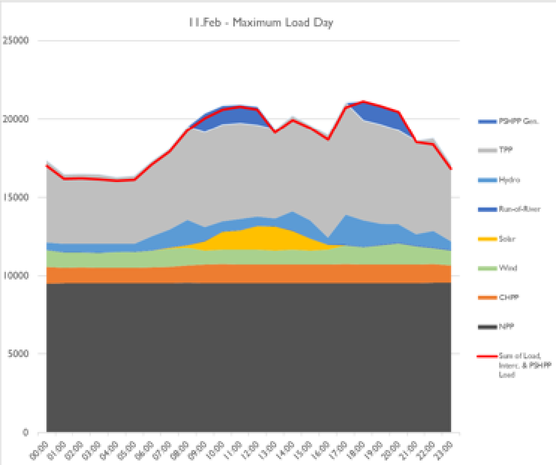
Figure 80: Feb 11st Maximum Load Day: As-Is

Feb 11st Maximum Load Day: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9516	1068	1055	0	29	471	5226	0	17017
01:00	9534	991	963	0	27	531	4421	0	16179
02:00	9540	1001	940	0	28	543	4450	0	16221
03:00	9536	991	923	0	28	553	4433	0	16139
04:00	9532	993	983	0	28	518	4238	0	16057
05:00	9540	984	988	0	28	514	4328	0	16112
06:00	9549	995	1062	0	28	903	4798	0	17081
07:00	9542	1033	1162	60	28	1126	5173	0	17925
08:00	9559	1102	1140	137	28	1601	5960	0	19278
09:00	9540	1201	858	600	44	871	6054	1208	20051
10:00	9540	1220	915	1113	46	630	6188	1208	20606
11:00	9544	1197	930	1223	46	683	6102	1208	20778
12:00	9536	1190	938	1504	46	579	5808	1208	20604
13:00	9545	1183	885	1514	46	492	5677	0	19133
14:00	9536	1182	963	1194	48	1207	6110	0	19940
15:00	9542	1186	885	753	48	1123	6091	0	19423
16:00	9520	1207	955	288	48	423	6573	0	18681
17:00	9538	1213	1190	16	48	1899	7146	0	20731
18:00	9539	1185	1095	0	48	1679	6379	1208	21132
19:00	9540	1187	1232	0	48	1321	6304	1208	20829
20:00	9536	1201	1334	0	48	1176	5974	1208	20442
21:00	9537	1193	1155	0	48	713	5972	0	18517
22:00	9560	1203	1010	0	48	1045	5912	0	18365
23:00	9560	1097	963	0	45	541	4898	0	16817

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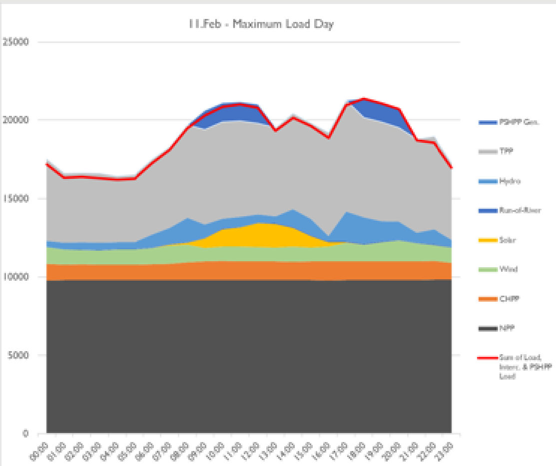
Figure 81: Feb 11st Maximum Load Day: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Feb 11st Maximum Load Day: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9780	1068	1055	0	29	376	5226	0	17186
01:00	9799	991	963	0	27	428	4421	0	16341
02:00	9805	1001	940	0	28	436	4450	0	16379
03:00	9801	991	923	0	28	444	4433	0	16295
04:00	9797	993	983	0	28	409	4238	0	16212
05:00	9805	984	988	0	28	406	4328	0	16269
06:00	9814	995	1062	0	28	808	4798	0	17251
07:00	9807	1033	1162	60	28	1043	5173	0	18107
08:00	9824	1102	1140	137	28	1565	5927	0	19474
09:00	9805	1201	858	600	44	849	6054	1208	20294
10:00	9805	1220	915	1113	46	607	6188	1208	20848
11:00	9809	1197	930	1223	46	647	6102	1208	21007
12:00	9801	1190	938	1504	46	512	5808	1208	20802
13:00	9810	1183	885	1514	46	423	5677	0	19328
14:00	9801	1182	963	1194	48	1147	6110	0	20145
15:00	9807	1186	885	753	48	1054	6091	0	19619
16:00	9785	1207	955	288	48	349	6573	0	18871
17:00	9803	1213	1190	16	48	1899	7098	0	20948
18:00	9804	1185	1095	0	48	1668	6379	1208	21386
19:00	9805	1187	1232	0	48	1305	6304	1208	21077
20:00	9800	1201	1334	0	48	1157	5974	1208	20688
21:00	9802	1193	1155	0	48	636	5972	0	18705
22:00	9825	1203	1010	0	48	971	5912	0	18556
23:00	9825	1097	963	0	45	447	4898	0	16989

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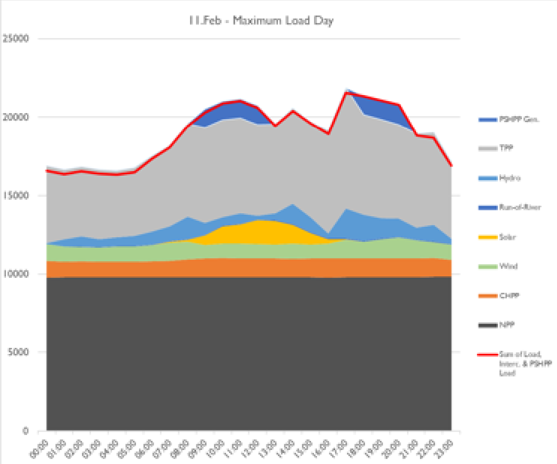
Figure 82: Feb 11st Maximum Load Day: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Feb 11st Maximum Load Day: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9780	1068	1055	0	29	46	4912	0	16576
01:00	9799	991	963	0	27	455	4421	0	16371
02:00	9805	1001	940	0	28	621	4450	0	16551
03:00	9801	991	923	0	28	481	4433	0	16389
04:00	9797	993	983	0	28	554	4238	0	16341
05:00	9805	984	988	0	28	631	4328	0	16497
06:00	9814	995	1062	0	28	827	4798	0	17342
07:00	9807	1033	1162	60	28	945	5173	0	18083
08:00	9824	1102	1140	137	28	1420	5927	0	19417
09:00	9805	1201	858	600	44	766	6054	1208	20307
10:00	9805	1220	915	1113	46	541	6188	1208	20870
11:00	9809	1197	930	1223	46	654	6102	1208	21023
12:00	9801	1190	938	1504	46	245	5808	1208	20599
13:00	9810	1183	885	1514	46	449	5677	0	19436
14:00	9801	1182	963	1194	48	1293	6110	0	20391
15:00	9807	1186	885	753	48	939	6091	0	19589
16:00	9785	1207	955	288	48	310	6573	0	18934
17:00	9803	1213	1190	16	48	1899	7701	0	21547
18:00	9804	1185	1095	0	48	1652	6379	1208	21357
19:00	9805	1187	1232	0	48	1294	6304	1208	21076
20:00	9800	1201	1334	0	48	1167	5974	1208	20792
21:00	9802	1193	1155	0	48	760	5972	0	18825
22:00	9825	1203	1010	0	48	1044	5912	0	18687
23:00	9825	1097	963	0	45	310	4898	0	16922

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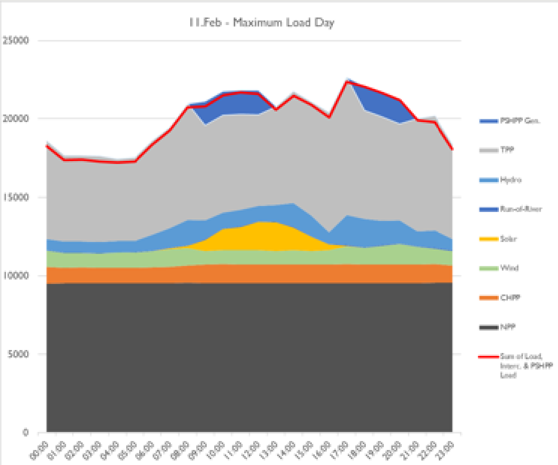
Figure 83: Feb 11st Maximum Load Day: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	9516	1068	1020	0	29	717	6266	0	18267
01:00	9534	991	931	0	27	718	5464	0	17378
02:00	9540	1001	909	0	28	717	5475	0	17389
03:00	9536	991	892	0	28	717	5455	0	17294
04:00	9532	993	950	0	28	718	5220	0	17206
05:00	9540	984	955	0	28	717	5320	0	17274
06:00	9549	995	1027	0	28	1020	5977	0	18342
07:00	9542	1033	1124	72	28	1235	6436	0	19271
08:00	9559	1102	1102	164	28	1601	7417	0	20725
09:00	9540	1201	830	721	44	1205	6054	1532	20802
10:00	9540	1220	885	1338	46	1006	6188	1532	21501
11:00	9544	1197	900	1469	46	1041	6102	1532	21675
12:00	9536	1190	907	1807	46	976	5808	1532	21598
13:00	9545	1183	856	1819	46	1060	6280	0	20579
14:00	9536	1182	931	1434	48	1510	7115	0	21456
15:00	9542	1186	856	905	48	1300	7243	0	20875
16:00	9520	1207	924	346	48	717	7662	0	20090
17:00	9538	1213	1151	19	48	1899	8786	0	22335
18:00	9539	1185	1059	0	48	1811	6886	1532	22059
19:00	9540	1187	1192	0	48	1553	6609	1532	21650
20:00	9536	1201	1290	0	48	1458	6150	1532	21181
21:00	9537	1193	1117	0	48	926	7188	0	19908
22:00	9560	1203	977	0	48	1097	7307	0	19779
23:00	9560	1097	931	0	45	723	6018	0	18088

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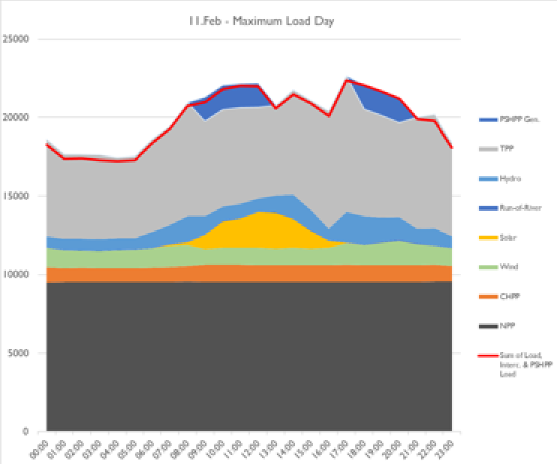
Figure 84: Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	9516	961	1224	0	29	717	6168	0	18267
01:00	9534	892	1117	0	27	718	5377	0	17378
02:00	9540	901	1091	0	28	717	5394	0	17389
03:00	9536	892	1071	0	28	717	5375	0	17294
04:00	9532	894	1140	0	28	718	5129	0	17206
05:00	9540	886	1146	0	28	717	5228	0	17274
06:00	9549	896	1233	0	28	1020	5871	0	18342
07:00	9542	930	1349	91	28	1235	6296	0	19271
08:00	9559	992	1323	208	28	1601	7263	0	20725
09:00	9540	1081	996	913	44	1143	6054	1532	20979
10:00	9540	1098	1062	1694	46	885	6188	1532	21791
11:00	9544	1077	1080	1861	46	913	6102	1532	22000
12:00	9536	1071	1088	2289	46	818	5808	1532	21984
13:00	9545	1065	1027	2304	46	1060	5742	0	20579
14:00	9536	1064	1117	1817	48	1510	6665	0	21456
15:00	9542	1067	1027	1146	48	1300	6949	0	20875
16:00	9520	1086	1109	438	48	717	7505	0	20090
17:00	9538	1092	1381	24	48	1899	8672	0	22335
18:00	9539	1067	1271	0	48	1811	6793	1532	22059
19:00	9540	1068	1430	0	48	1553	6490	1532	21650
20:00	9536	1081	1548	0	48	1458	6012	1532	21181
21:00	9537	1074	1340	0	48	926	7084	0	19908
22:00	9560	1083	1172	0	48	1097	7232	0	19779
23:00	9560	987	1117	0	45	723	5942	0	18088

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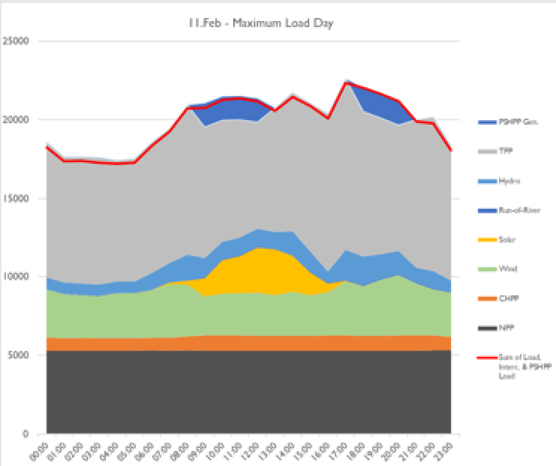
Figure 85: Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



11.02.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	5287	854	3061	0	29	717	8668	0	18267
01:00	5297	793	2793	0	27	718	8037	0	17378
02:00	5300	801	2728	0	28	717	8097	0	17389
03:00	5298	793	2677	0	28	717	8106	0	17294
04:00	5296	794	2851	0	28	718	7754	0	17206
05:00	5300	787	2865	0	28	717	7847	0	17274
06:00	5305	796	3082	0	28	1020	8365	0	18342
07:00	5301	826	3372	114	28	1235	8593	0	19271
08:00	5311	882	3307	263	28	1601	9583	0	20725
09:00	5300	961	2489	1154	44	1224	8369	1532	20748
10:00	5300	976	2656	2140	46	1103	7770	1532	21268
11:00	5302	958	2699	2351	46	1154	7499	1532	21386
12:00	5298	952	2721	2892	46	1140	6821	1532	21196
13:00	5303	946	2569	2910	46	1060	7954	0	20579
14:00	5298	946	2793	2295	48	1510	8867	0	21456
15:00	5301	949	2569	1447	48	1300	9465	0	20875
16:00	5289	966	2771	554	48	717	10079	0	20090
17:00	5299	970	3452	31	48	1899	10955	0	22335
18:00	5300	948	3177	0	48	1811	9245	1532	22059
19:00	5300	950	3575	0	48	1553	8704	1532	21650
20:00	5298	961	3871	0	48	1458	8047	1532	21181
21:00	5299	954	3350	0	48	926	9432	0	19908
22:00	5311	962	2931	0	48	1097	9843	0	19779
23:00	5311	878	2793	0	45	723	8624	0	18088

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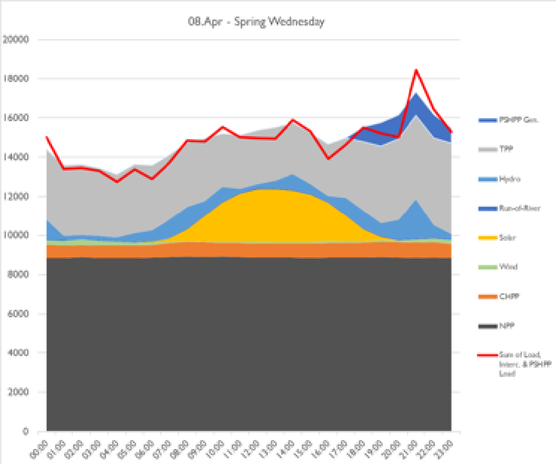
Figure 86: Feb 11st Maximum Load Day: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Apr 8th Spring Wednesday: As-Is



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8844	680	220	0	40	1054	3576	0	15028
01:00	8859	635	244	0	40	201	3613	0	13417
02:00	8887	631	275	0	40	189	3607	0	13455
03:00	8847	627	254	0	40	199	3485	0	13317
04:00	8849	641	183	0	40	199	3221	0	12752
05:00	8844	640	139	0	40	469	3507	0	13384
06:00	8873	629	117	54	40	564	3320	0	12902
07:00	8903	696	86	155	40	960	3282	0	13717
08:00	8928	752	58	566	52	1104	3306	0	14852
09:00	8903	750	29	1325	49	694	3205	0	14790
10:00	8914	694	64	2014	54	740	2722	0	15533
11:00	8887	723	64	2474	54	199	2734	0	15012
12:00	8873	718	88	2701	53	199	2749	0	14978
13:00	8868	720	80	2701	48	389	2711	0	14952
14:00	8863	714	82	2637	48	809	2617	0	15899
15:00	8856	722	89	2423	50	487	2634	0	15326
16:00	8881	724	115	1972	50	281	2632	0	13909
17:00	8882	720	98	1326	55	856	3037	0	14628
18:00	8866	765	72	602	55	912	3524	742	15521
19:00	8897	777	113	131	56	660	3928	1208	15205
20:00	8879	771	93	9	58	1007	4128	1208	15010
21:00	8857	774	175	0	57	1999	4261	1208	18458
22:00	8874	777	190	0	57	637	4440	1208	16468
23:00	8855	705	211	0	51	239	4665	737	15299

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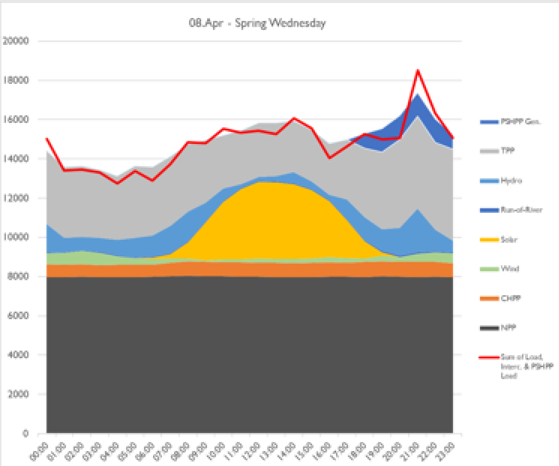
Figure 87: Apr 8th Spring Wednesday: As-Is

Apr 8th Spring Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7960	680	542	0	40	1470	3723	0	15028
01:00	7973	635	601	0	40	730	3613	0	13417
02:00	7998	631	677	0	40	676	3607	0	13455
03:00	7962	627	625	0	40	712	3485	0	13317
04:00	7964	641	451	0	40	783	3254	0	12752
05:00	7960	640	342	0	40	1000	3657	0	13384
06:00	7986	629	288	78	40	1076	3499	0	12902
07:00	8013	696	212	225	40	1394	3542	0	13717
08:00	8035	752	143	822	52	1510	3452	0	14852
09:00	8013	750	71	1923	49	944	3205	0	14790
10:00	8023	694	158	2923	54	629	2722	0	15533
11:00	7998	723	158	3591	54	192	2734	0	15327
12:00	7986	718	217	3920	53	191	2749	0	15431
13:00	7981	720	197	3920	48	251	2711	0	15263
14:00	7977	714	202	3828	48	562	2617	0	16076
15:00	7970	722	219	3517	50	373	2634	0	15550
16:00	7993	724	283	2862	50	256	2632	0	14055
17:00	7994	720	241	1925	55	1002	3037	0	14628
18:00	7979	765	177	874	55	1175	3524	742	15274
19:00	8007	777	278	190	56	1107	3928	1208	14986
20:00	7991	771	229	13	58	1432	4500	1208	15059
21:00	7971	774	431	0	57	2229	4710	1208	18507
22:00	7987	777	468	0	57	1110	4440	1208	16331
23:00	7970	705	519	0	51	575	4665	737	15058

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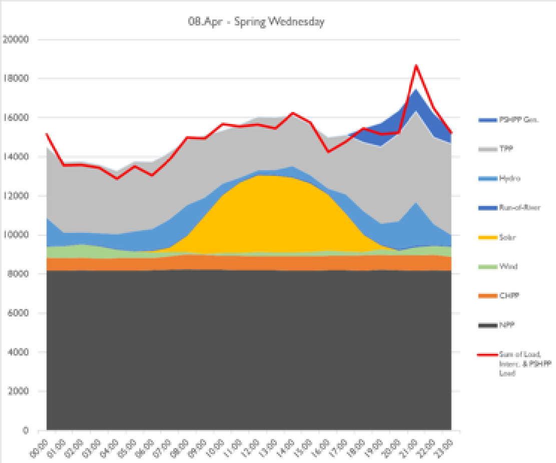
Figure 88: Apr 8th Spring Wednesday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 8th Spring Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8181	680	542	0	40	1470	3634	0	15161
01:00	8195	635	601	0	40	643	3613	0	13551
02:00	8220	631	677	0	40	583	3607	0	13585
03:00	8183	627	625	0	40	618	3485	0	13444
04:00	8185	641	451	0	40	725	3221	0	12882
05:00	8181	640	342	0	40	1000	3565	0	13513
06:00	8208	629	288	78	40	1076	3414	0	13038
07:00	8235	696	212	225	40	1394	3459	0	13856
08:00	8258	752	143	822	52	1510	3369	0	14991
09:00	8235	750	71	1923	49	873	3205	0	14942
10:00	8245	694	158	2923	54	551	2722	0	15678
11:00	8220	723	158	3591	54	191	2734	0	15548
12:00	8208	718	217	3920	53	190	2749	0	15652
13:00	8203	720	197	3920	48	229	2711	0	15463
14:00	8198	714	202	3828	48	516	2617	0	16252
15:00	8192	722	219	3517	50	346	2634	0	15745
16:00	8215	724	283	2862	50	246	2632	0	14266
17:00	8216	720	241	1925	55	927	3037	0	14775
18:00	8201	765	177	874	55	1137	3524	742	15457
19:00	8230	777	278	190	56	1063	3928	1208	15165
20:00	8213	771	229	13	58	1432	4453	1208	15234
21:00	8193	774	431	0	57	2229	4646	1208	18664
22:00	8208	777	468	0	57	1061	4440	1208	16503
23:00	8191	705	519	0	51	535	4665	737	15240

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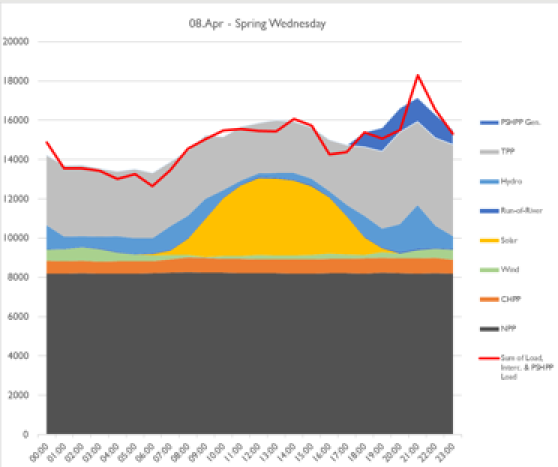
Figure 89: Apr 8th Spring Wednesday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 8th Spring Wednesday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8181	680	542	0	40	1207	3576	0	14874
01:00	8195	635	601	0	40	601	3613	0	13554
02:00	8220	631	677	0	40	527	3607	0	13549
03:00	8183	627	625	0	40	590	3485	0	13421
04:00	8185	641	451	0	40	783	3301	0	13020
05:00	8181	640	342	0	40	802	3507	0	13249
06:00	8208	629	288	78	40	757	3320	0	12642
07:00	8235	696	212	225	40	1191	3282	0	13457
08:00	8258	752	143	822	52	1129	3306	0	14563
09:00	8235	750	71	1923	49	986	3205	0	15053
10:00	8245	694	158	2923	54	360	2722	0	15497
11:00	8220	723	158	3591	54	192	2734	0	15555
12:00	8208	718	217	3920	53	190	2554	0	15451
13:00	8203	720	197	3920	48	223	2711	0	15441
14:00	8198	714	202	3828	48	340	2617	0	16064
15:00	8192	722	219	3517	50	318	2634	0	15718
16:00	8215	724	283	2862	50	253	2632	0	14269
17:00	8216	720	241	1925	55	538	3037	0	14379
18:00	8201	765	177	874	55	1054	3524	742	15380
19:00	8230	777	278	190	56	951	3928	1208	15062
20:00	8213	771	229	13	58	1432	4692	1208	15506
21:00	8193	774	431	0	57	2229	4265	1208	18294
22:00	8208	777	468	0	57	1135	4451	1208	16570
23:00	8191	705	519	0	51	629	4665	737	15314

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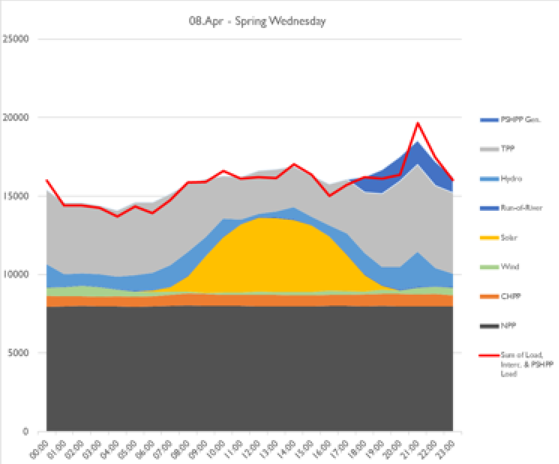
Figure 90: Apr 8th Spring Wednesday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7960	680	524	0	40	1470	4723	0	16011
01:00	7973	635	581	0	40	785	4572	0	14410
02:00	7998	631	655	0	40	775	4490	0	14416
03:00	7962	627	605	0	40	783	4375	0	14257
04:00	7964	641	436	0	40	783	4228	0	13711
05:00	7960	640	331	0	40	1000	4623	0	14338
06:00	7986	629	279	94	40	1076	4501	0	13910
07:00	8013	696	205	270	40	1394	4534	0	14747
08:00	8035	752	138	987	52	1510	4324	0	15884
09:00	8013	750	69	2311	49	1181	3704	0	15912
10:00	8023	694	152	3513	54	1118	2722	0	16607
11:00	7998	723	152	4315	54	263	2734	0	16117
12:00	7986	718	210	4711	53	198	2749	0	16221
13:00	7981	720	190	4711	48	366	2711	0	16163
14:00	7977	714	195	4600	48	752	2617	0	17032
15:00	7970	722	212	4226	50	497	2634	0	16377
16:00	7993	724	274	3440	50	647	2632	0	15013
17:00	7994	720	233	2313	55	1311	3434	0	15714
18:00	7979	765	171	1050	55	1356	3858	978	16195
19:00	8007	777	269	228	56	1153	4671	1532	16129
20:00	7991	771	221	16	58	1432	5475	1532	16353
21:00	7971	774	417	0	57	2229	5561	1532	19667
22:00	7987	777	452	0	57	1135	5268	1532	17492
23:00	7970	705	502	0	51	815	5167	972	16018

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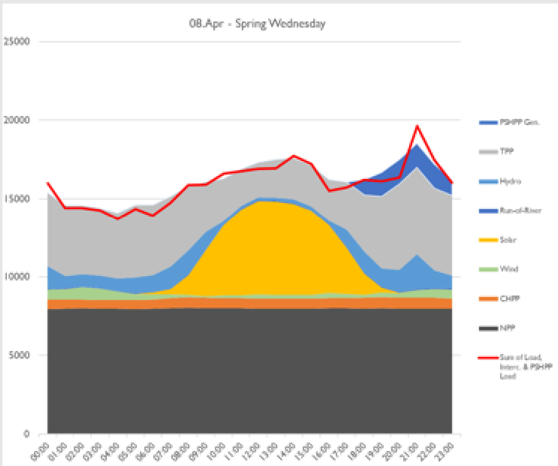
Figure 91: Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7960	612	629	0	40	1470	4686	0	16011
01:00	7973	572	697	0	40	785	4519	0	14410
02:00	7998	568	786	0	40	775	4423	0	14416
03:00	7962	564	726	0	40	783	4316	0	14257
04:00	7964	577	523	0	40	783	4205	0	13711
05:00	7960	576	397	0	40	1000	4620	0	14338
06:00	7986	566	334	119	40	1076	4483	0	13910
07:00	8013	626	246	342	40	1394	4491	0	14747
08:00	8035	677	166	1251	52	1510	4108	0	15884
09:00	8013	675	83	2927	49	1125	3205	0	15912
10:00	8023	625	183	4450	54	220	2722	0	16607
11:00	7998	651	183	5466	54	190	2349	0	16768
12:00	7986	646	251	5968	53	190	2233	0	16924
13:00	7981	648	229	5968	48	190	2434	0	16933
14:00	7977	643	234	5826	48	254	2617	0	17728
15:00	7970	650	254	5353	50	239	2634	0	17216
16:00	7993	652	329	4357	50	228	2632	0	15494
17:00	7994	648	280	2930	55	1117	3037	0	15714
18:00	7979	689	206	1330	55	1356	3620	978	16195
19:00	8007	699	323	289	56	1153	4634	1532	16129
20:00	7991	694	266	20	58	1432	5503	1532	16353
21:00	7971	697	500	0	57	2229	5555	1532	19667
22:00	7987	699	543	0	57	1135	5255	1532	17492
23:00	7970	635	603	0	51	815	5137	972	16018

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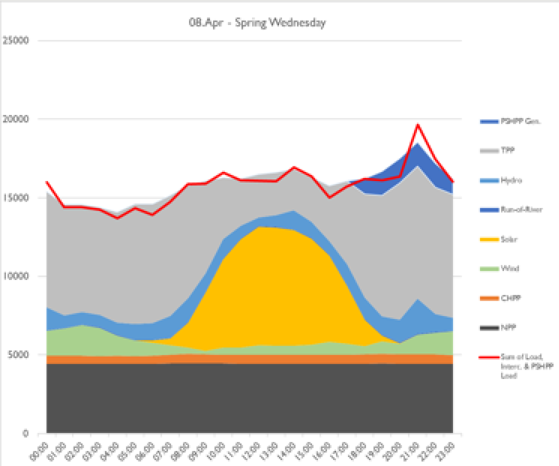
Figure 92: Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



08.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	4422	544	1571	0	40	1470	7349	0	16011
01:00	4430	508	1743	0	40	785	7080	0	14410
02:00	4444	505	1964	0	40	775	6862	0	14416
03:00	4424	502	1814	0	40	783	6829	0	14257
04:00	4425	513	1307	0	40	783	7024	0	13711
05:00	4422	512	993	0	40	1000	7626	0	14338
06:00	4437	503	836	151	40	1076	7562	0	13910
07:00	4452	557	614	433	40	1394	7663	0	14747
08:00	4464	602	414	1580	52	1510	7177	0	15884
09:00	4452	600	207	3698	49	1181	5890	0	15912
10:00	4457	555	457	5621	54	1218	3914	0	16607
11:00	4444	578	457	6904	54	783	3019	0	16117
12:00	4437	574	629	7538	53	512	2749	0	16088
13:00	4434	576	571	7538	48	749	2711	0	16063
14:00	4432	571	586	7359	48	1210	2617	0	16952
15:00	4428	578	636	6762	50	1015	2844	0	16377
16:00	4441	579	821	5504	50	849	3516	0	15013
17:00	4441	576	700	3701	55	1311	5277	0	15714
18:00	4433	612	514	1680	55	1356	6585	978	16195
19:00	4449	622	807	366	56	1153	7710	1532	16129
20:00	4440	617	664	25	58	1432	8728	1532	16353
21:00	4429	619	1250	0	57	2229	8425	1532	19667
22:00	4437	622	1357	0	57	1135	8068	1532	17492
23:00	4428	564	1507	0	51	815	7845	972	16018

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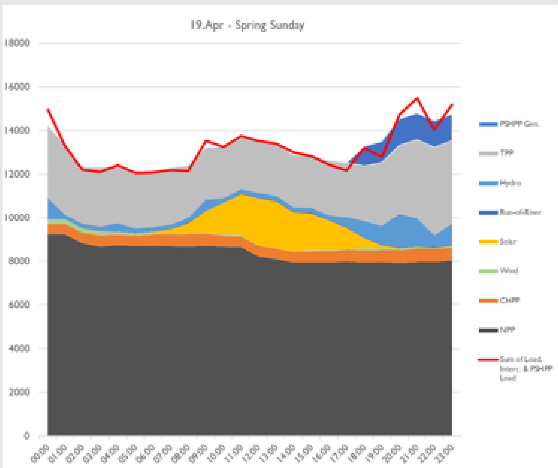
Figure 93: Apr 8th Spring Wednesday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Apr 19th Spring Sunday: As-Is



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	9212	498	202	0	42	981	3300	0	14980
01:00	9216	491	207	0	18	203	3217	0	13295
02:00	8818	496	192	0	17	202	2591	0	12229
03:00	8678	490	201	0	17	204	2734	0	12103
04:00	8728	485	138	0	17	372	2607	0	12422
05:00	8693	489	105	0	19	202	2602	0	12063
06:00	8721	498	75	58	21	203	2595	0	12093
07:00	8698	514	72	176	22	202	2604	0	12193
08:00	8676	558	89	432	49	200	2398	0	12161
09:00	8723	534	69	983	28	501	2388	0	13533
10:00	8677	500	66	1439	28	202	2358	0	13259
11:00	8644	495	36	1908	52	202	2367	0	13758
12:00	8229	488	26	2159	50	204	2376	0	13537
13:00	8086	489	6	2182	50	202	2397	0	13402
14:00	7937	490	24	1800	50	204	2389	0	13013
15:00	7949	490	96	1684	52	202	2389	0	12837
16:00	7951	500	66	1356	52	200	2500	0	12439
17:00	7976	550	40	957	52	457	2499	0	12181
18:00	7946	555	87	469	47	759	2532	883	13207
19:00	7957	559	88	128	49	825	2926	971	12792
20:00	7919	595	69	12	47	1549	3150	1208	14754
21:00	7965	614	89	0	46	1284	3593	1208	15499
22:00	7969	609	57	0	46	523	4038	1208	14040
23:00	8030	605	85	0	46	948	3843	1208	15189

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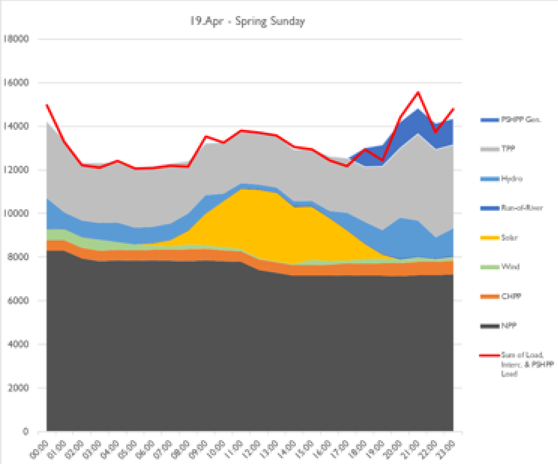
Figure 94: Apr 19th Spring Sunday: As-Is

Apr 19th Spring Sunday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8291	498	497	0	42	1385	3522	0	14980
01:00	8294	491	510	0	18	750	3289	0	13295
02:00	7936	496	473	0	17	750	2645	0	12229
03:00	7810	490	495	0	17	751	2761	0	12103
04:00	7855	485	340	0	17	888	2762	0	12422
05:00	7824	489	259	0	19	750	2770	0	12063
06:00	7849	498	185	84	21	750	2784	0	12093
07:00	7828	514	177	255	22	750	2742	0	12193
08:00	7808	558	219	627	49	742	2398	0	12161
09:00	7851	534	170	1427	28	829	2388	0	13533
10:00	7809	500	162	2089	28	324	2358	0	13259
11:00	7780	495	89	2769	52	201	2367	0	13806
12:00	7406	488	64	3134	50	198	2376	0	13721
13:00	7277	489	15	3167	50	197	2397	0	13583
14:00	7143	490	59	2613	50	202	2389	0	13065
15:00	7154	490	236	2444	52	200	2389	0	12941
16:00	7156	500	162	1968	52	286	2500	0	12439
17:00	7178	550	98	1389	52	764	2499	0	12181
18:00	7151	555	214	681	47	960	2532	883	12953
19:00	7161	559	217	186	49	1076	2926	971	12434
20:00	7127	595	170	17	47	1848	3203	1208	14420
21:00	7169	614	219	0	46	1632	3973	1208	15560
22:00	7172	609	140	0	46	939	4038	1208	13742
23:00	7227	605	209	0	46	1233	3843	1208	14795

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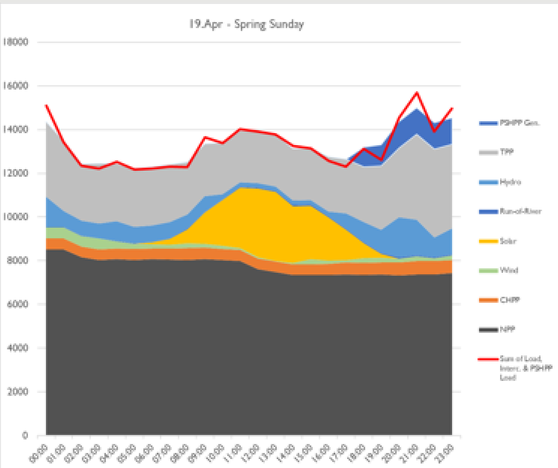
Figure 95: Apr 19th Spring Sunday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 19th Spring Sunday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8521	498	497	0	42	1385	3420	0	15109
01:00	8525	491	510	0	18	722	3217	0	13425
02:00	8157	496	473	0	17	702	2591	0	12348
03:00	8027	490	495	0	17	681	2734	0	12223
04:00	8073	485	340	0	17	888	2659	0	12537
05:00	8041	489	259	0	19	750	2669	0	12179
06:00	8067	498	185	84	21	750	2683	0	12210
07:00	8046	514	177	255	22	750	2642	0	12311
08:00	8025	558	219	627	49	649	2398	0	12285
09:00	8069	534	170	1427	28	733	2388	0	13656
10:00	8026	500	162	2089	28	233	2358	0	13386
11:00	7996	495	89	2769	52	198	2367	0	14020
12:00	7612	488	64	3134	50	196	2376	0	13924
13:00	7480	489	15	3167	50	195	2397	0	13783
14:00	7342	490	59	2613	50	200	2389	0	13262
15:00	7353	490	236	2444	52	199	2389	0	13138
16:00	7355	500	162	1968	52	212	2500	0	12563
17:00	7378	550	98	1389	52	690	2499	0	12307
18:00	7350	555	214	681	47	928	2532	883	13120
19:00	7360	559	217	186	49	1050	2926	971	12607
20:00	7325	595	170	17	47	1843	3150	1208	14560
21:00	7368	614	219	0	46	1632	3911	1208	15697
22:00	7371	609	140	0	46	906	4038	1208	13909
23:00	7428	605	209	0	46	1204	3843	1208	14967

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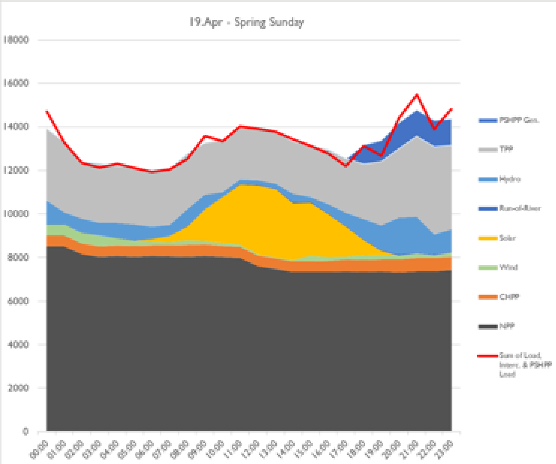
Figure 96: Apr 19th Spring Sunday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 19th Spring Sunday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8521	498	497	0	42	1061	3300	0	14698
01:00	8525	491	510	0	18	544	3217	0	13290
02:00	8157	496	473	0	17	647	2591	0	12346
03:00	8027	490	495	0	17	557	2734	0	12131
04:00	8073	485	340	0	17	681	2607	0	12302
05:00	8041	489	259	0	19	730	2602	0	12105
06:00	8067	498	185	84	21	552	2595	0	11928
07:00	8046	514	177	255	22	491	2604	0	12036
08:00	8025	558	219	627	49	748	2546	0	12539
09:00	8069	534	170	1427	28	659	2388	0	13594
10:00	8026	500	162	2089	28	202	2358	0	13348
11:00	7996	495	89	2769	52	201	2367	0	14019
12:00	7612	488	64	3134	50	195	2376	0	13915
13:00	7480	489	15	3167	50	192	2397	0	13772
14:00	7342	490	59	2613	50	385	2389	0	13437
15:00	7353	490	236	2444	52	195	2389	0	13130
16:00	7355	500	162	1968	52	411	2500	0	12765
17:00	7378	550	98	1389	52	578	2499	0	12200
18:00	7350	555	214	681	47	916	2532	883	13128
19:00	7360	559	217	186	49	1117	2926	971	12683
20:00	7325	595	170	17	47	1687	3150	1208	14422
21:00	7368	614	219	0	46	1632	3699	1208	15483
22:00	7371	609	140	0	46	892	4038	1208	13898
23:00	7428	605	209	0	46	1028	3843	1208	14815

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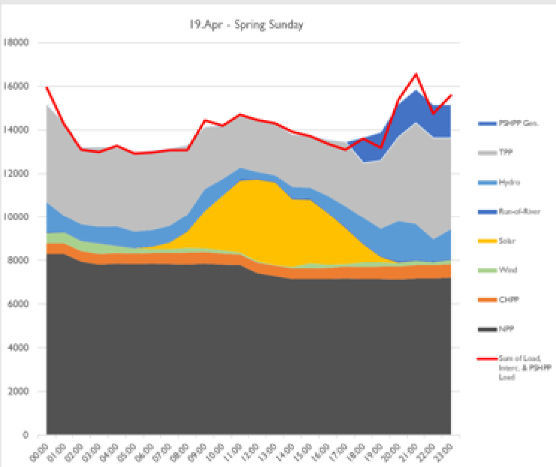
Figure 97: Apr 19th Spring Sunday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8291	498	481	0	42	1385	4490	0	15931
01:00	8294	491	493	0	18	750	4268	0	14258
02:00	7936	496	457	0	17	750	3542	0	13111
03:00	7810	490	479	0	17	751	3664	0	12990
04:00	7855	485	329	0	17	888	3627	0	13276
05:00	7824	489	250	0	19	750	3640	0	12925
06:00	7849	498	179	101	21	750	3640	0	12960
07:00	7828	514	171	307	22	750	3571	0	13068
08:00	7808	558	212	754	49	748	3189	0	13077
09:00	7851	534	164	1715	28	993	2850	0	14442
10:00	7809	500	157	2510	28	750	2454	0	14197
11:00	7780	495	86	3328	52	536	2367	0	14698
12:00	7406	488	62	3766	50	301	2376	0	14454
13:00	7277	489	14	3806	50	281	2397	0	14305
14:00	7143	490	57	3140	50	521	2389	0	13909
15:00	7154	490	229	2937	52	496	2389	0	13722
16:00	7156	500	157	2365	52	748	2564	0	13356
17:00	7178	550	95	1669	52	957	2958	0	13111
18:00	7151	555	207	818	47	1194	2532	1164	13597
19:00	7161	559	210	223	49	1258	3154	1280	13182
20:00	7127	595	164	21	47	1848	3877	1532	15416
21:00	7169	614	212	0	46	1632	4672	1532	16576
22:00	7172	609	136	0	46	1011	4656	1532	14752
23:00	7227	605	202	0	46	1358	4197	1532	15591

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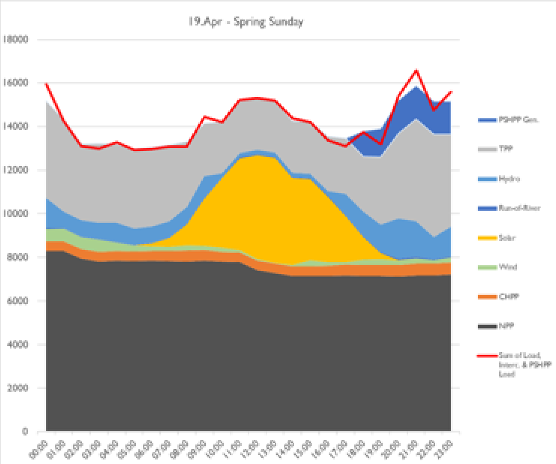
Figure 98: Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8291	448	577	0	42	1385	4443	0	15931
01:00	8294	442	591	0	18	750	4219	0	14258
02:00	7936	446	549	0	17	750	3500	0	13111
03:00	7810	441	574	0	17	751	3618	0	12990
04:00	7855	437	394	0	17	888	3610	0	13276
05:00	7824	440	300	0	19	750	3639	0	12925
06:00	7849	448	214	128	21	750	3628	0	12960
07:00	7828	463	206	389	22	750	3506	0	13068
08:00	7808	502	254	954	49	748	3002	0	13077
09:00	7851	481	197	2172	28	993	2413	0	14442
10:00	7809	450	189	3179	28	202	2358	0	14204
11:00	7780	446	103	4216	52	195	2367	0	15211
12:00	7406	439	74	4770	50	190	2376	0	15311
13:00	7277	440	17	4821	50	190	2397	0	15183
14:00	7143	441	69	3977	50	196	2389	0	14384
15:00	7154	441	274	3721	52	196	2389	0	14202
16:00	7156	450	189	2996	52	200	2500	0	13356
17:00	7178	495	114	2114	52	957	2549	0	13111
18:00	7151	500	249	1036	47	1123	2532	1164	13731
19:00	7161	503	251	283	49	1258	3108	1280	13182
20:00	7127	536	197	27	47	1848	3898	1532	15416
21:00	7169	553	254	0	46	1632	4691	1532	16576
22:00	7172	548	163	0	46	1011	4690	1532	14752
23:00	7227	545	243	0	46	1358	4217	1532	15591

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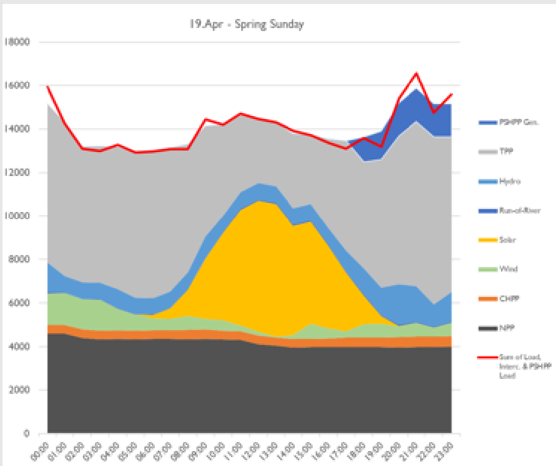
Figure 99: Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



19.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	4606	398	1443	0	42	1385	7312	0	15931
01:00	4608	393	1479	0	18	750	7067	0	14258
02:00	4409	397	1371	0	17	750	6254	0	13111
03:00	4339	392	1436	0	17	751	6276	0	12990
04:00	4364	388	986	0	17	888	6558	0	13276
05:00	4347	391	750	0	19	750	6715	0	12925
06:00	4361	398	536	162	21	750	6811	0	12960
07:00	4349	411	514	491	22	750	6626	0	13068
08:00	4338	446	636	1206	49	748	5896	0	13077
09:00	4362	427	493	2743	28	993	5089	0	14442
10:00	4339	400	471	4016	28	750	4204	0	14197
11:00	4322	396	257	5325	52	750	3542	0	14698
12:00	4115	390	186	6025	50	751	2932	0	14454
13:00	4043	391	43	6090	50	750	2948	0	14305
14:00	3969	392	171	5023	50	751	3433	0	13909
15:00	3975	392	686	4700	52	750	3193	0	13722
16:00	3976	400	471	3784	52	748	4111	0	13356
17:00	3988	440	286	2671	52	957	5067	0	13111
18:00	3973	444	621	1309	47	1204	4887	1164	13578
19:00	3979	447	629	357	49	1258	5896	1280	13182
20:00	3960	476	493	33	47	1848	6823	1532	15416
21:00	3983	491	636	0	46	1632	7557	1532	16576
22:00	3985	487	407	0	46	1011	7694	1532	14752
23:00	4015	484	607	0	46	1358	7125	1532	15591

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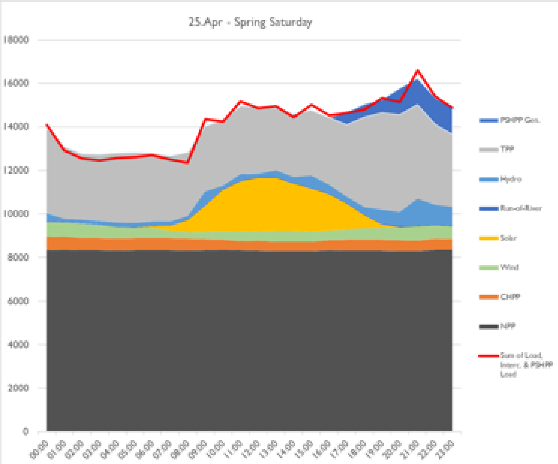
Figure 100: Apr 19th Spring Sunday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

Apr 25th Spring Saturday: As-Is



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	8343	608	686	0	43	356	3905	64	14092
01:00	8371	603	646	0	18	153	3305	0	12926
02:00	8331	555	692	0	18	155	3003	0	12540
03:00	8332	552	617	0	18	153	3058	0	12462
04:00	8313	552	531	0	18	201	3184	0	12575
05:00	8332	556	479	0	20	201	3231	0	12620
06:00	8334	549	484	65	22	199	3161	0	12715
07:00	8338	544	382	201	22	161	3032	0	12512
08:00	8312	549	291	580	46	155	2883	0	12358
09:00	8331	524	329	1190	53	607	2991	0	14353
10:00	8359	462	365	1927	37	155	2998	0	14248
11:00	8328	434	403	2347	46	274	3122	0	15165
12:00	8326	444	446	2444	44	155	3024	0	14868
13:00	8302	438	490	2430	44	302	2860	0	14942
14:00	8297	434	510	2155	44	273	2886	0	14448
15:00	8304	437	455	1974	46	560	2983	0	15017
16:00	8331	472	470	1640	46	394	3084	0	14538
17:00	8322	507	487	1153	46	296	3300	573	14638
18:00	8327	493	523	595	46	336	4140	592	14790
19:00	8320	509	534	163	48	627	4453	594	15331
20:00	8300	500	586	17	48	641	4474	1208	15149
21:00	8284	504	648	0	47	1232	4304	1208	16596
22:00	8357	500	622	0	47	907	3686	1208	15400
23:00	8363	492	582	0	46	861	3321	1208	14873

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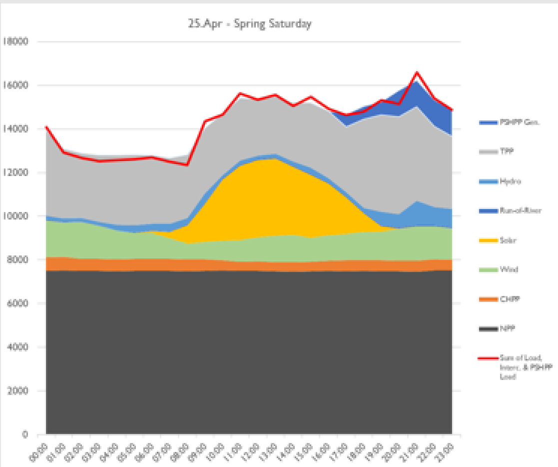
Figure 101: Apr 25th Spring Saturday: As-Is

Apr 25th Spring Saturday: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7509	608	1689	0	43	190	3902	64	14092
01:00	7534	603	1590	0	18	153	3198	0	12926
02:00	7498	555	1704	0	18	155	2965	0	12680
03:00	7499	552	1519	0	18	153	3058	0	12531
04:00	7482	552	1307	0	18	256	3184	0	12575
05:00	7499	556	1179	0	20	334	3231	0	12620
06:00	7501	549	1192	94	22	295	3161	0	12715
07:00	7504	544	940	292	22	346	3032	0	12512
08:00	7481	549	716	842	46	299	2883	0	12358
09:00	7498	524	810	1727	53	422	2991	0	14353
10:00	7523	462	899	2797	37	155	2850	0	14668
11:00	7495	434	992	3407	46	190	2866	0	15641
12:00	7493	444	1098	3547	44	155	2578	0	15345
13:00	7472	438	1206	3527	44	190	2603	0	15556
14:00	7467	434	1256	3128	44	190	2689	0	15057
15:00	7474	437	1120	2865	46	287	2983	0	15470
16:00	7498	472	1157	2380	46	193	3084	0	14931
17:00	7490	507	1199	1674	46	190	3006	573	14638
18:00	7494	493	1288	864	46	190	4086	592	14790
19:00	7488	509	1315	237	48	605	4453	594	15331
20:00	7470	500	1443	25	48	608	4474	1208	15150
21:00	7456	504	1595	0	47	1120	4304	1208	16602
22:00	7521	500	1531	0	47	839	3686	1208	15405
23:00	7527	492	1433	0	46	846	3321	1208	14873

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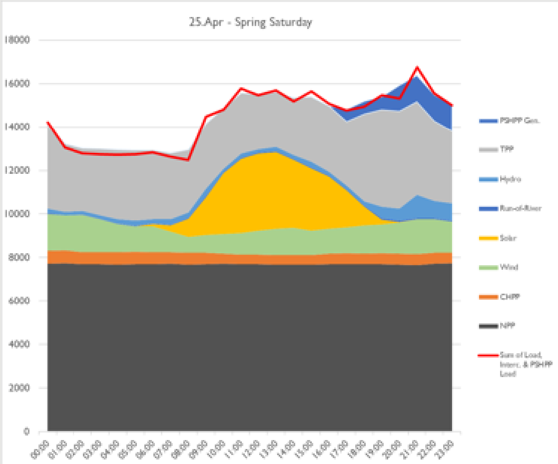
Figure 102: Apr 25th Spring Saturday: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 25th Spring Saturday: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7717	608	1689	0	43	190	3827	64	14224
01:00	7743	603	1590	0	18	153	3116	0	13054
02:00	7706	555	1704	0	18	155	2879	0	12802
03:00	7707	552	1519	0	18	153	3058	0	12739
04:00	7690	552	1307	0	18	200	3184	0	12727
05:00	7707	556	1179	0	20	244	3231	0	12738
06:00	7709	549	1192	94	22	206	3161	0	12834
07:00	7713	544	940	292	22	261	3032	0	12636
08:00	7689	549	716	842	46	224	2883	0	12491
09:00	7706	524	810	1727	53	345	2991	0	14484
10:00	7732	462	899	2797	37	155	2780	0	14807
11:00	7703	434	992	3407	46	190	2797	0	15780
12:00	7702	444	1098	3547	44	155	2511	0	15486
13:00	7679	438	1206	3527	44	190	2533	0	15694
14:00	7675	434	1256	3128	44	190	2623	0	15198
15:00	7681	437	1120	2865	46	260	2983	0	15651
16:00	7706	472	1157	2380	46	190	3021	0	15073
17:00	7698	507	1199	1674	46	190	2940	573	14780
18:00	7702	493	1288	864	46	190	4025	592	14938
19:00	7696	509	1315	237	48	546	4453	594	15480
20:00	7678	500	1443	25	48	563	4474	1208	15312
21:00	7663	504	1595	0	47	1076	4304	1208	16765
22:00	7730	500	1531	0	47	787	3686	1208	15562
23:00	7736	492	1433	0	46	779	3321	1208	15014

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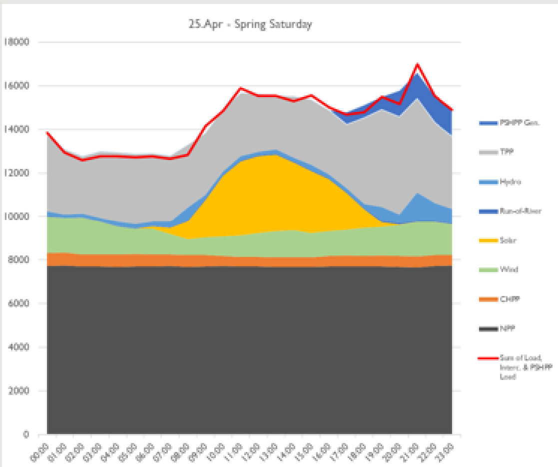
Figure 103: Apr 25th Spring Saturday: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 25th Spring Saturday: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7717	608	1689	0	43	190	3504	64	13846
01:00	7743	603	1590	0	18	153	2971	0	12947
02:00	7706	555	1704	0	18	155	2653	0	12589
03:00	7707	552	1519	0	18	153	3058	0	12765
04:00	7690	552	1307	0	18	198	3184	0	12769
05:00	7707	556	1179	0	20	198	3231	0	12721
06:00	7709	549	1192	94	22	197	3161	0	12774
07:00	7713	544	940	292	22	260	3032	0	12671
08:00	7689	549	716	842	46	578	2883	0	12828
09:00	7706	524	810	1727	53	190	2829	0	14162
10:00	7732	462	899	2797	37	155	2854	0	14852
11:00	7703	434	992	3407	46	190	2906	0	15898
12:00	7702	444	1098	3547	44	155	2646	0	15546
13:00	7679	438	1206	3527	44	190	2459	0	15552
14:00	7675	434	1256	3128	44	190	2809	0	15308
15:00	7681	437	1120	2865	46	237	2983	0	15561
16:00	7706	472	1157	2380	46	190	2952	0	15018
17:00	7698	507	1199	1674	46	190	2924	573	14686
18:00	7702	493	1288	864	46	190	3964	592	14798
19:00	7696	509	1315	237	48	648	4453	594	15499
20:00	7678	500	1443	25	48	414	4474	1208	15167
21:00	7663	504	1595	0	47	1307	4304	1208	17000
22:00	7730	500	1531	0	47	818	3686	1208	15544
23:00	7736	492	1433	0	46	654	3321	1208	14904

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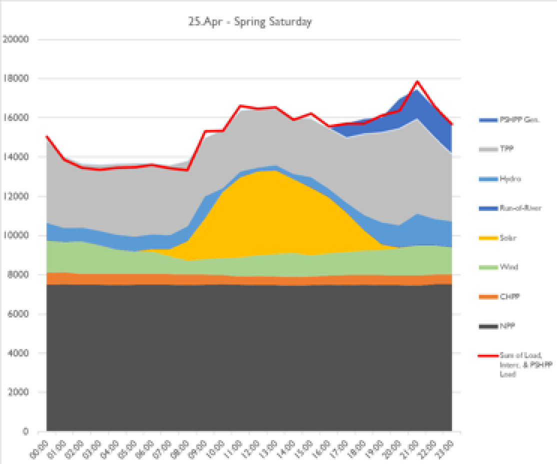
Figure 104: Apr 25th Spring Saturday: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7509	608	1633	0	43	862	4215	84	15041
01:00	7534	603	1538	0	18	696	3654	0	13873
02:00	7498	555	1648	0	18	697	3243	0	13445
03:00	7499	552	1469	0	18	696	3389	0	13354
04:00	7482	552	1264	0	18	735	3625	0	13452
05:00	7499	556	1140	0	20	735	3742	0	13493
06:00	7501	549	1152	113	22	733	3623	0	13594
07:00	7504	544	910	351	22	702	3564	0	13428
08:00	7481	549	693	1012	46	697	3325	0	13345
09:00	7498	524	783	2076	53	1068	2993	0	15322
10:00	7523	462	869	3361	37	155	2998	0	15350
11:00	7495	434	960	4094	46	236	3122	0	16597
12:00	7493	444	1062	4263	44	155	3024	0	16470
13:00	7472	438	1167	4239	44	240	2860	0	16535
14:00	7467	434	1214	3759	44	241	2886	0	15894
15:00	7474	437	1083	3443	46	491	2983	0	16215
16:00	7498	472	1119	2861	46	389	3084	0	15570
17:00	7490	507	1160	2011	46	480	3300	755	15702
18:00	7494	493	1245	1038	46	721	4140	780	15696
19:00	7488	509	1271	284	48	1084	4570	783	16120
20:00	7470	500	1395	30	48	1096	4908	1532	16353
21:00	7456	504	1543	0	47	1580	4816	1532	17847
22:00	7521	500	1481	0	47	1314	4120	1532	16587
23:00	7527	492	1386	0	46	1276	3421	1532	15679

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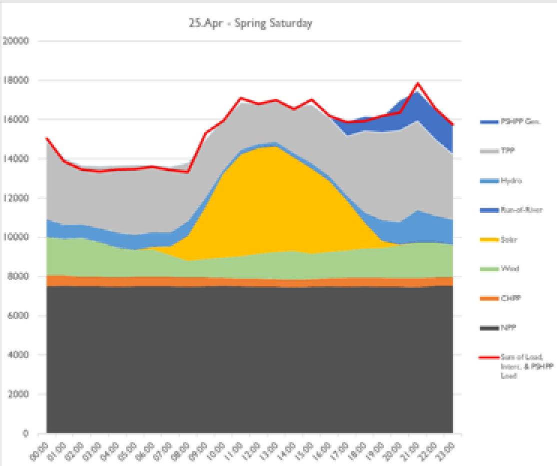
Figure 105: Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7509	547	1960	0	43	862	3949	84	15041
01:00	7534	543	1846	0	18	696	3407	0	13873
02:00	7498	500	1977	0	18	663	3003	0	13445
03:00	7499	497	1763	0	18	696	3150	0	13354
04:00	7482	497	1517	0	18	735	3427	0	13452
05:00	7499	500	1369	0	20	735	3569	0	13493
06:00	7501	494	1383	144	22	733	3417	0	13594
07:00	7504	490	1091	444	22	702	3343	0	13428
08:00	7481	494	831	1281	46	697	2972	0	13345
09:00	7498	472	940	2629	53	412	2991	0	15322
10:00	7523	416	1043	4258	37	155	2584	0	15961
11:00	7495	391	1151	5185	46	190	2418	0	17088
12:00	7493	400	1274	5400	44	155	2057	0	16809
13:00	7472	394	1400	5369	44	190	2055	0	17000
14:00	7467	391	1457	4761	44	190	2365	0	16524
15:00	7474	393	1300	4361	46	204	2983	0	17019
16:00	7498	425	1343	3623	46	190	2974	0	16200
17:00	7490	456	1391	2547	46	190	3044	755	15874
18:00	7494	444	1494	1315	46	481	4140	780	15932
19:00	7488	458	1526	360	48	1007	4453	783	16205
20:00	7470	450	1674	38	48	1096	4671	1532	16353
21:00	7456	454	1851	0	47	1580	4558	1532	17847
22:00	7521	450	1777	0	47	1314	3874	1532	16587
23:00	7527	443	1663	0	46	1222	3321	1532	15753

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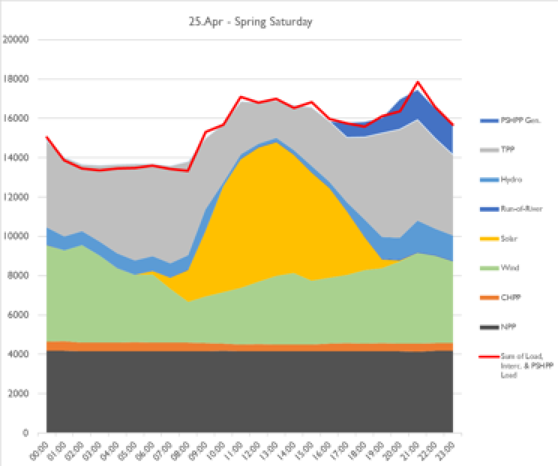
Figure 106: Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



25.04.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	4172	486	4900	0	43	862	4407	84	15041
01:00	4186	482	4614	0	18	696	4047	0	13873
02:00	4166	444	4943	0	18	697	3391	0	13445
03:00	4166	442	4407	0	18	696	3894	0	13354
04:00	4157	442	3793	0	18	735	4532	0	13452
05:00	4166	445	3421	0	20	735	4905	0	13493
06:00	4167	439	3457	181	22	733	4693	0	13594
07:00	4169	435	2729	561	22	702	4978	0	13428
08:00	4156	439	2079	1619	46	697	4767	0	13345
09:00	4166	419	2350	3321	53	1068	3618	0	15322
10:00	4180	370	2607	5378	37	155	2998	0	15669
11:00	4164	347	2879	6550	46	190	2701	0	17088
12:00	4163	355	3186	6821	44	155	2100	0	16809
13:00	4151	350	3500	6782	44	190	1906	0	17000
14:00	4149	347	3643	6014	44	190	2288	0	16524
15:00	4152	350	3250	5509	46	274	2983	0	16822
16:00	4166	378	3357	4577	46	262	3084	0	15971
17:00	4161	406	3479	3218	46	430	3300	755	15748
18:00	4164	394	3736	1661	46	846	4210	780	15573
19:00	4160	407	3814	455	48	1084	5286	783	16120
20:00	4150	400	4186	47	48	1096	5520	1532	16353
21:00	4142	403	4629	0	47	1580	5145	1532	17847
22:00	4179	400	4443	0	47	1314	4601	1532	16587
23:00	4182	394	4157	0	46	1276	4093	1532	15679

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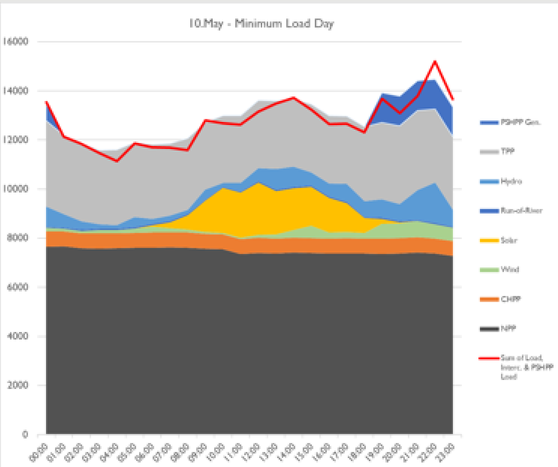
Figure 107: Apr 25th Spring Saturday: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction

May 10th Minimum Load Day: As-Is



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	7649	621	156	0	48	816	3500	689	13549
01:00	7664	617	109	0	47	548	3202	0	12128
02:00	7579	609	105	0	48	350	3154	0	11843
03:00	7572	616	151	0	48	176	3018	0	11467
04:00	7585	613	138	0	49	151	3064	0	11132
05:00	7610	612	175	0	49	421	3021	0	11867
06:00	7617	611	249	53	49	211	3025	0	11701
07:00	7625	613	181	228	49	222	2932	0	11691
08:00	7612	619	112	599	49	155	2922	0	11592
09:00	7565	615	82	1255	39	415	2732	0	12790
10:00	7541	618	59	1829	39	155	2743	0	12686
11:00	7345	619	61	1838	38	339	2741	0	12615
12:00	7399	623	107	2138	51	533	2753	0	13153
13:00	7366	619	175	1760	50	850	2771	0	13491
14:00	7407	614	308	1710	50	818	2771	0	13717
15:00	7389	618	497	1595	51	529	2769	0	13234
16:00	7367	618	253	1405	51	534	2755	0	12647
17:00	7371	623	252	1188	51	732	2744	0	12665
18:00	7367	620	226	599	51	641	3026	0	12318
19:00	7360	619	598	211	51	736	3141	1208	13670
20:00	7370	621	620	31	51	692	3184	1208	13097
21:00	7410	620	666	0	39	1228	3235	1208	13796
22:00	7368	612	595	0	53	1647	2978	1208	15210
23:00	7268	622	532	0	51	684	2973	1208	13662

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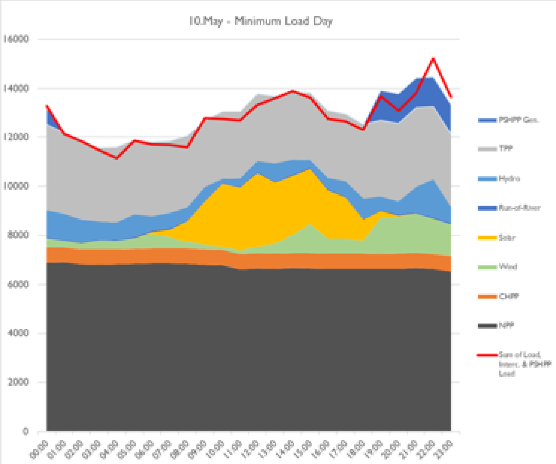
Figure 108: May 10th Minimum Load Day: As-Is

May 10th Minimum Load Day: 2021, 0,0% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 10% NPP Reduction, 0% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	6884	621	379	0	48	1105	3500	689	13296
01:00	6898	617	265	0	47	1054	3307	0	12128
02:00	6821	609	255	0	48	918	3194	0	11843
03:00	6815	616	367	0	48	718	3018	0	11467
04:00	6827	613	335	0	49	712	3064	0	11132
05:00	6849	612	425	0	49	932	3021	0	11867
06:00	6855	611	605	74	49	596	3025	0	11701
07:00	6863	613	439	320	49	634	2932	0	11691
08:00	6851	619	272	842	49	514	2922	0	11592
09:00	6809	615	199	1763	39	546	2732	0	12790
10:00	6787	618	143	2570	39	155	2743	0	12757
11:00	6611	619	148	2582	38	318	2741	0	12692
12:00	6659	623	260	3004	51	427	2753	0	13325
13:00	6629	619	425	2473	50	727	2771	0	13594
14:00	6666	614	748	2403	50	610	2771	0	13901
15:00	6650	618	1207	2241	51	295	2769	0	13617
16:00	6630	618	614	1974	51	459	2755	0	12766
17:00	6634	623	612	1669	51	628	2744	0	12665
18:00	6630	620	549	842	51	812	3026	0	12318
19:00	6624	619	1452	296	51	533	3141	1208	13670
20:00	6633	621	1505	44	51	531	3184	1208	13097
21:00	6669	620	1617	0	39	1035	3235	1208	13812
22:00	6631	612	1445	0	53	1542	2978	1208	15217
23:00	6541	622	1292	0	51	651	2973	1208	13662

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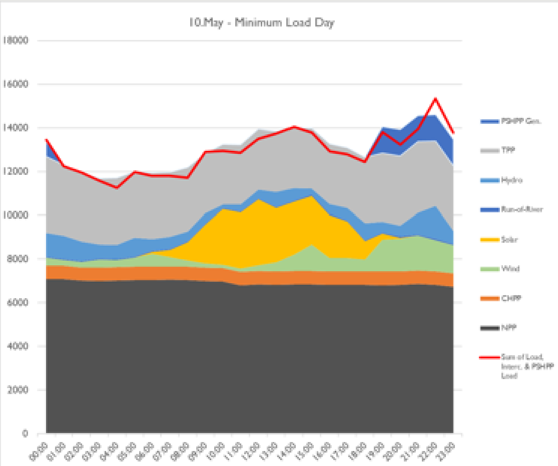
Figure 109: May 10th Minimum Load Day: 2021, 0,0% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 10% NPP Reduction, 0% CHPP Reduction

May 10th Minimum Load Day: 2021, 0,5% Yearly Growth, Intercon. 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP load
00:00	7075	621	379	0	48	1070	3500	689	13452
01:00	7089	617	265	0	47	1054	3233	0	12245
02:00	7011	609	255	0	48	880	3154	0	11955
03:00	7004	616	367	0	48	640	3018	0	11579
04:00	7016	613	335	0	49	637	3064	0	11246
05:00	7039	612	425	0	49	848	3021	0	11973
06:00	7046	611	605	74	49	517	3025	0	11813
07:00	7053	613	439	320	49	554	2932	0	11802
08:00	7041	619	272	842	49	438	2922	0	11707
09:00	6998	615	199	1763	39	474	2732	0	12907
10:00	6975	618	143	2570	39	155	2743	0	12945
11:00	6794	619	148	2582	38	305	2741	0	12862
12:00	6844	623	260	3004	51	405	2753	0	13489
13:00	6814	619	425	2473	50	696	2771	0	13747
14:00	6851	614	748	2403	50	577	2771	0	14053
15:00	6835	618	1207	2241	51	272	2769	0	13778
16:00	6814	618	614	1974	51	436	2755	0	12927
17:00	6818	623	612	1669	51	566	2744	0	12787
18:00	6814	620	549	842	51	754	3026	0	12444
19:00	6808	619	1452	296	51	478	3141	1208	13799
20:00	6817	621	1505	44	51	486	3184	1208	13235
21:00	6854	620	1617	0	39	1000	3235	1208	13962
22:00	6815	612	1445	0	53	1494	2978	1208	15353
23:00	6723	622	1292	0	51	597	2973	1208	13789

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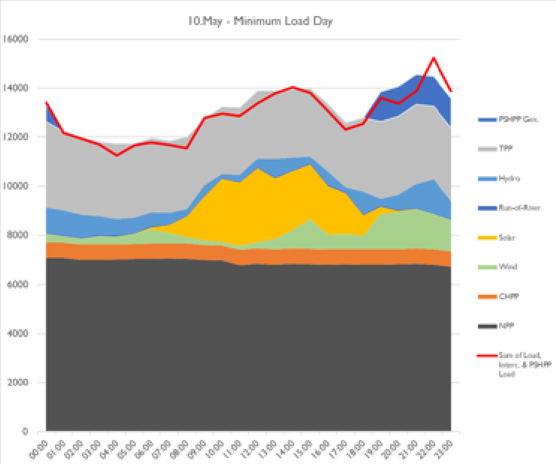
Figure 110: May 10th Minimum Load Day: 2021, 0,5% Yearly Growth, Intercon. 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

May 10th Minimum Load Day: 2021, 0,5% Yearly Growth, Iso 6241MW Solar, 2585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	7075	621	379	0	48	1012	3500	689	13405
01:00	7089	617	265	0	47	997	3202	0	12172
02:00	7011	609	255	0	48	908	3154	0	11937
03:00	7004	616	367	0	48	756	3018	0	11697
04:00	7016	613	335	0	49	653	3064	0	11256
05:00	7039	612	425	0	49	590	3021	0	11665
06:00	7046	611	605	74	49	552	3025	0	11792
07:00	7053	613	439	320	49	445	2932	0	11693
08:00	7041	619	272	842	49	255	2922	0	11538
09:00	6998	615	199	1763	39	410	2732	0	12781
10:00	6975	618	143	2570	39	155	2743	0	12960
11:00	6794	619	148	2582	38	286	2741	0	12854
12:00	6844	623	260	3004	51	352	2753	0	13375
13:00	6814	619	425	2473	50	730	2771	0	13775
14:00	6851	614	748	2403	50	505	2771	0	14025
15:00	6835	618	1207	2241	51	254	2769	0	13794
16:00	6814	618	614	1974	51	527	2755	0	13060
17:00	6818	623	612	1669	51	190	2636	0	12318
18:00	6814	620	549	842	51	893	3026	0	12540
19:00	6808	619	1452	296	51	266	3141	1208	13607
20:00	6817	621	1505	44	51	622	3184	1208	13367
21:00	6854	620	1617	0	39	970	3235	1208	13879
22:00	6815	612	1445	0	53	1362	2978	1208	15227
23:00	6723	622	1292	0	51	704	2973	1208	13881

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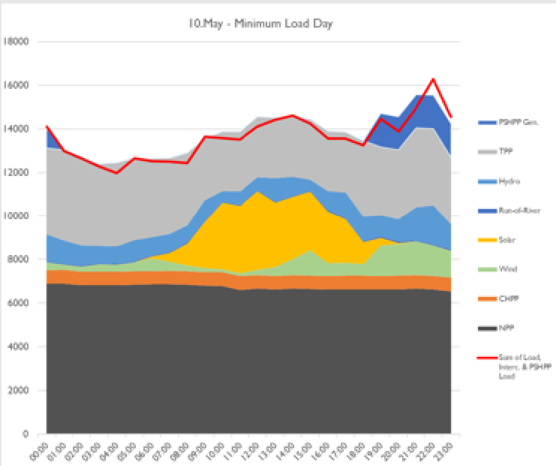
Figure 111: May 10th Minimum Load Day: 2021, 0,5% Yearly Growth, Iso 6,241MW Solar, 2,585MW Wind, 7,5% NPP Reduction, 0% CHPP Reduction

May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 7500MW Solar, 2500MW Wind, 10% NPP Reduction, 0% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	6884	621	366	0	48	1238	3975	908	14110
01:00	6898	617	256	0	47	1054	4184	0	12997
02:00	6821	609	247	0	48	918	4030	0	12670
03:00	6815	616	355	0	48	798	3775	0	12293
04:00	6827	613	324	0	49	781	3848	0	11974
05:00	6849	612	411	0	49	966	3788	0	12654
06:00	6855	611	585	89	49	822	3630	0	12528
07:00	6863	613	425	385	49	830	3509	0	12514
08:00	6851	619	263	1011	49	784	3339	0	12440
09:00	6809	615	193	2119	39	962	2831	0	13654
10:00	6787	618	139	3088	39	476	2743	0	13591
11:00	6611	619	143	3103	38	624	2741	0	13513
12:00	6659	623	251	3610	51	607	2753	0	14103
13:00	6629	619	411	2972	50	1077	2771	0	14429
14:00	6666	614	723	2887	50	877	2771	0	14628
15:00	6650	618	1167	2693	51	501	2769	0	14236
16:00	6630	618	594	2372	51	886	2755	0	13571
17:00	6634	623	592	2006	51	1180	2780	0	13570
18:00	6630	620	531	1011	51	1118	3502	0	13251
19:00	6624	619	1404	356	51	983	3141	1532	14456
20:00	6633	621	1456	52	51	1038	3184	1532	13887
21:00	6669	620	1564	0	39	1521	3640	1532	14975
22:00	6631	612	1397	0	53	1809	3512	1532	16295
23:00	6541	622	1249	0	51	1147	3085	1532	14551

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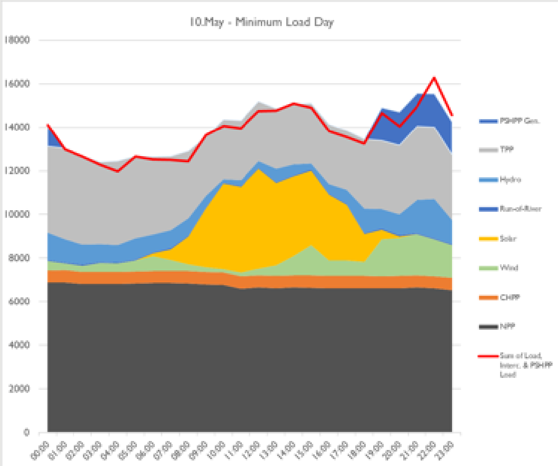
Figure 112: May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 7,500MW Solar, 2,500MW Wind, 10% NPP Reduction, 0% CHPP Reduction

May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 9500MW Solar, 3000MW Wind, 10% NPP Reduction, 10% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	6884	559	440	0	48	1238	3964	908	14110
01:00	6898	555	307	0	47	1054	4195	0	12997
02:00	6821	548	296	0	48	918	4042	0	12670
03:00	6815	554	425	0	48	798	3766	0	12293
04:00	6827	552	389	0	49	781	3845	0	11974
05:00	6849	551	493	0	49	966	3767	0	12654
06:00	6855	550	702	113	49	822	3550	0	12528
07:00	6863	552	510	488	49	830	3382	0	12514
08:00	6851	557	316	1281	49	784	3079	0	12440
09:00	6809	554	231	2684	39	519	2732	0	13654
10:00	6787	556	166	3912	39	155	2743	0	14060
11:00	6611	557	172	3931	38	272	2741	0	13955
12:00	6659	561	301	4573	51	306	2753	0	14752
13:00	6629	557	493	3764	50	614	2771	0	14779
14:00	6666	553	868	3657	50	508	2771	0	15112
15:00	6650	556	1400	3411	51	272	2769	0	14896
16:00	6630	556	713	3005	51	445	2755	0	13819
17:00	6634	561	710	2541	51	626	2744	0	13570
18:00	6630	558	637	1281	51	1118	3188	0	13251
19:00	6624	557	1685	451	51	879	3141	1532	14666
20:00	6633	559	1747	66	51	945	3184	1532	14037
21:00	6669	558	1877	0	39	1521	3390	1532	14975
22:00	6631	551	1677	0	53	1809	3294	1532	16295
23:00	6541	560	1499	0	51	1106	2973	1532	14585

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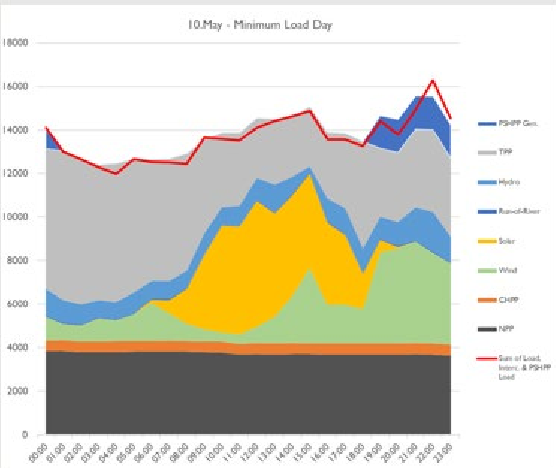
Figure 113: May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 9,500MW Solar, 3,000MW Wind, 10% NPP Reduction, 10% CHPP Reduction

May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 12000MW Solar, 7500MW Wind, 50% NPP Reduction, 20% CHPP Reduction



10.05.2020	NPP	CHPP	Wind	Solar	Run-of-River	Hydro	TPP	PSHPP Gen.	Load + Intercon. + PSHPP_load
00:00	3825	497	1099	0	48	1238	6427	908	14110
01:00	3832	494	768	0	47	1054	6861	0	12997
02:00	3790	487	740	0	48	918	6690	0	12670
03:00	3786	493	1064	0	48	798	6218	0	12293
04:00	3793	490	972	0	49	781	6357	0	11974
05:00	3805	490	1233	0	49	966	6132	0	12654
06:00	3809	489	1754	143	49	822	5576	0	12528
07:00	3813	490	1275	616	49	830	5600	0	12514
08:00	3806	495	789	1618	49	784	5375	0	12440
09:00	3783	492	578	3390	39	962	4323	0	13654
10:00	3771	494	416	4941	39	784	3445	0	13591
11:00	3673	495	430	4965	38	910	3368	0	13513
12:00	3700	498	754	5776	51	1022	2753	0	14103
13:00	3683	495	1233	4755	50	1261	3052	0	14429
14:00	3704	491	2170	4620	50	805	2771	0	14649
15:00	3695	494	3501	4309	51	277	2769	0	14882
16:00	3684	494	1782	3796	51	1044	3056	0	13571
17:00	3686	498	1775	3209	51	1180	3466	0	13570
18:00	3684	496	1592	1618	51	1118	4904	0	13251
19:00	3680	495	4212	570	51	999	3141	1532	14426
20:00	3685	497	4367	84	51	1088	3184	1532	13807
21:00	3705	496	4691	0	39	1521	3601	1532	14975
22:00	3684	490	4191	0	53	1809	3788	1532	16295
23:00	3634	498	3748	0	51	1147	3619	1532	14551

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Figure 114: May 10th Minimum Load Day: 2025, 1,2% Yearly Growth, Intercon. 12,000MW Solar, 7,500MW Wind, 50% NPP Reduction, 20% CHPP Reduction