



Technical Assistance Consultant's Report

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September 2013

Mongolia: Updating the Energy Sector Development Plan

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Prepared by E. Gen Consultants Ltd. Bangladesh in association with MVV decon GmbH, Germany, and Mon-Energy Consult, Mongolia

For Ministry of Energy, Mongolia

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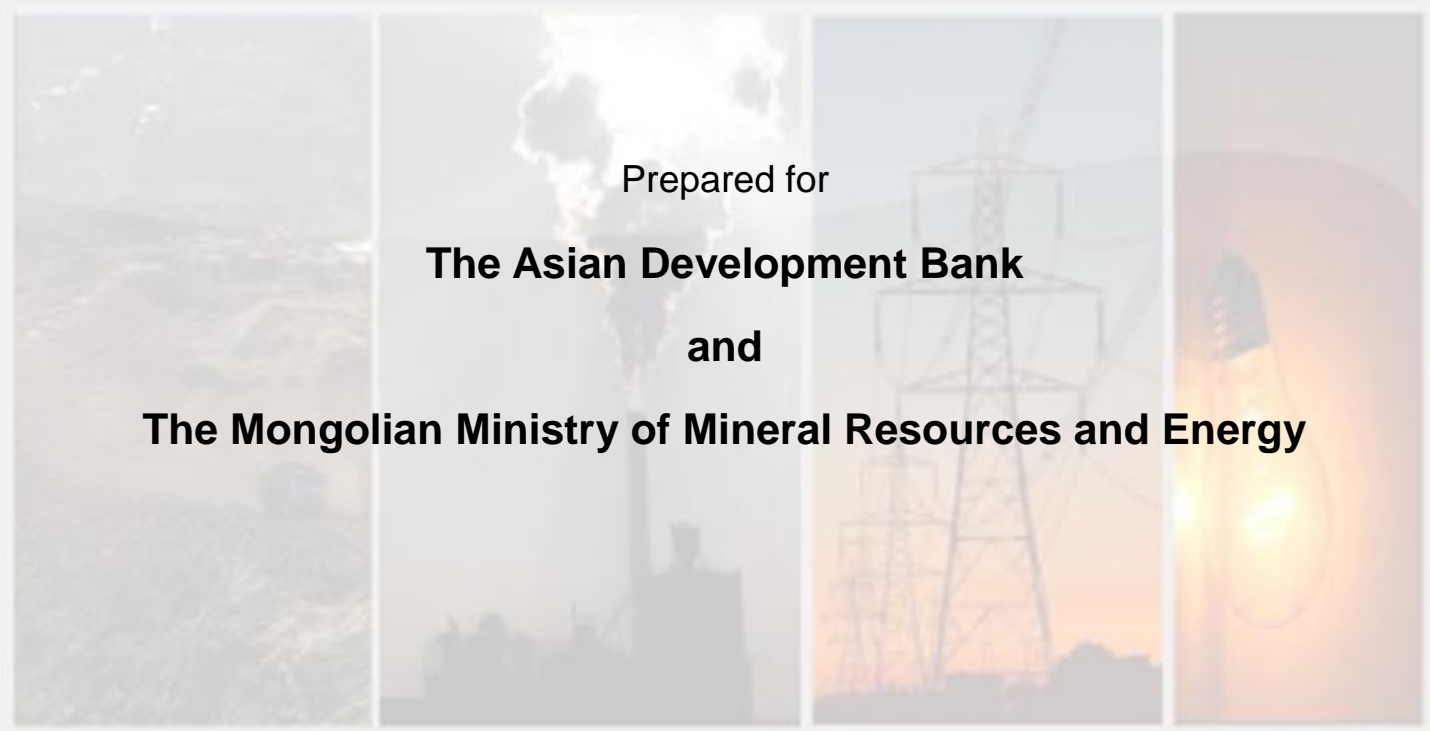
Updating Energy Sector Development Plan

Project Number: TA No. 7619-MON

FINAL REPORT

PART C: Volume - VI of X

CES ELECTRICITY EXPANSION PLAN ***APPENDICES D TO P***



Prepared for
The Asian Development Bank
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Prepared by



e.Gen Consultants Ltd.

in association with



19 October 2013

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APPENDIX D: SCENARIO PLANS: CAPACITY EXPANSION TABLES

Table 1: Scenario Plan 1a – CHP Reference Plan – LOW ELECTRICITY GROWTH

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	- 119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	- 177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	- 246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	- 230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	- 300	-25.4%	365	6,993,786
2018	879	300	300	0	50	0	132	650	1,661	1,254	229	18.2%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,318	296	22.4%	-	7,793,414
2020	860	300	450	0	50	0	0	800	1,660	1,369	245	17.9%	-	8,093,865
2021	860	450	450	0	50	0	0	950	1,810	1,461	303	20.7%	-	8,640,948
2022	860	450	600	0	50	0	0	1100	1,960	1,562	351	22.5%	-	9,240,669
2023	860	600	600	0	50	0	0	1250	2,110	1,656	408	24.6%	-	9,791,300
2024	860	600	750	0	50	0	0	1400	2,260	1,749	465	26.6%	-	10,341,340
2025	860	750	900	0	50	0	0	1700	2,560	1,842	672	36.5%	-	10,891,971

Table 2: Scenario Plan 1a – CHP Reference Plan – MEDIUM ELECTRICITY GROWTH

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-262	-22.2%	365	6,993,786
2018	879	300	450	0	50	0	102	800	1,781	1,286	347	26.9%	-	7,606,518
2019	860	300	600	0	50	0	0	950	1,810	1,457	344	23.6%	-	8,164,247
2020	860	300	600	0	50	0	0	950	1,810	1,480	284	19.2%	-	8,752,730
2021	860	450	750	0	50	0	0	1250	2,110	1,648	416	25.3%	-	9,743,985
2022	860	450	900	0	50	0	0	1400	2,260	1,825	388	21.3%	-	10,796,158
2023	860	600	900	0	50	0	0	1550	2,410	1,994	370	18.5%	-	11,792,735
2024	860	600	1200	0	50	0	0	1850	2,710	2,162	501	23.2%	-	12,789,313
2025	860	750	1200	0	50	0	0	2000	2,860	2,331	483	20.7%	-	13,785,890

Table 3: Scenario Plan 1a – CHP Reference Plan – HIGH ELECTRICITY GROWTH

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	998	-181	-18.2%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,066	-250	-23.4%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,154	-234	-20.3%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,224	-304	-24.8%	365	6,993,786
2018	879	300	600	0	50	0	0	950	1,829	1,357	426	31.4%	-	8,023,484
2019	860	300	750	0	50	0	0	1100	1,960	1,501	412	27.4%	-	8,879,890
2020	860	300	900	0	50	0	0	1250	2,110	1,661	403	24.3%	-	9,821,464
2021	860	450	900	0	50	0	0	1400	2,260	1,922	292	15.2%	-	11,365,124
2022	860	450	1200	0	50	0	0	1700	2,560	2,195	318	14.5%	-	12,983,305
2023	860	600	1350	0	50	0	0	2000	2,860	2,458	356	14.5%	-	14,535,837
2024	860	600	1650	0	50	0	0	2300	3,160	2,720	393	14.5%	-	16,088,960
2025	860	750	1800	0	50	0	0	2600	3,460	2,983	431	14.4%	-	17,641,492

Table 4: Scenario Plan 1b – HOB Reference Plan

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	- 119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	- 219	-21.9%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	- 287	-27.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	- 271	-23.5%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	- 341	-27.9%	365	6,993,786
2018	879	0	750	0	50	0	0	800	1,679	1,331	224	15.9%	-	7,416,074
2019	860	0	900	0	50	0	0	950	1,810	1,318	219	15.7%	-	7,793,414
2020	860	0	900	0	50	0	0	950	1,810	1,369	395	28.9%	-	8,093,865
2021	860	0	1050	0	50	0	0	1100	1,960	1,538	413	26.8%	-	8,640,948
2022	860	0	1200	0	50	0	0	1250	2,110	1,562	501	32.1%	-	9,240,669
2023	860	0	1200	0	50	0	0	1250	2,110	1,656	408	24.6%	-	9,791,300
2024	860	0	1350	0	50	0	0	1400	2,260	1,749	465	26.6%	-	10,341,340
2025	860	0	1500	0	50	0	0	1550	2,410	1,842	522	28.3%	-	10,891,971

Table 5: Scenario Plan 2a – Sheuren River Flow Operation + Coal

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	- 119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	- 177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	- 246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	- 230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	- 300	-25.4%	365	6,993,786
2018	879	300	300	0	50	0	132	650	1,661	1,254	229	18.2%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,318	296	22.4%	-	7,793,414
2020	860	300	450	0	50	0	0	800	1,660	1,369	245	17.9%	-	8,093,865
2021	860	450	450	100	50	0	0	1050	1,909	1,461	402	27.5%	-	8,640,948
2022	860	450	600	100	50	0	0	1200	2,059	1,562	451	28.8%	-	9,240,669
2023	860	600	600	100	50	0	0	1350	2,209	1,656	508	30.7%	-	9,791,300
2024	860	600	600	100	50	0	0	1350	2,209	1,749	415	23.7%	-	10,341,340
2025	860	750	750	100	50	0	0	1650	2,509	1,842	621	33.7%	-	10,891,971

Table 6: Scenario Plan 2b – Sheuren Flat Operation + Coal

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-300	-25.4%	365	6,993,786
2018	879	300	450	0	50	0	90	800	1,769	1,409	224	15.9%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,394	219	15.7%	-	7,793,414
2020	860	300	450	0	50	0	0	800	1,660	1,445	168	11.6%	-	8,093,865
2021	860	450	450	170	50	0	0	1120	1,979	1,461	472	32.3%	-	8,640,948
2022	860	450	450	170	50	0	0	1120	1,979	1,562	371	23.7%	-	9,240,669
2023	860	600	450	170	50	0	0	1270	2,129	1,656	428	25.8%	-	9,791,300
2024	860	600	600	170	50	0	0	1420	2,279	1,749	485	27.7%	-	10,341,340
2025	860	750	600	170	50	0	0	1570	2,429	1,842	542	29.4%	-	10,891,971

Table 7: Scenario Plan 2c – Sheuren Flat Operation + Wind

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-300	-25.4%	365	6,993,786
2018	879	300	300	0	50	0	132	650	1,661	1,254	229	18.2%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,318	296	22.4%	-	7,793,414
2020	860	300	450	0	150	0	0	900	1,760	1,369	253	18.5%	-	8,093,865
2021	860	450	450	170	150	0	0	1220	2,079	1,461	480	32.9%	-	8,640,948
2022	860	450	450	170	200	0	0	1270	2,129	1,562	383	24.5%	-	9,240,669
2023	860	600	450	170	200	0	0	1420	2,279	1,656	440	26.6%	-	9,791,300
2024	860	600	600	170	200	0	0	1570	2,429	1,749	497	28.4%	-	10,341,340
2025	860	750	600	170	400	0	0	1920	2,779	1,842	570	30.9%	-	10,891,971

Table 8: Scenario Plan 2d – Carbon Tax

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	998	-181	-18.2%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,066	-250	-23.4%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,154	-234	-20.3%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,224	-304	-24.8%	365	6,993,786
2018	879	300	600	0	50	0	0	950	1,829	1,357	426	31.4%	-	8,023,484
2019	860	300	750	0	50	0	0	1100	1,960	1,501	412	27.4%	-	8,879,890
2020	860	300	900	0	50	0	0	1250	2,110	1,661	403	24.3%	-	9,821,464
2021	860	450	900	0	50	0	0	1400	2,260	1,922	292	15.2%	-	11,365,124
2022	860	450	1200	0	50	0	0	1700	2,560	2,195	318	14.5%	-	12,983,305
2023	860	600	1350	0	50	0	0	2000	2,860	2,458	356	14.5%	-	14,535,837
2024	860	600	1650	0	50	0	0	2300	3,160	2,720	393	14.5%	-	16,088,960
2025	860	750	1800	0	50	0	0	2600	3,460	2,983	431	14.4%	-	17,641,492

Table 9: Scenario Plan 3a – Alternates IPP1; 600MW Coal by 2018

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-300	-25.4%	365	6,993,786
2018	879	300	450	0	50	0	0	800	1,679	1,254	379	30.2%	-	7,416,074
2019	860	300	600	0	50	0	0	950	1,810	1,318	446	33.8%	-	7,793,414
2020	860	300	600	0	50	0	0	950	1,810	1,369	395	28.9%	-	8,093,865
2021	860	450	600	0	50	0	0	1100	1,960	1,461	453	31.0%	-	8,640,948
2022	860	450	600	0	50	0	0	1100	1,960	1,562	351	22.5%	-	9,240,669
2023	860	600	600	0	50	0	0	1250	2,110	1,656	408	24.6%	-	9,791,300
2024	860	600	600	0	50	0	0	1250	2,110	1,749	315	18.0%	-	10,341,340
2025	860	750	600	0	50	0	0	1400	2,260	1,842	372	20.2%	-	10,891,971

Table 10: Scenario Plan 3b – Alternates IPP2; 600MW Coal by 2020

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	- 119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	- 177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	- 246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	- 230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	- 300	-25.4%	365	6,993,786
2018	879	300	450	0	50	0	90	800	1,769	1,254	379	30.2%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,318	296	22.4%	-	7,793,414
2020	860	300	600	0	50	0	0	950	1,810	1,369	395	28.9%	-	8,093,865
2021	860	450	600	0	50	0	0	1100	1,960	1,461	453	31.0%	-	8,640,948
2022	860	450	600	0	50	0	0	1100	1,960	1,562	351	22.5%	-	9,240,669
2023	860	600	600	0	50	0	0	1250	2,110	1,656	408	24.6%	-	9,791,300
2024	860	600	600	0	50	0	0	1250	2,110	1,749	315	18.0%	-	10,341,340
2025	860	750	750	0	50	0	0	1550	2,410	1,842	522	28.3%	-	10,891,971

Table 11: Scenario Plan 3c – Alternates IPP (wind)

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-300	-25.4%	365	6,993,786
2018	879	300	300	0	50	0	132	650	1,661	1,254	229	18.2%	-	7,416,074
2019	860	300	450	0	50	0	0	800	1,660	1,318	296	22.4%	-	7,793,414
2020	860	300	450	0	250	0	0	1000	1,860	1,369	261	19.1%	-	8,093,865
2021	860	450	450	0	450	0	0	1350	2,210	1,461	335	22.9%	-	8,640,948
2022	860	450	600	0	650	0	0	1700	2,560	1,562	399	25.5%	-	9,240,669
2023	860	600	600	0	850	0	0	2050	2,910	1,656	472	28.5%	-	9,791,300
2024	860	600	600	0	1050	0	0	2250	3,110	1,749	395	22.6%	-	10,341,340
2025	860	750	600	0	1200	0	0	2550	3,410	1,842	464	25.2%	-	10,891,971

Table 12: Scenario Plan 4 – Lowest CO2

	Existing CHPs (2013)	New CHP	Coal	Hydro (firm)	Wind (full)	Solar PV	Import	Total New Build	Total System Capacity	Peak Demand (net sent-out) Forecast	Mongolian Reliable Reserve Margin	Mongolian Reliable Capacity Reserve Margin	Annual Exceedence of Import Limit 175MW	Annual Energy (net sent-out) Forecast
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	Hours	GWh
2013	775	0	0	0	0	0	119	0	893	893	-119	-13.3%	-	5,283,931
2014	775	0	0	0	50	0	175	50	1,000	956	-177	-18.5%	31	5,655,356
2015	775	0	0	0	50	0	175	50	1,000	1,025	-246	-24.0%	154	6,061,675
2016	879	0	0	0	50	0	175	50	1,104	1,113	-230	-20.7%	31	6,580,960
2017	879	0	0	0	50	0	175	50	1,104	1,183	-300	-25.4%	365	6,993,786
2018	879	300	300	0	50	0	132	650	1,661	1,254	229	18.2%	-	7,416,074
2019	860	300	300	0	50	0	0	650	1,510	1,318	146	11.1%	-	7,793,414
2020	860	300	300	50	150	0	0	800	1,660	1,369	153	11.2%	-	8,093,865
2021	860	450	300	220	150	0	0	1120	1,979	1,461	380	26.0%	-	8,640,948
2022	860	450	450	220	200	0	0	1320	2,179	1,562	433	27.7%	-	9,240,669
2023	860	600	450	220	200	0	0	1470	2,329	1,656	490	29.6%	-	9,791,300
2024	860	600	600	220	200	0	0	1620	2,479	1,749	547	31.3%	-	10,341,340
2025	860	750	600	0	50	0	0	1400	2,260	1,842	372	20.2%	-	10,891,971

APPENDIX E: ELECTRICITY DISPATCH CURVES – Scenario 1A – LOW

Chart 1: CES Load Dispatch Curve - 2013

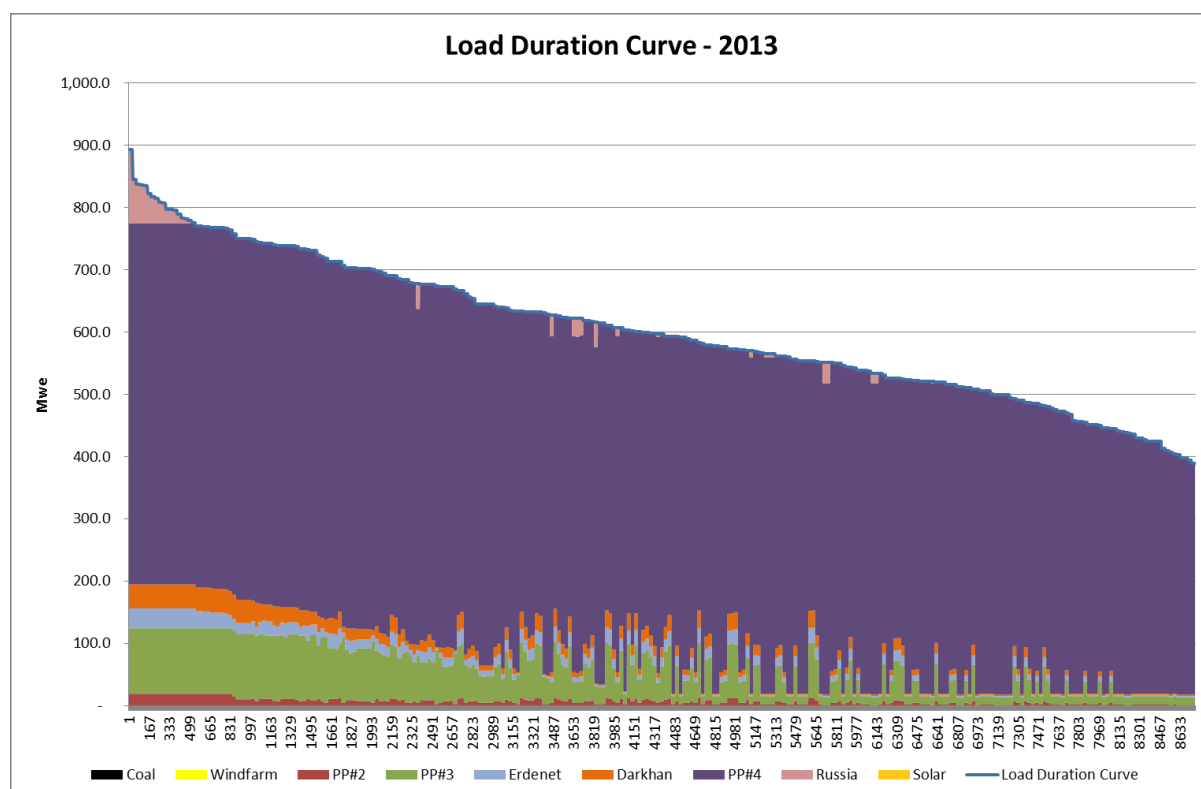


Chart 2: CES Load Dispatch Curve – 2014

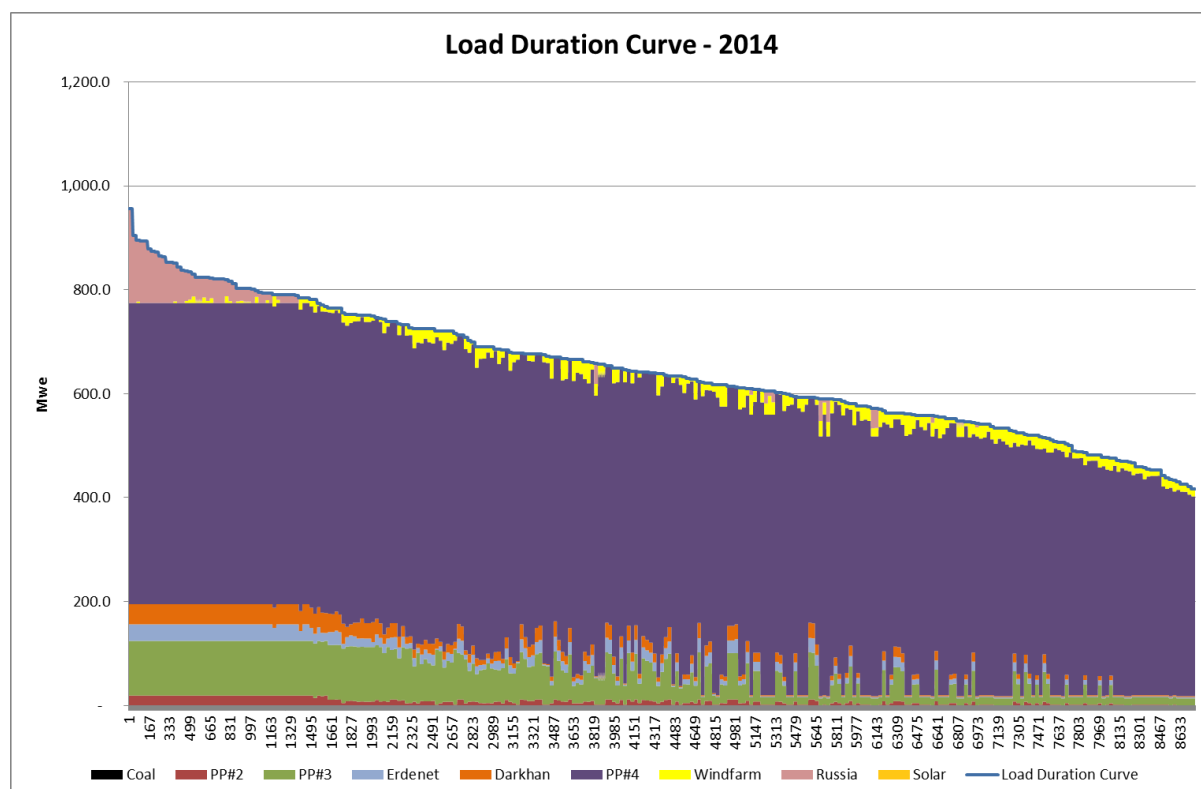


Chart 3: CES Load Dispatch Curve – 2015

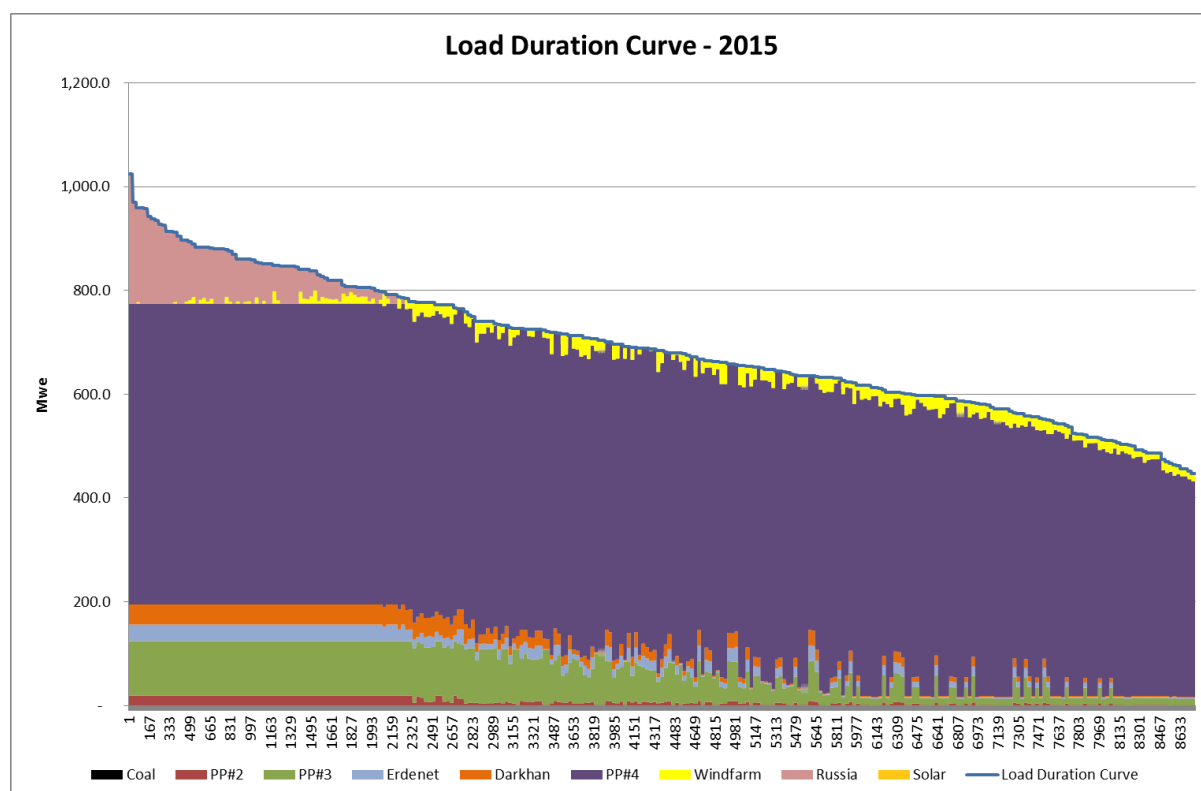


Chart 4: CES Load Dispatch Curve – 2016

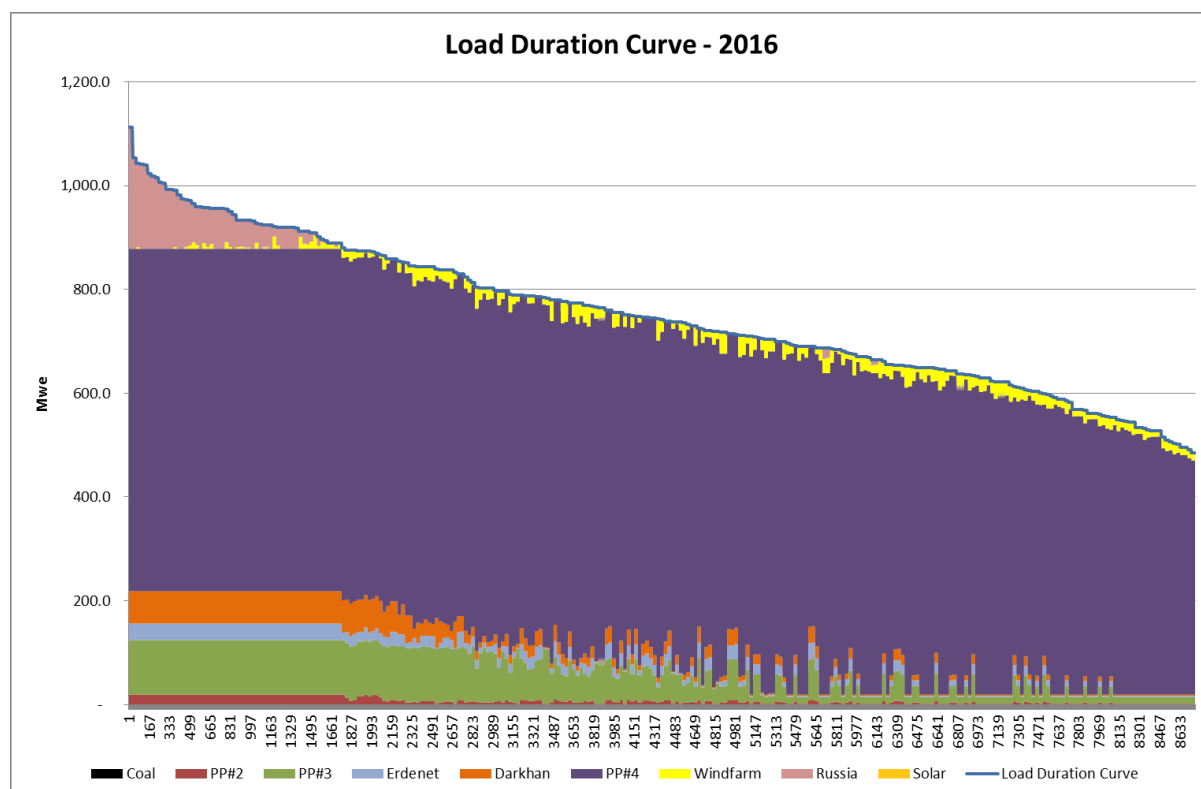


Chart 5: CES Load Dispatch Curve – 2017

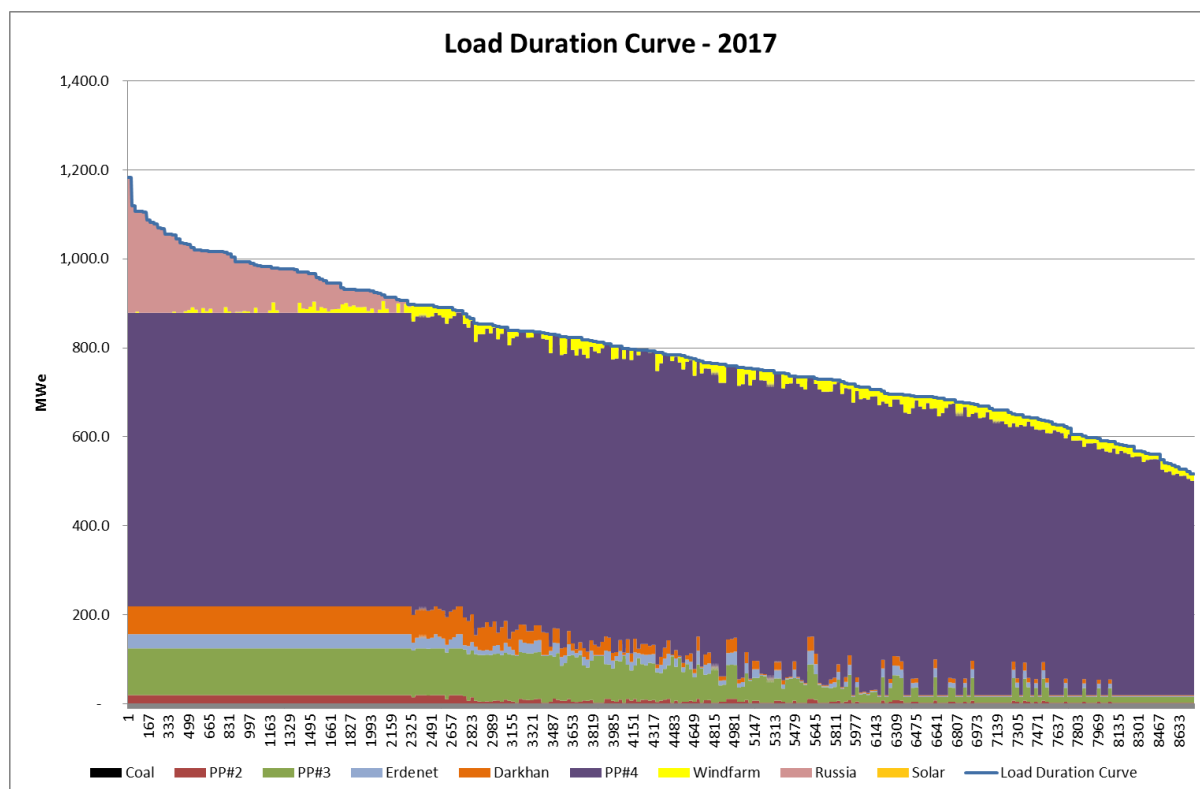


Chart 6: CES Load Dispatch Curve – 2018

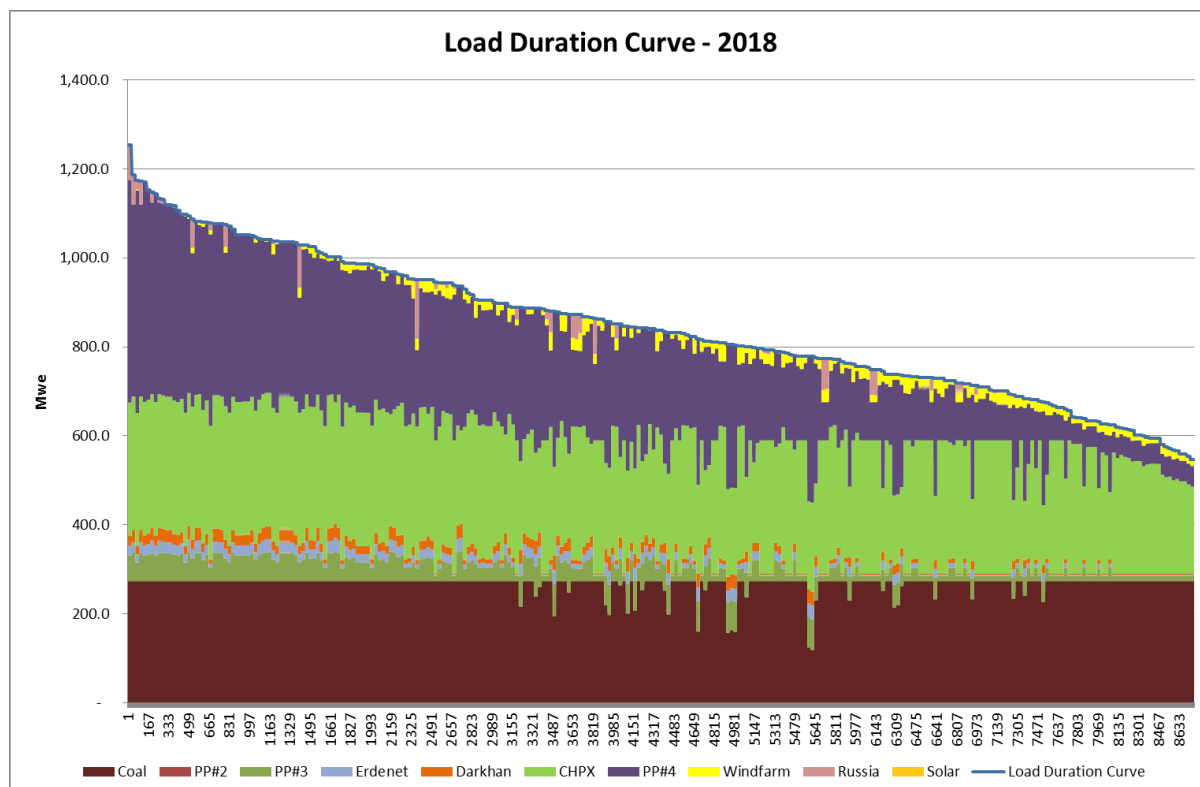


Chart 7: CES Load Dispatch Curve – 2019

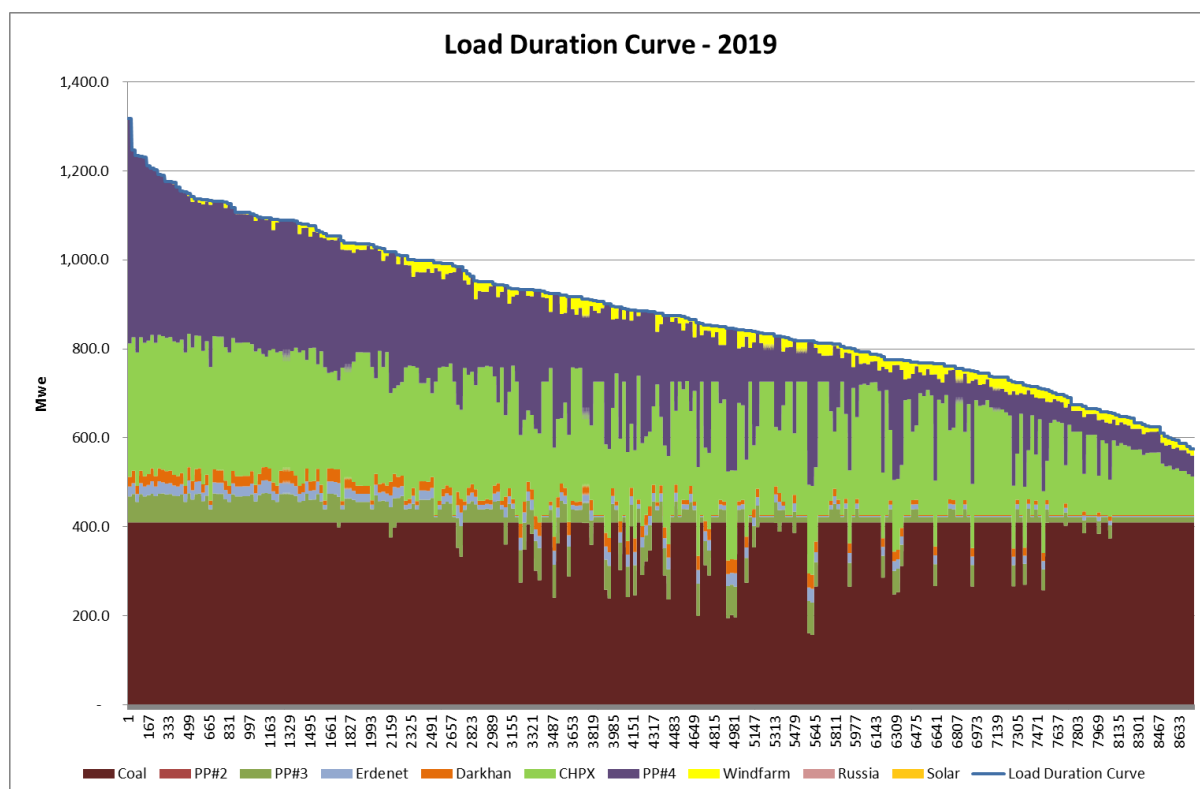


Chart 8: CES Load Dispatch Curve – 2020

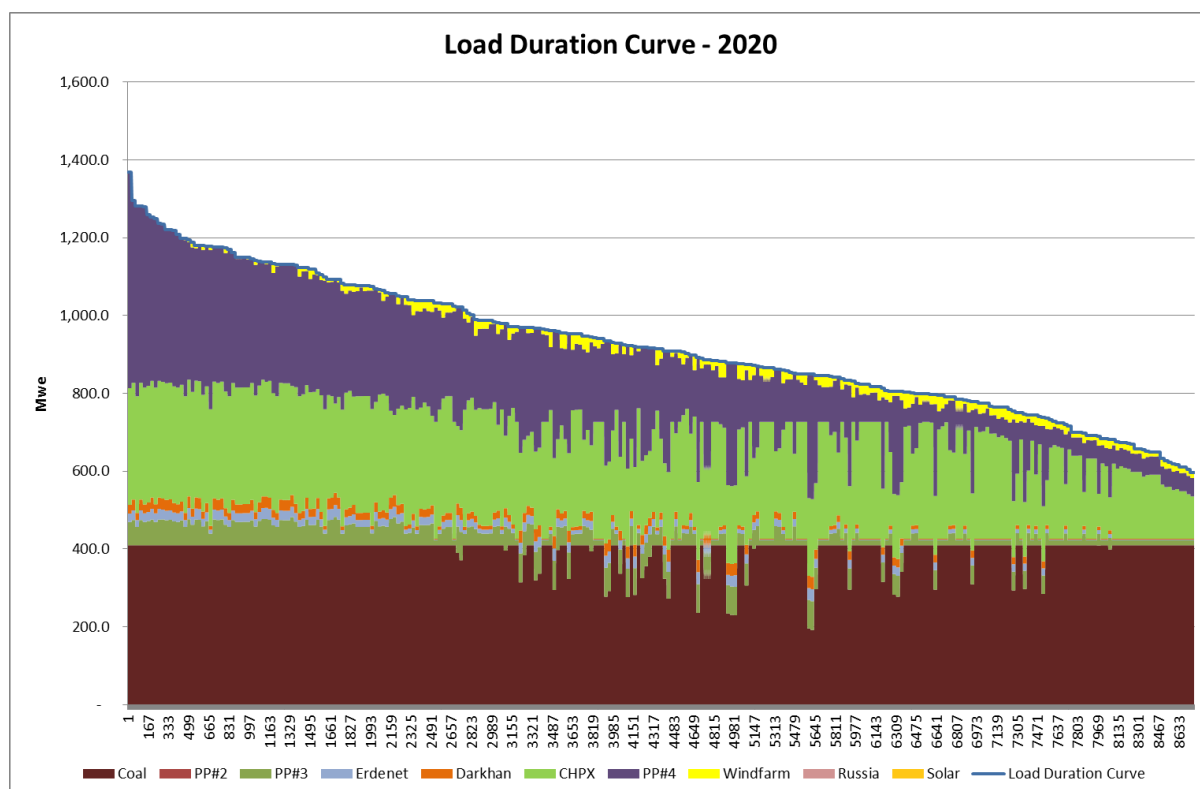


Chart 9: CES Load Dispatch Curve – 2021

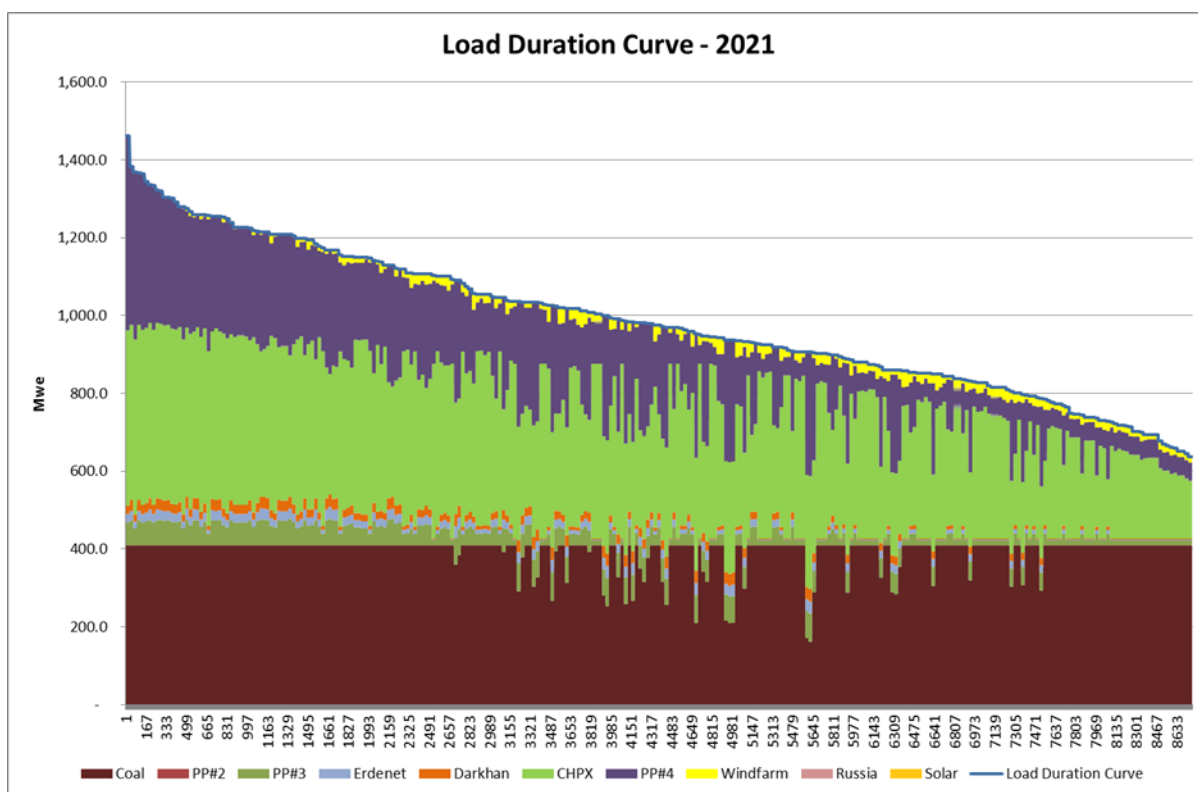


Chart 10: CES Load Dispatch Curve – 2022

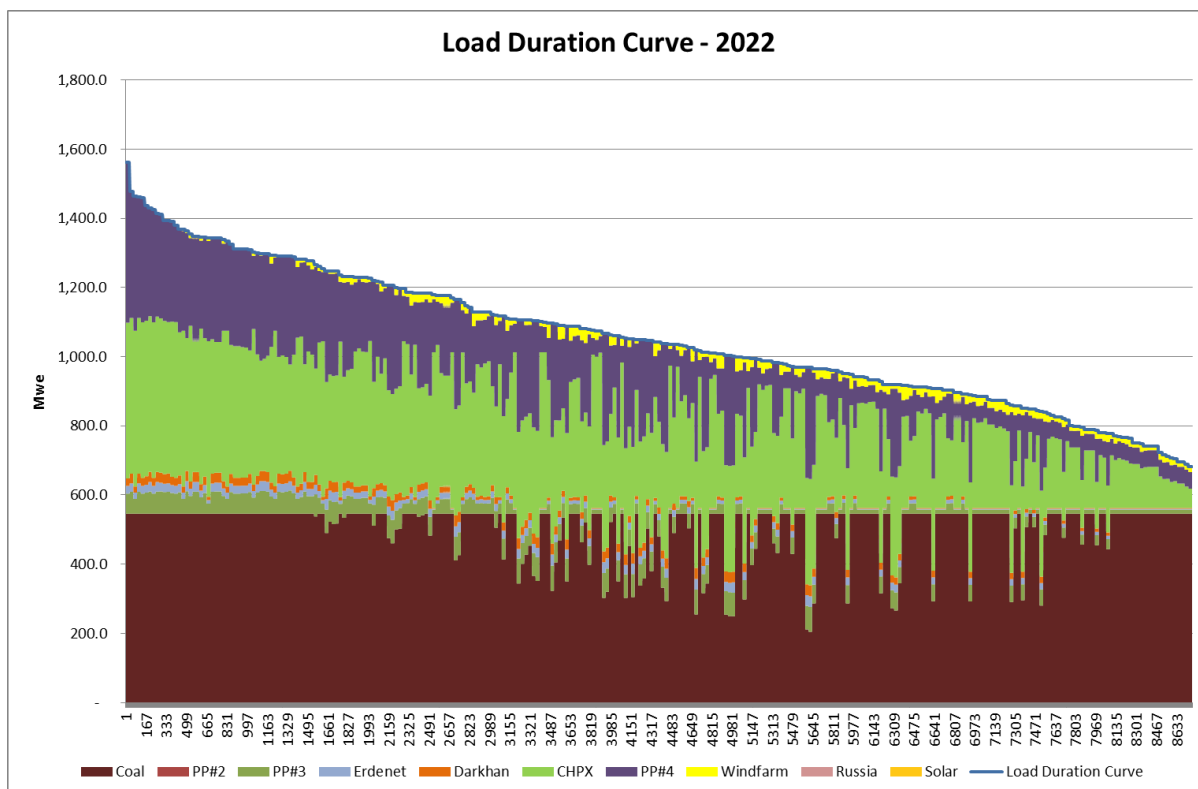


Chart 11: CES Load Dispatch Curve – 2023

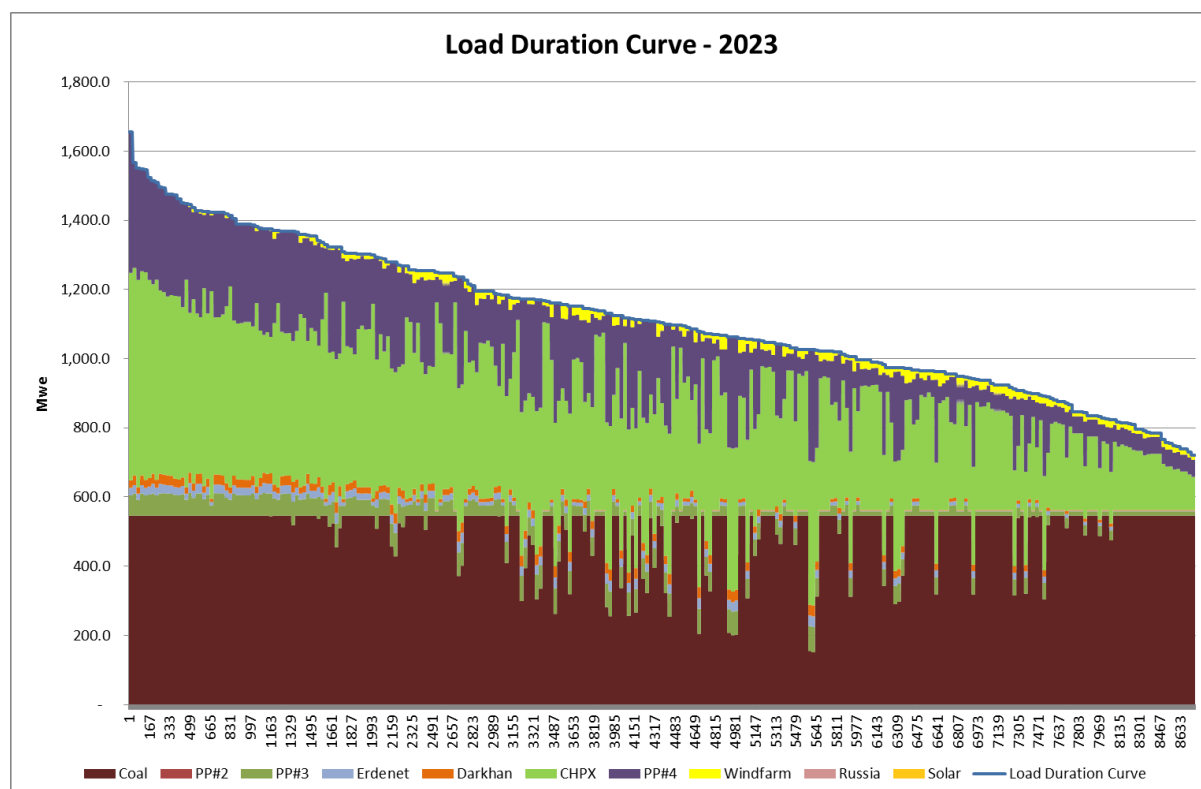


Chart 12: CES Load Dispatch Curve – 2024

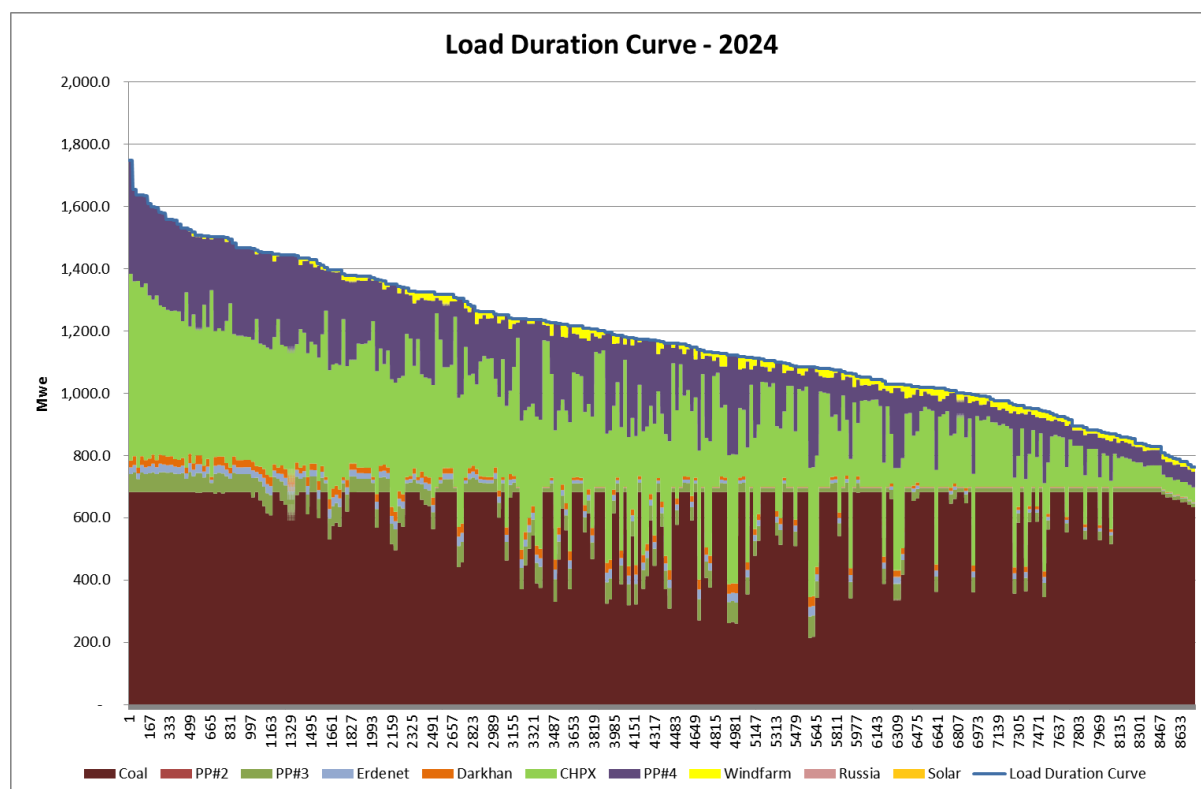
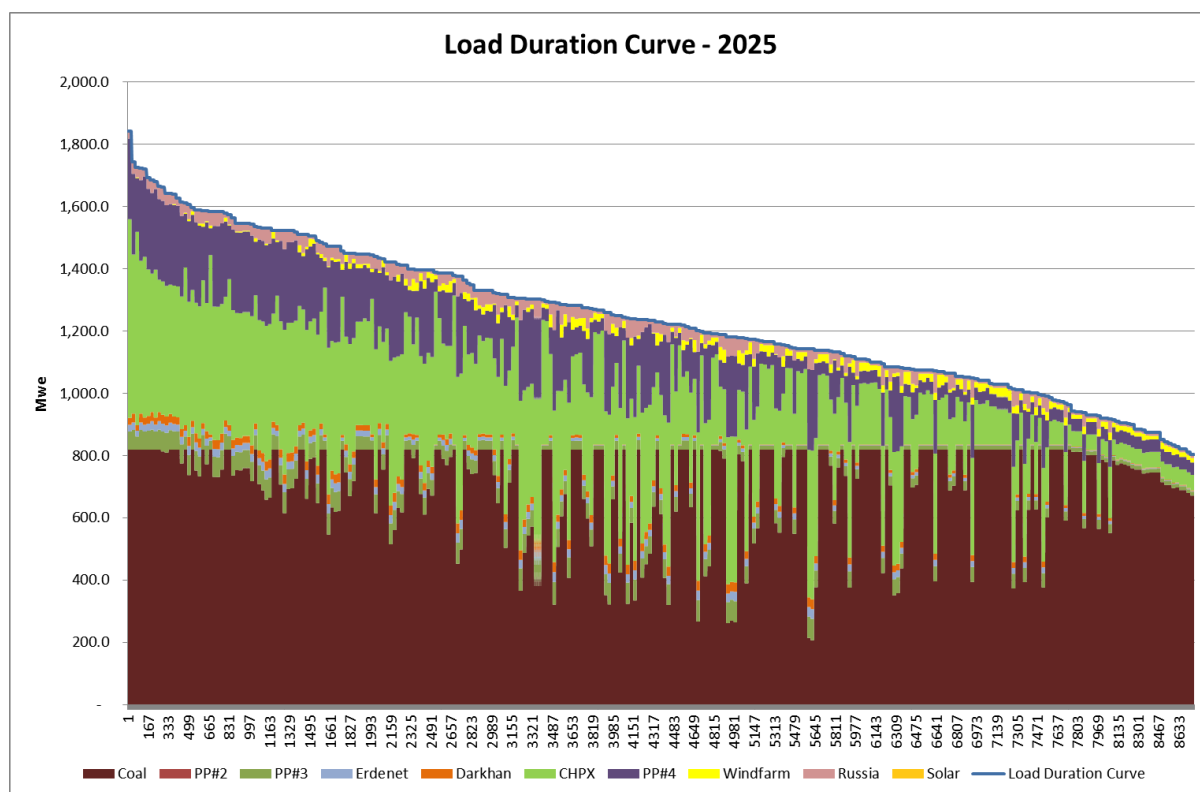


Chart 13: CES Load Dispatch Curve – 2025



APPENDIX F: ELECTRICITY DISPATCH CURVES – Scenario 1A – MEDIUM

Chart 1: CES Load Dispatch Curve - 2013

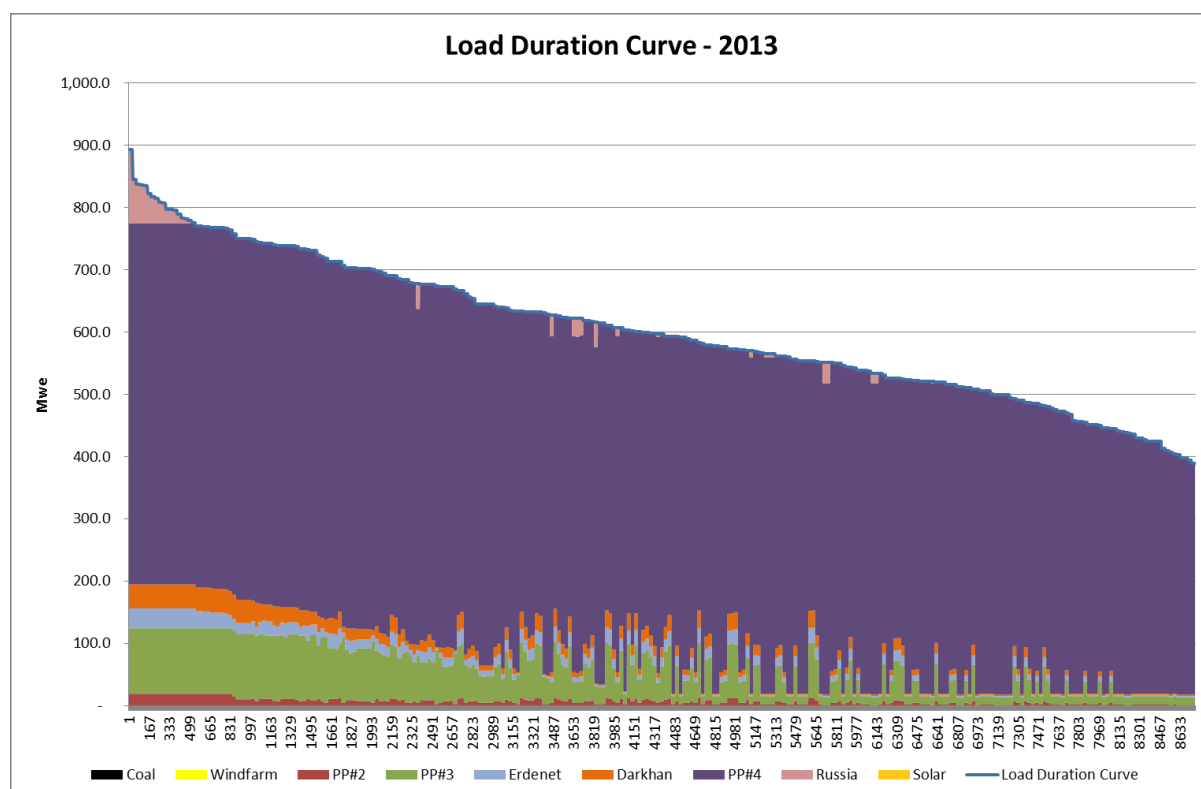


Chart 2: CES Load Dispatch Curve – 2014

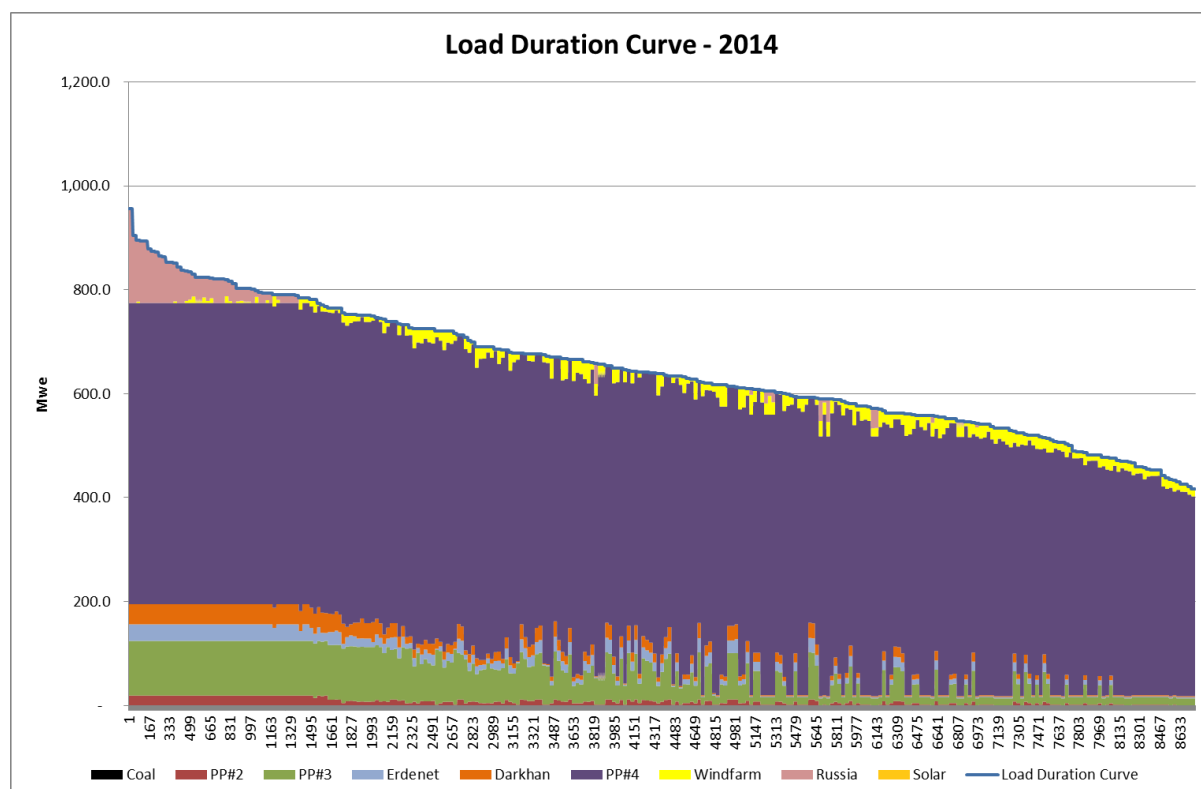


Chart 3: CES Load Dispatch Curve – 2015

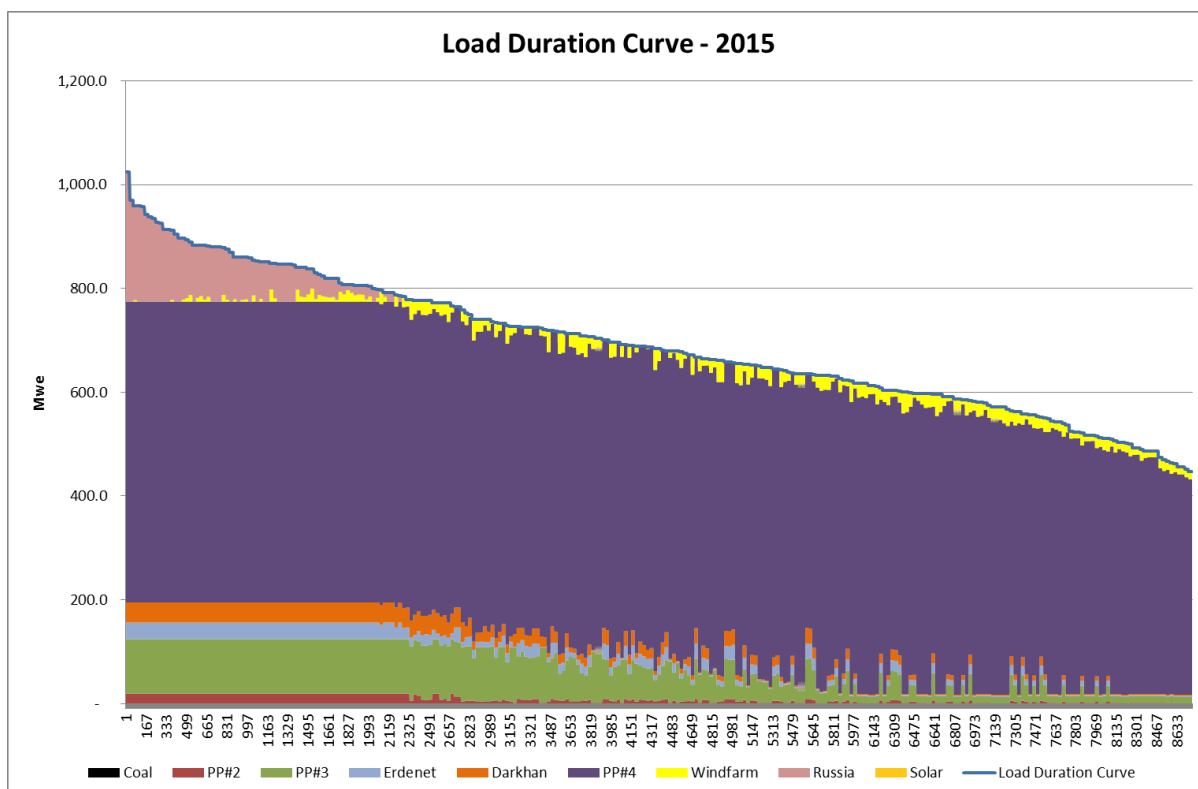


Chart 4: CES Load Dispatch Curve – 2016

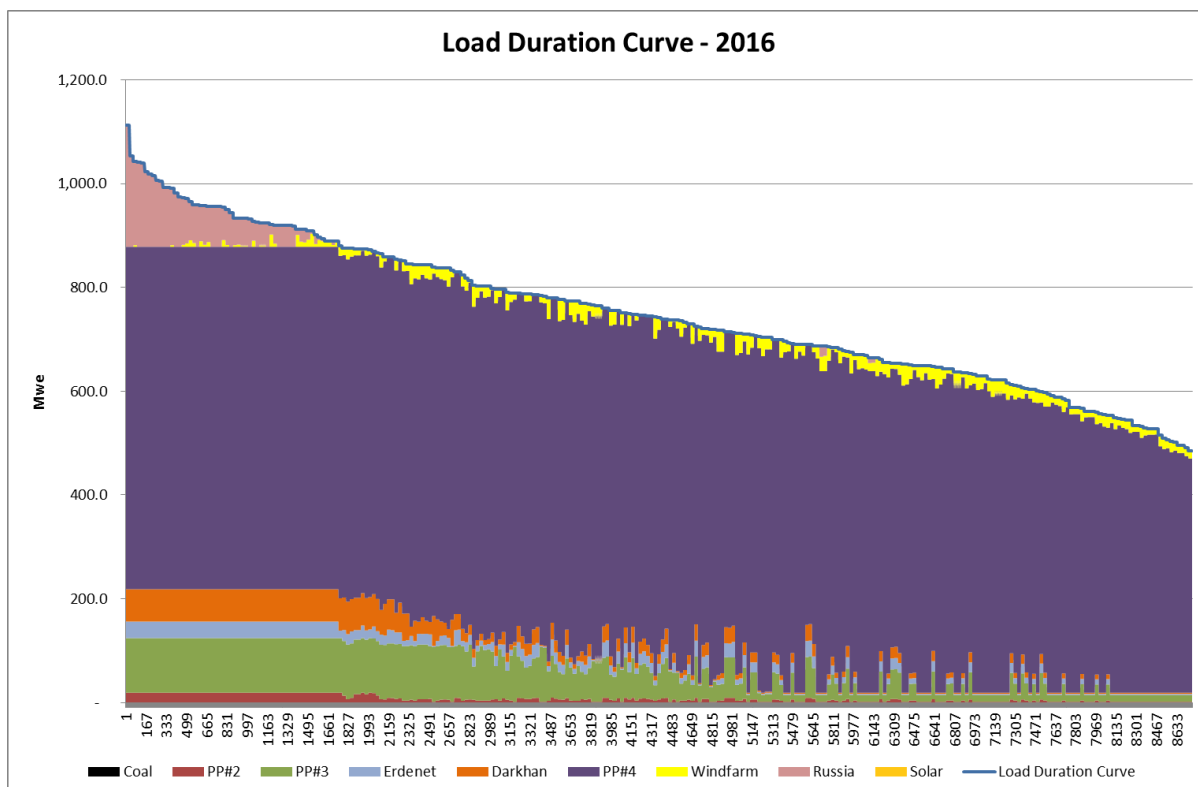


Chart 5: CES Load Dispatch Curve – 2017

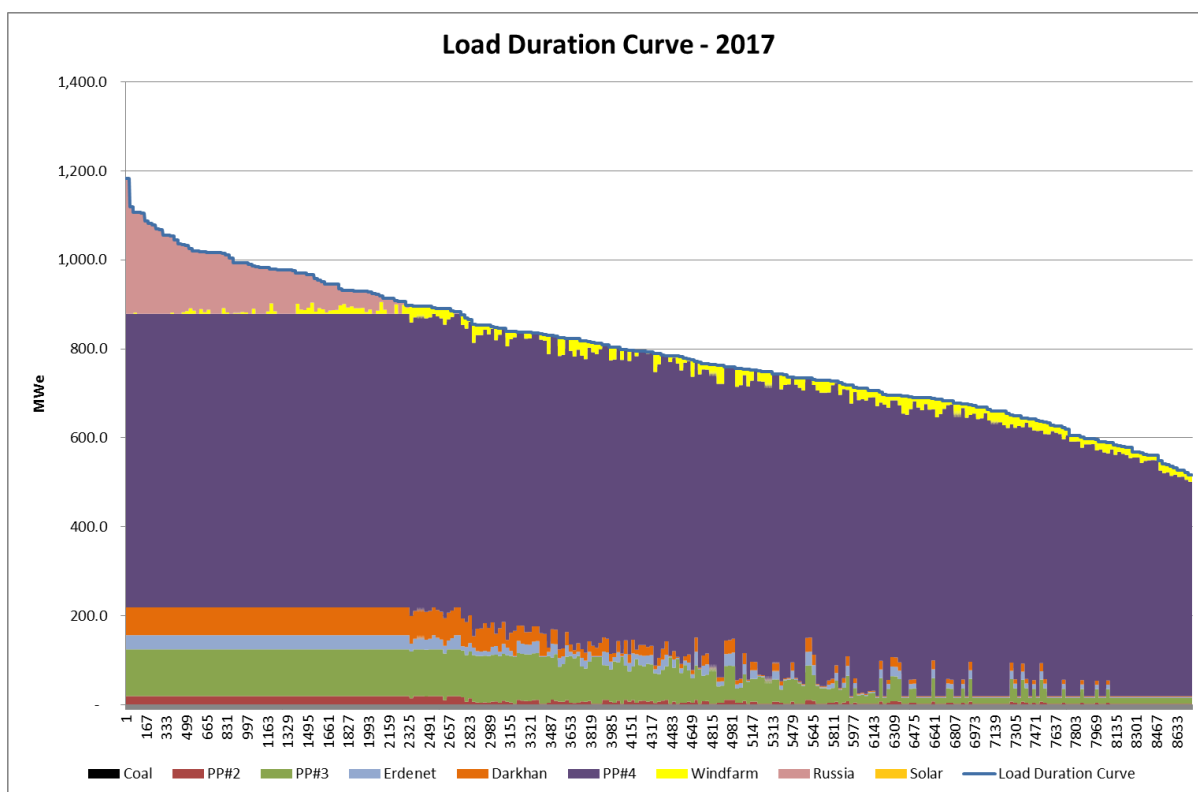


Chart 6: CES Load Dispatch Curve – 2018

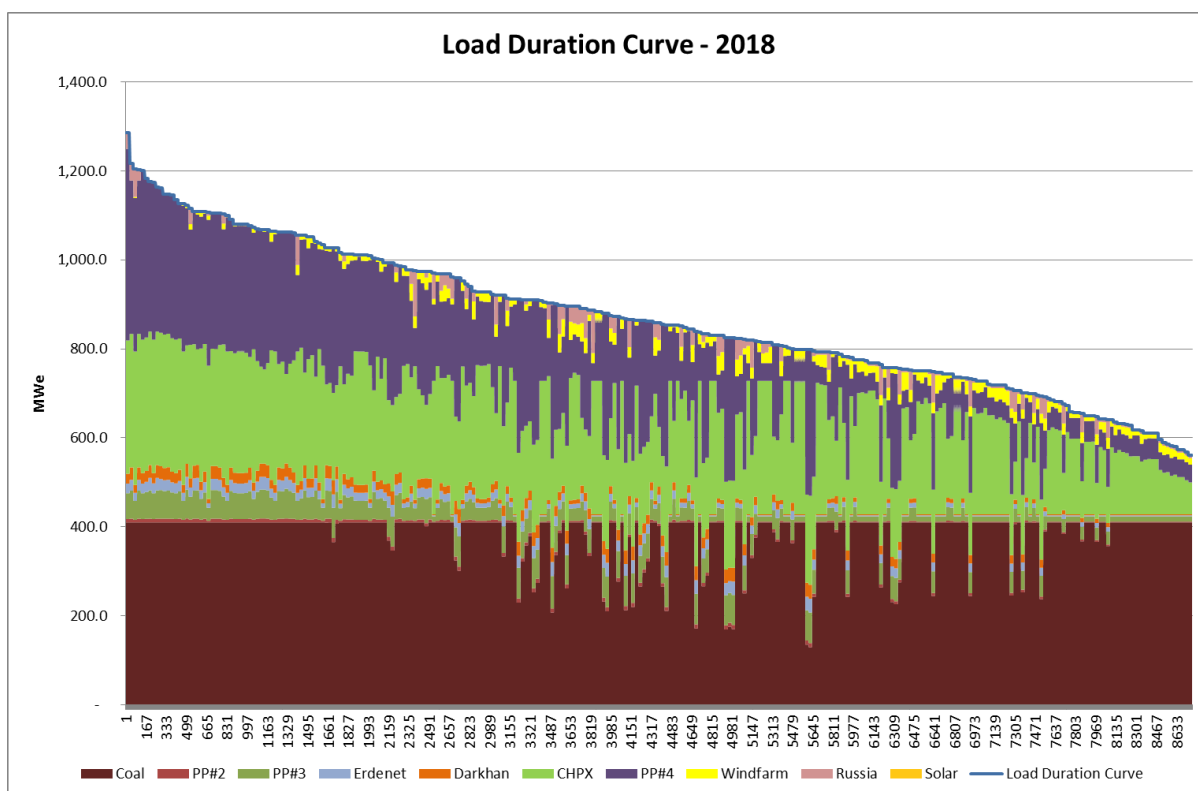


Chart 7: CES Load Dispatch Curve - 2019

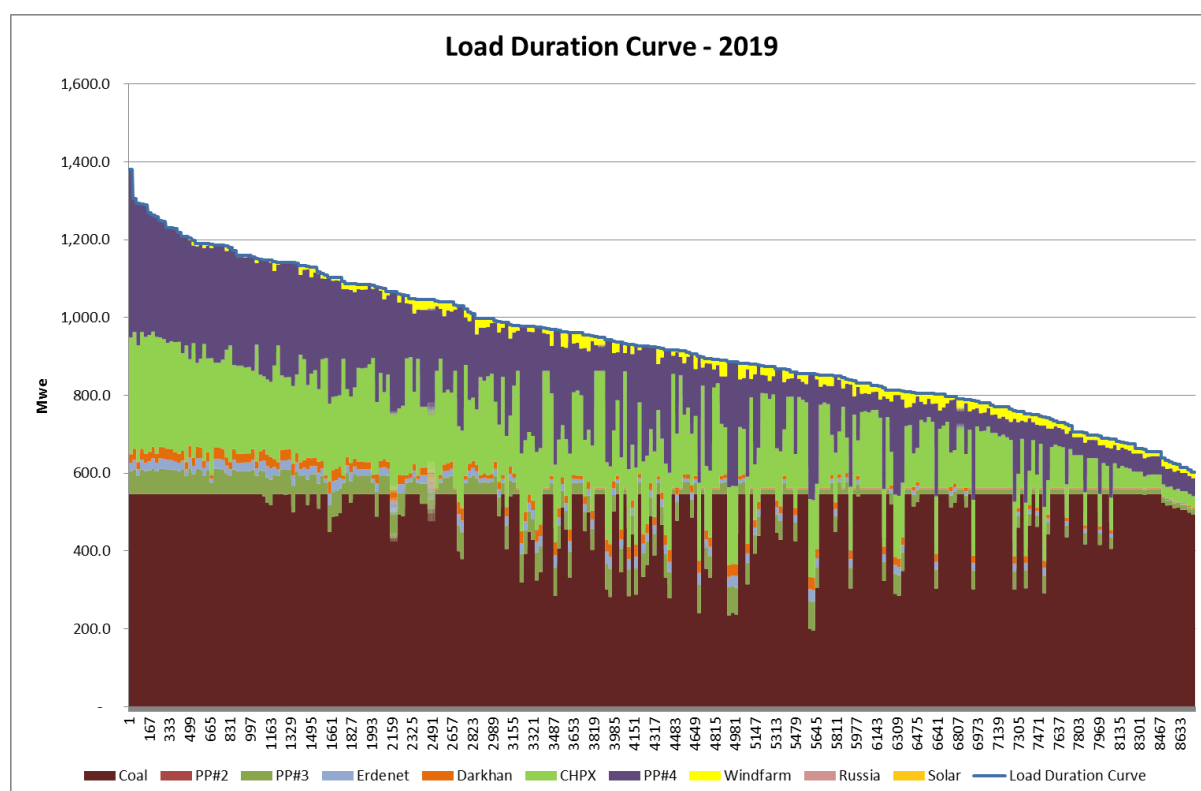


Chart 8: CES Load Dispatch Curve – 2020

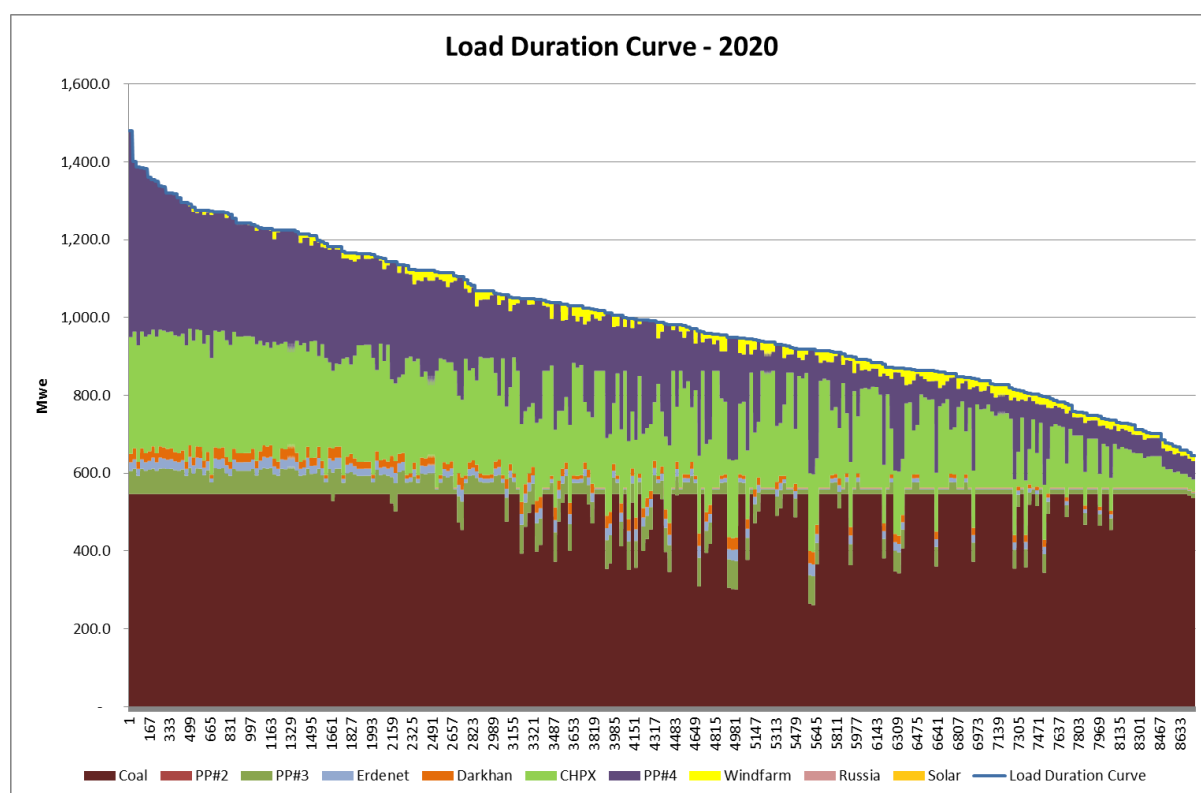


Chart 9: CES Load Dispatch Curve - 2021

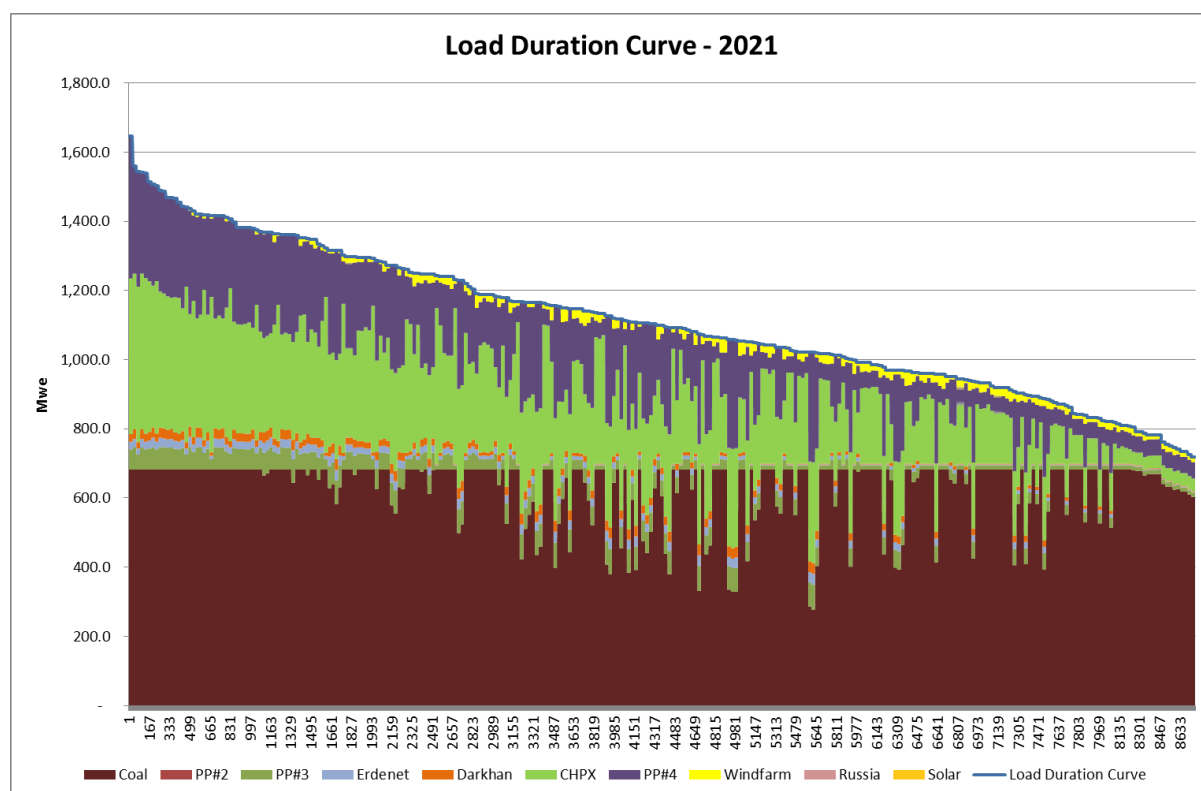


Chart 10: CES Load Dispatch Curve – 2022

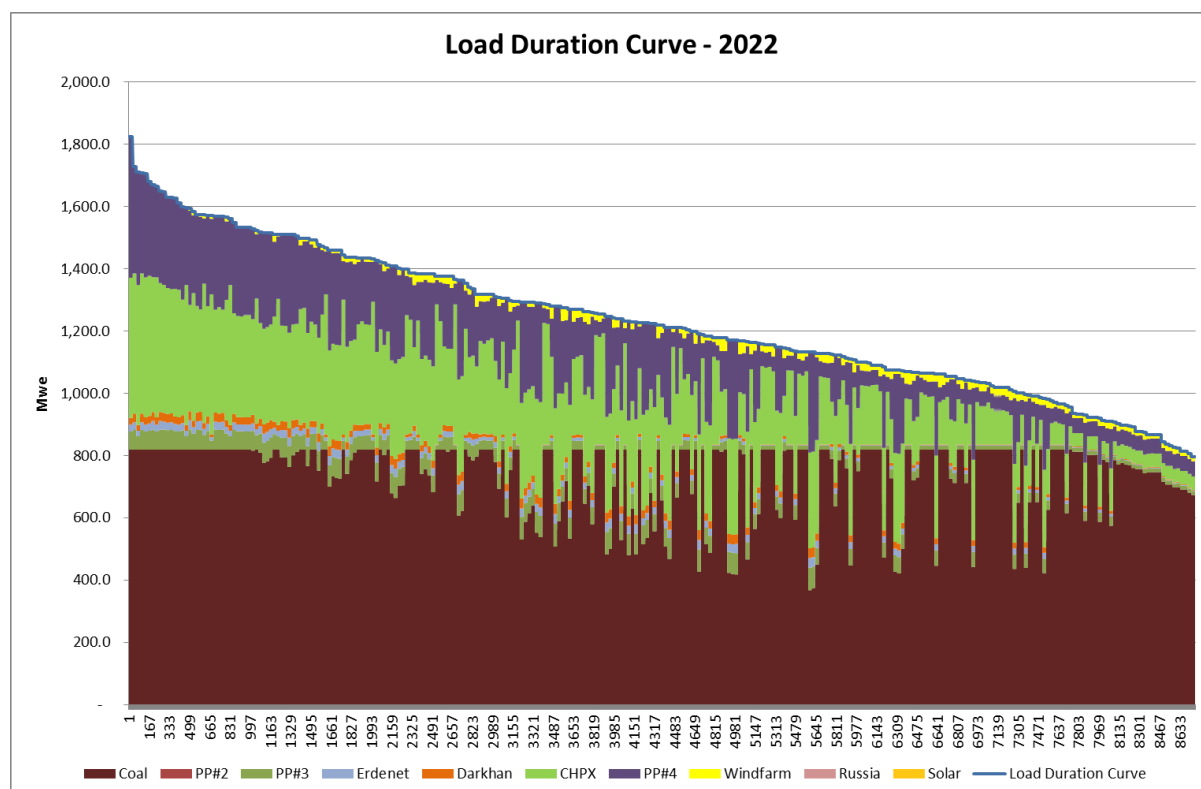


Chart 11: CES Load Dispatch Curve - 2023

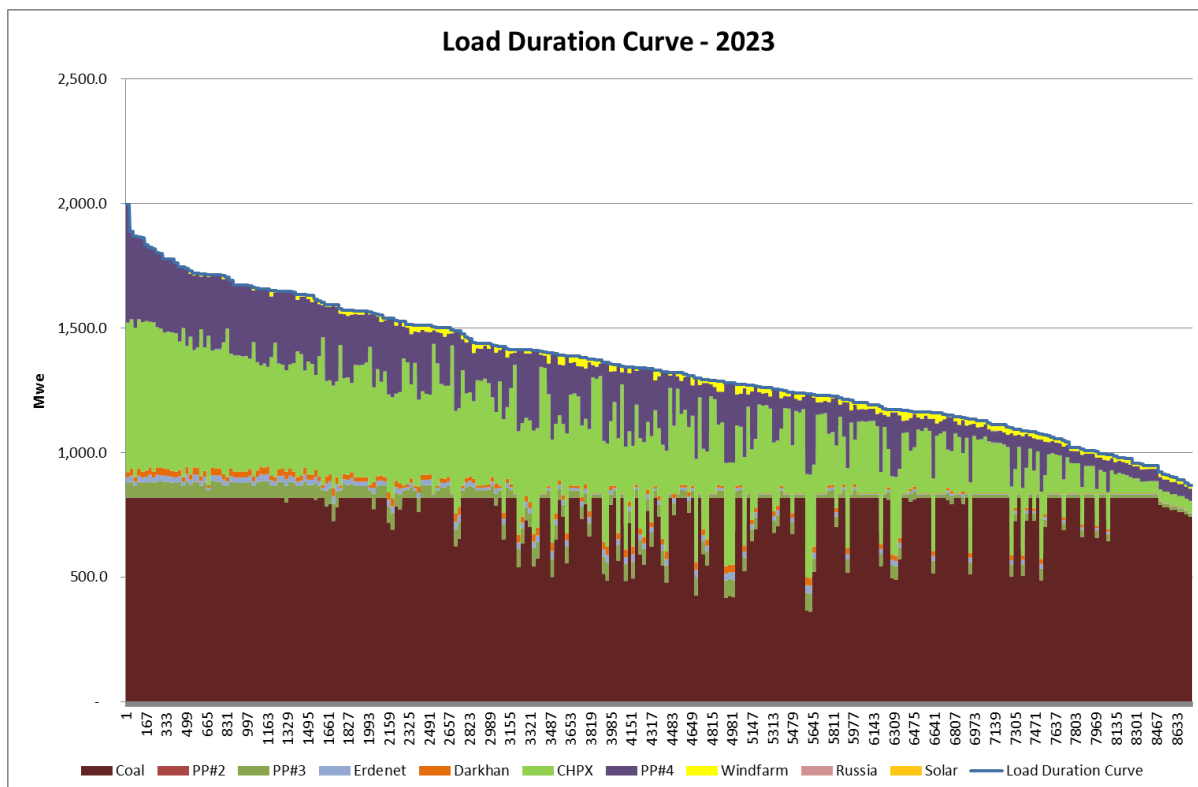


Chart 12: CES Load Dispatch Curve – 2024

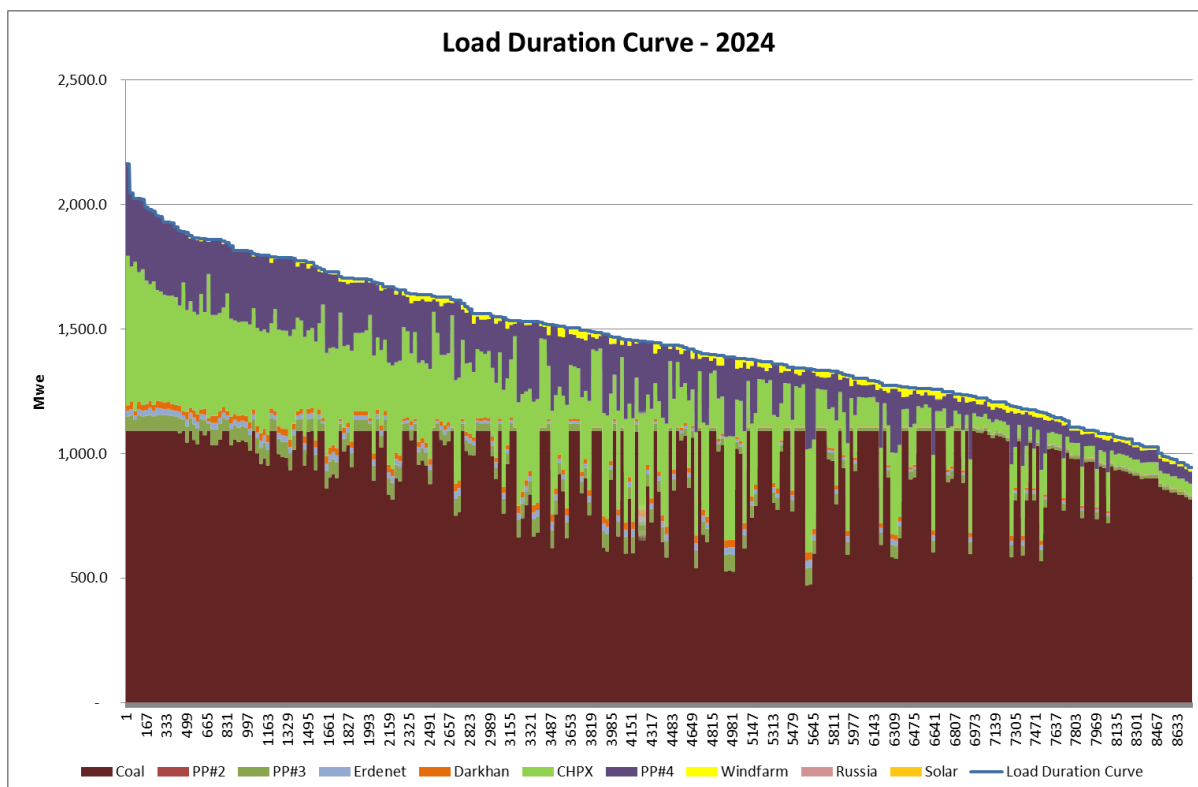
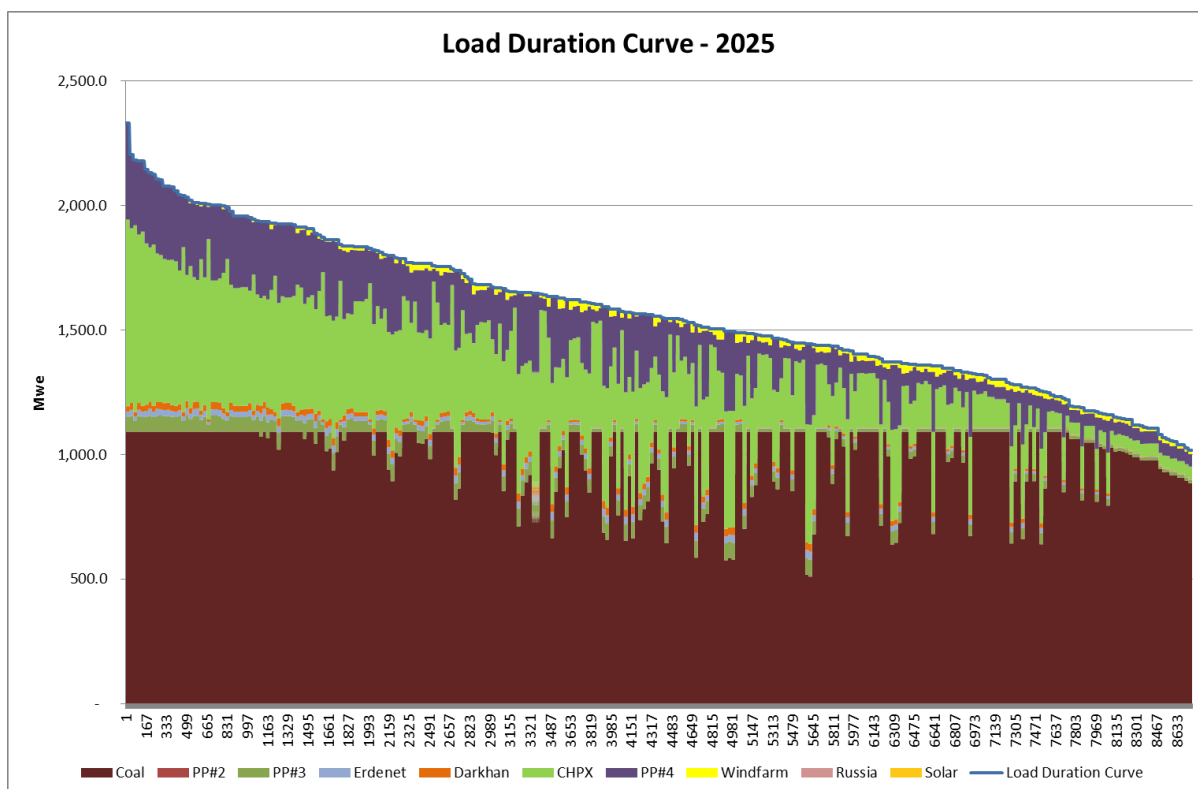


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX G: ELECTRICITY DISPATCH CURVES – Scenario 1A – HIGH

Chart 1: CES Load Dispatch Curve - 2013

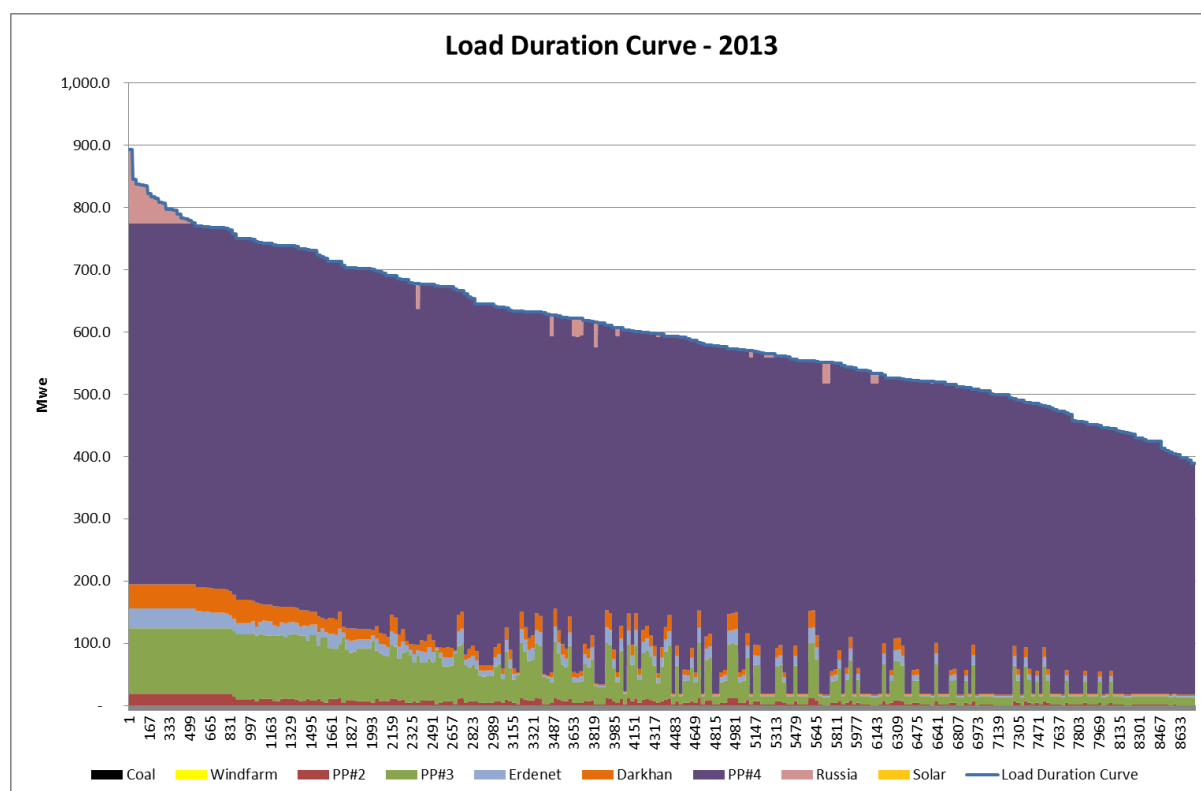


Chart 2: CES Load Dispatch Curve – 2014

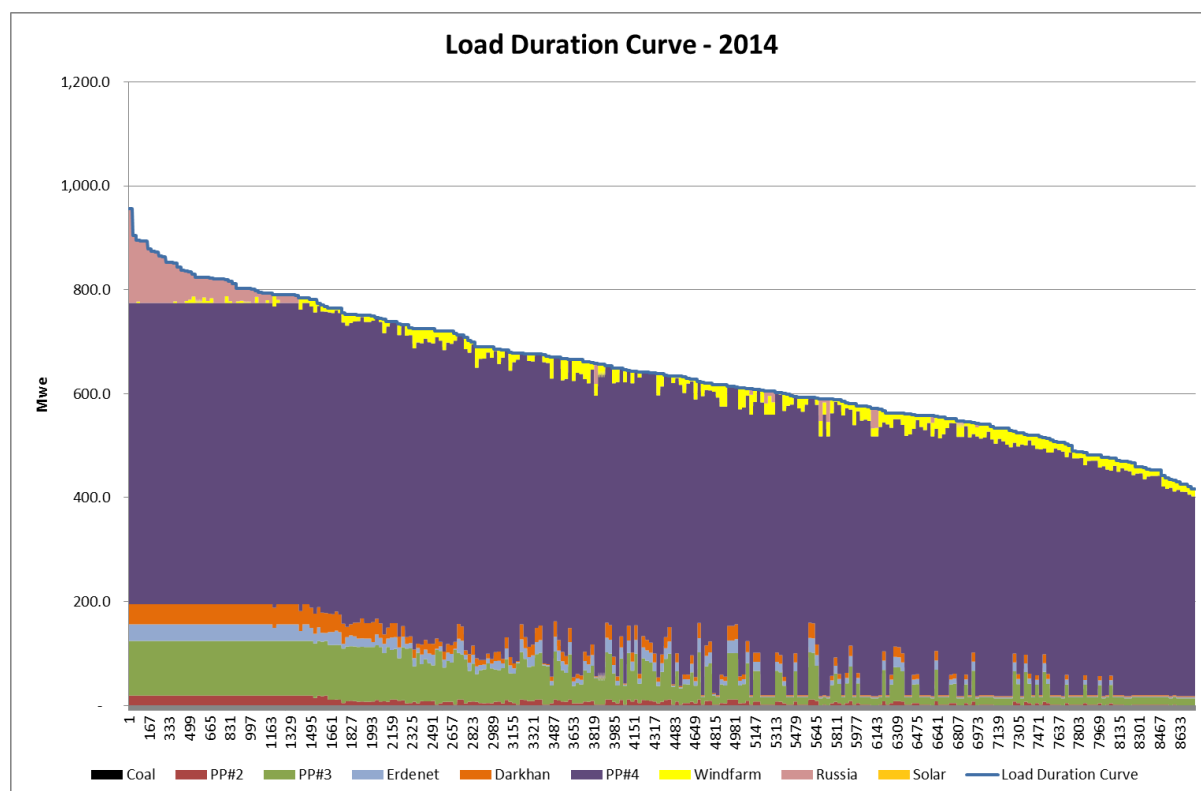


Chart 3: CES Load Dispatch Curve – 2015

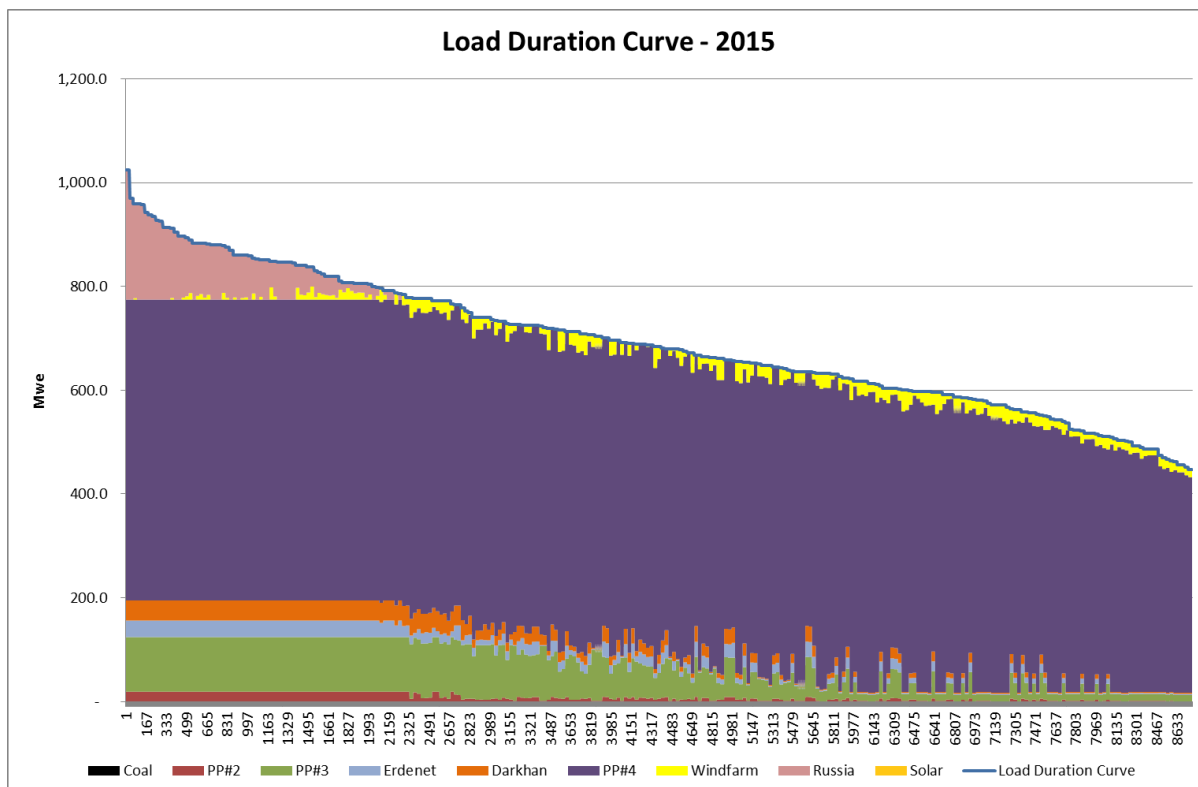


Chart 4: CES Load Dispatch Curve – 2016

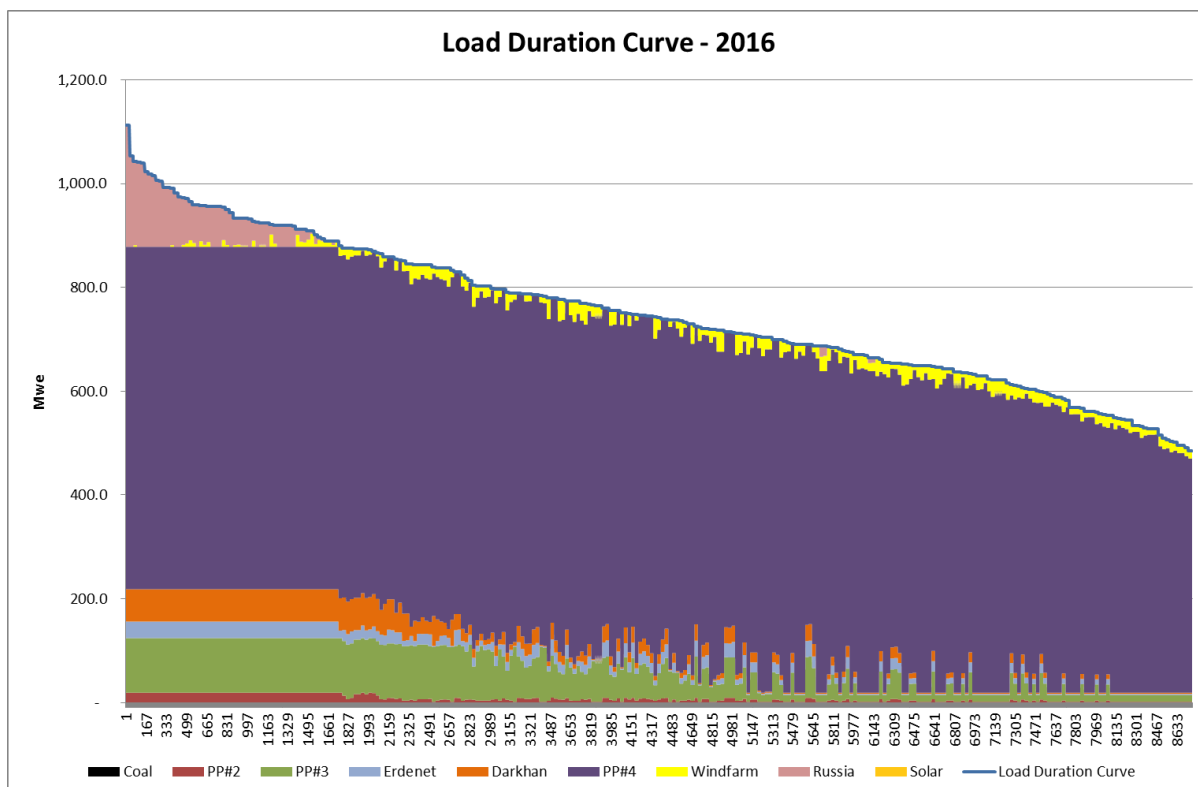


Chart 5: CES Load Dispatch Curve – 2017

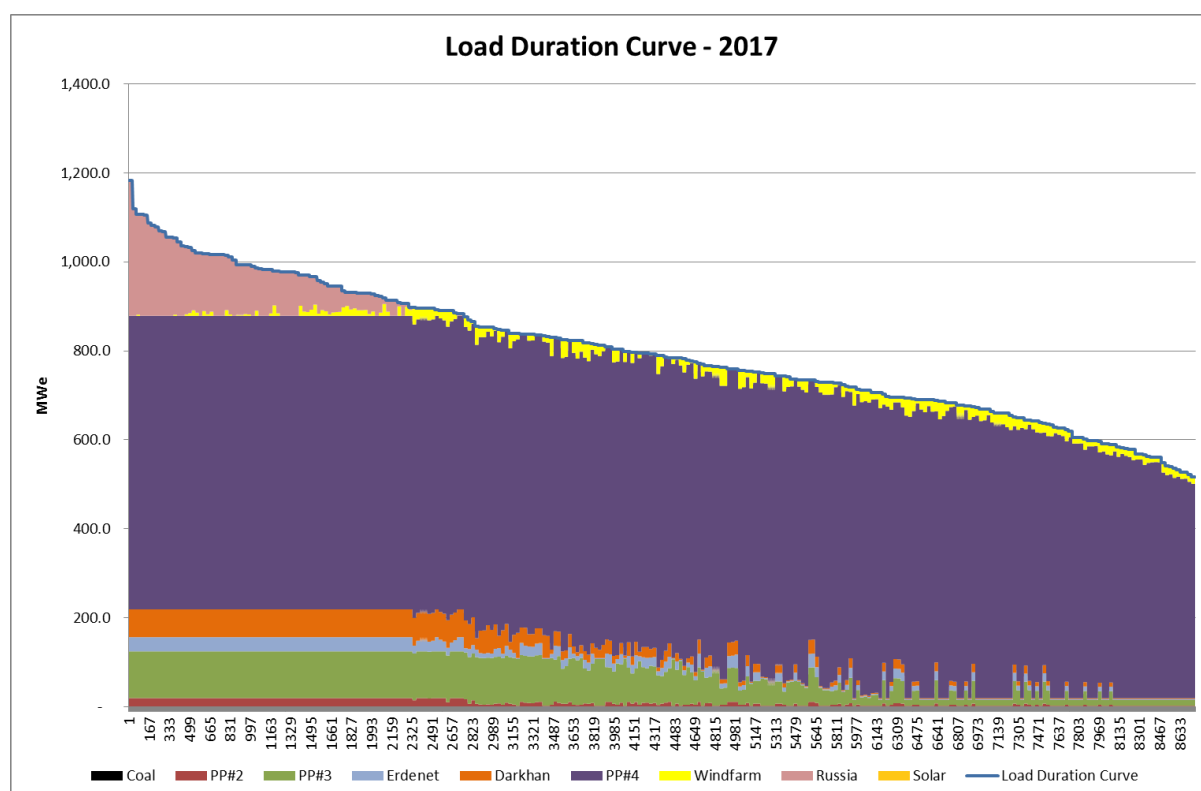


Chart 6: CES Load Dispatch Curve – 2018

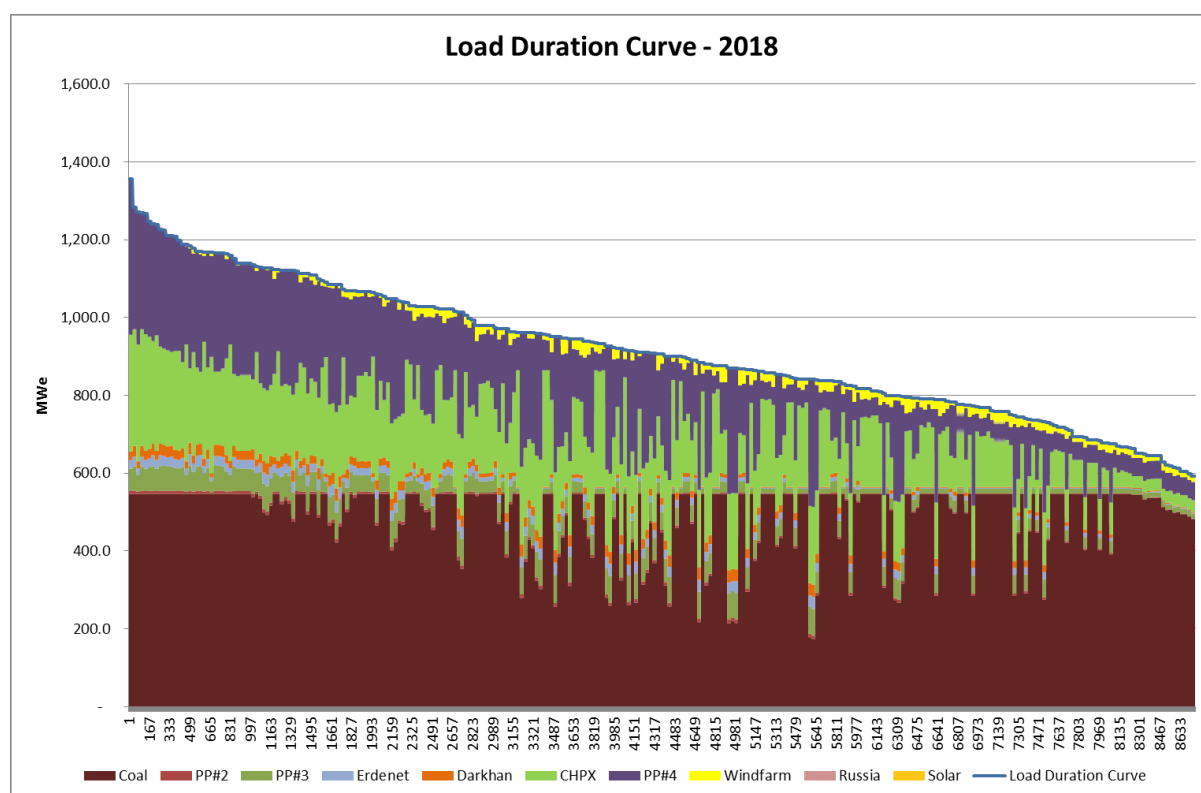


Chart 7: CES Load Dispatch Curve - 2019

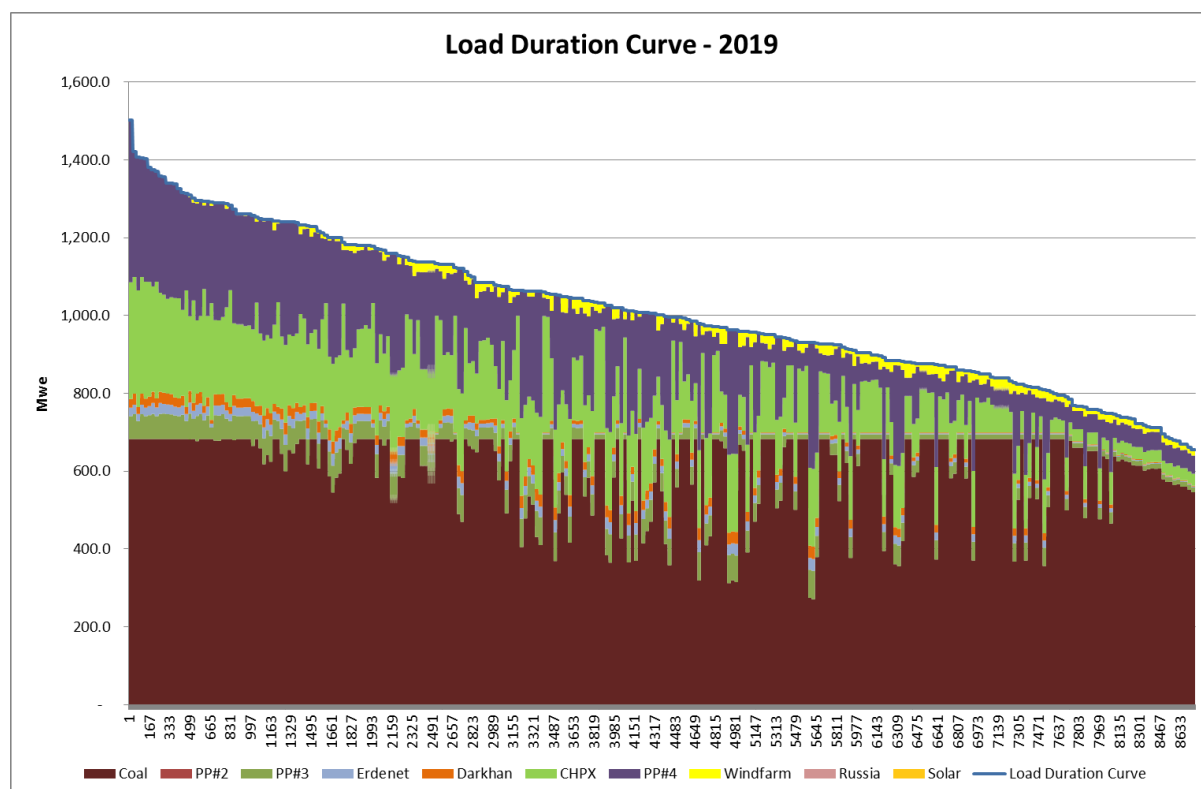


Chart 8: CES Load Dispatch Curve – 2020

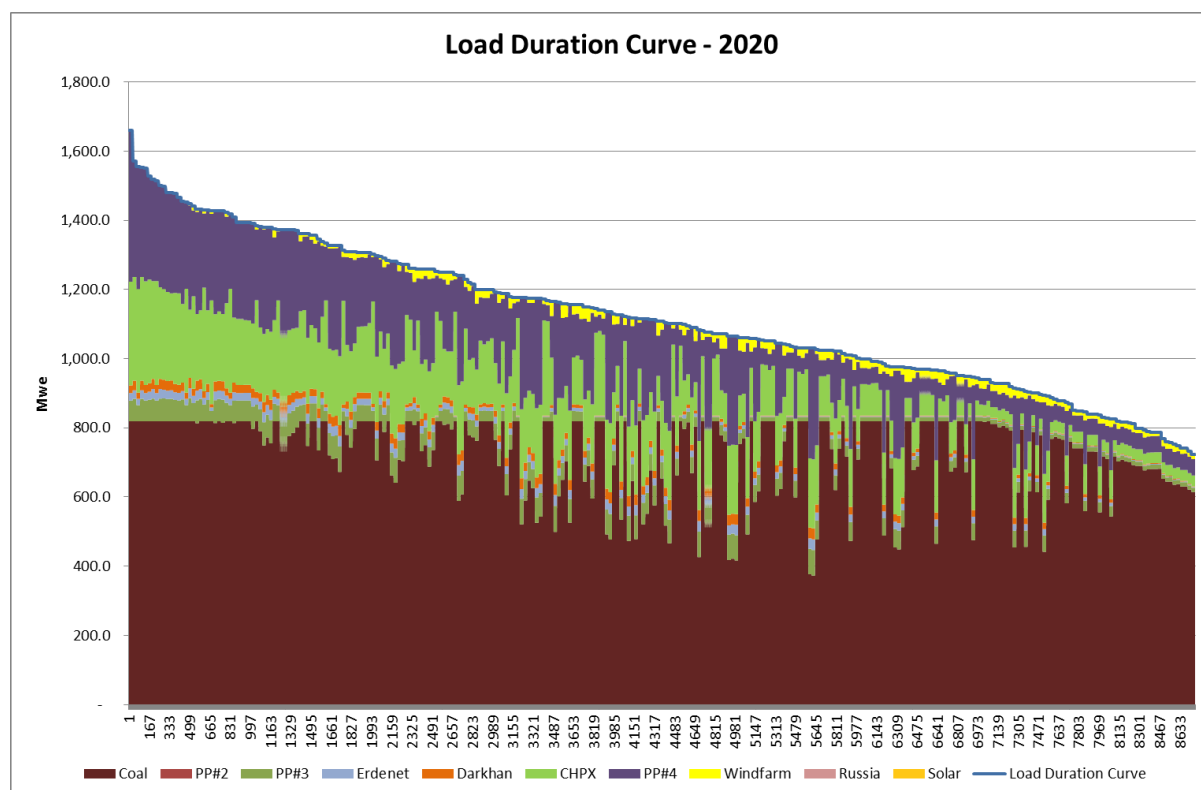


Chart 9: CES Load Dispatch Curve - 2021

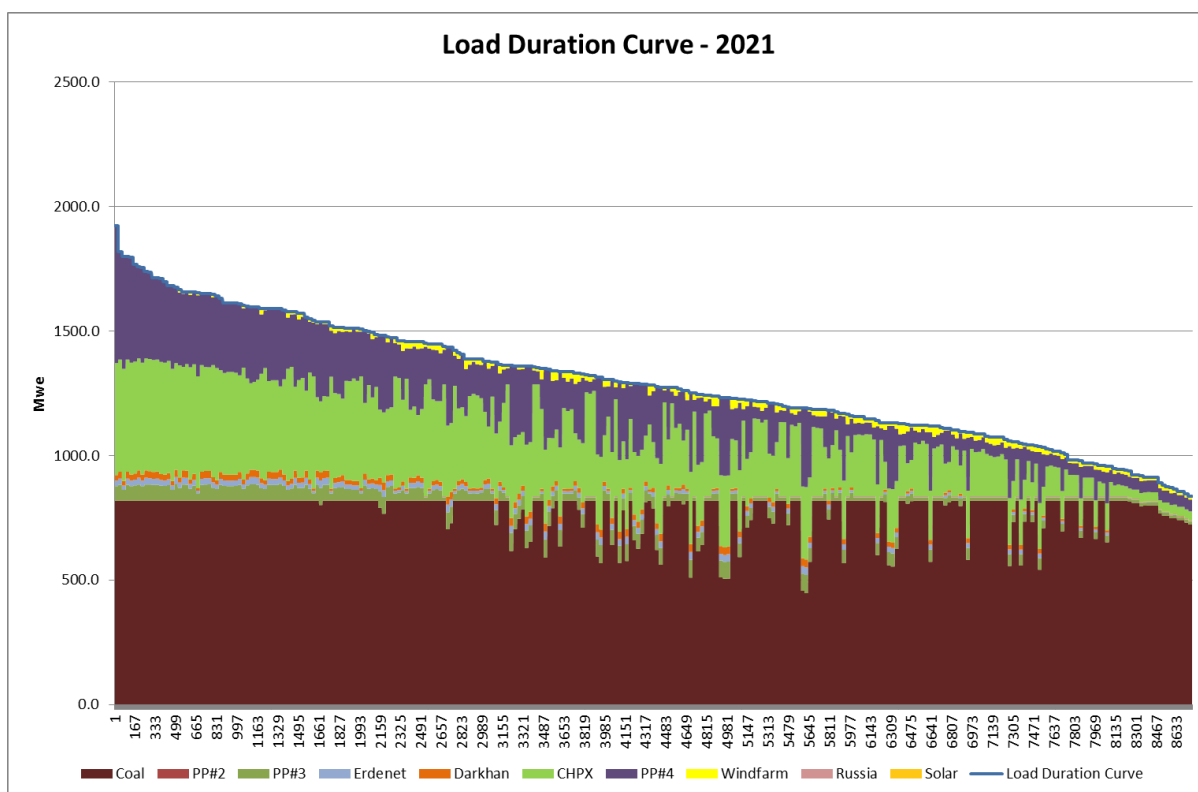


Chart 10: CES Load Dispatch Curve – 2022

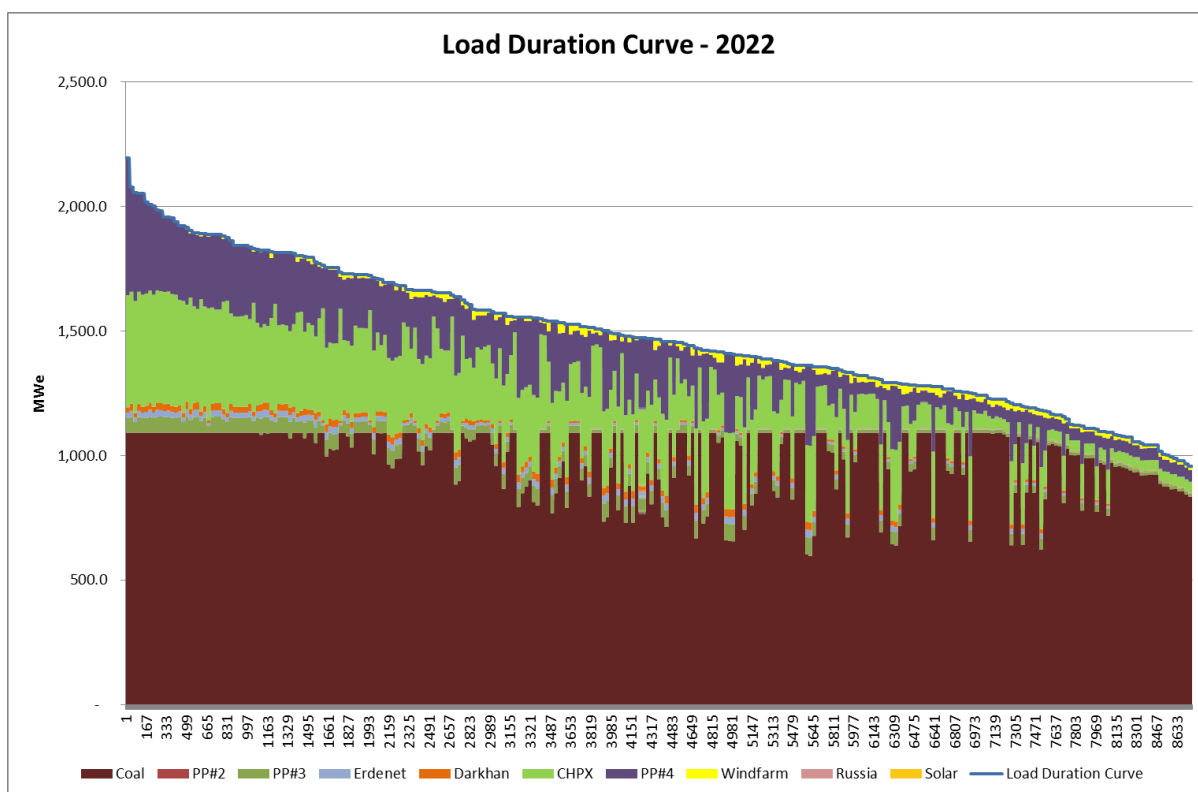


Chart 11: CES Load Dispatch Curve - 2023

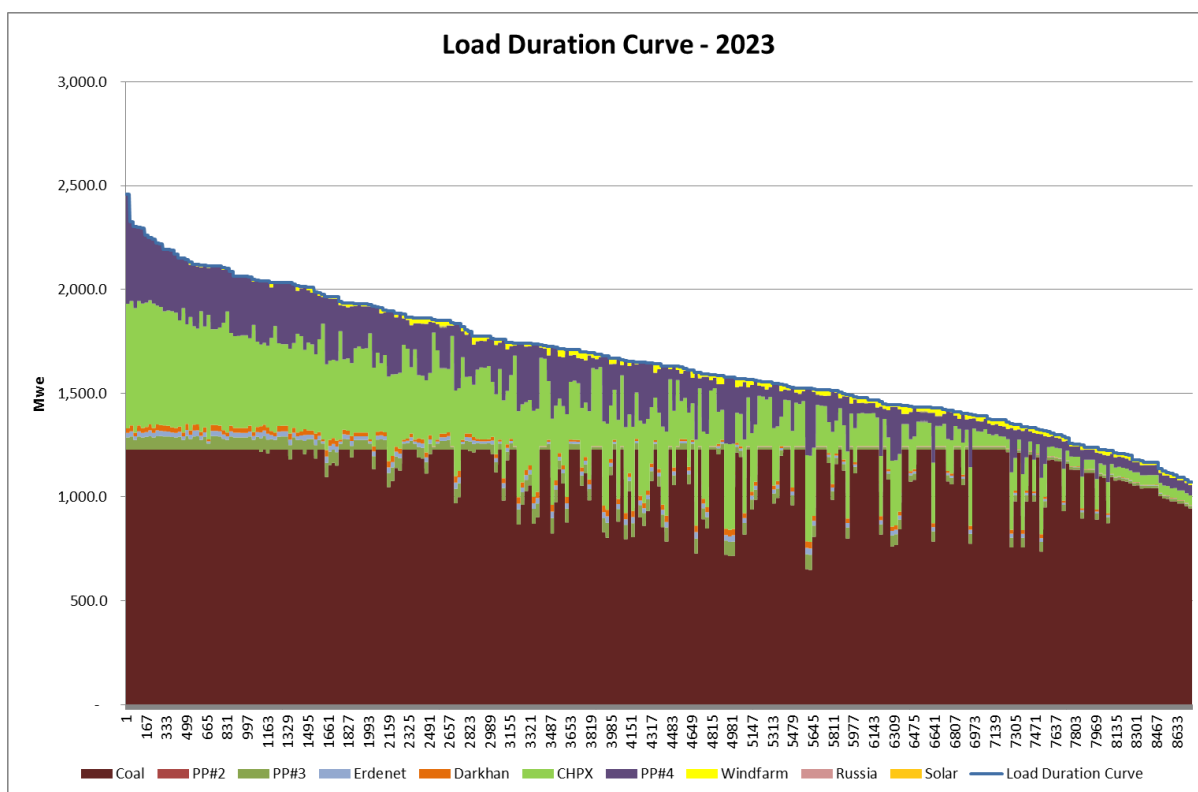


Chart 12: CES Load Dispatch Curve – 2024

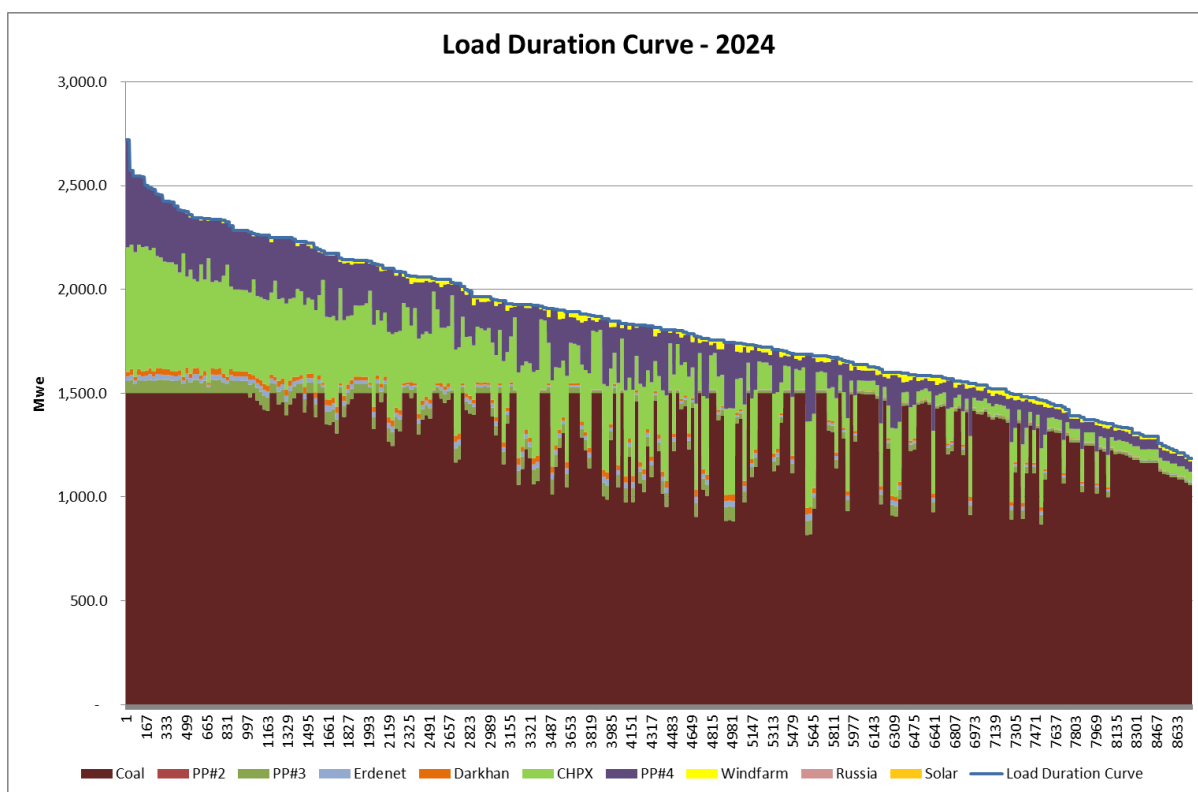
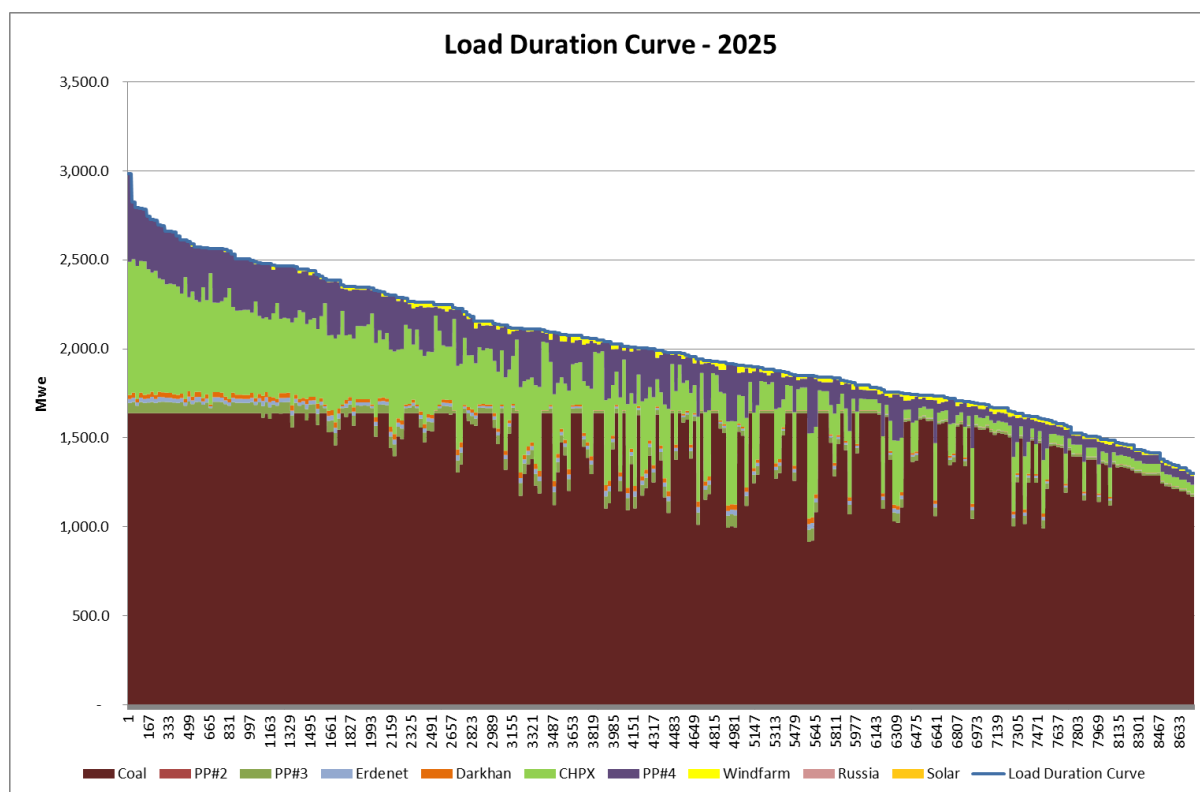


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX H: ELECTRICITY DISPATCH CURVES – Scenario 1B

Chart 1: CES Load Dispatch Curve - 2013

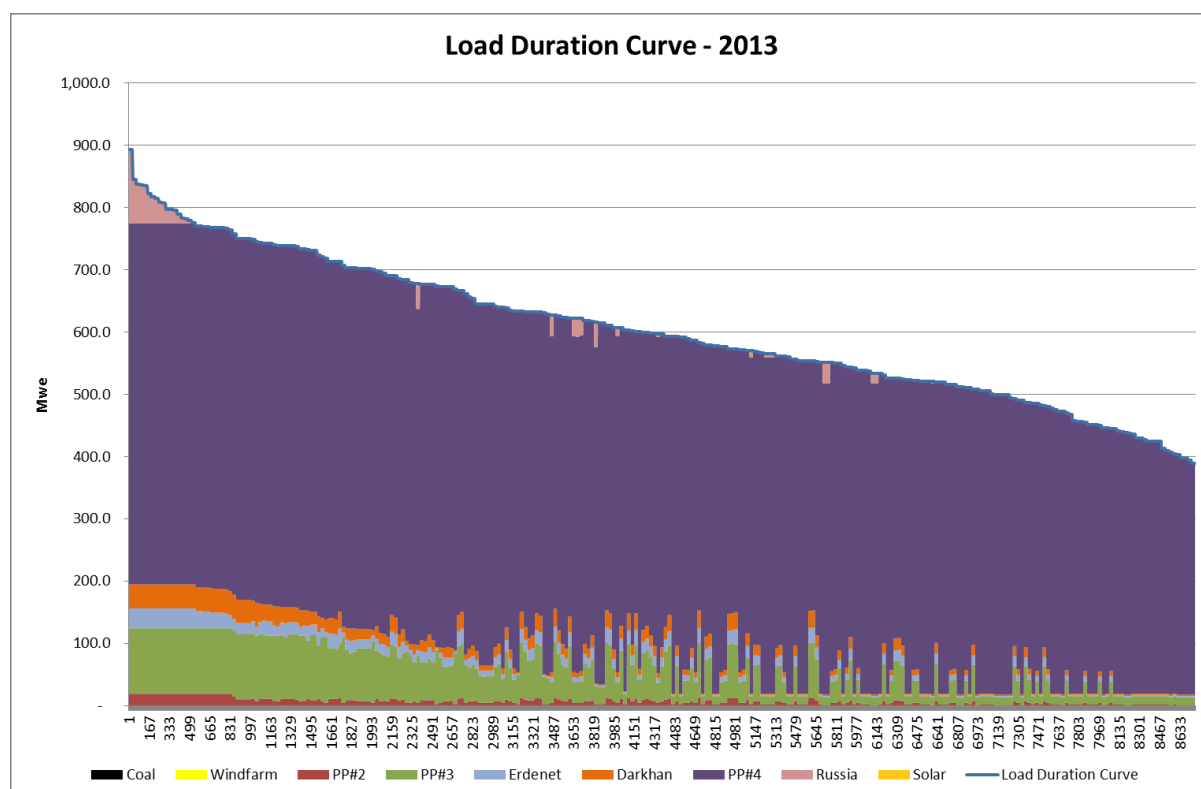


Chart 2: CES Load Dispatch Curve – 2014

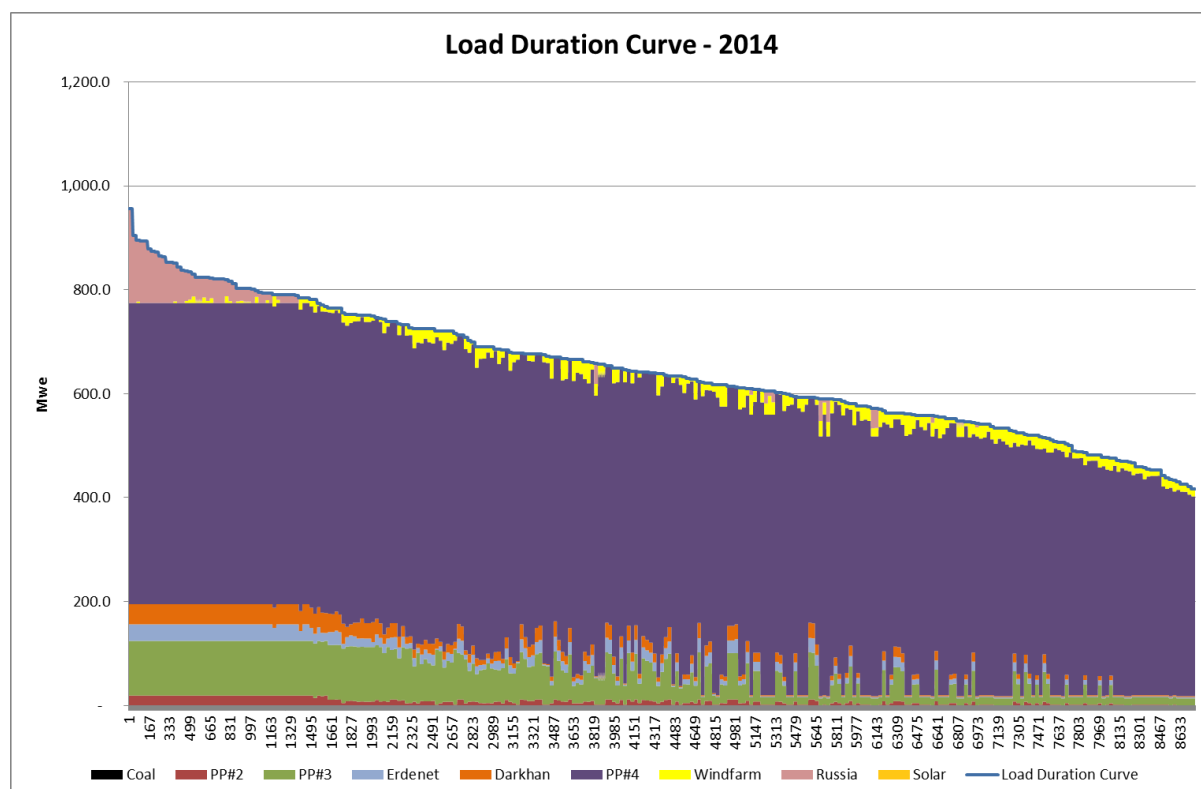


Chart 3: CES Load Dispatch Curve – 2015

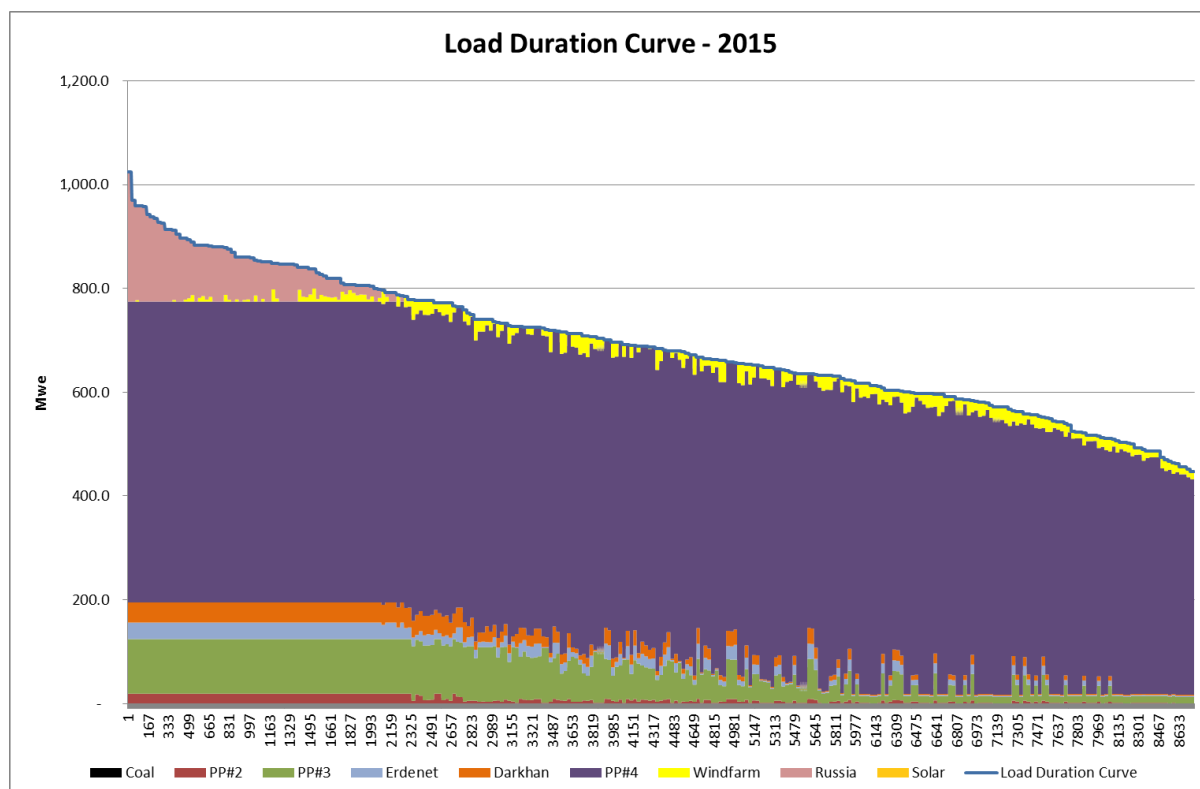


Chart 4: CES Load Dispatch Curve – 2016

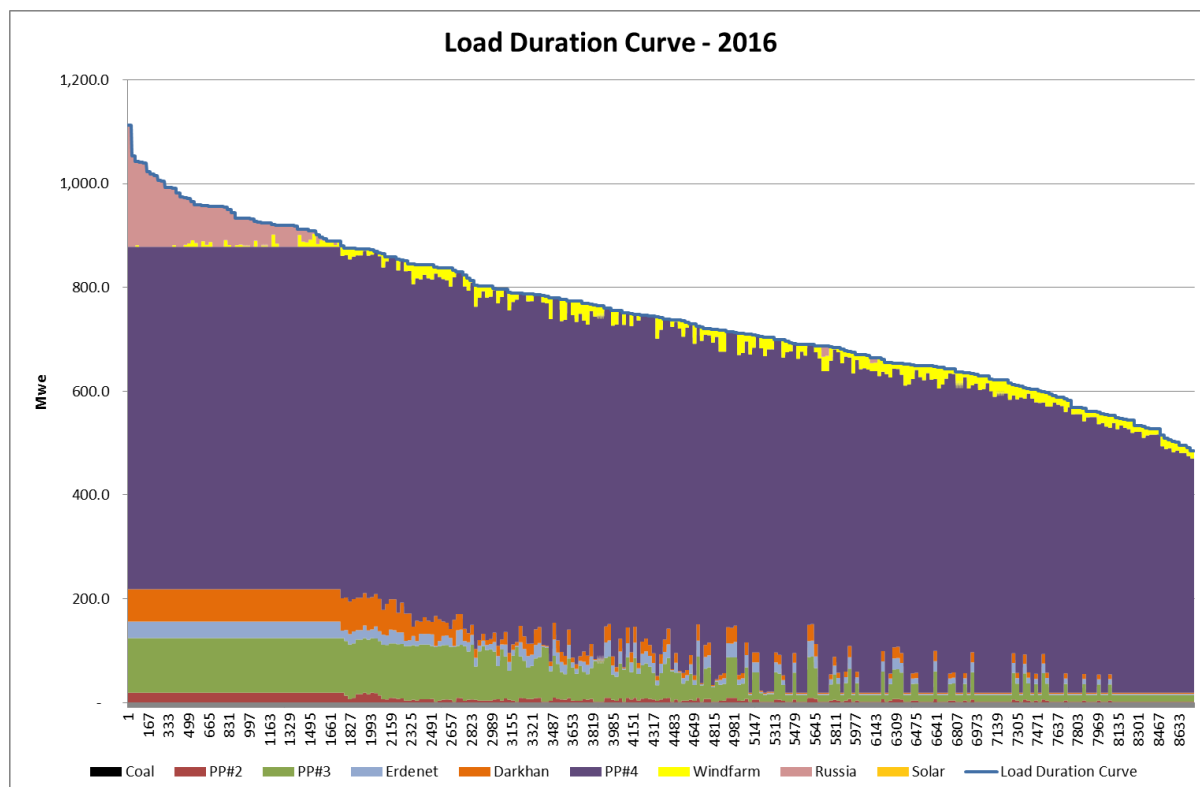


Chart 5: CES Load Dispatch Curve – 2017

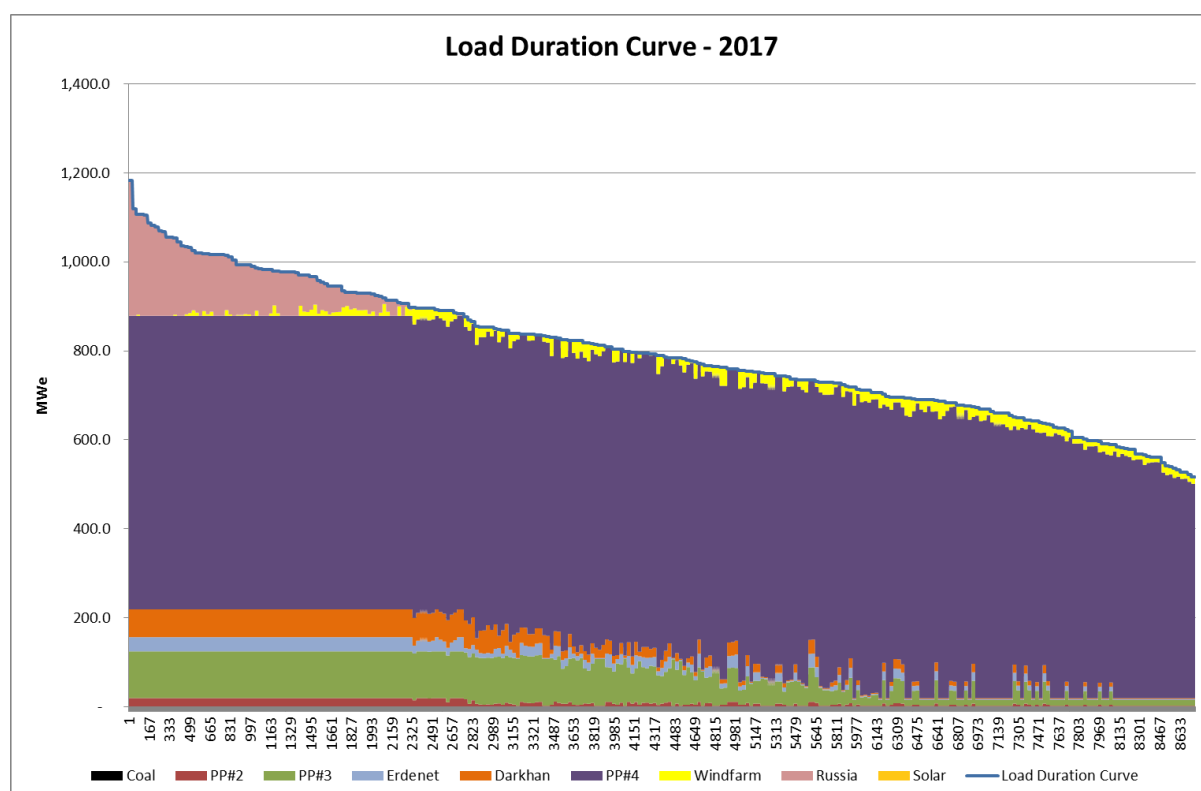


Chart 6: CES Load Dispatch Curve – 2018

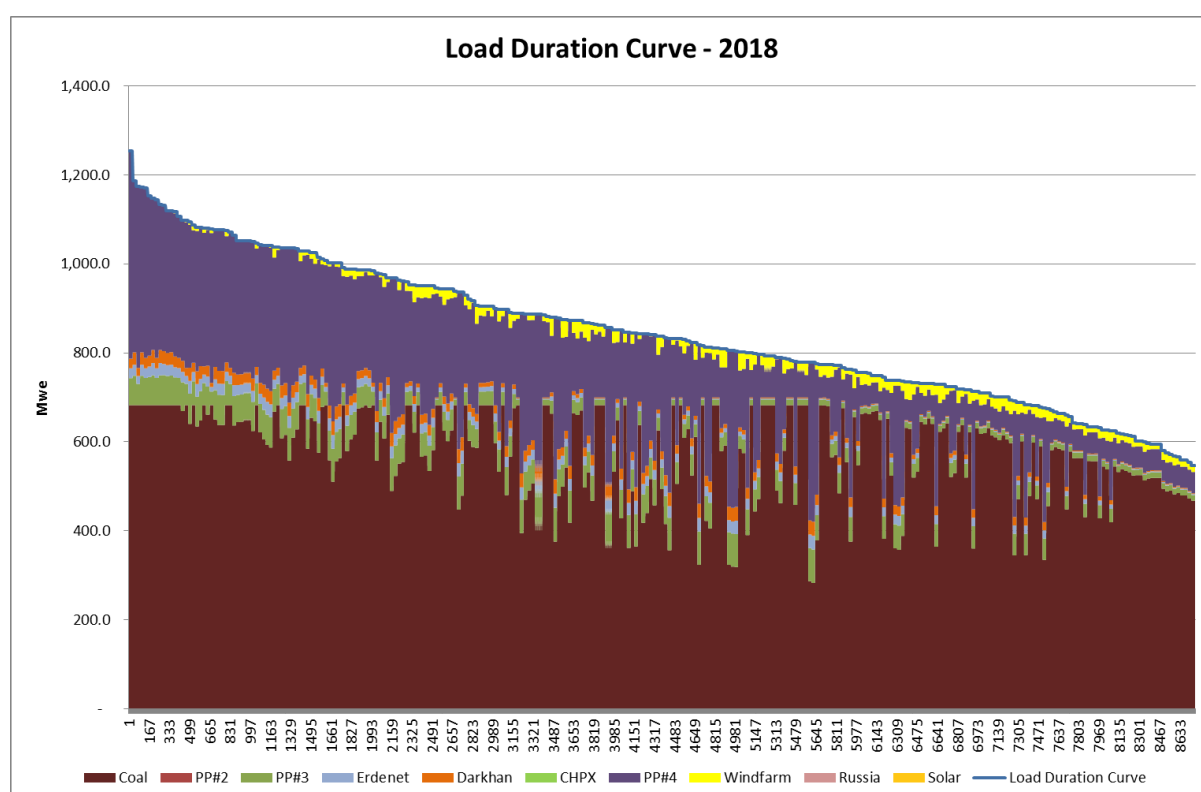


Chart 7: CES Load Dispatch Curve - 2019

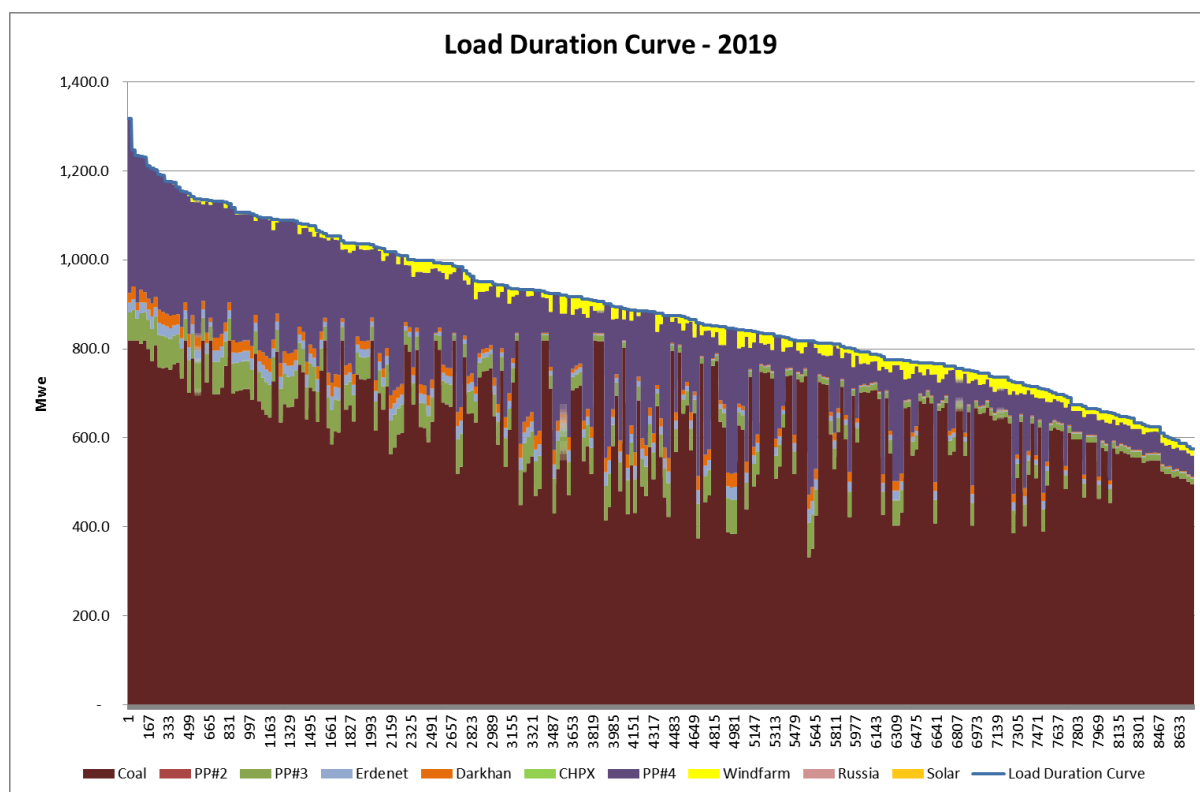


Chart 8: CES Load Dispatch Curve – 2020

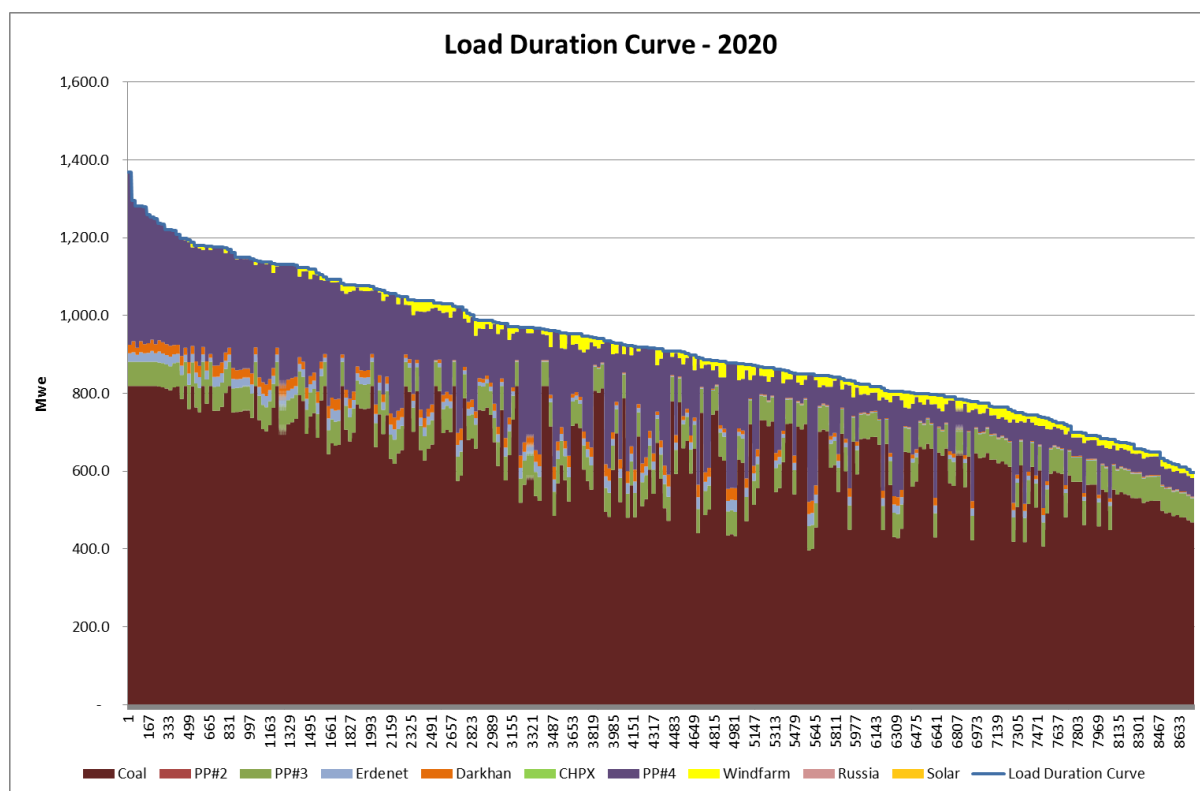


Chart 9: CES Load Dispatch Curve – 2021

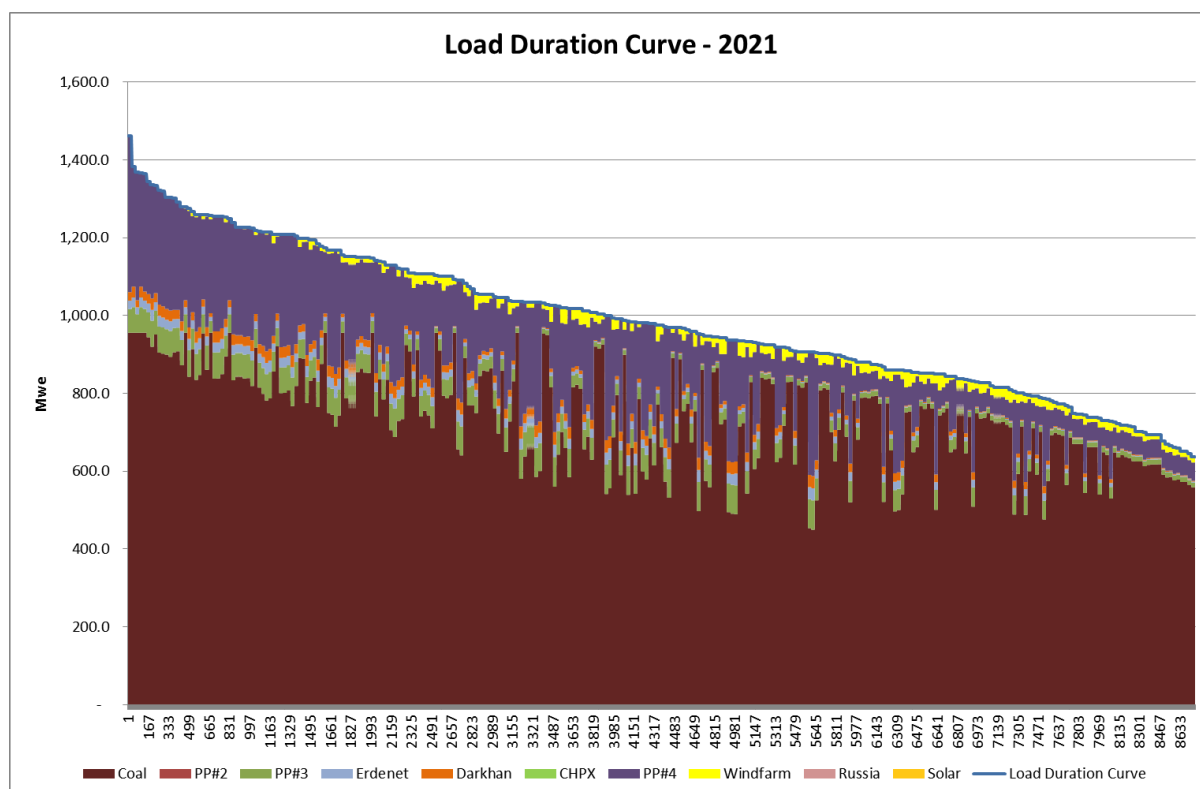


Chart 10: CES Load Dispatch Curve – 2022

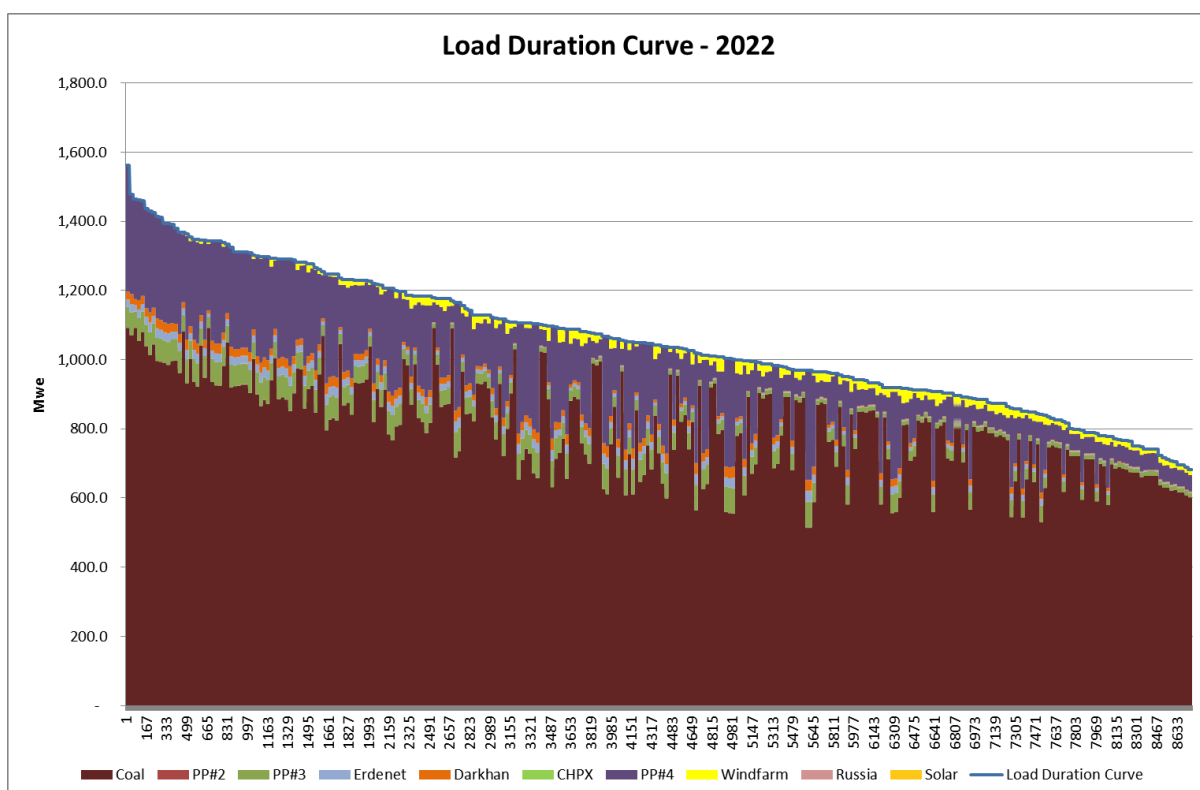


Chart 11: CES Load Dispatch Curve - 2023

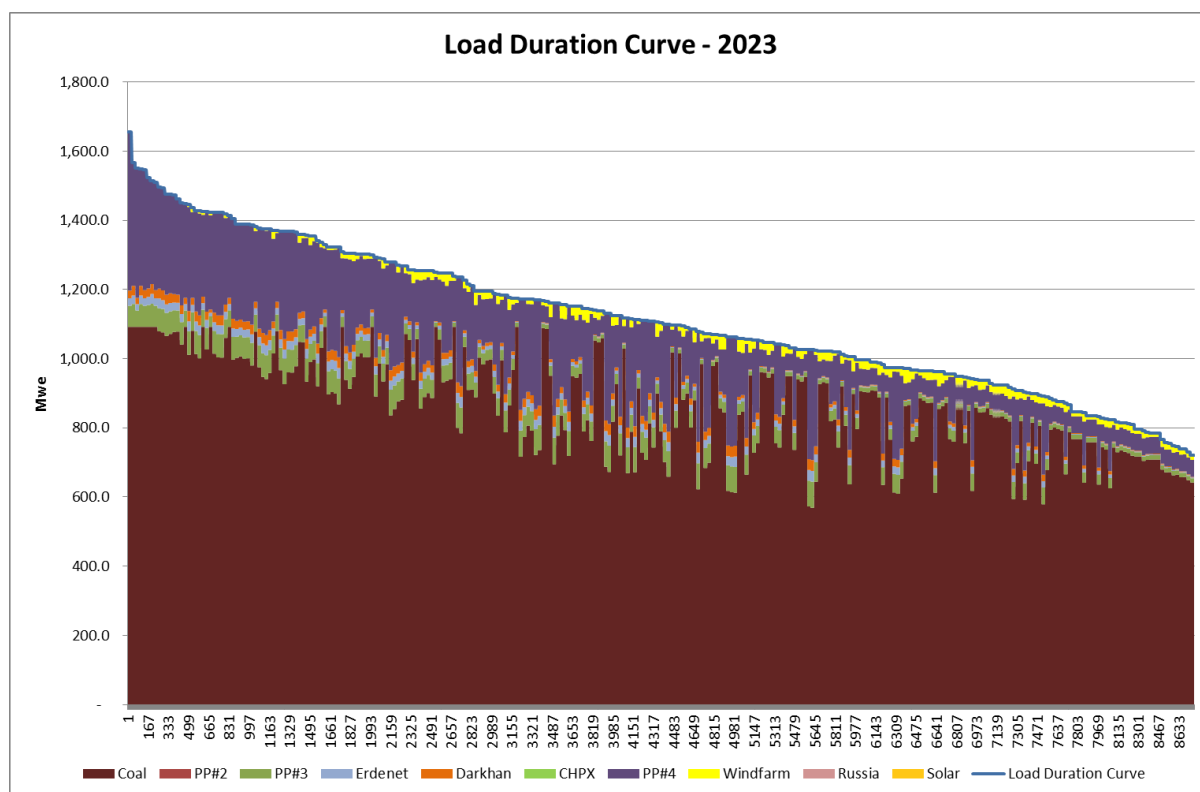


Chart 12: CES Load Dispatch Curve – 2024

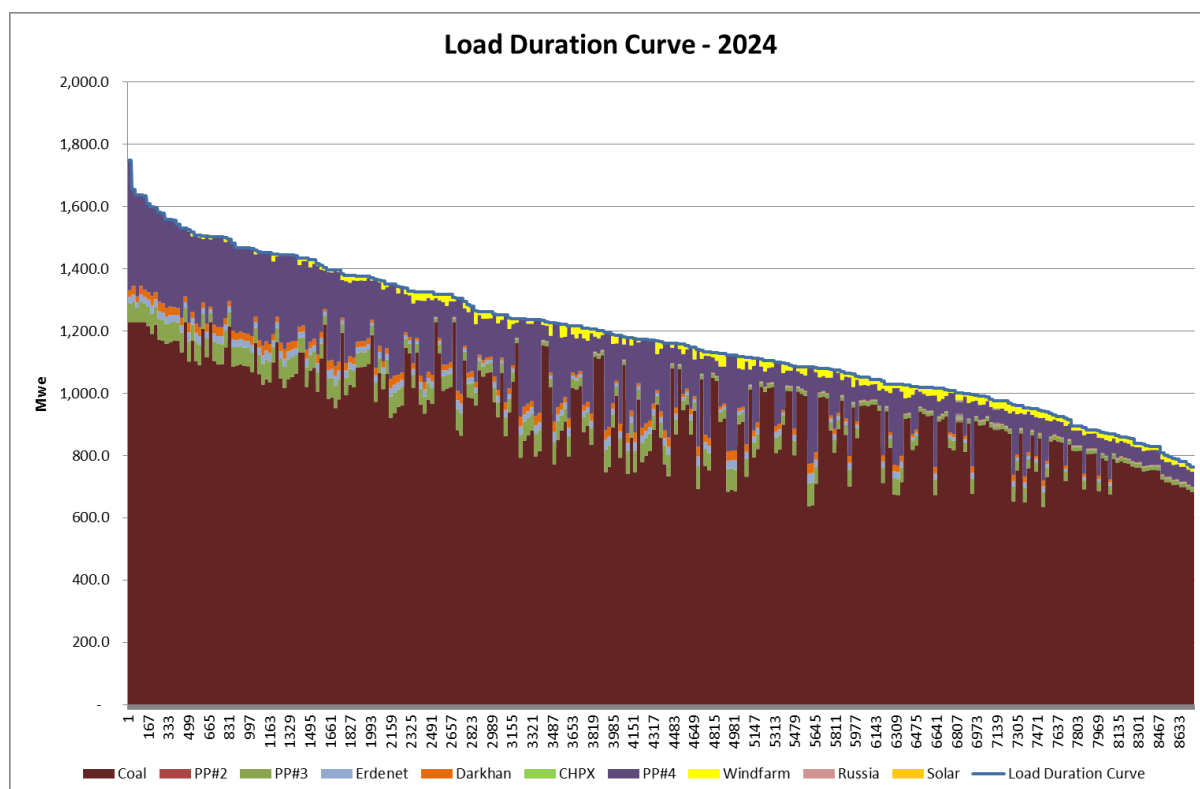
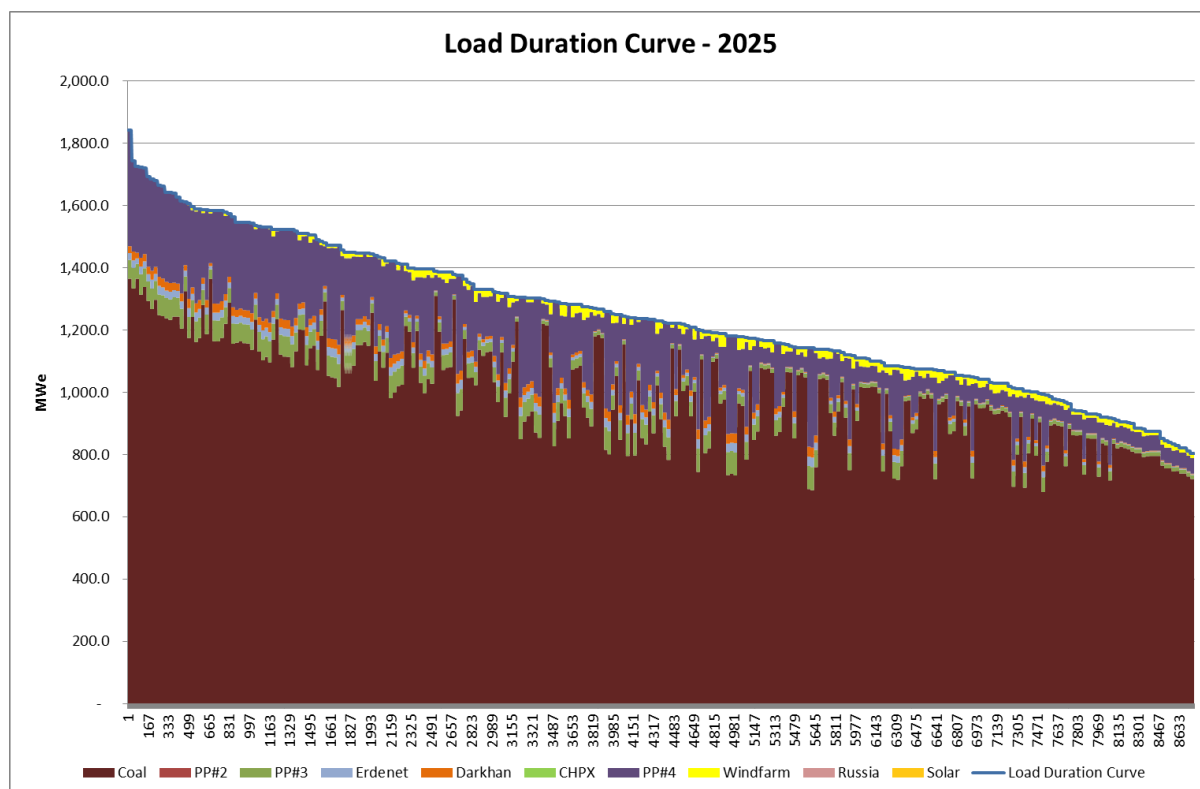


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX I: ELECTRICITY DISPATCH CURVES – Scenario 2A

Chart 1: CES Load Dispatch Curve - 2013

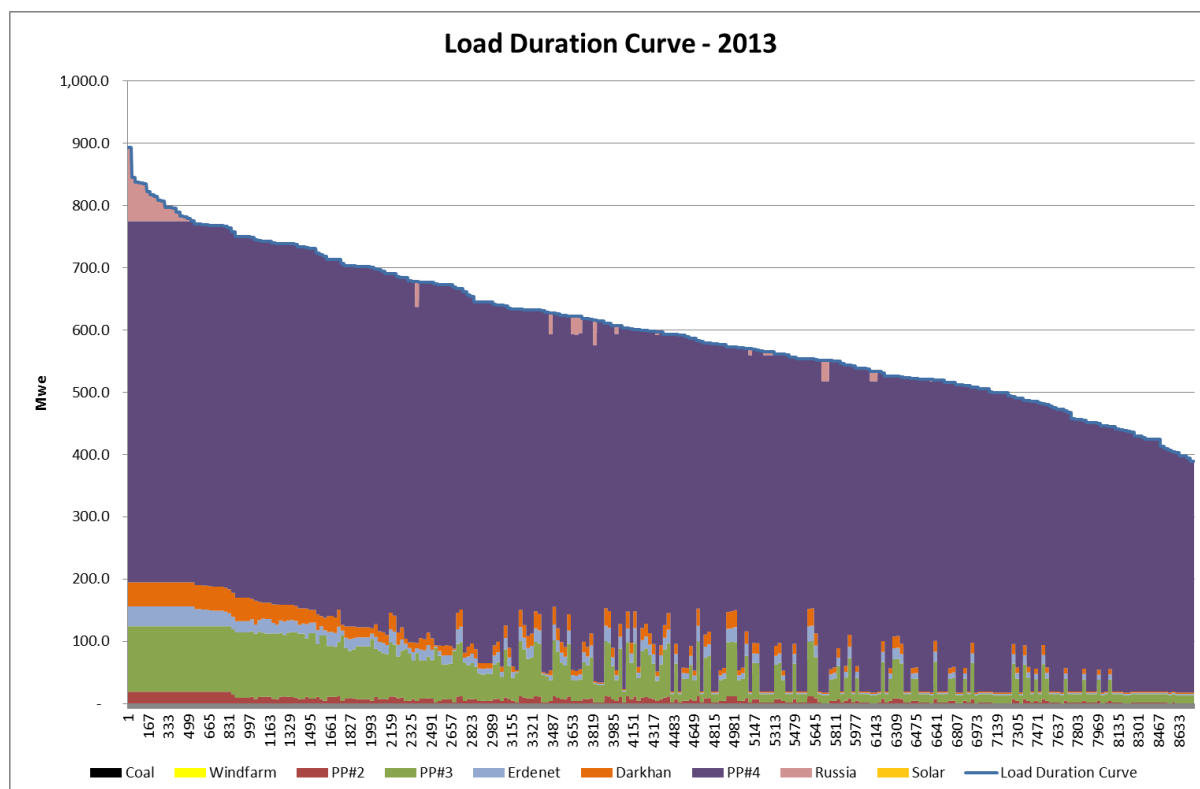


Chart 2: CES Load Dispatch Curve – 2014

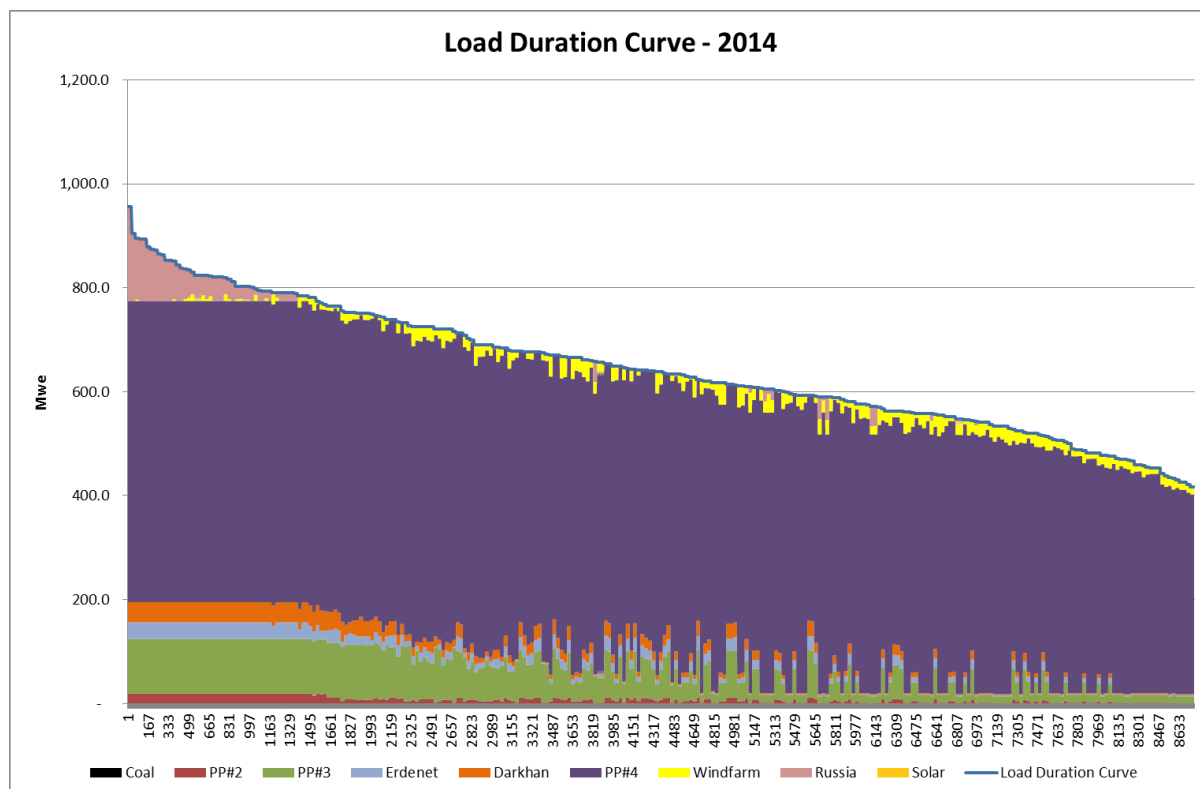


Chart 3: CES Load Dispatch Curve – 2015

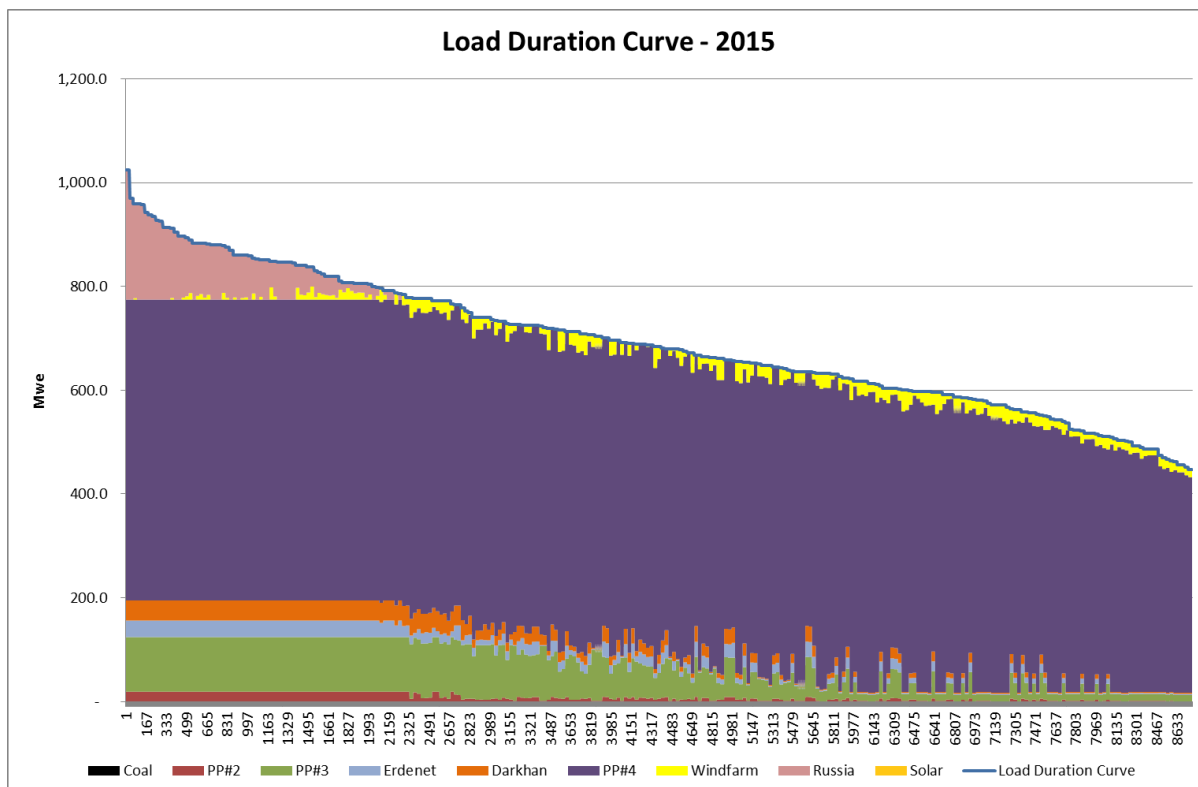


Chart 4: CES Load Dispatch Curve – 2016

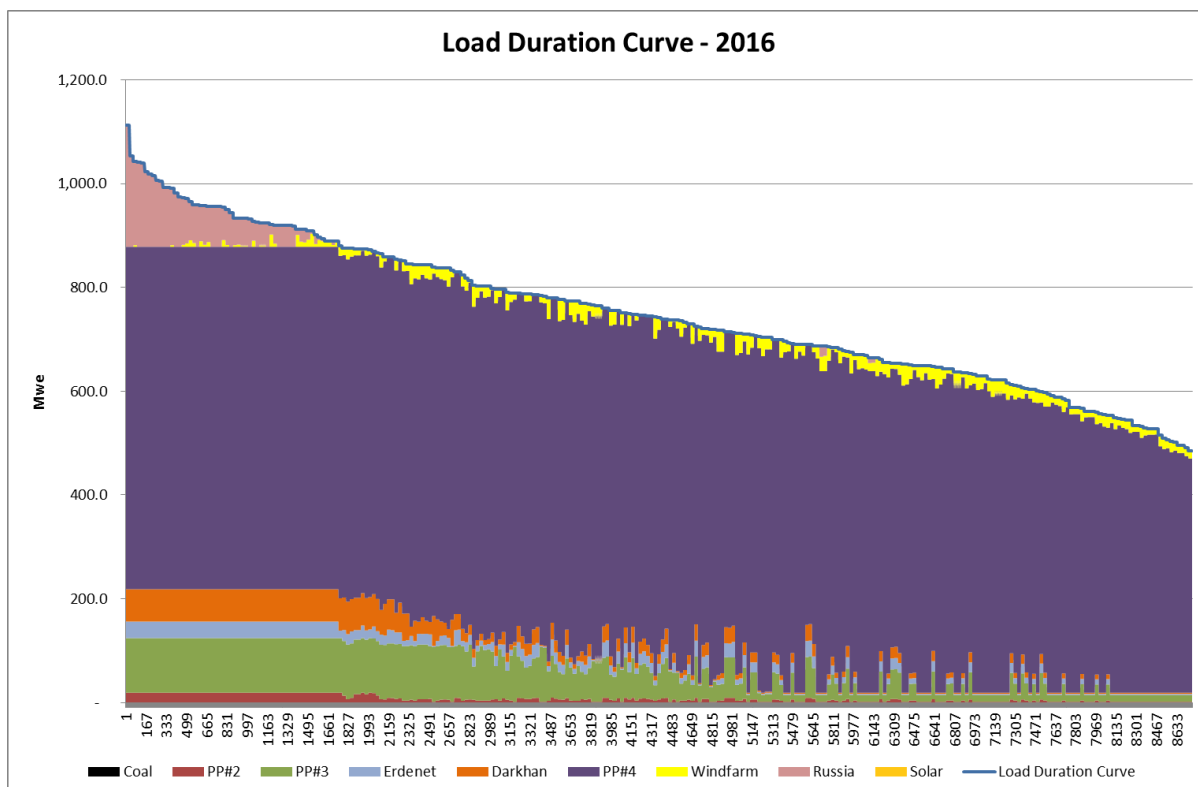


Chart 5: CES Load Dispatch Curve – 2017

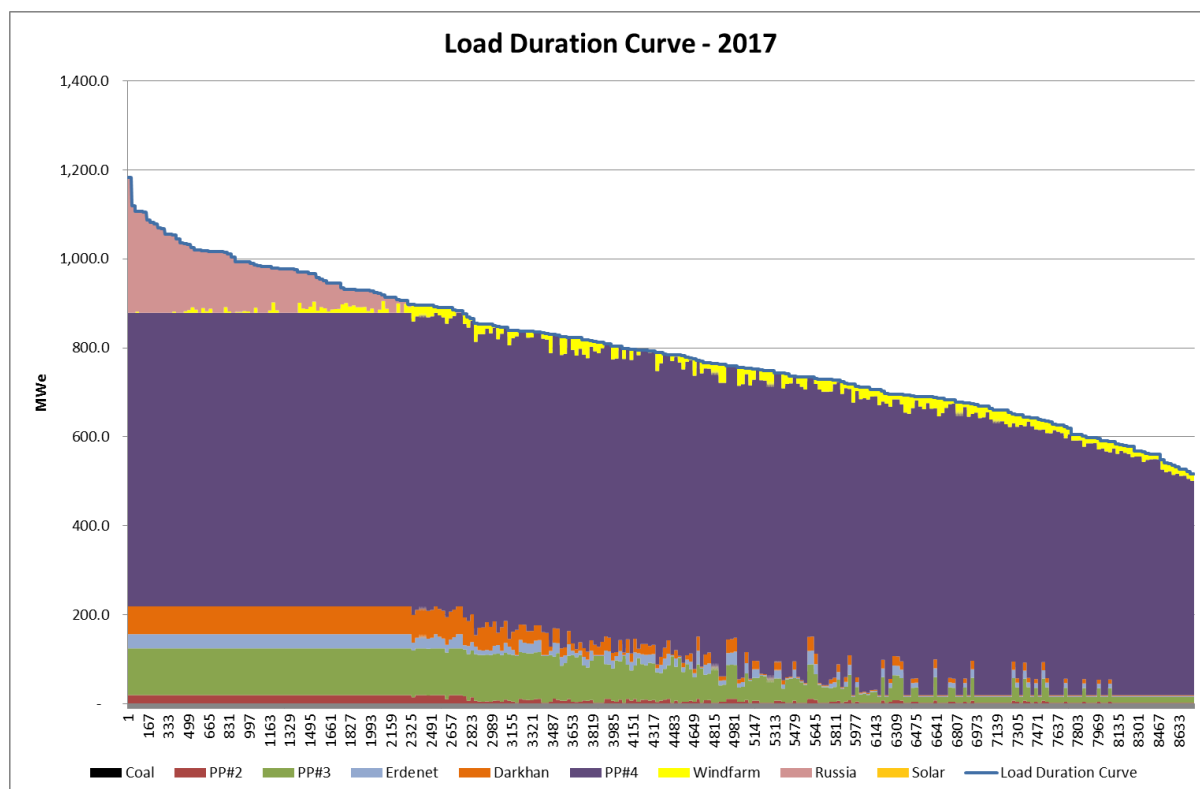


Chart 6: CES Load Dispatch Curve – 2018

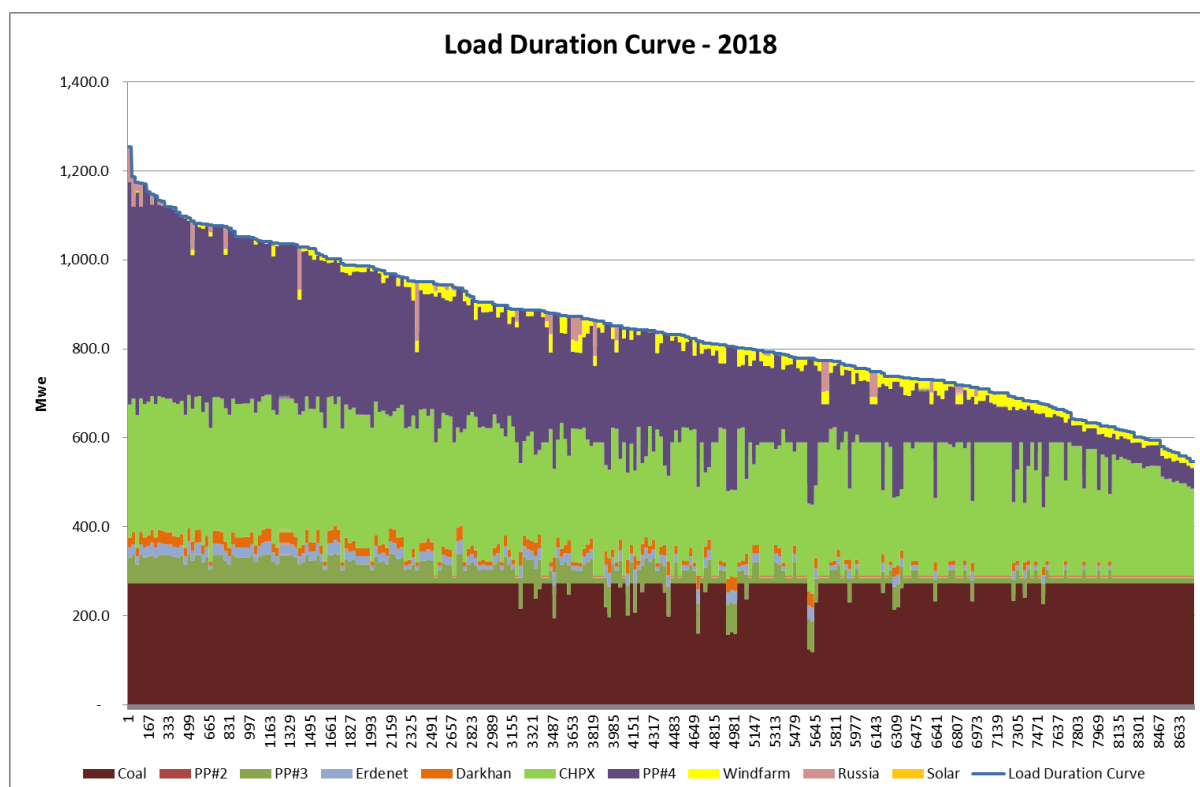


Chart 7: CES Load Dispatch Curve - 2019

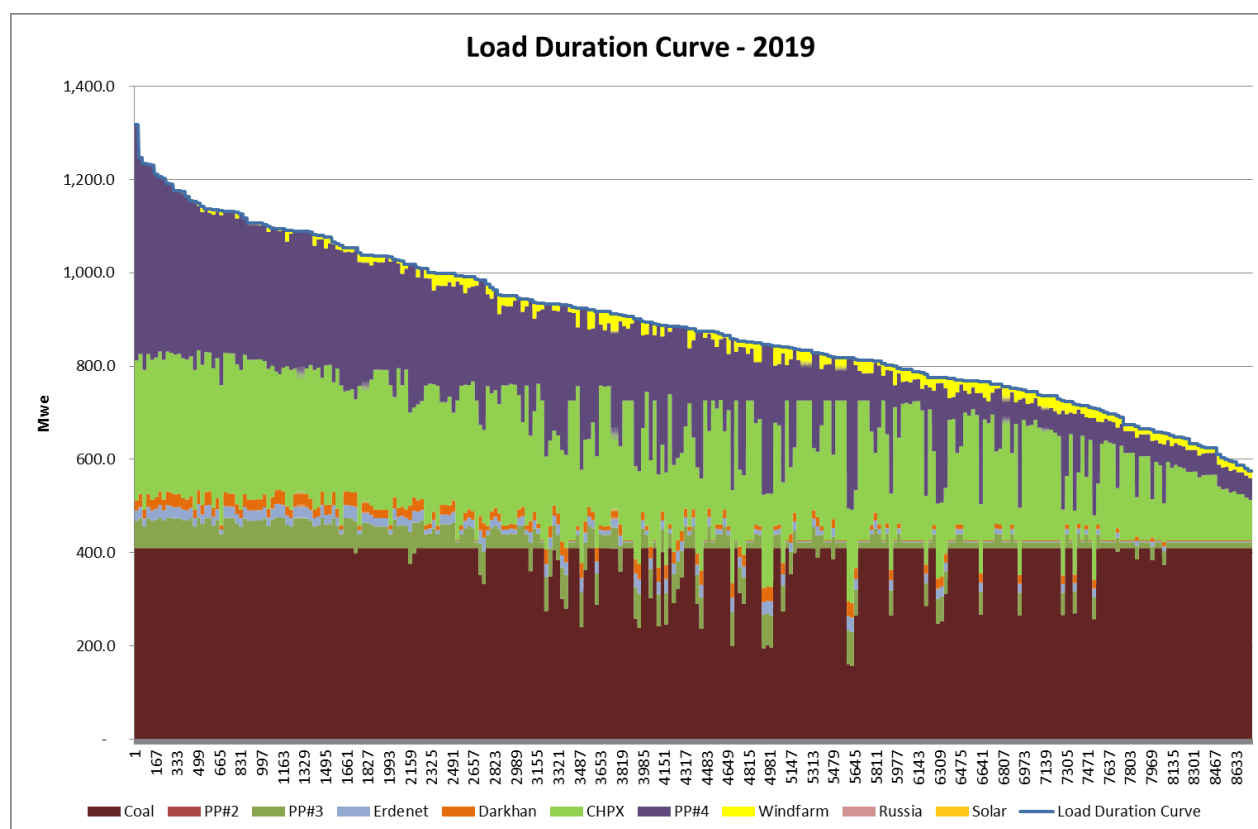


Chart 8: CES Load Dispatch Curve – 2020

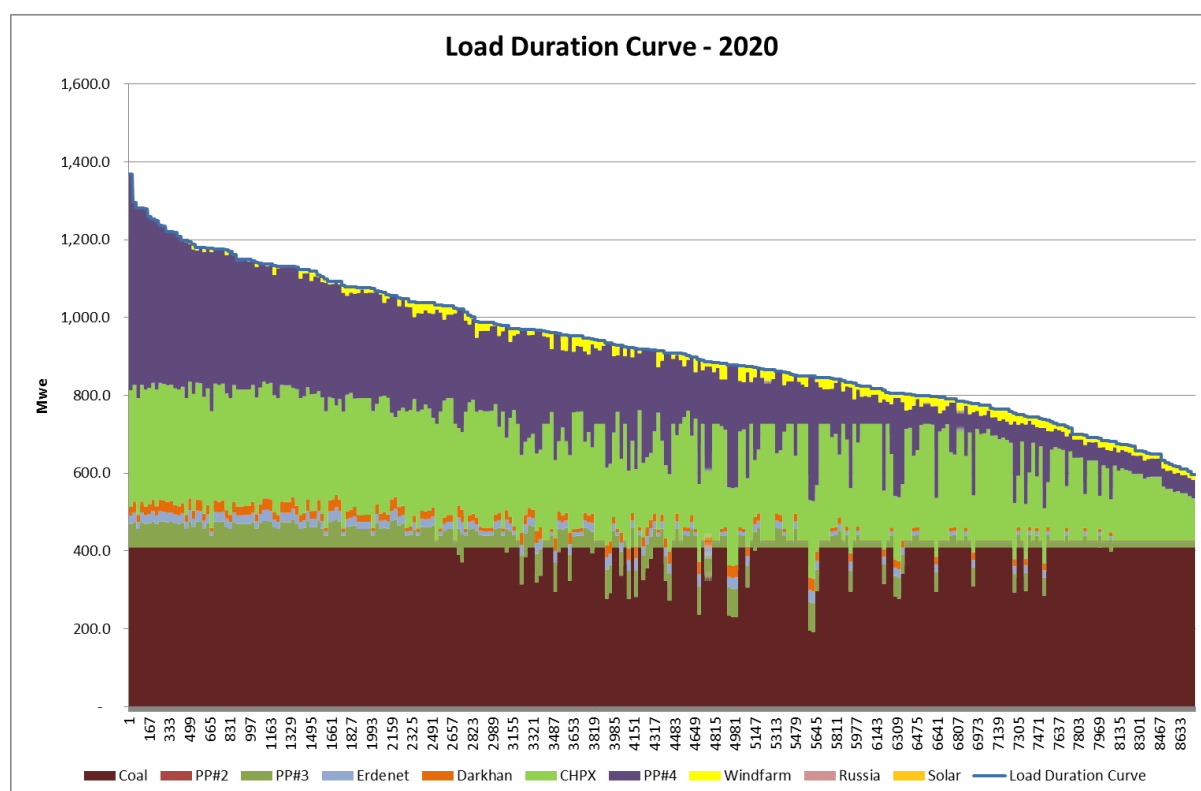


Chart 9: CES Load Dispatch Curve – 2021

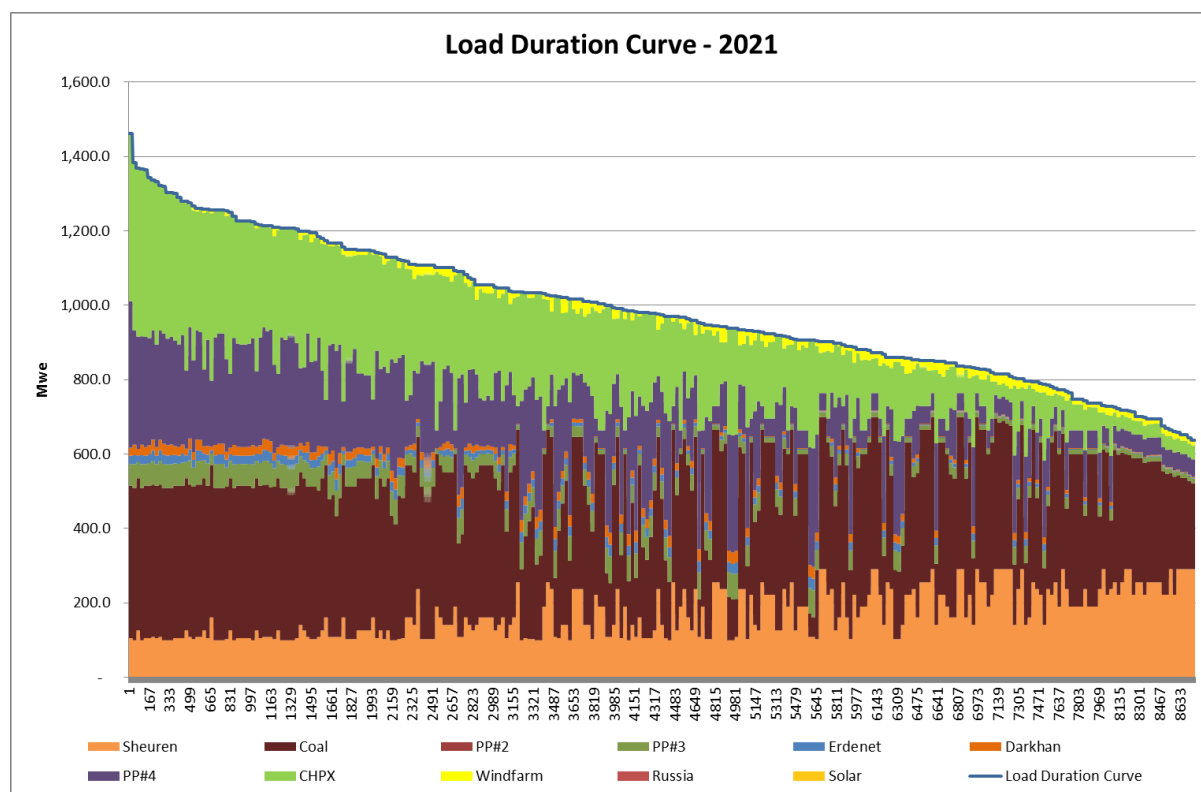


Chart 10: CES Load Dispatch Curve – 2022

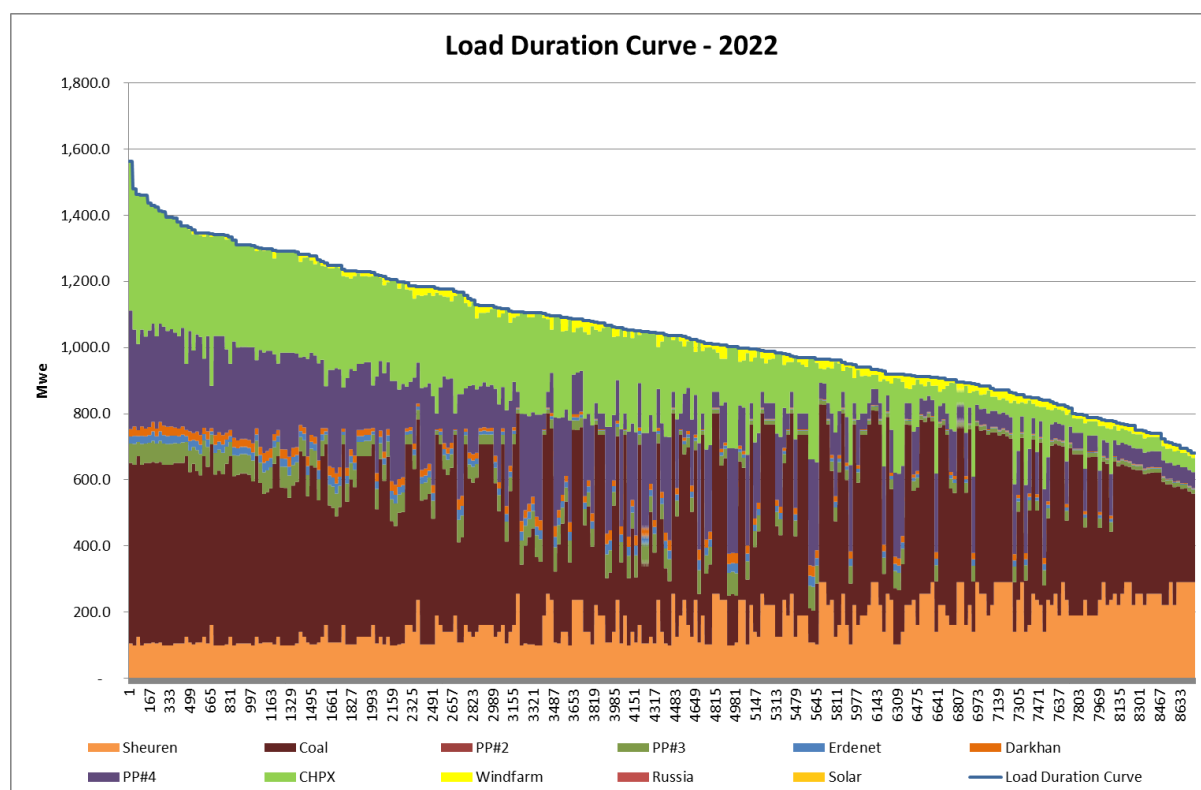


Chart 11: CES Load Dispatch Curve - 2023

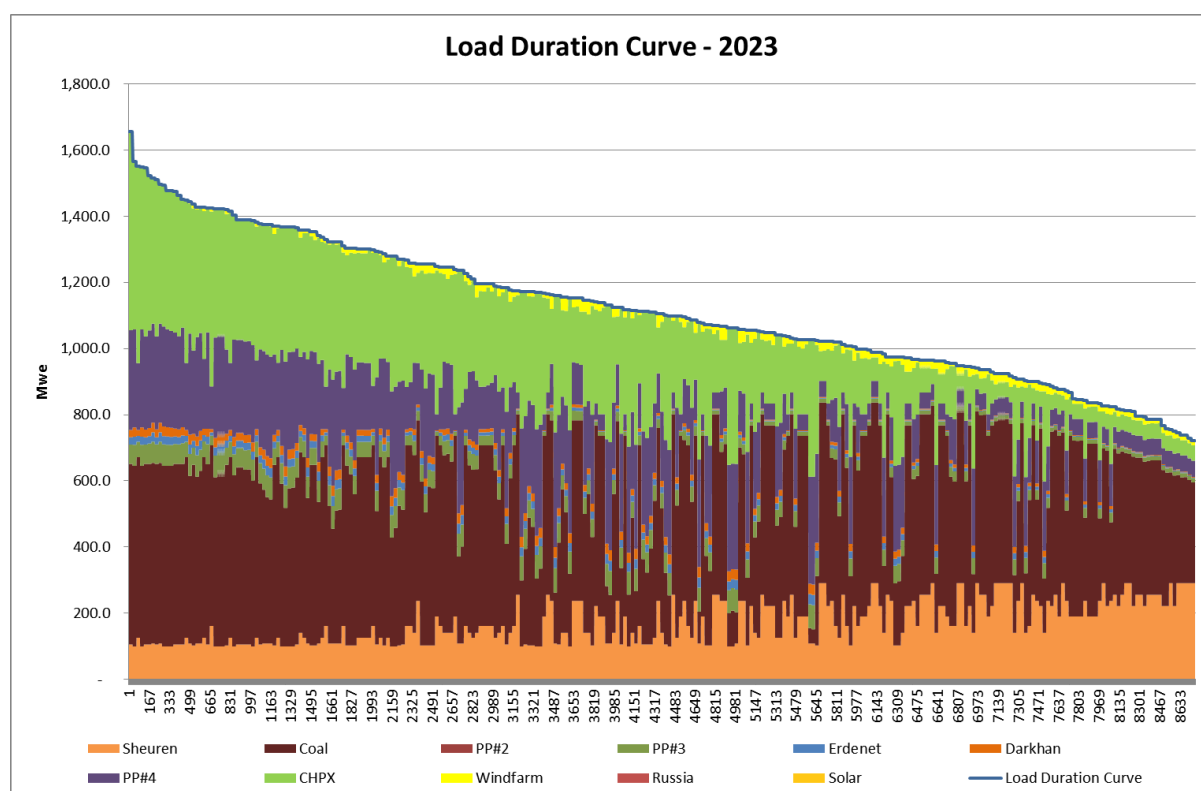


Chart 12: CES Load Dispatch Curve – 2024

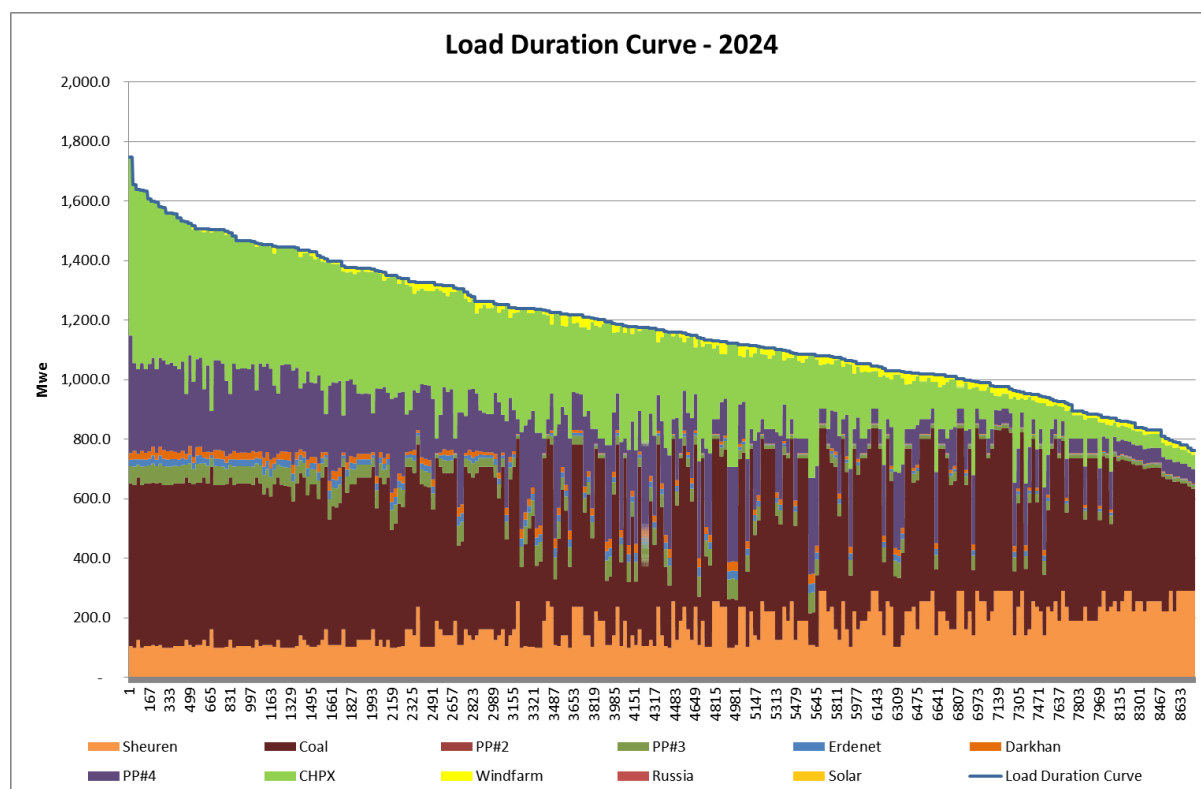
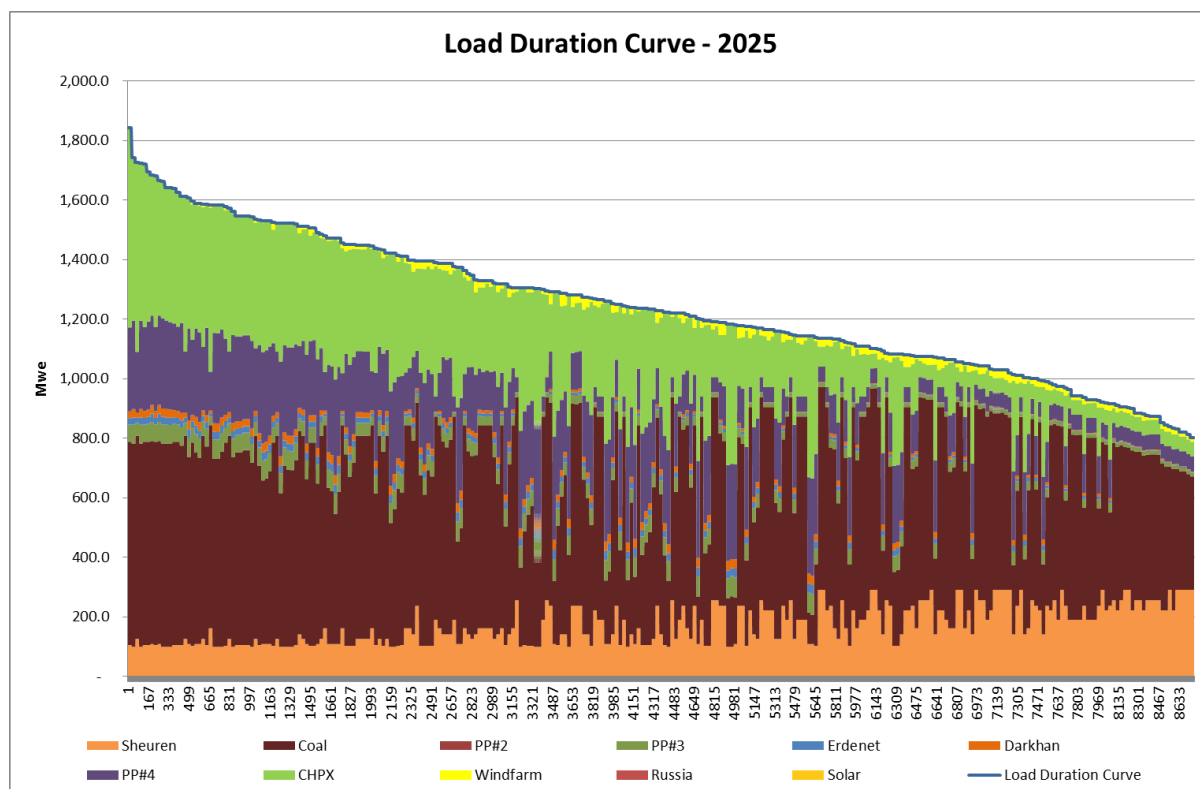


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX J: ELECTRICITY DISPATCH CURVES – Scenario 2B

Chart 1: CES Load Dispatch Curve - 2013

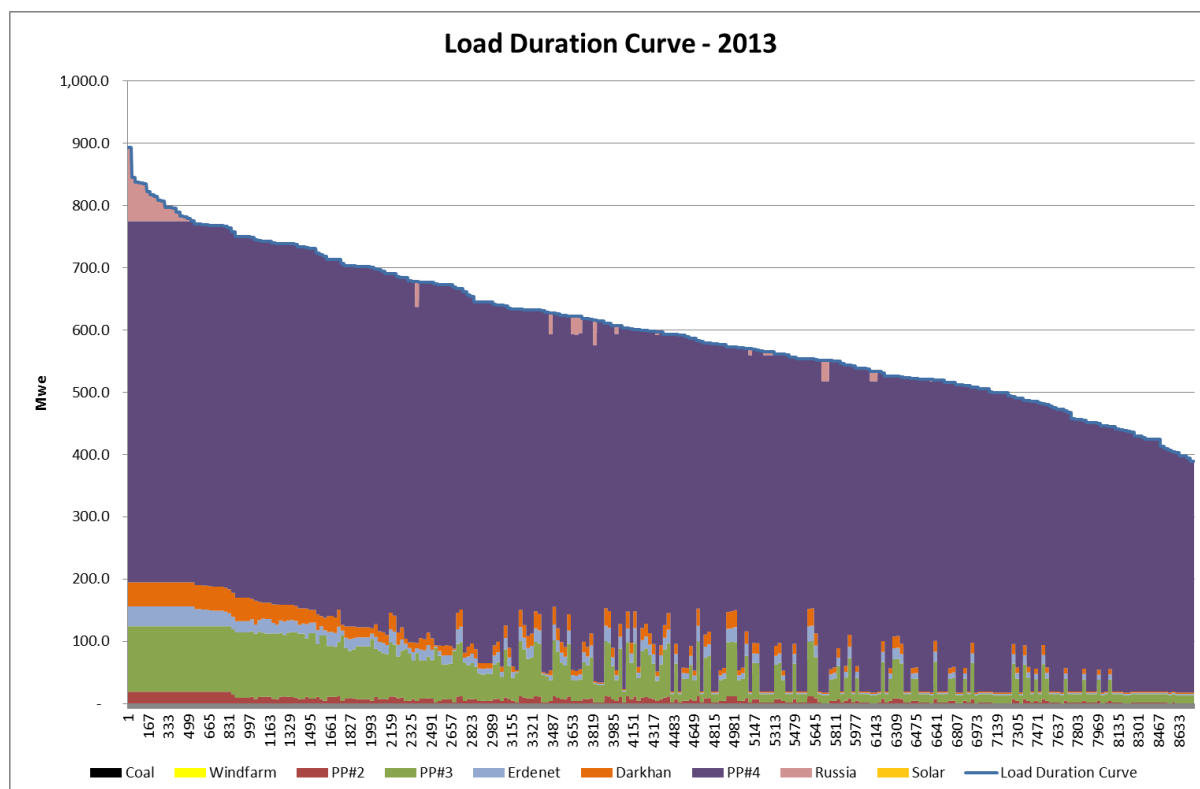


Chart 2: CES Load Dispatch Curve – 2014

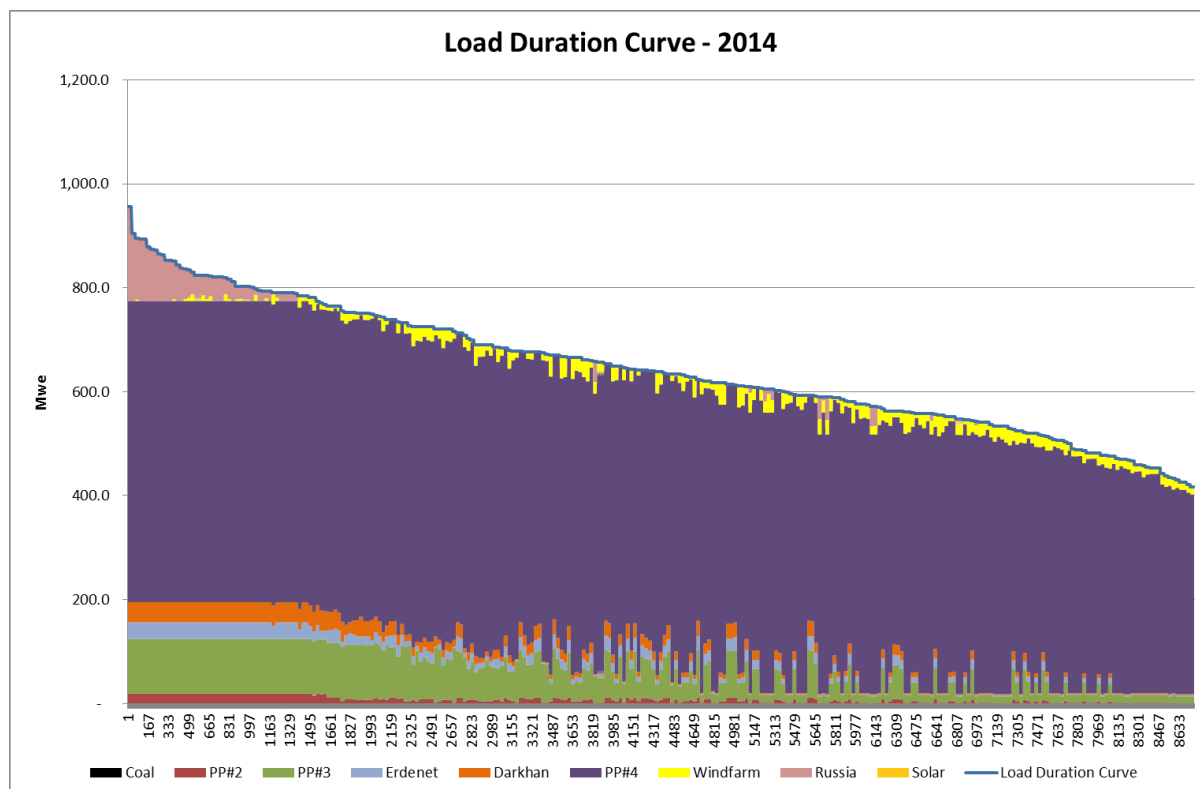


Chart 3: CES Load Dispatch Curve – 2015

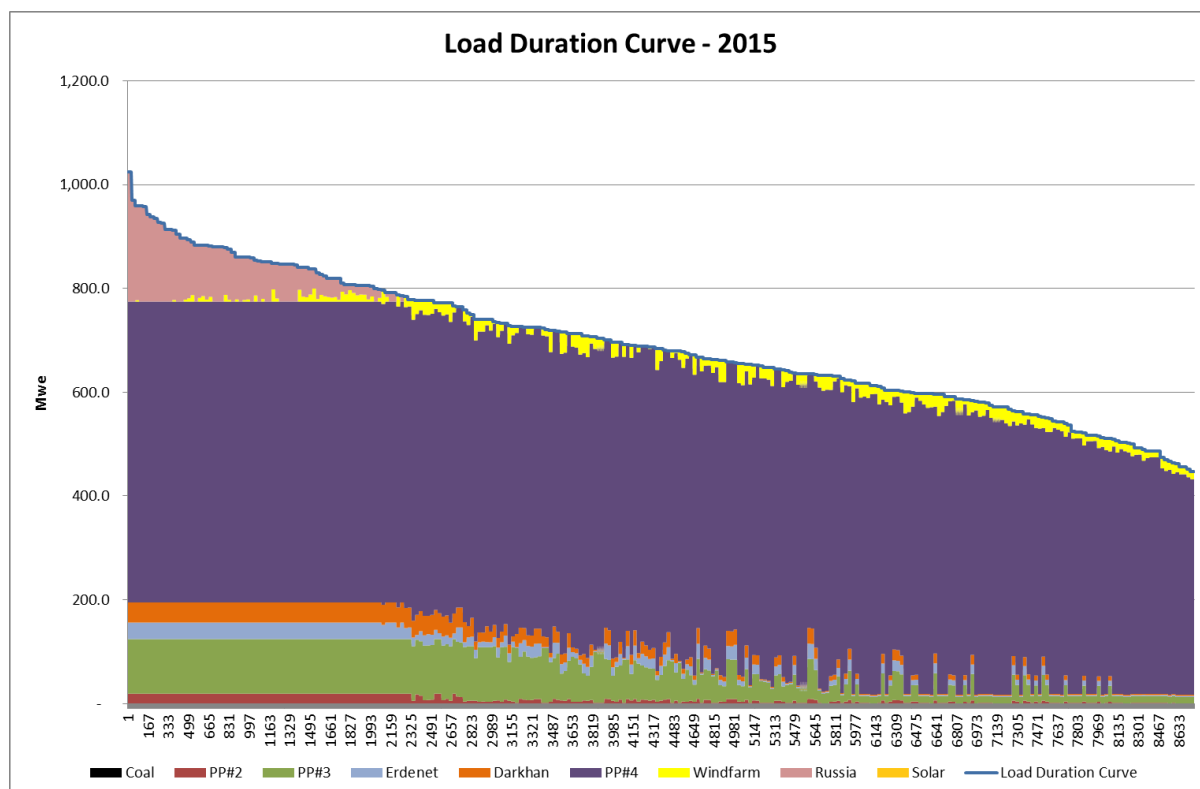


Chart 4: CES Load Dispatch Curve – 2016

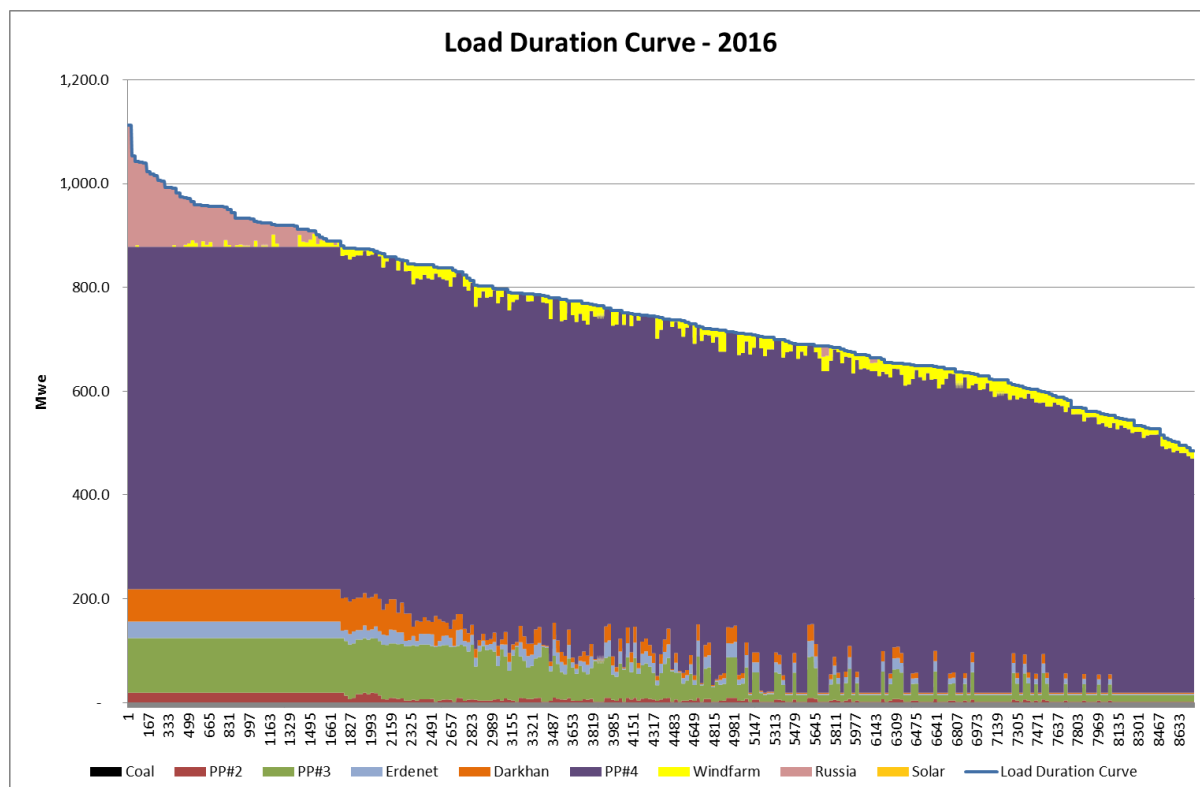


Chart 5: CES Load Dispatch Curve – 2017

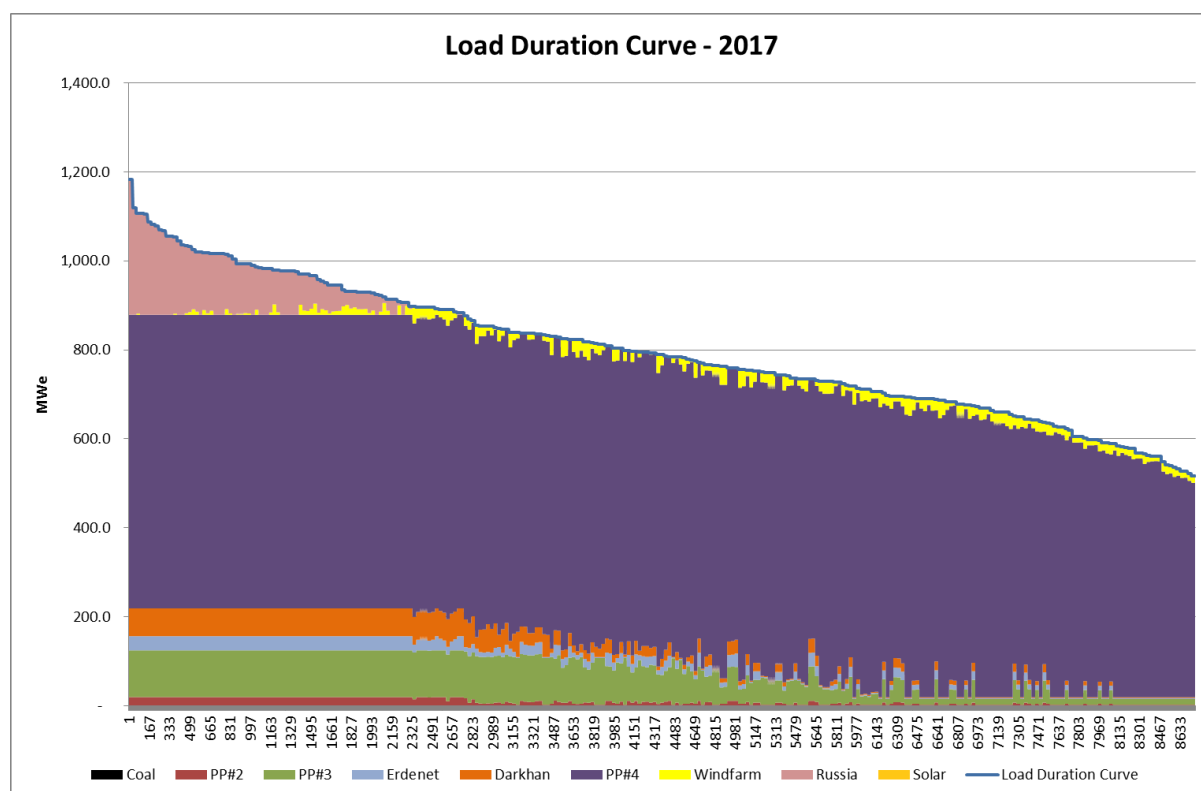


Chart 6: CES Load Dispatch Curve – 2018

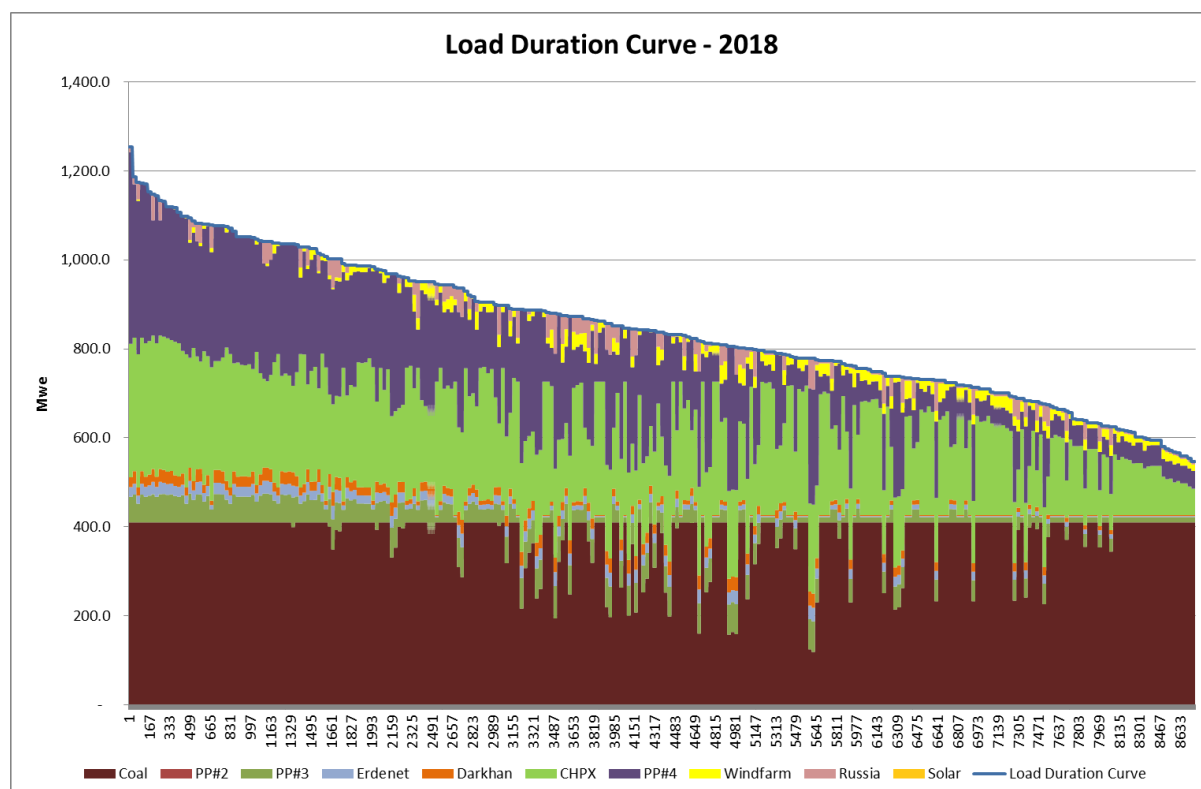


Chart 7: CES Load Dispatch Curve - 2019

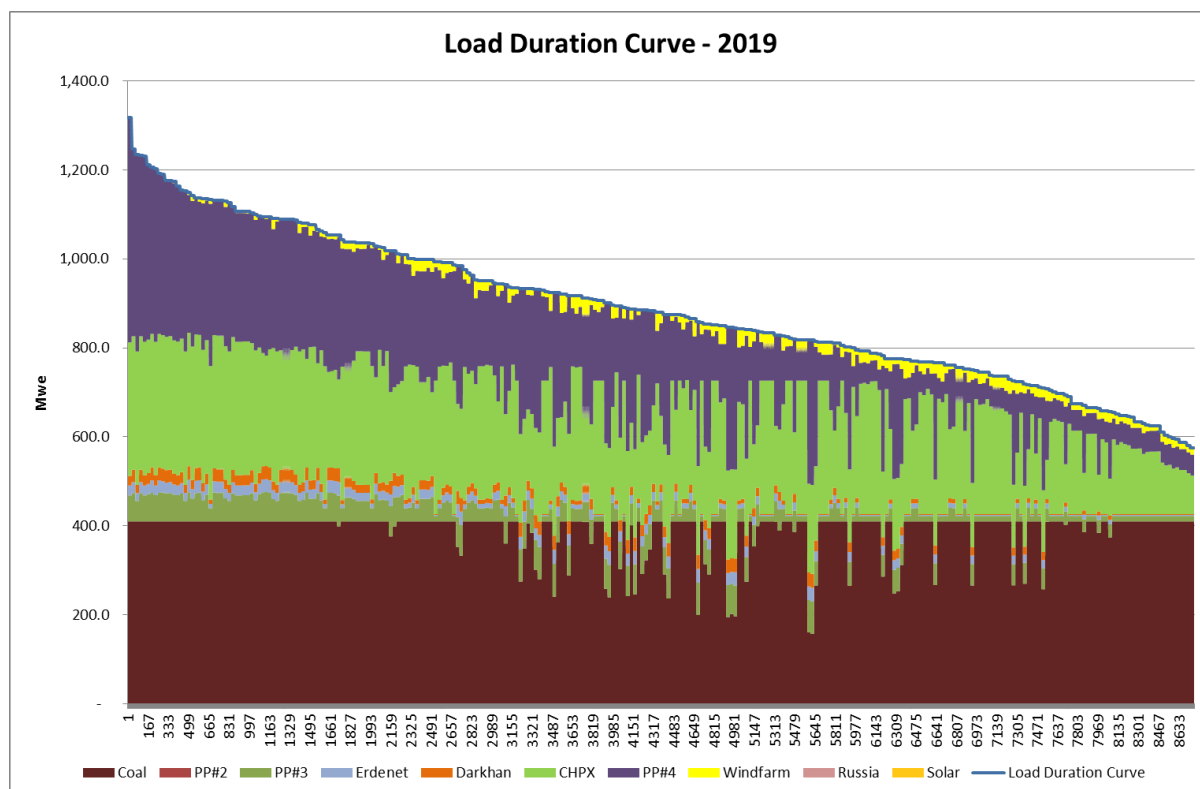


Chart 8: CES Load Dispatch Curve – 2020

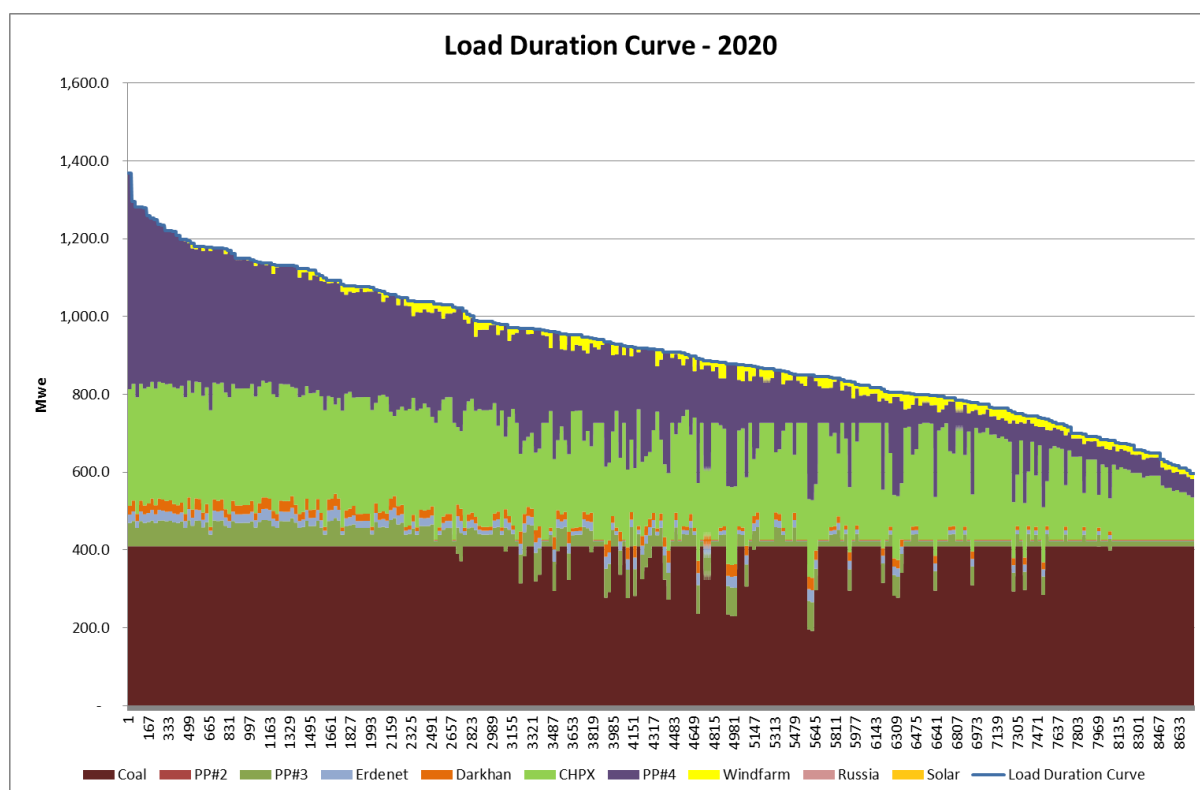


Chart 9: CES Load Dispatch Curve - 2021

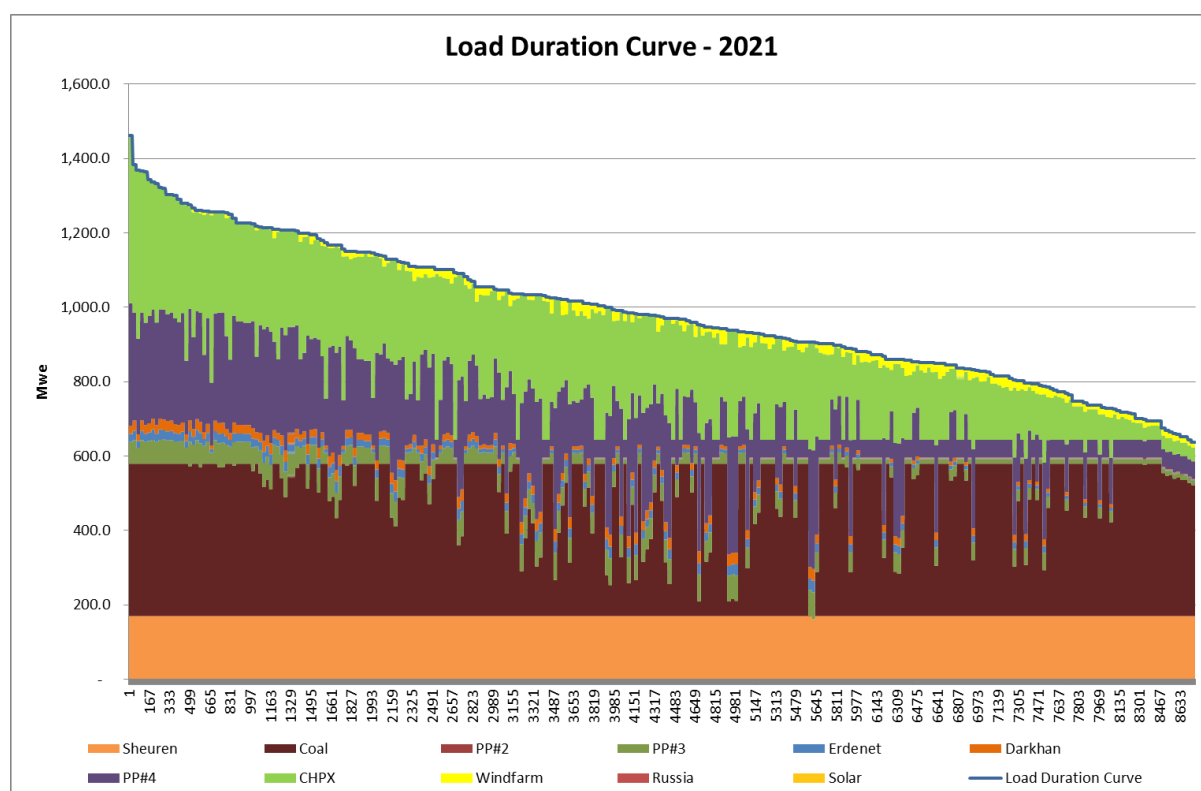


Chart 10: CES Load Dispatch Curve – 2022

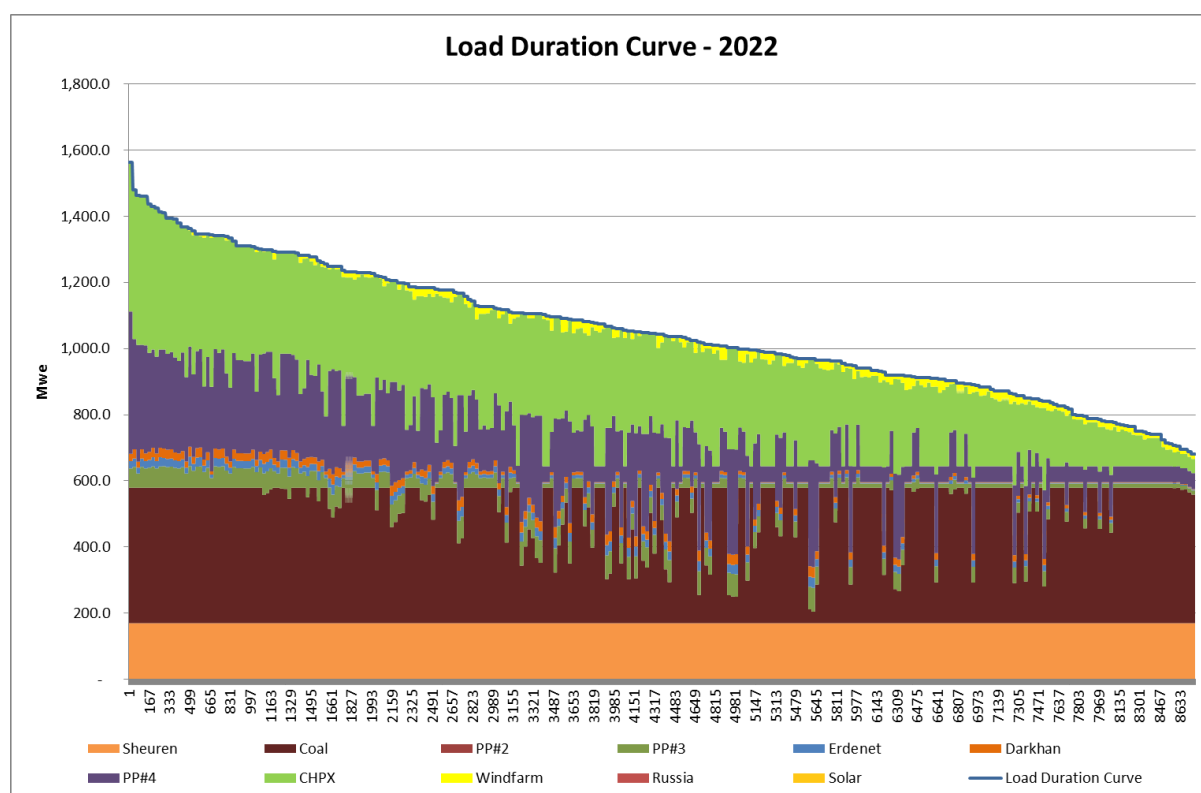


Chart 11: CES Load Dispatch Curve - 2023

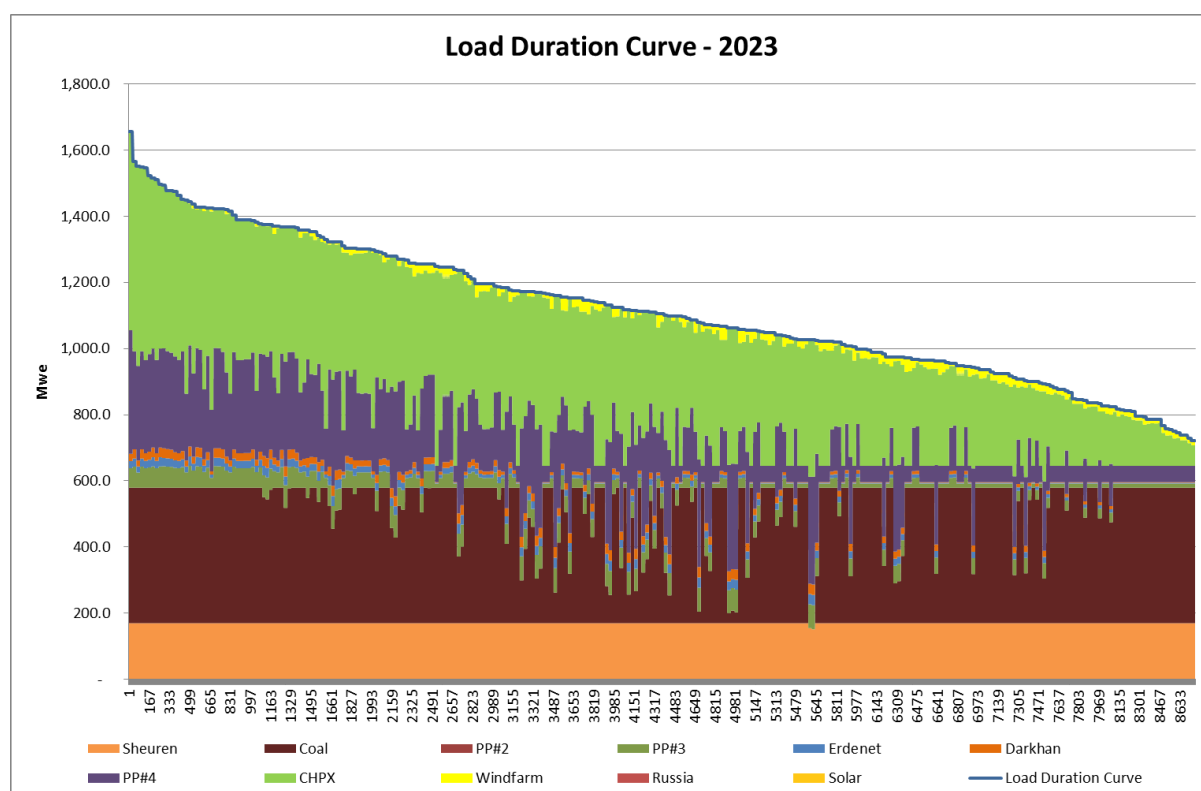


Chart 12: CES Load Dispatch Curve – 2024

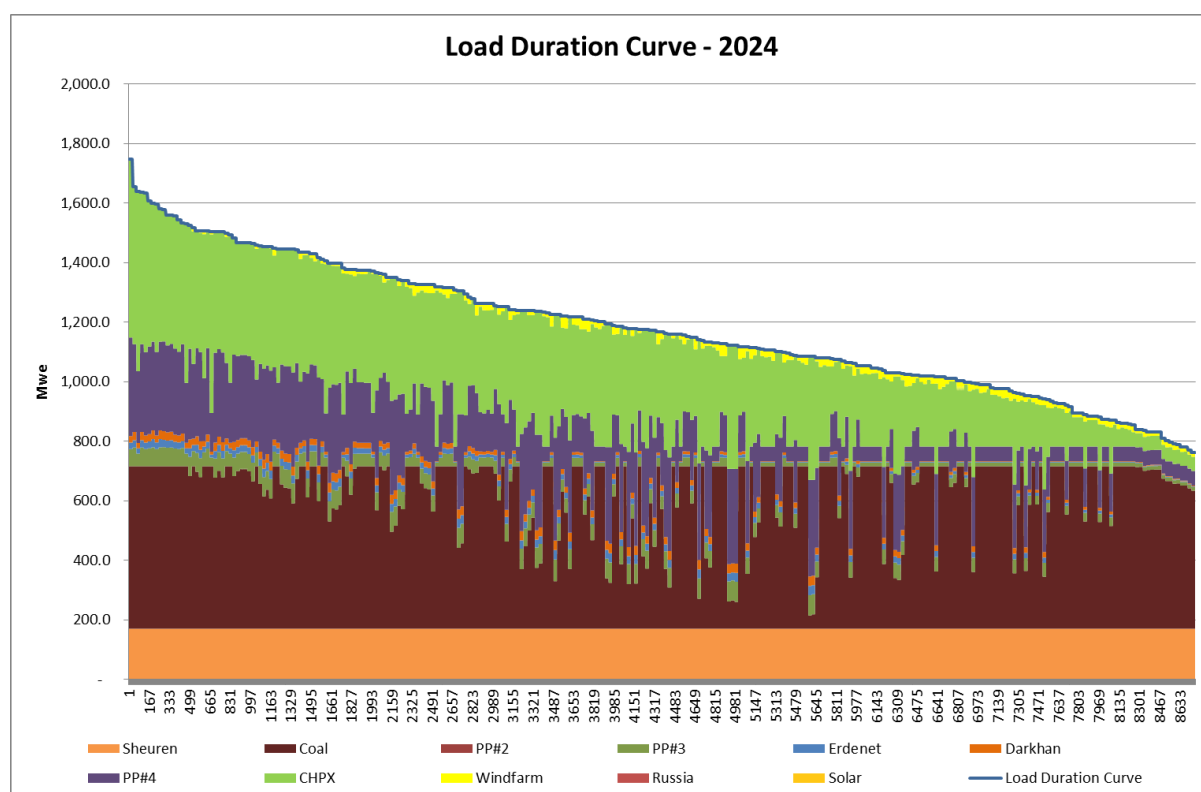
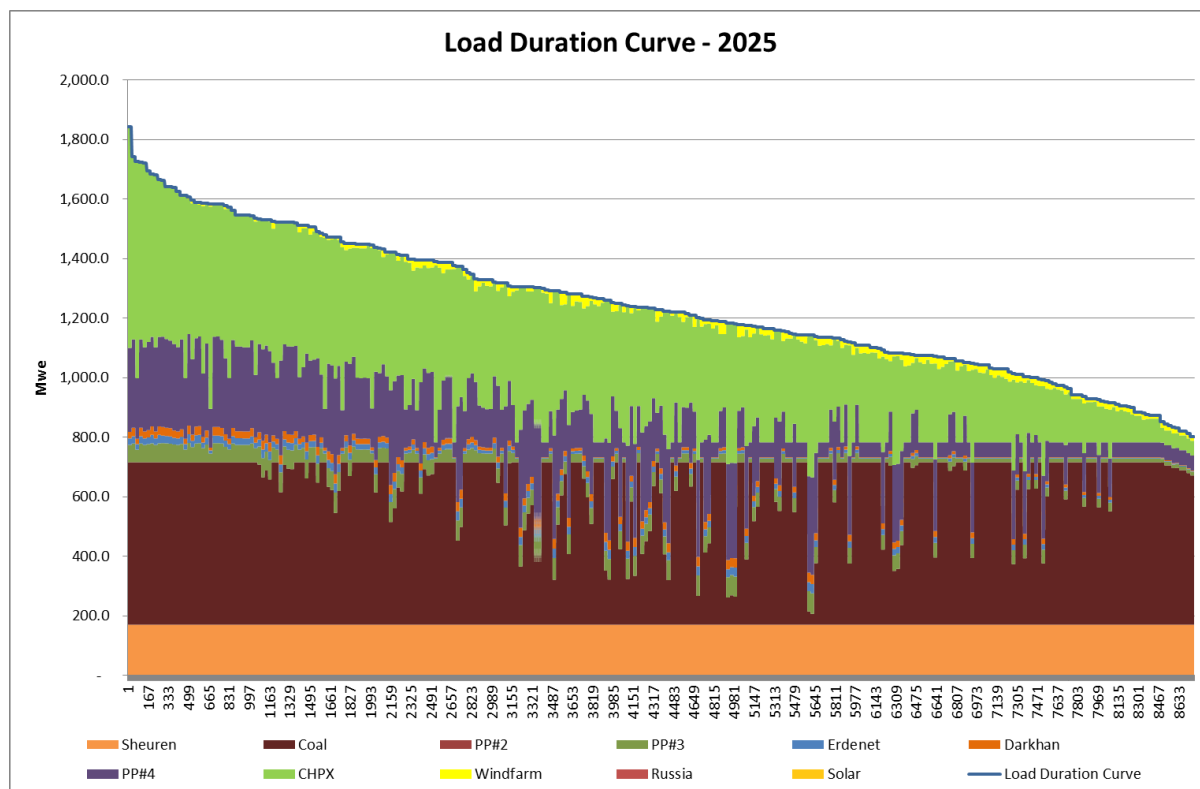


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX K: ELECTRICITY DISPATCH CURVES – Scenario 2C

Chart 1: CES Load Dispatch Curve - 2013

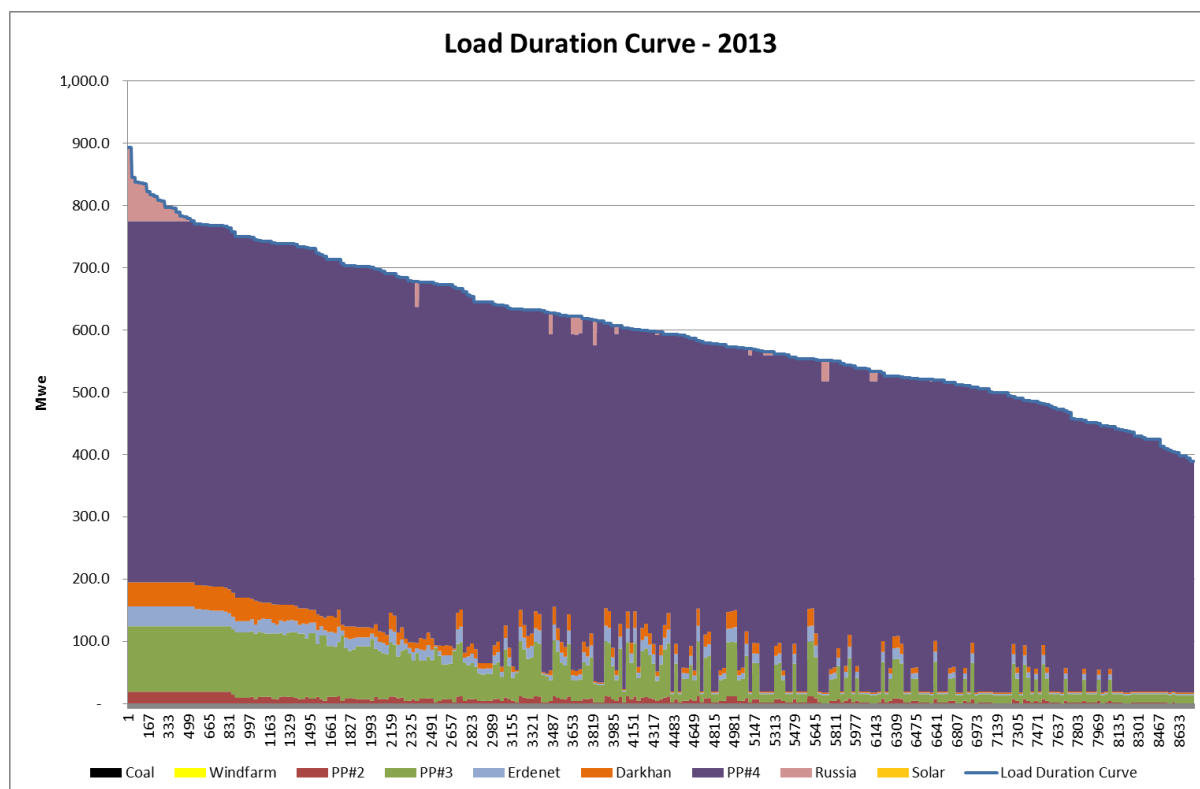


Chart 2: CES Load Dispatch Curve – 2014

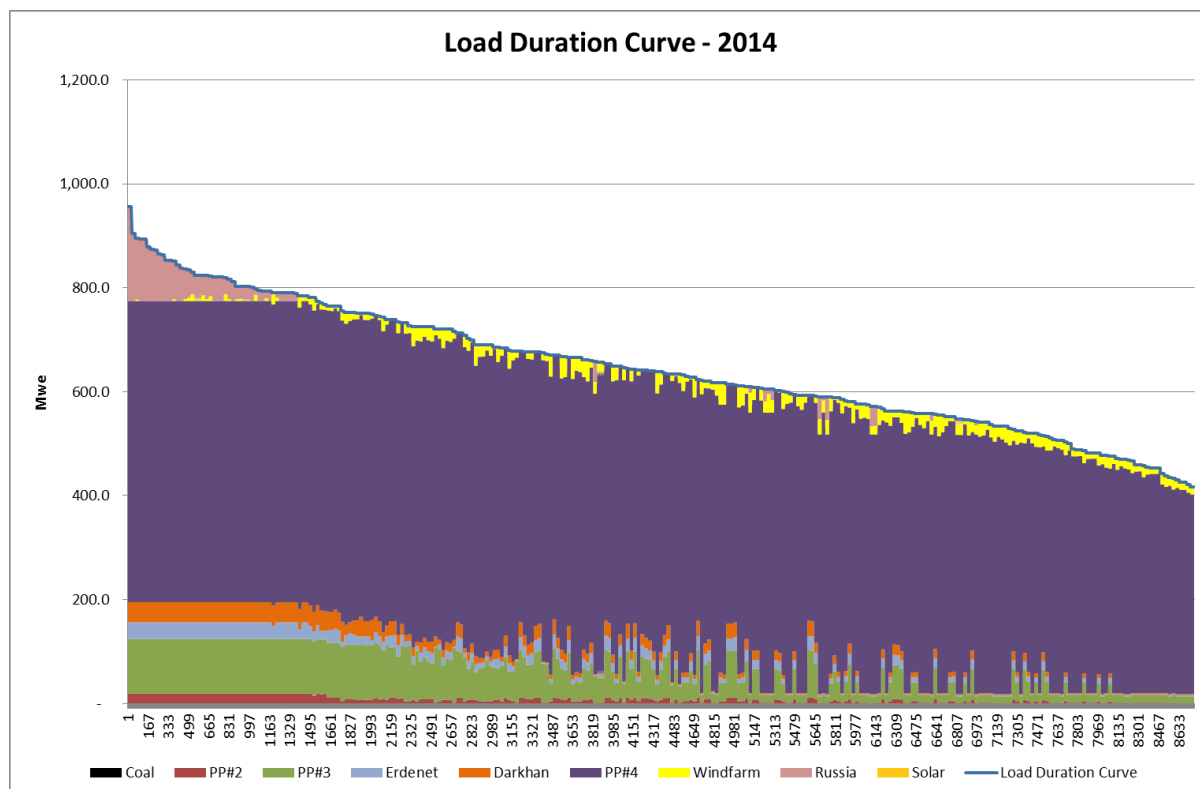


Chart 3: CES Load Dispatch Curve – 2015

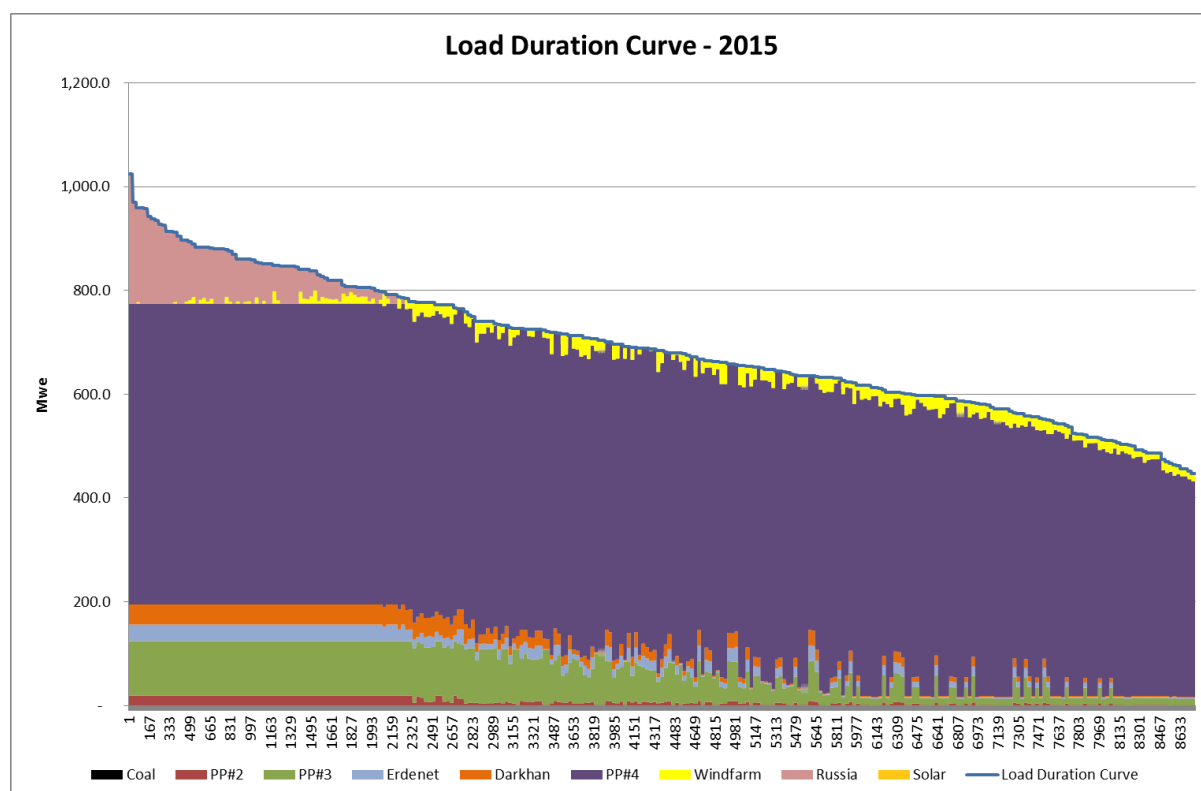


Chart 4: CES Load Dispatch Curve – 2016

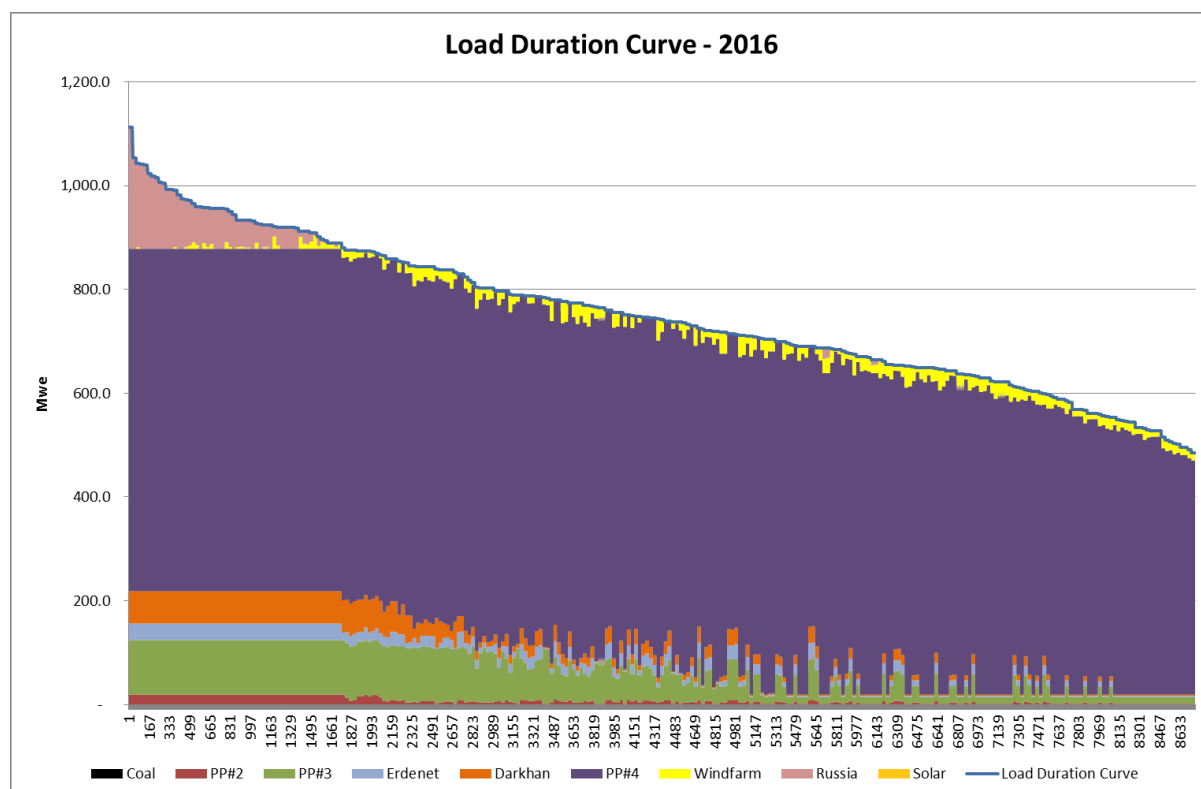


Chart 5: CES Load Dispatch Curve – 2017

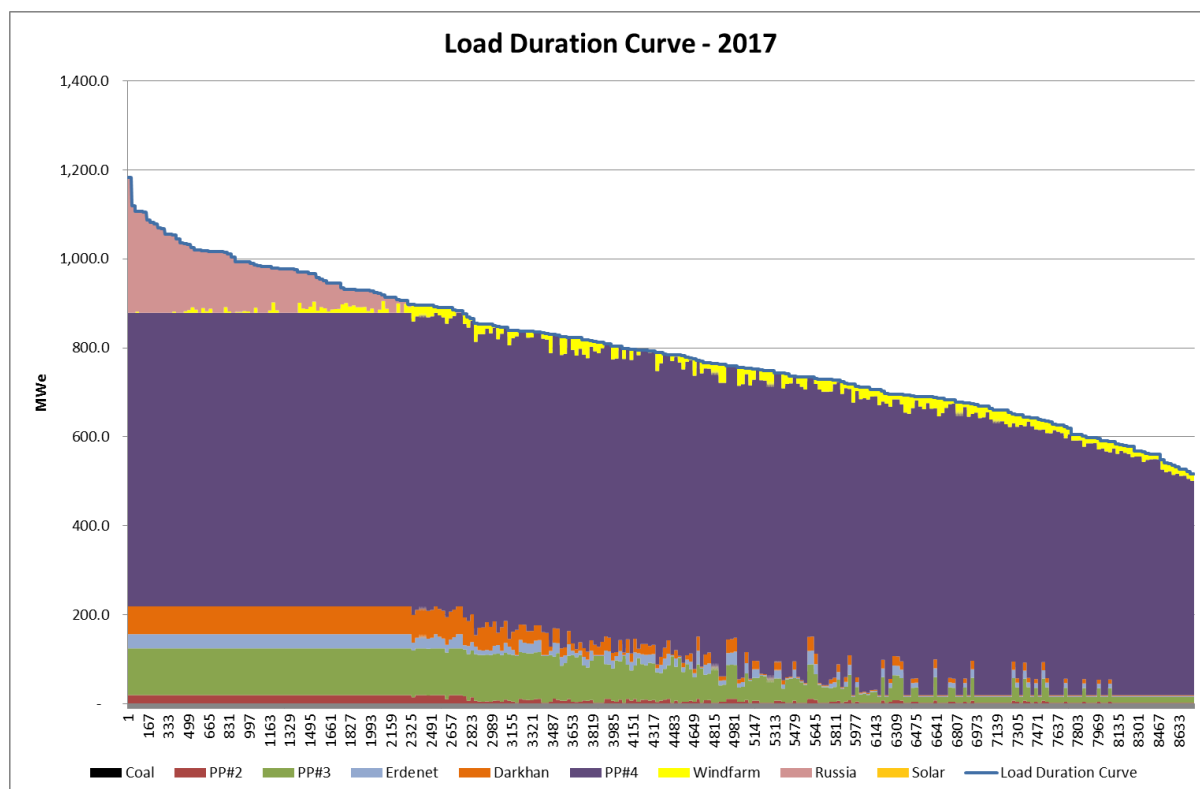


Chart 6: CES Load Dispatch Curve – 2018

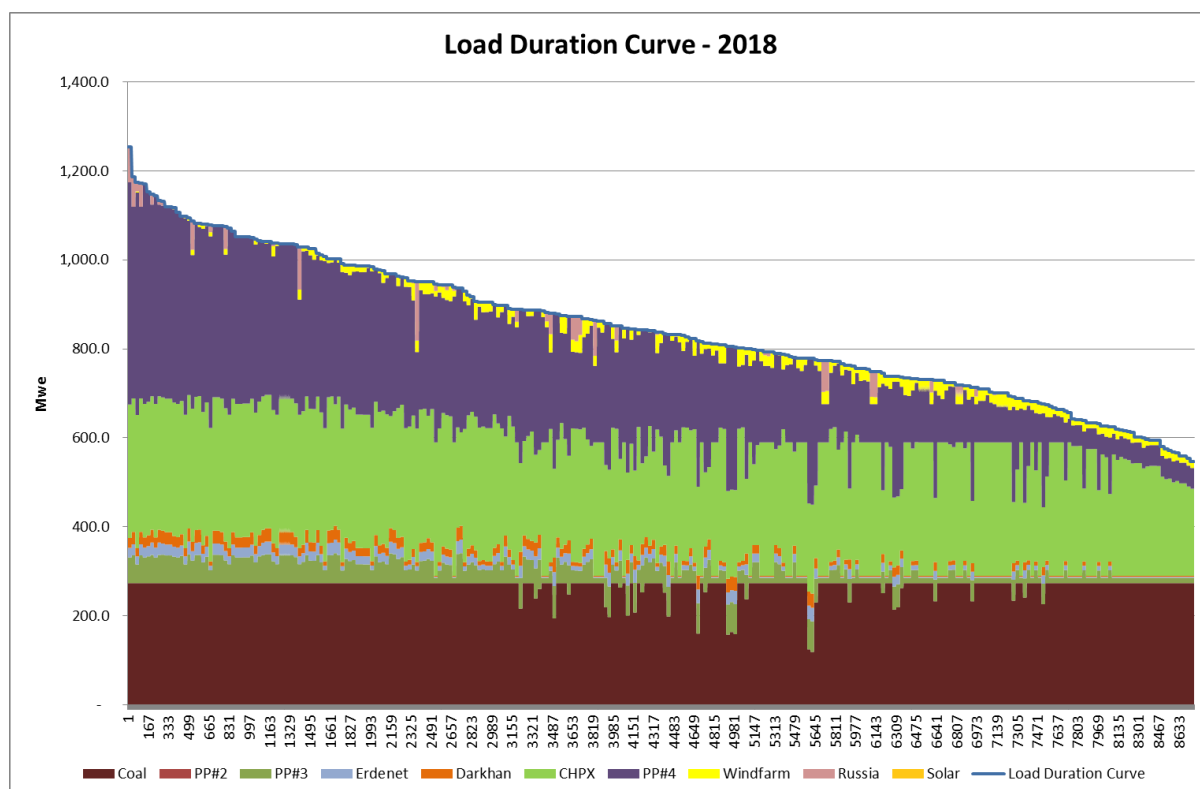


Chart 7: CES Load Dispatch Curve - 2019

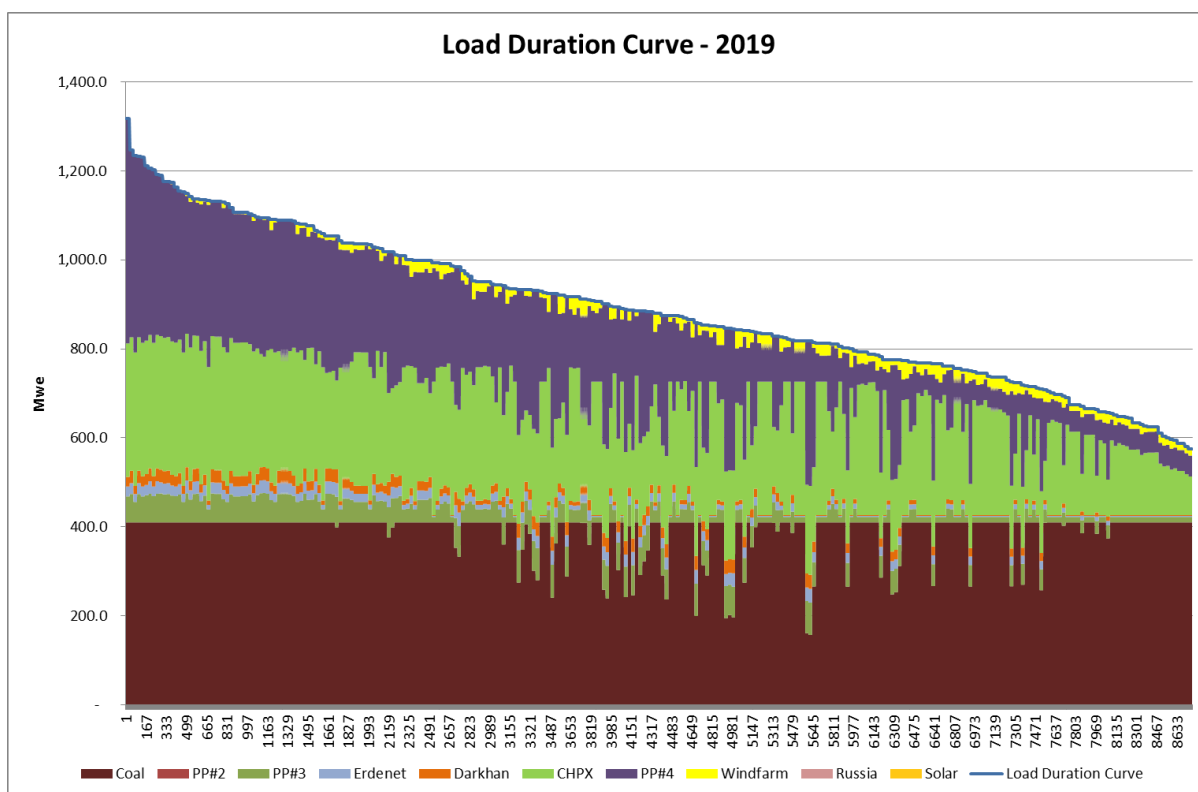


Chart 8: CES Load Dispatch Curve – 2020

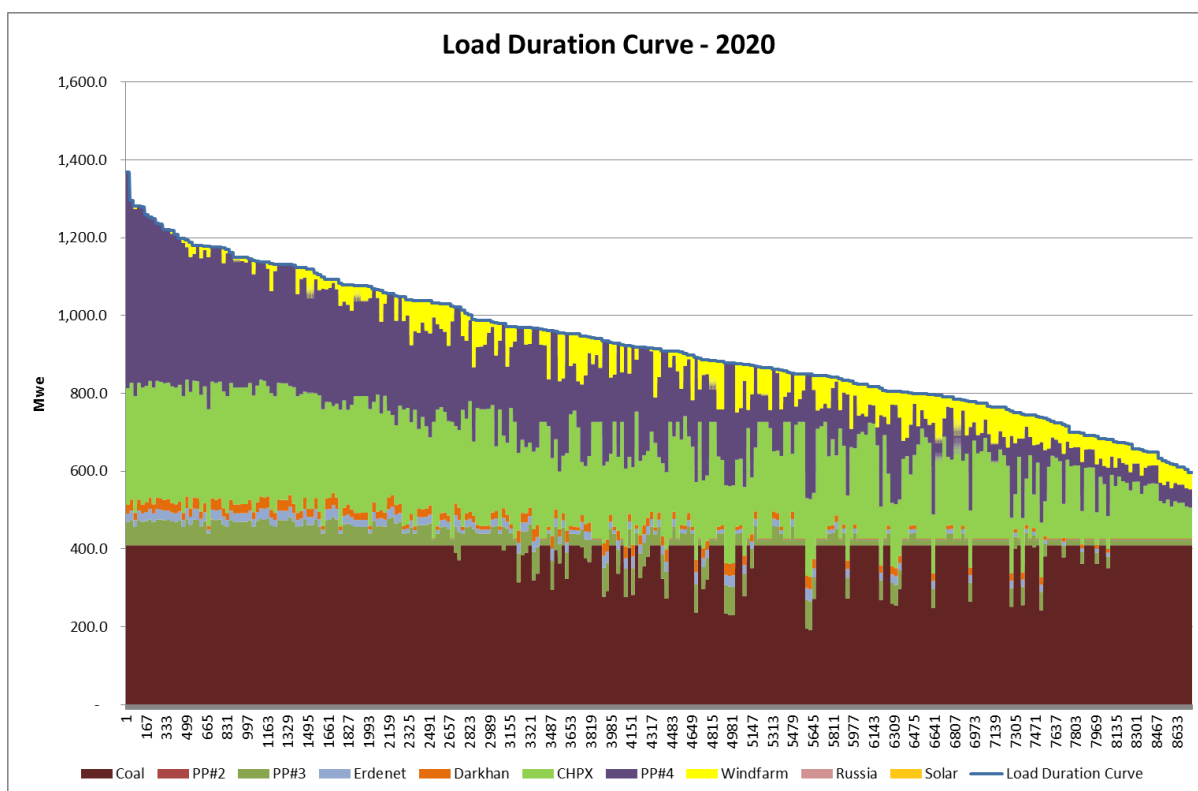


Chart 9: CES Load Dispatch Curve - 2021

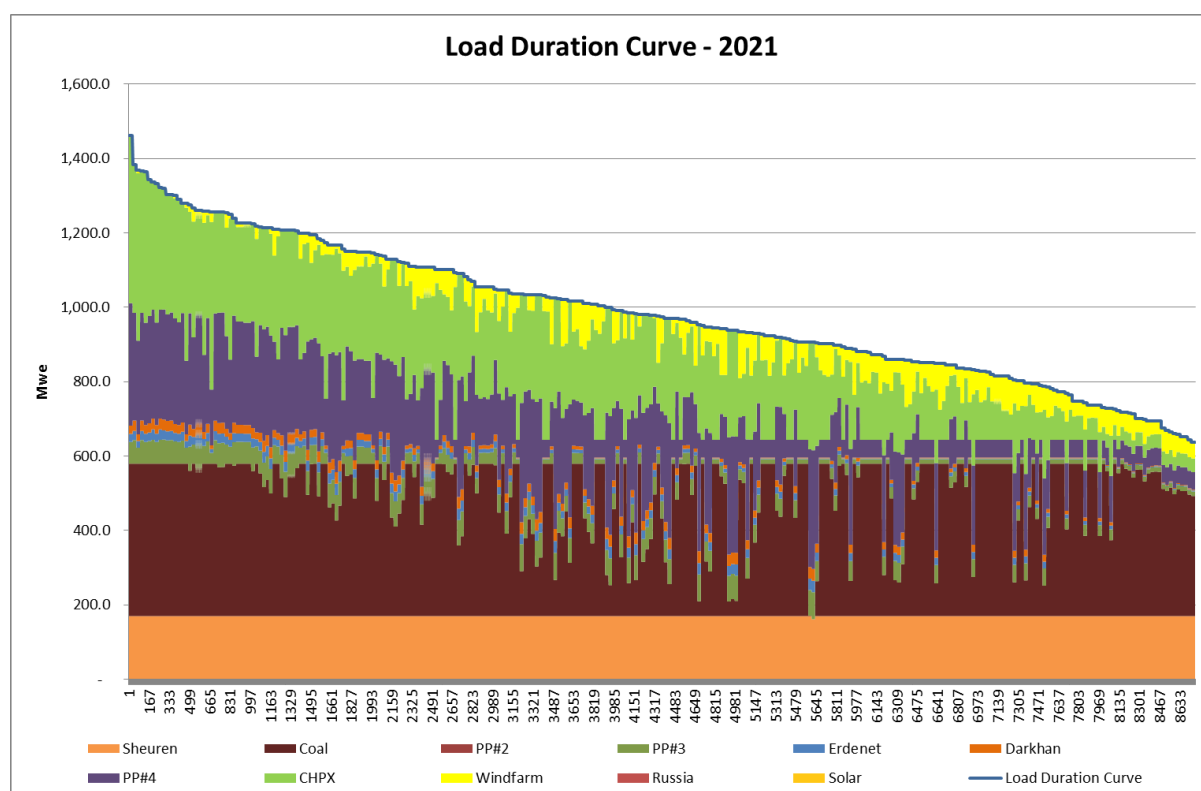


Chart 10: CES Load Dispatch Curve – 2022

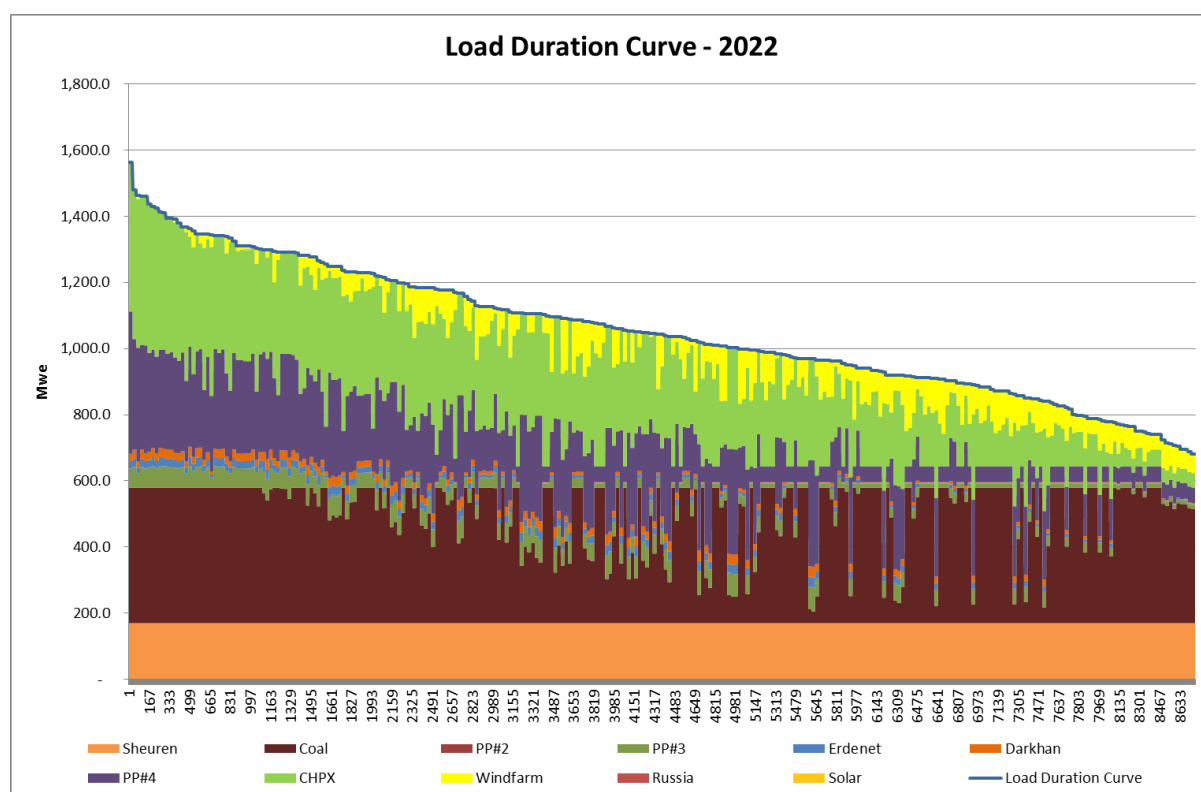


Chart 11: CES Load Dispatch Curve - 2023

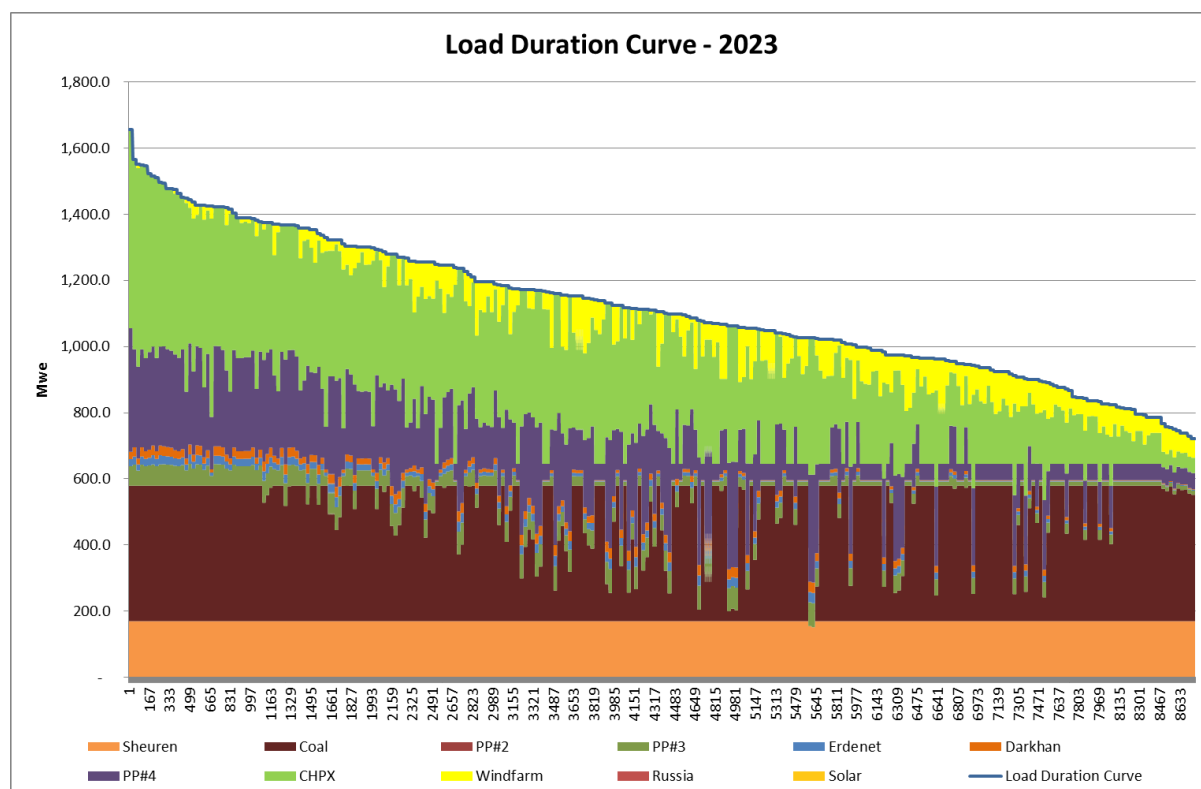


Chart 12: CES Load Dispatch Curve – 2024

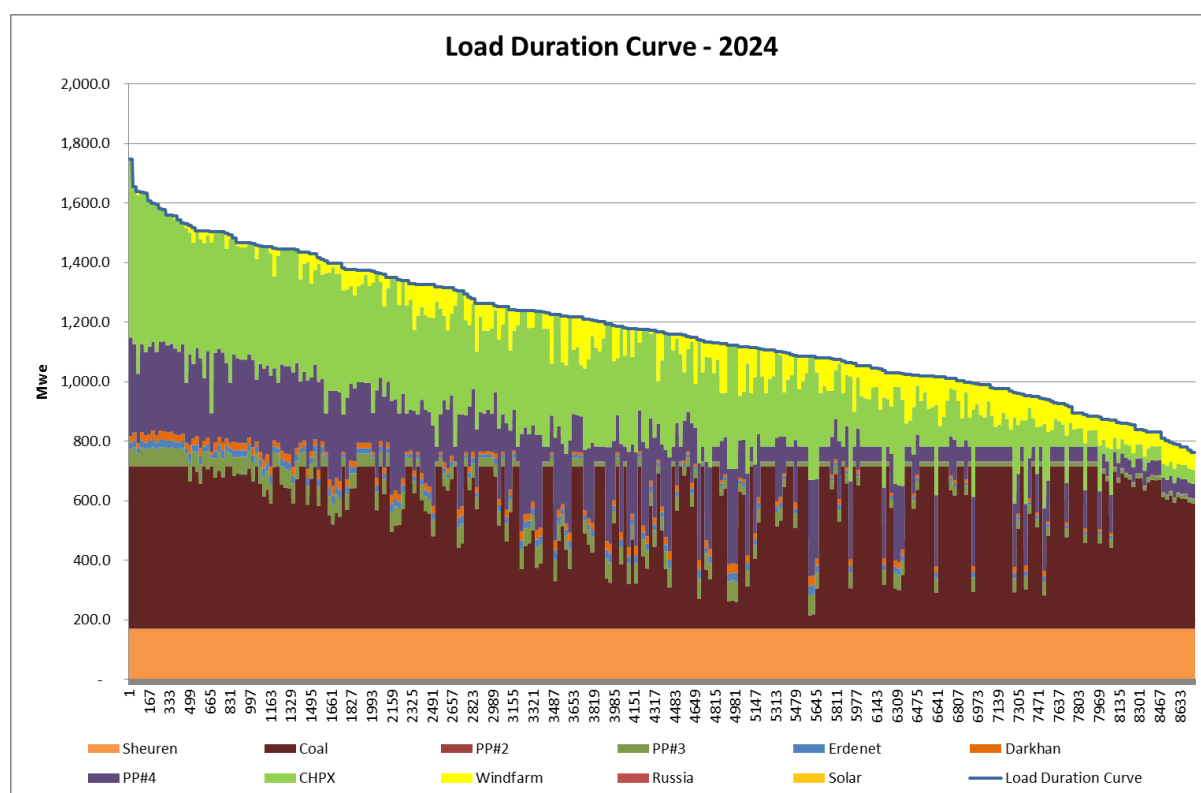
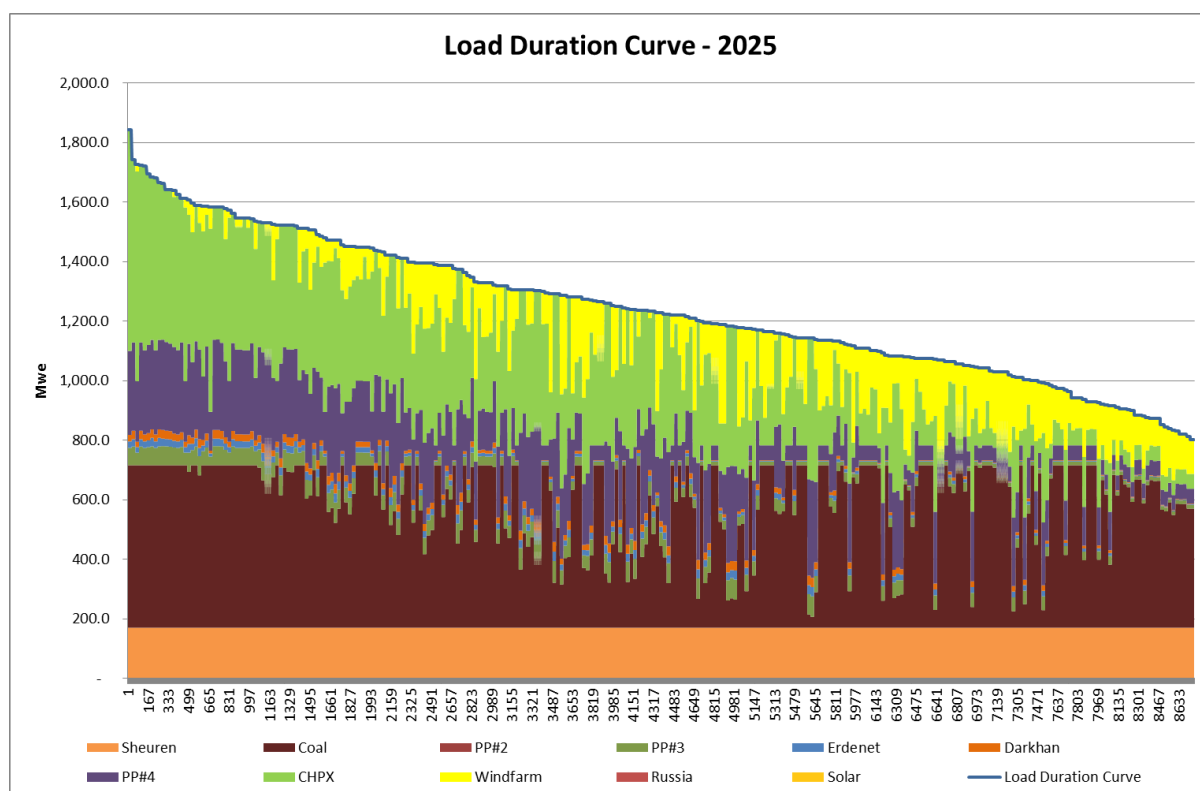


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX L: ELECTRICITY DISPATCH CURVES – Scenario 2D

Chart 1: CES Load Dispatch Curve - 2013

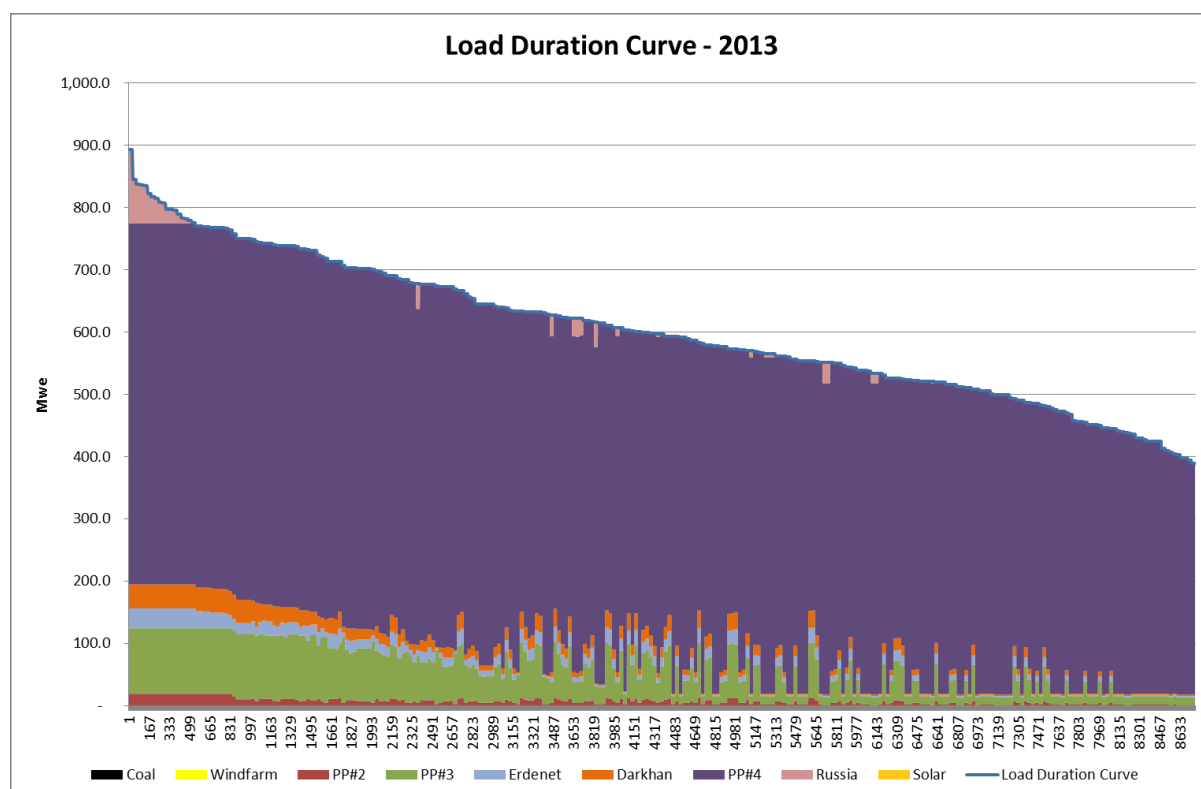


Chart 2: CES Load Dispatch Curve – 2014

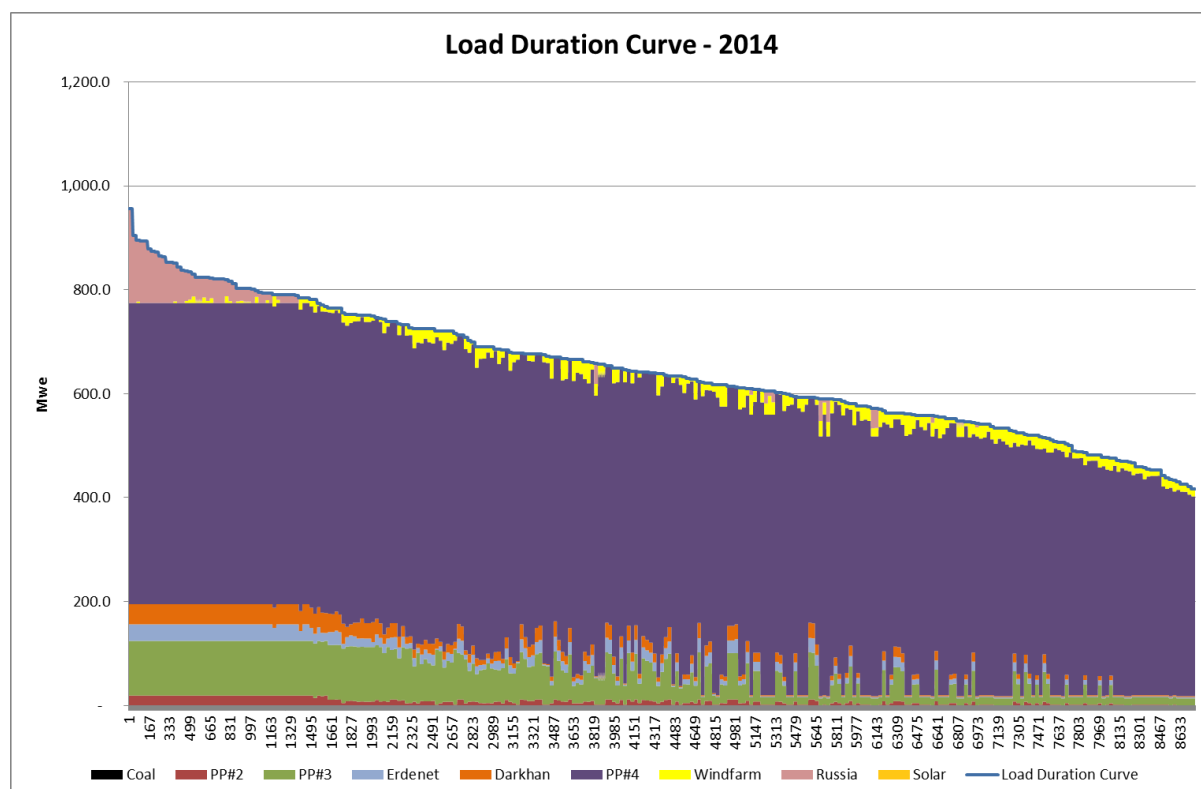


Chart 3: CES Load Dispatch Curve – 2015

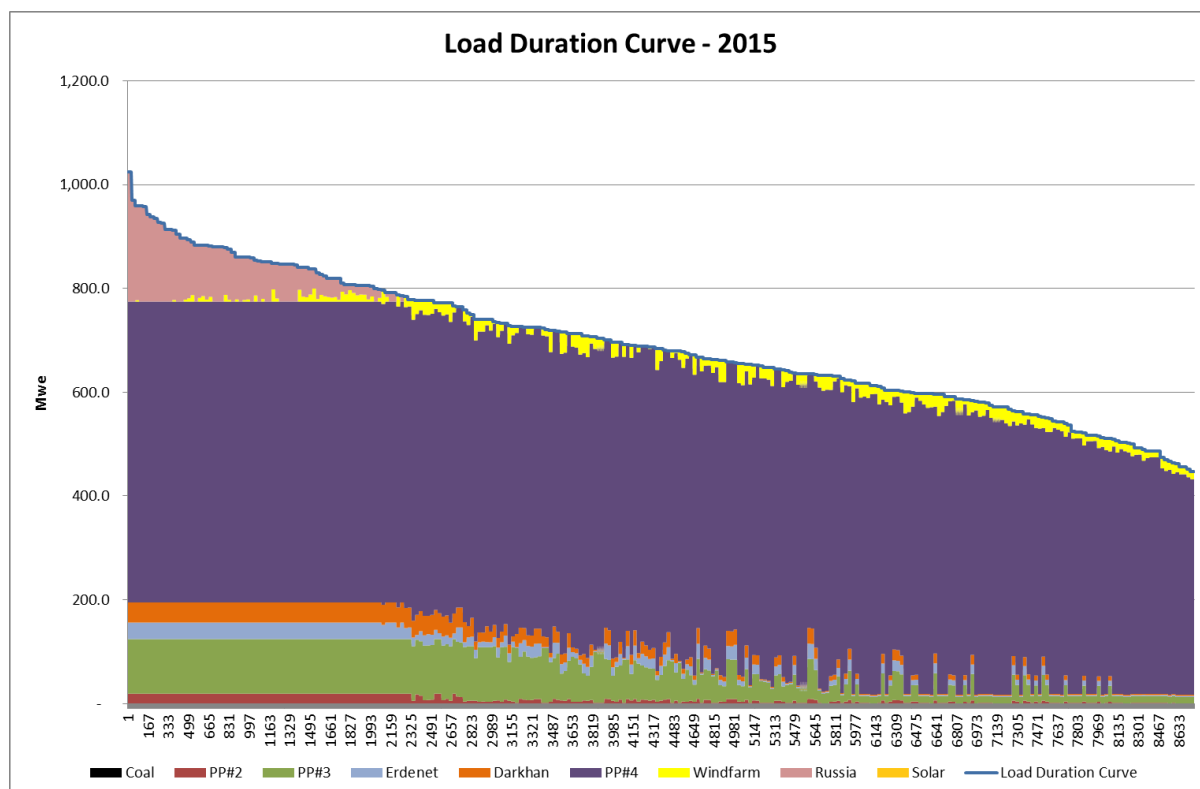


Chart 4: CES Load Dispatch Curve – 2016

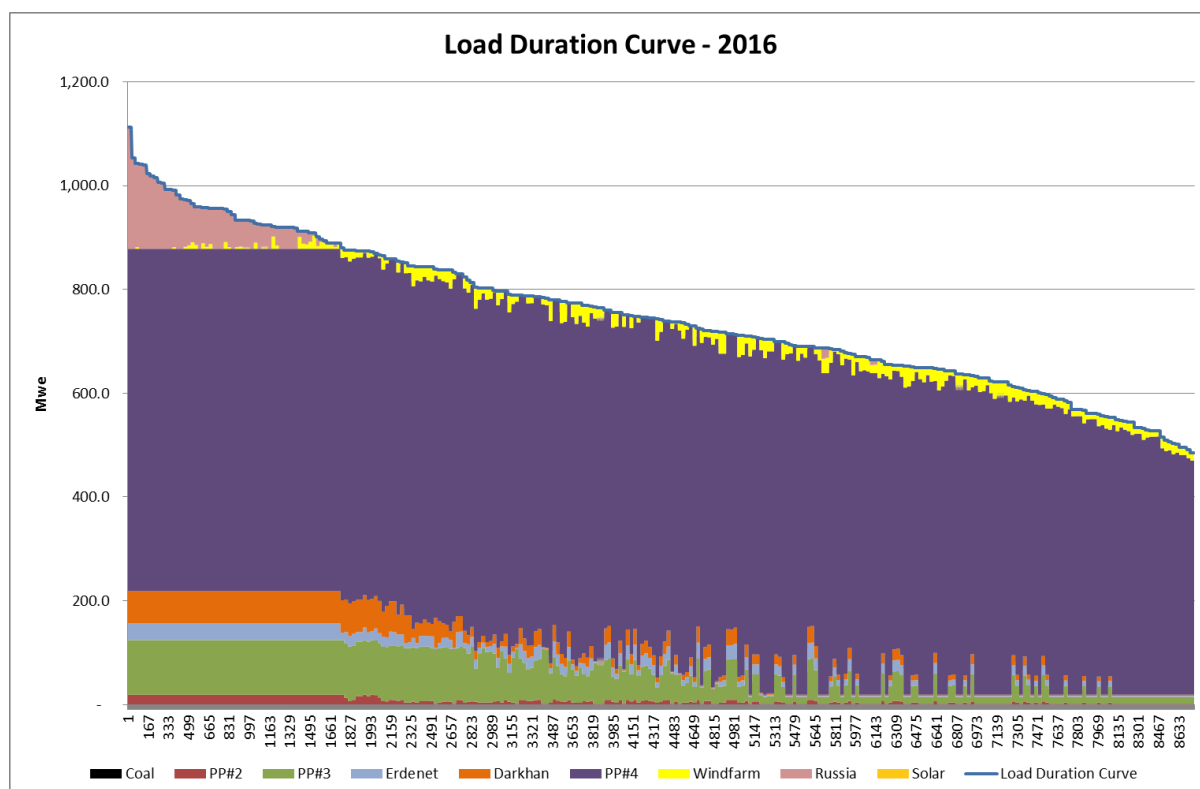


Chart 5: CES Load Dispatch Curve – 2017

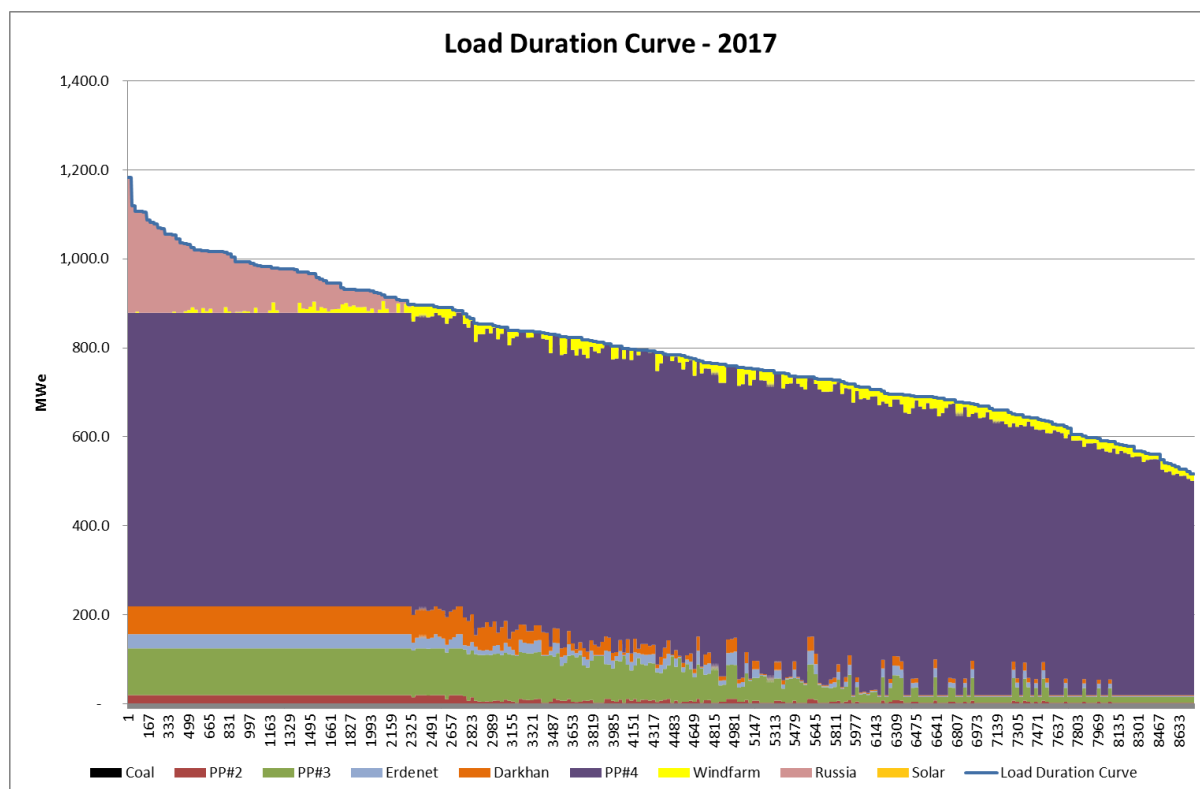


Chart 6: CES Load Dispatch Curve – 2018

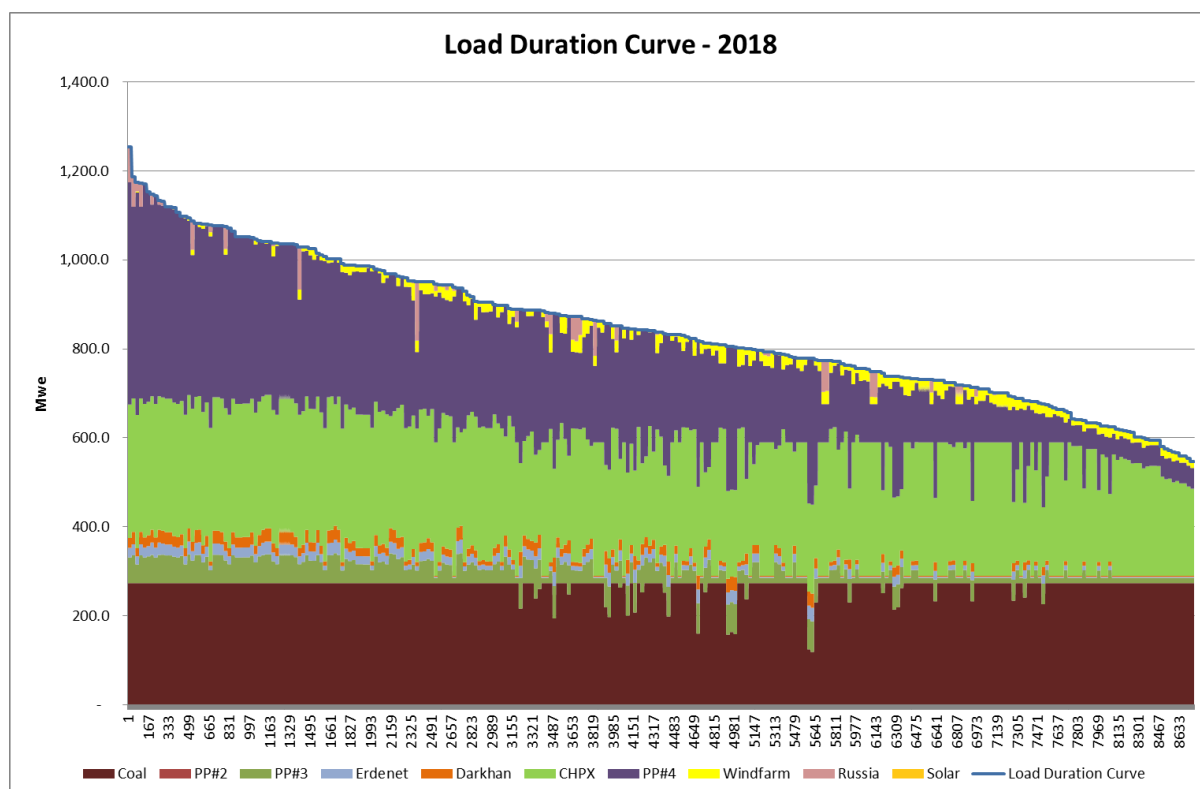


Chart 7: CES Load Dispatch Curve – 2019

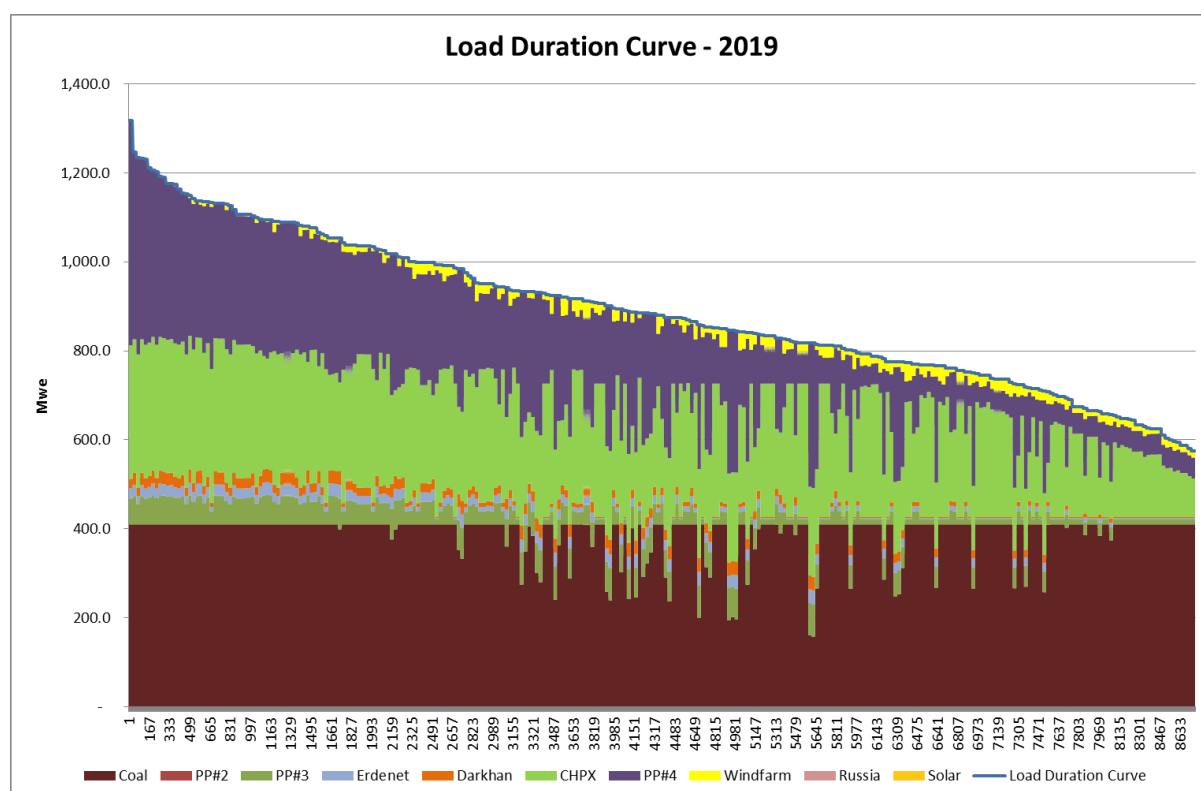


Chart 8: CES Load Dispatch Curve – 2020

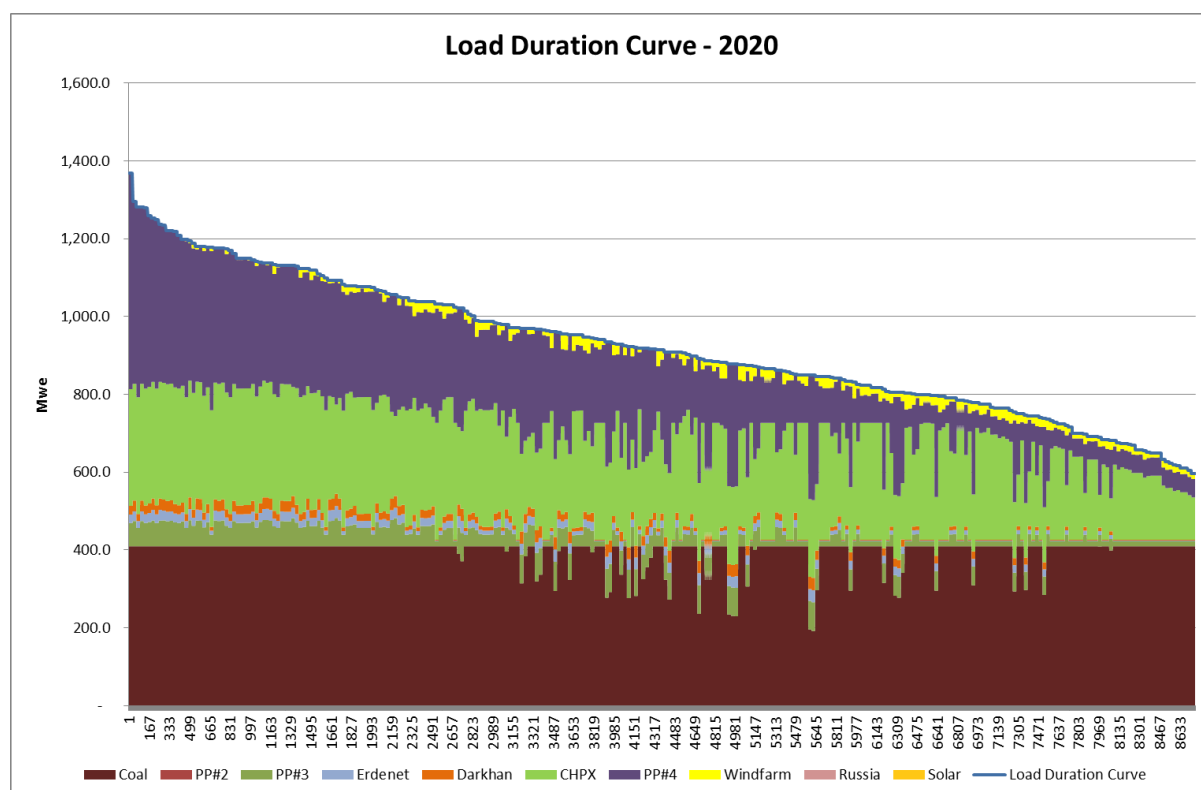


Chart 9: CES Load Dispatch Curve – 2021

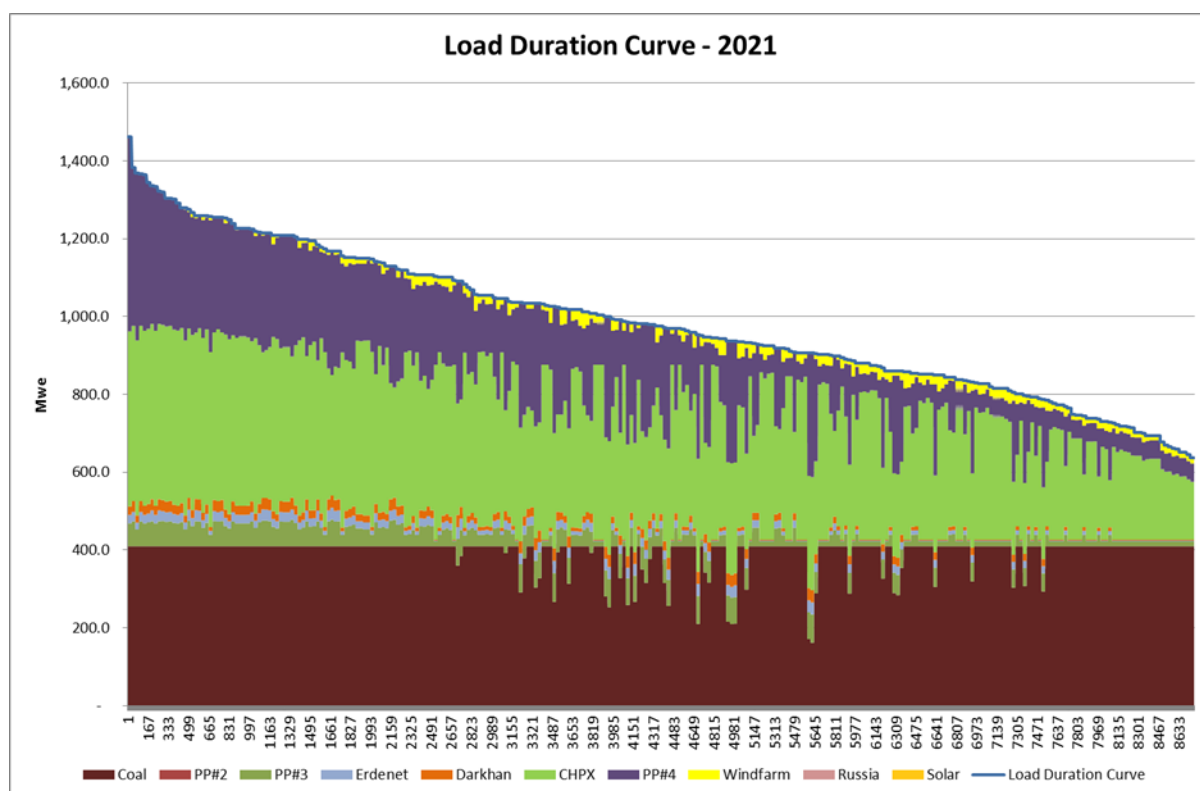


Chart 10: CES Load Dispatch Curve – 2022

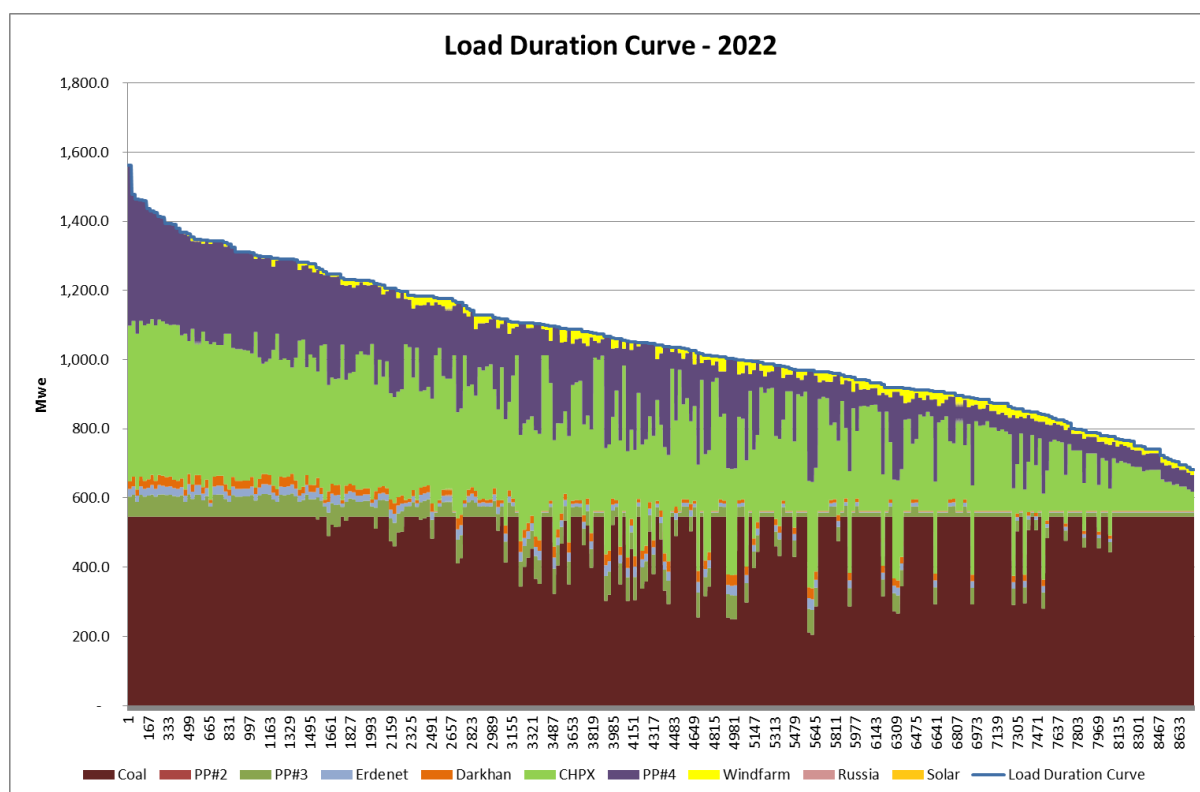


Chart 11: CES Load Dispatch Curve – 2023

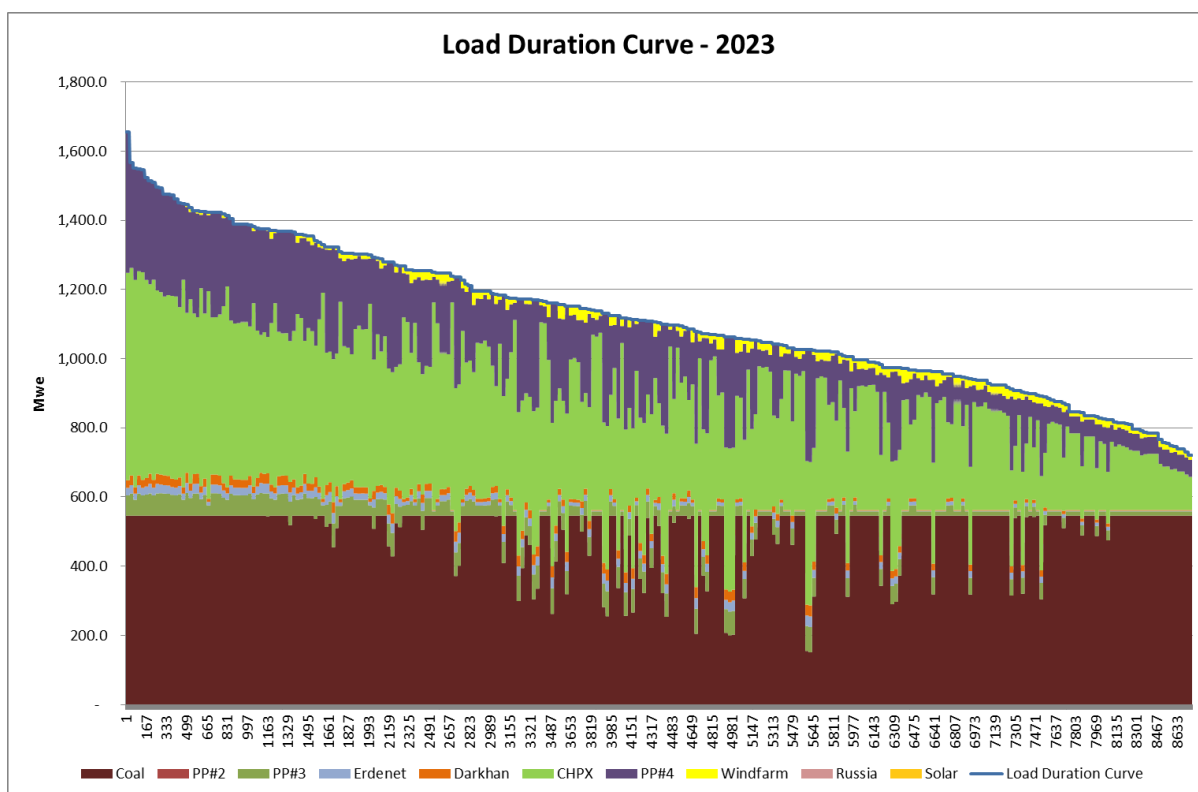


Chart 12: CES Load Dispatch Curve – 2024

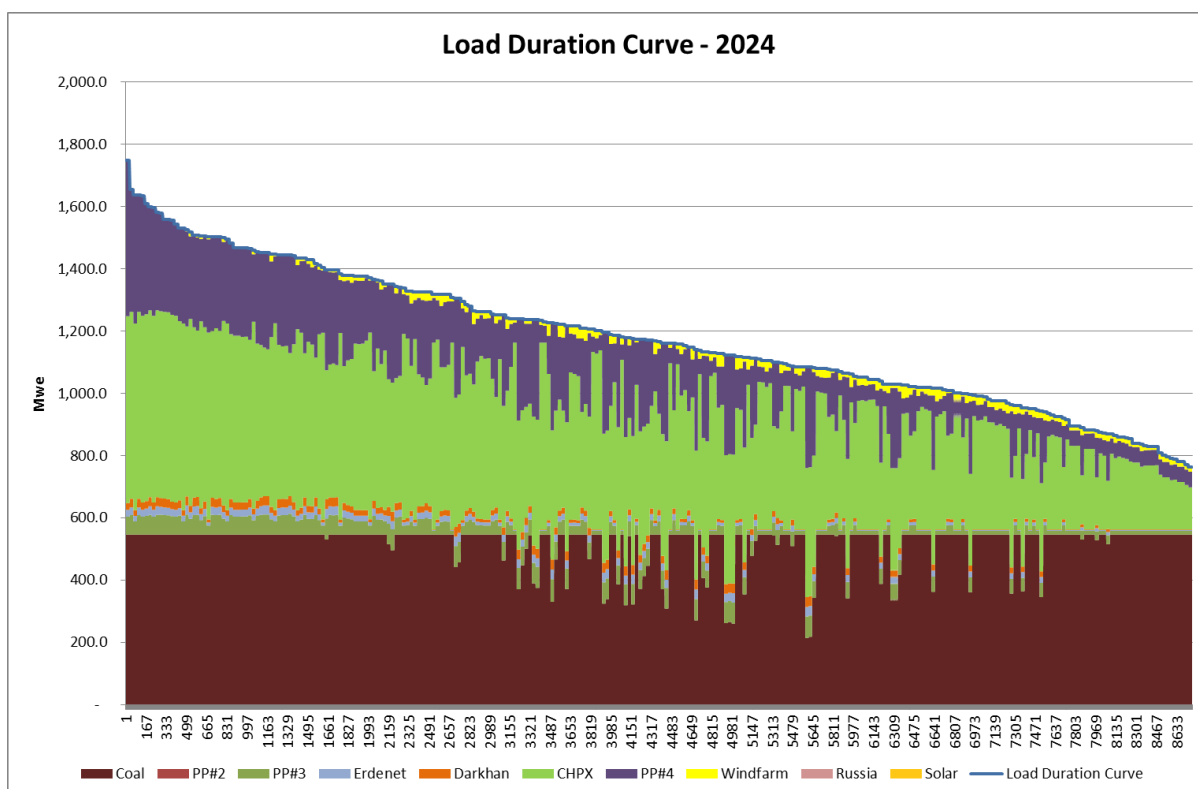
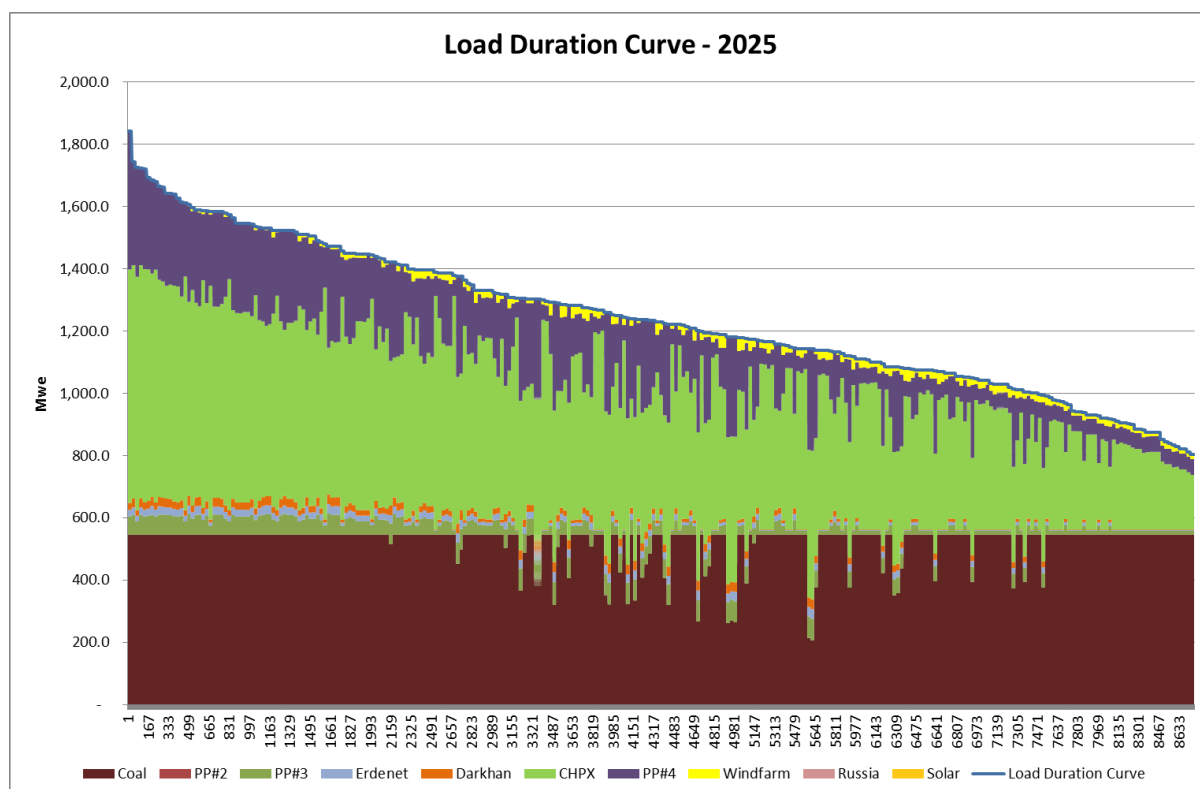


Chart 13: CES Load Dispatch Curve – 2025



APPENDIX M: ELECTRICITY DISPATCH CURVES – Scenario 3A

Chart 1: CES Load Dispatch Curve - 2013

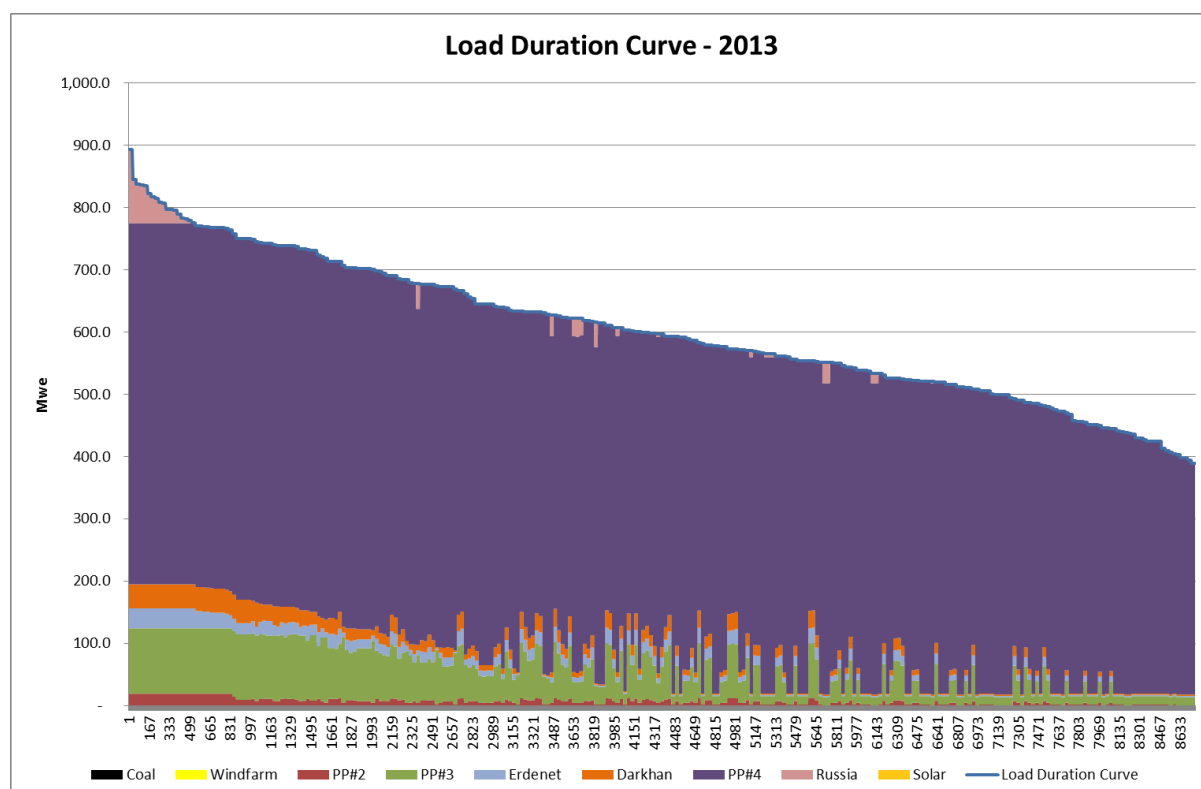


Chart 2: CES Load Dispatch Curve – 2014

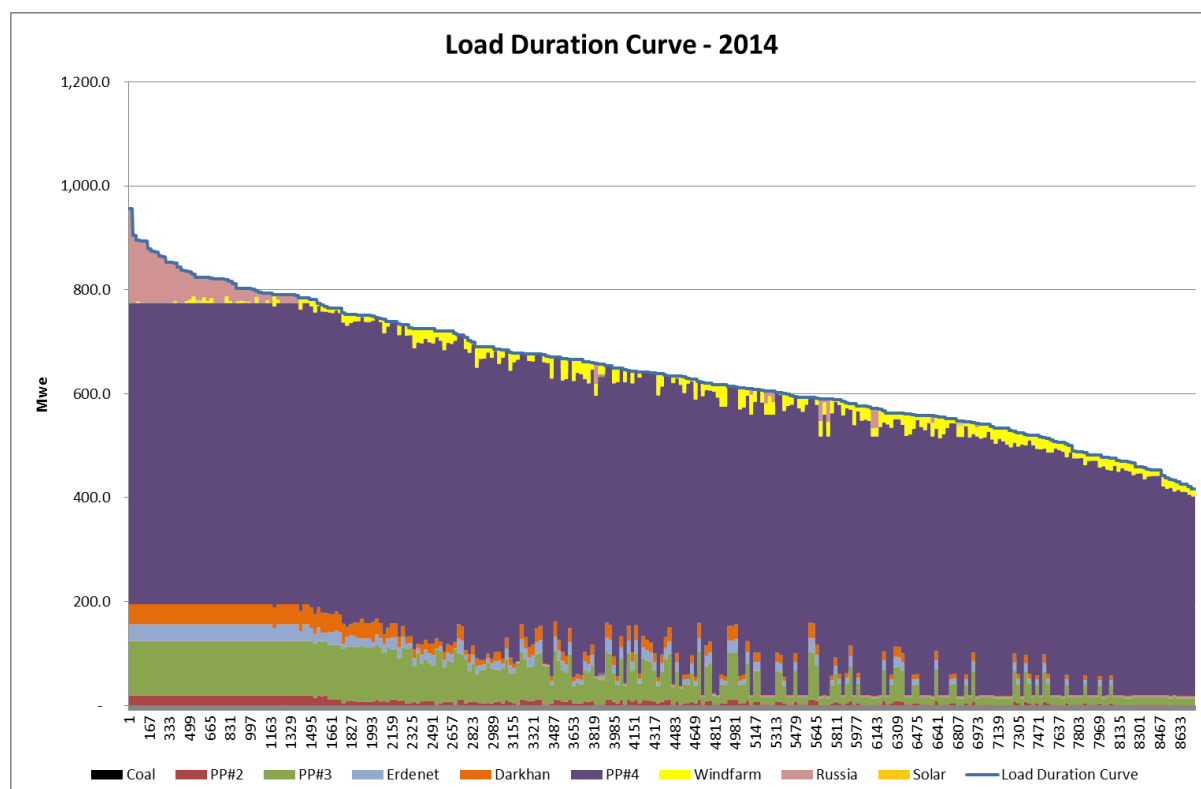


Chart 3: CES Load Dispatch Curve – 2015

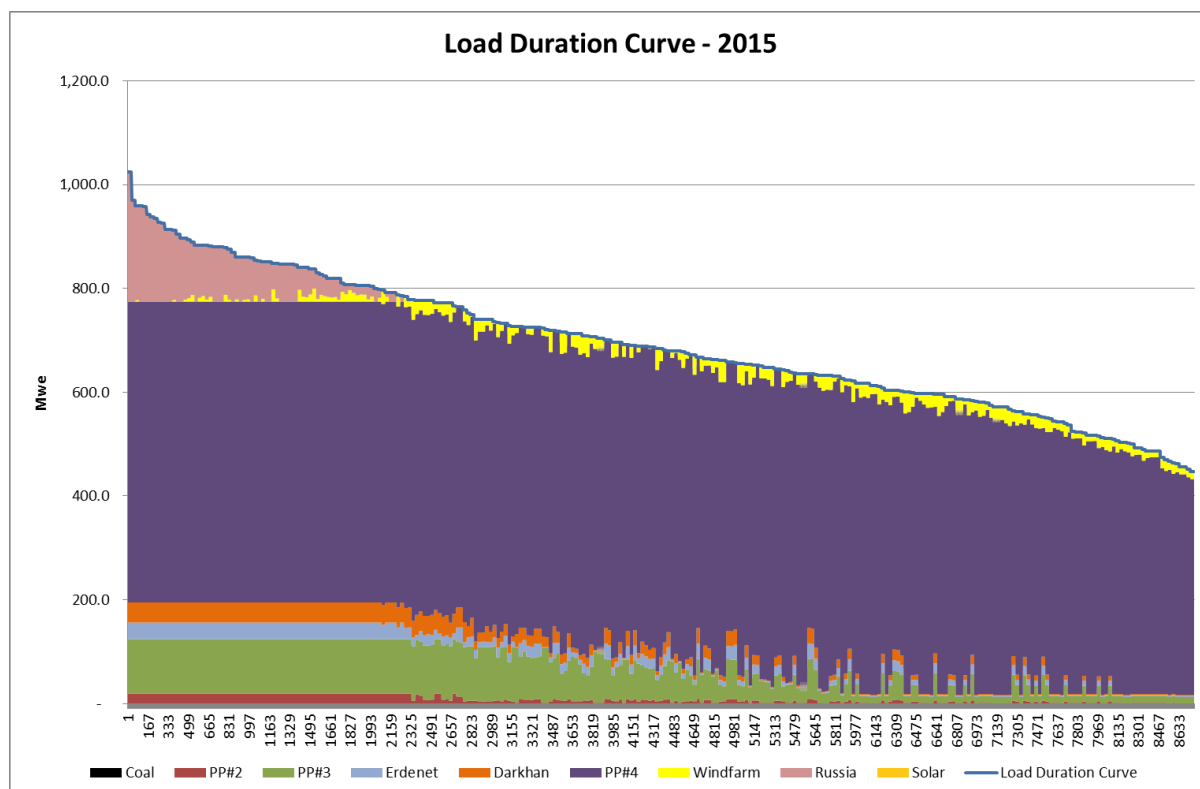


Chart 4: CES Load Dispatch Curve – 2016

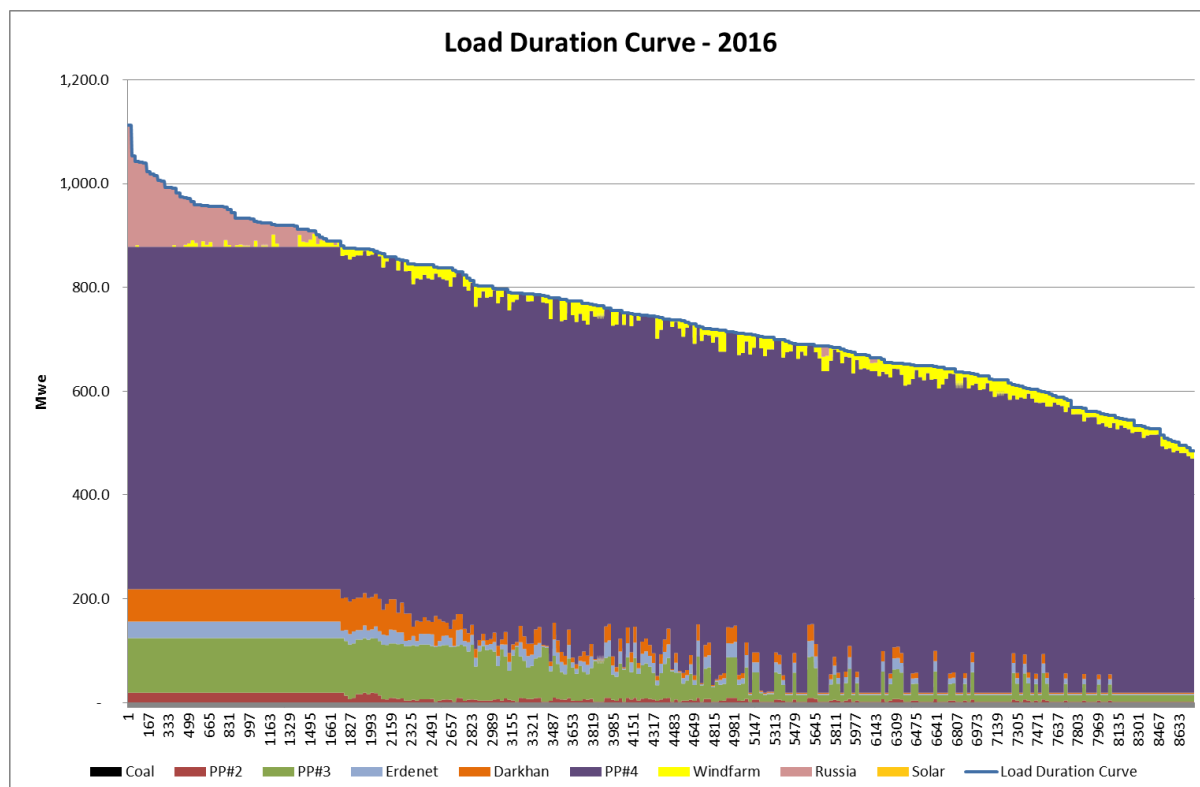


Chart 5: CES Load Dispatch Curve – 2017

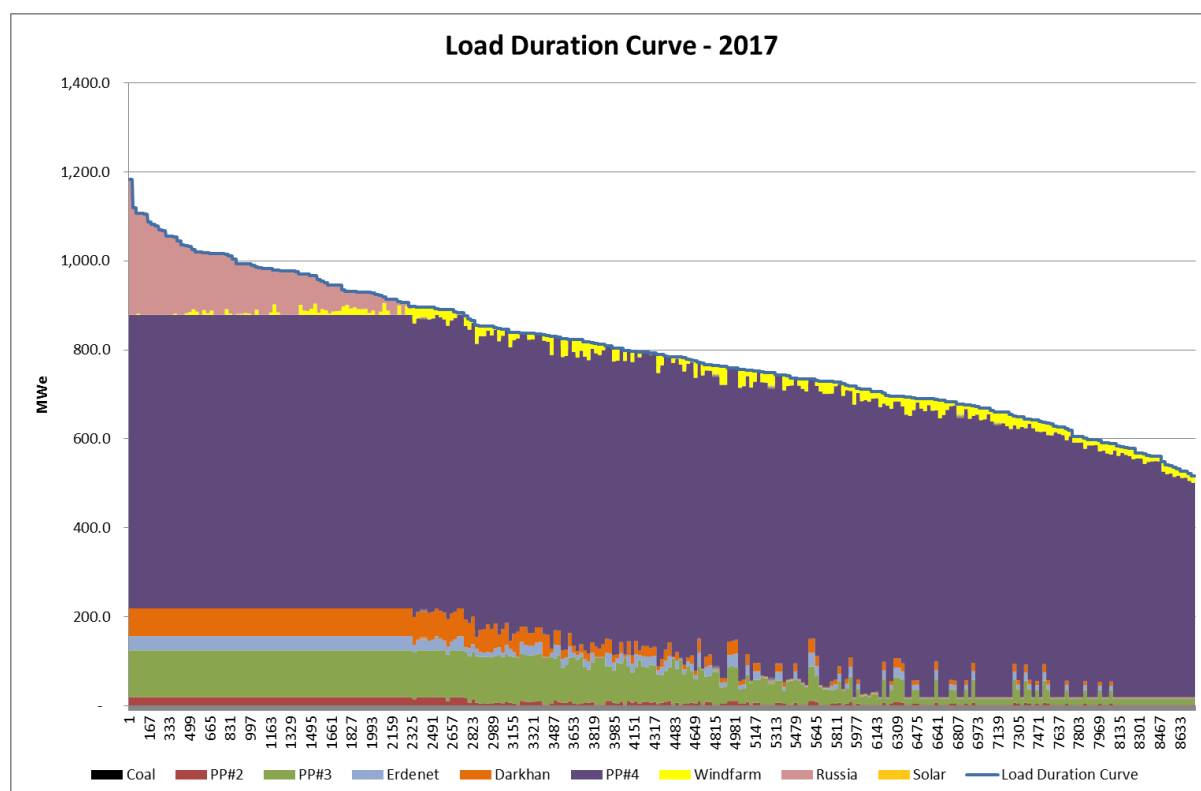


Chart 6: CES Load Dispatch Curve – 2018

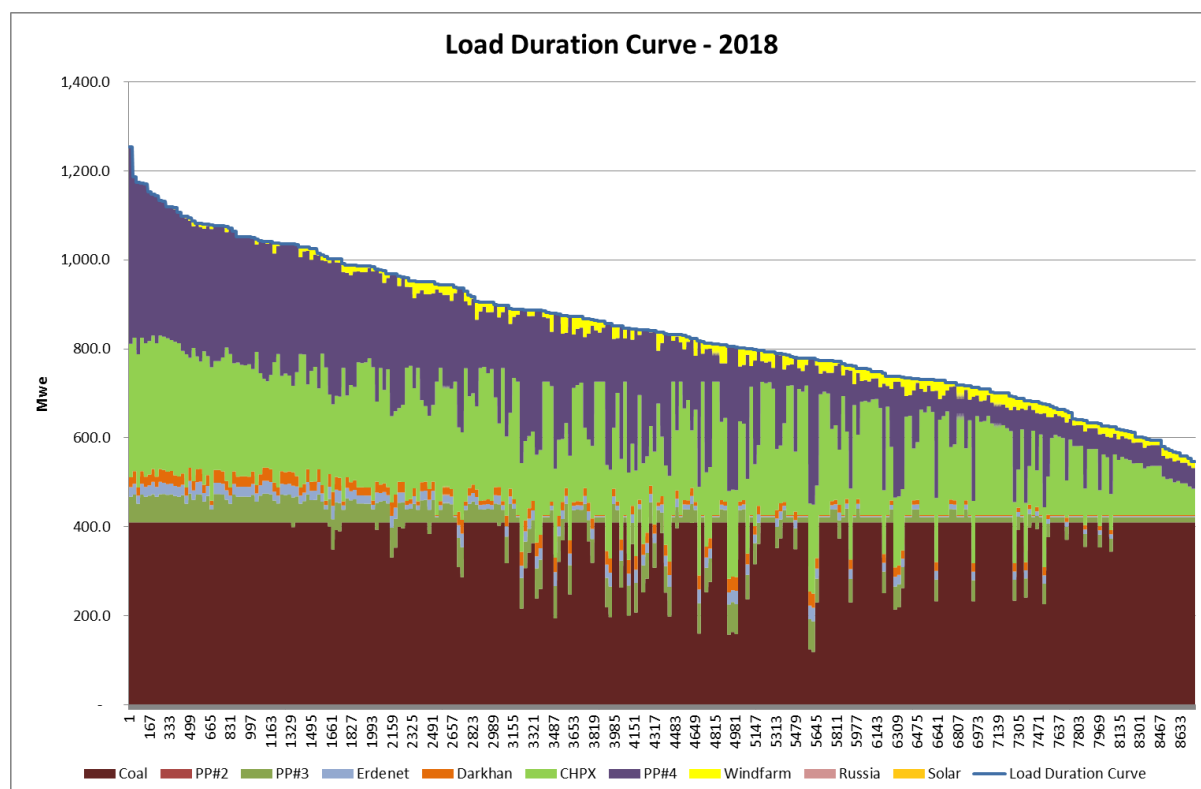


Chart 7: CES Load Dispatch Curve - 2019

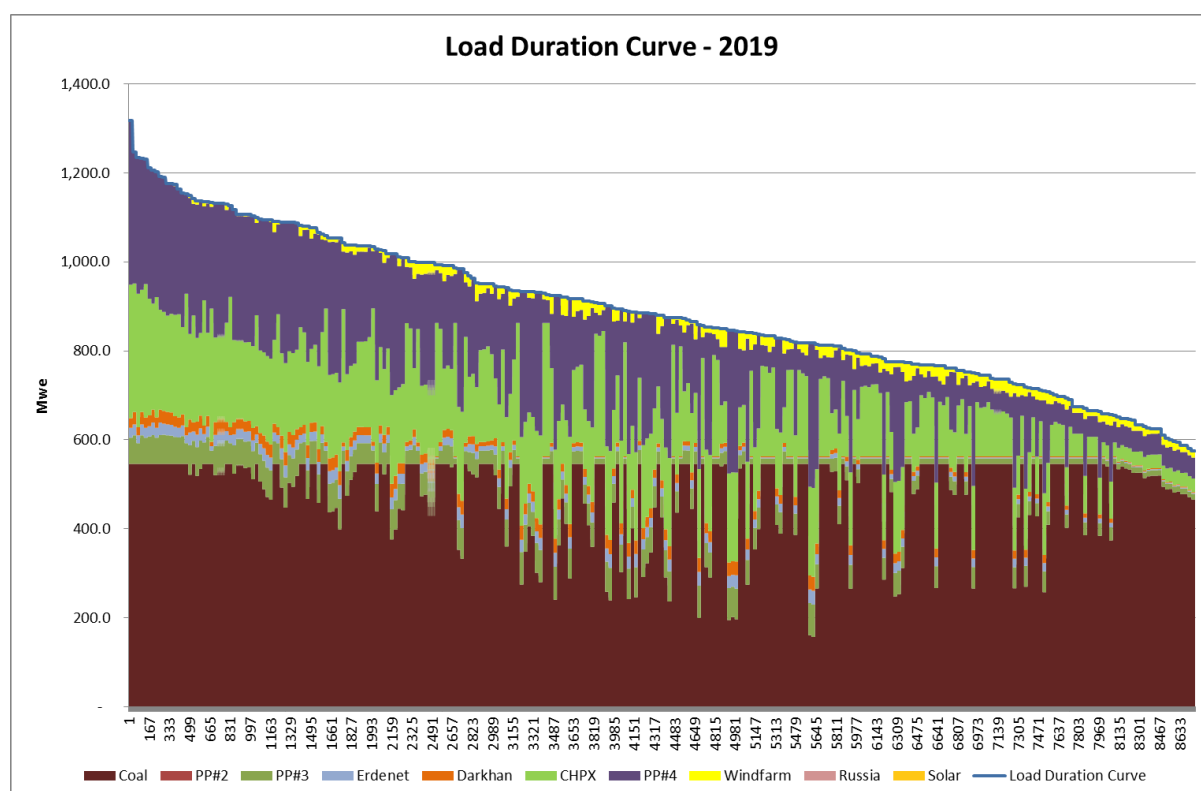


Chart 8: CES Load Dispatch Curve – 2020

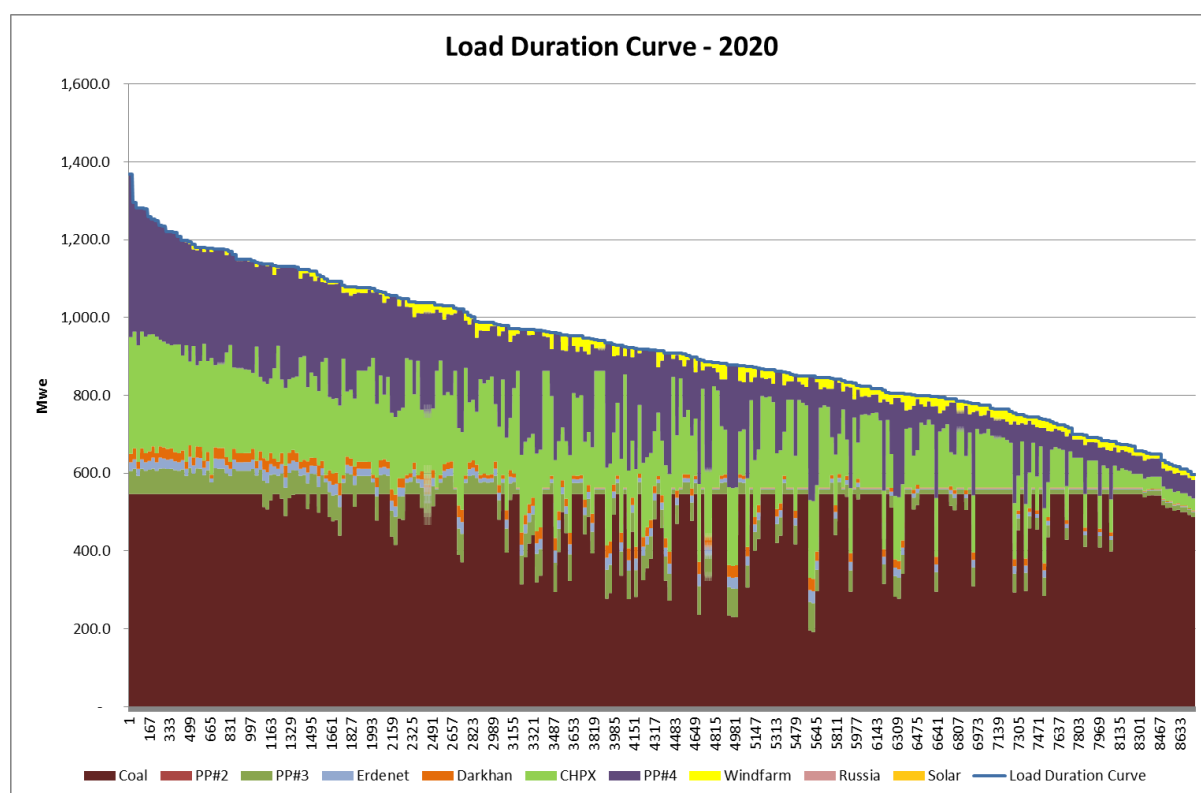


Chart 9: CES Load Dispatch Curve - 2021

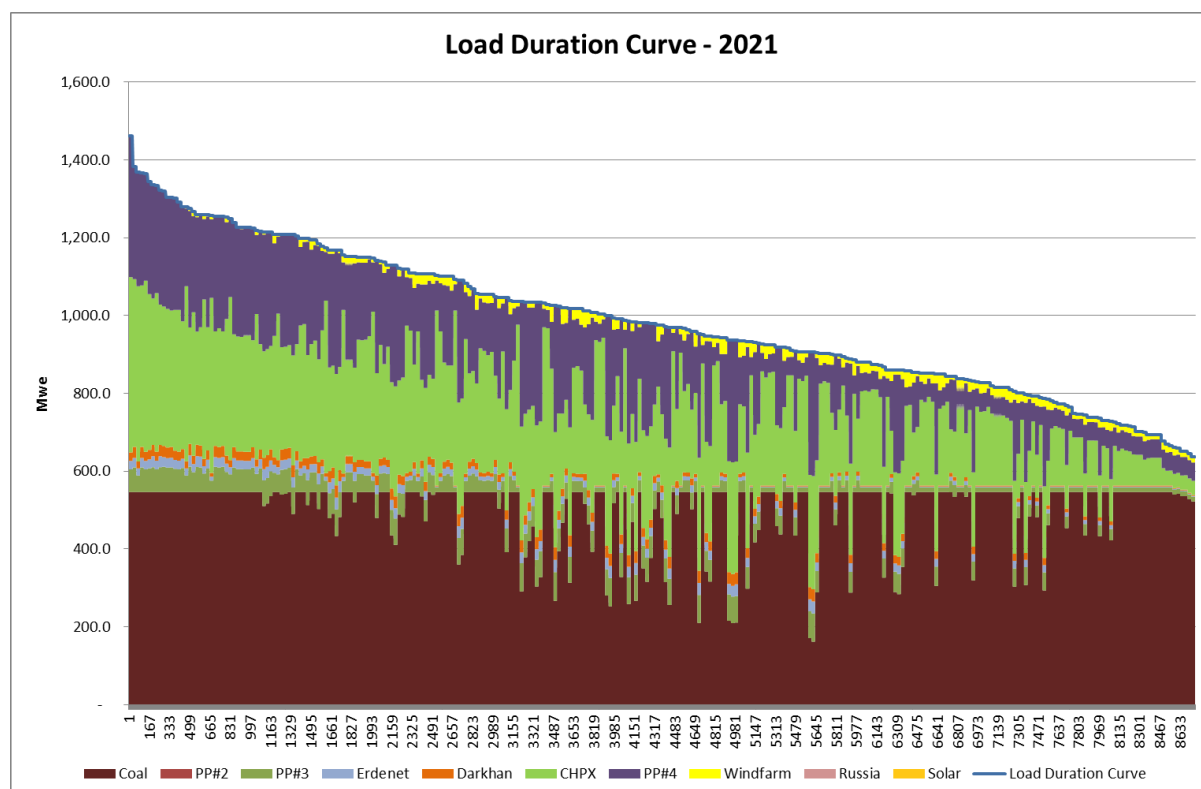


Chart 10: CES Load Dispatch Curve – 2022

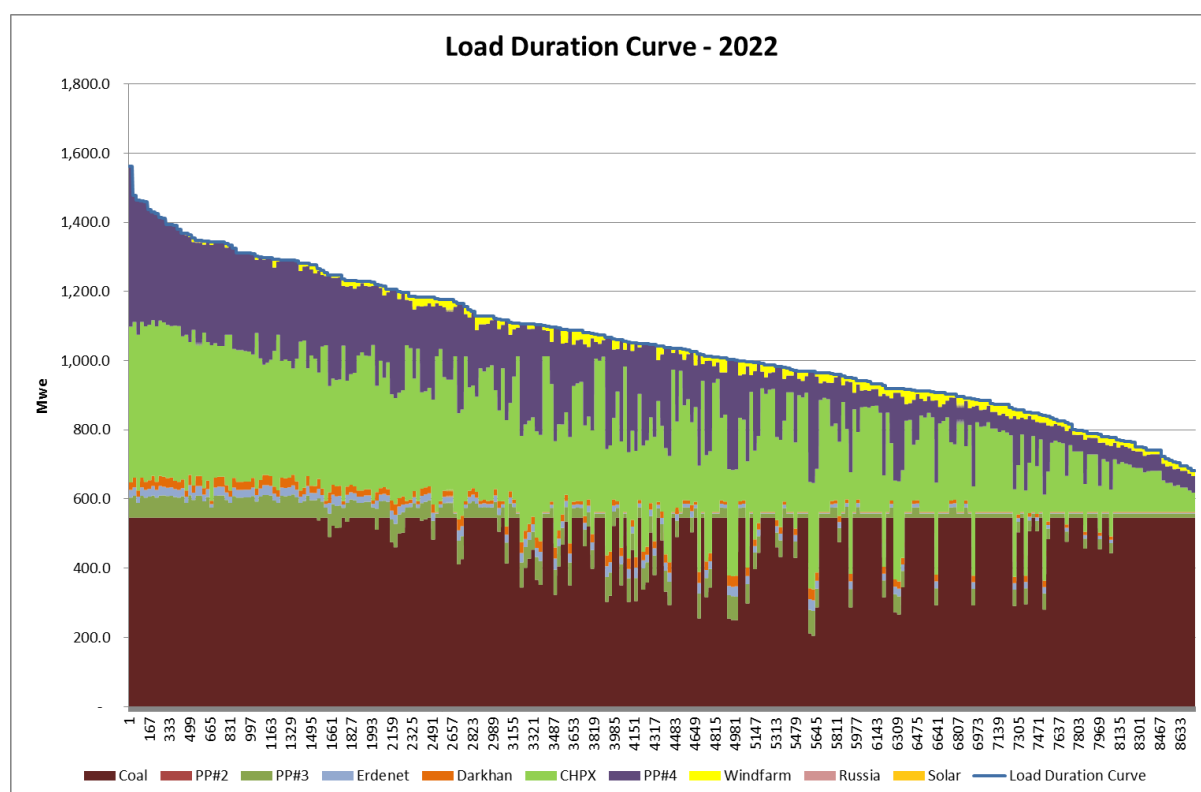


Chart 11: CES Load Dispatch Curve - 2023

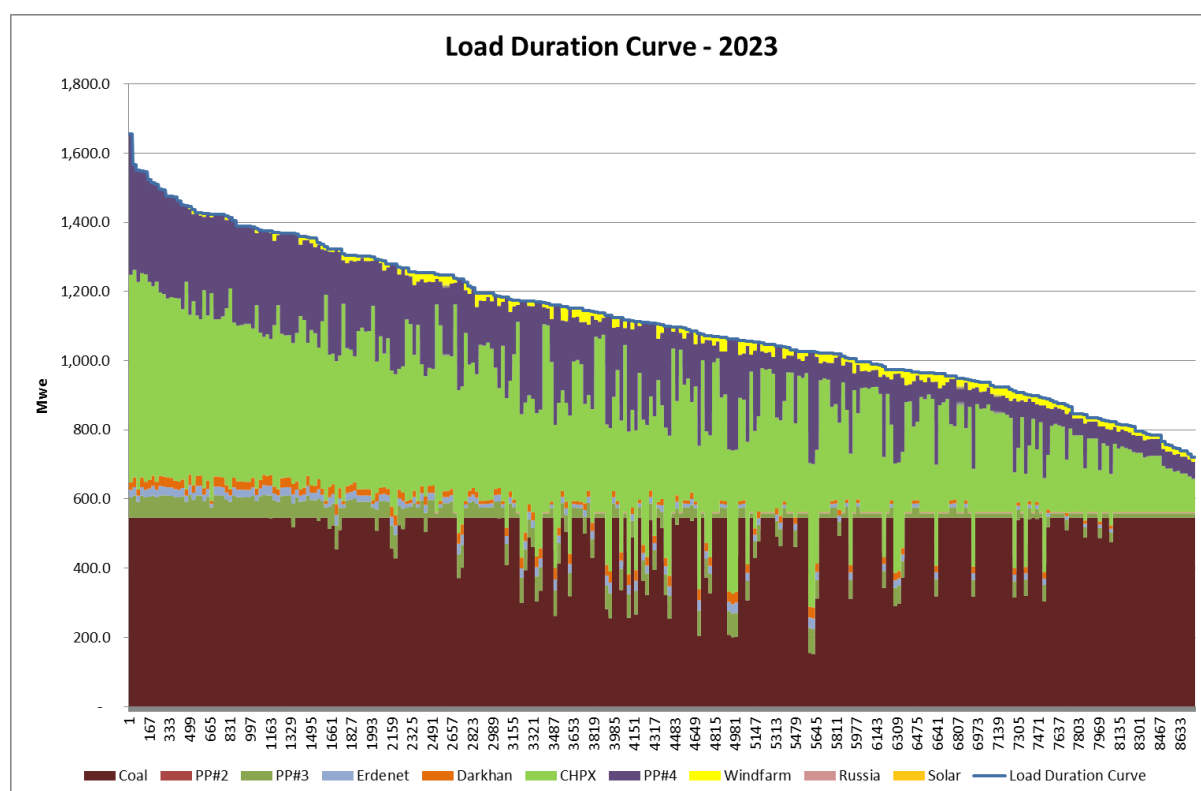


Chart 12: CES Load Dispatch Curve – 2024

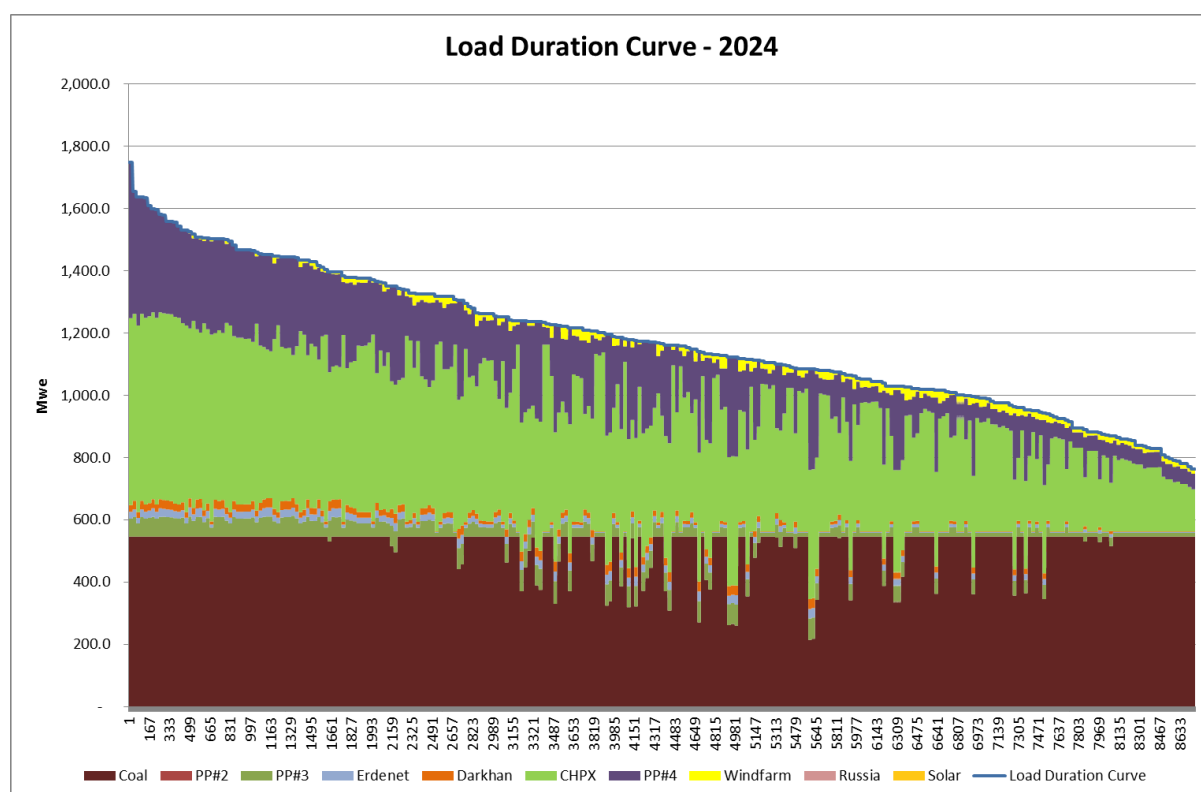
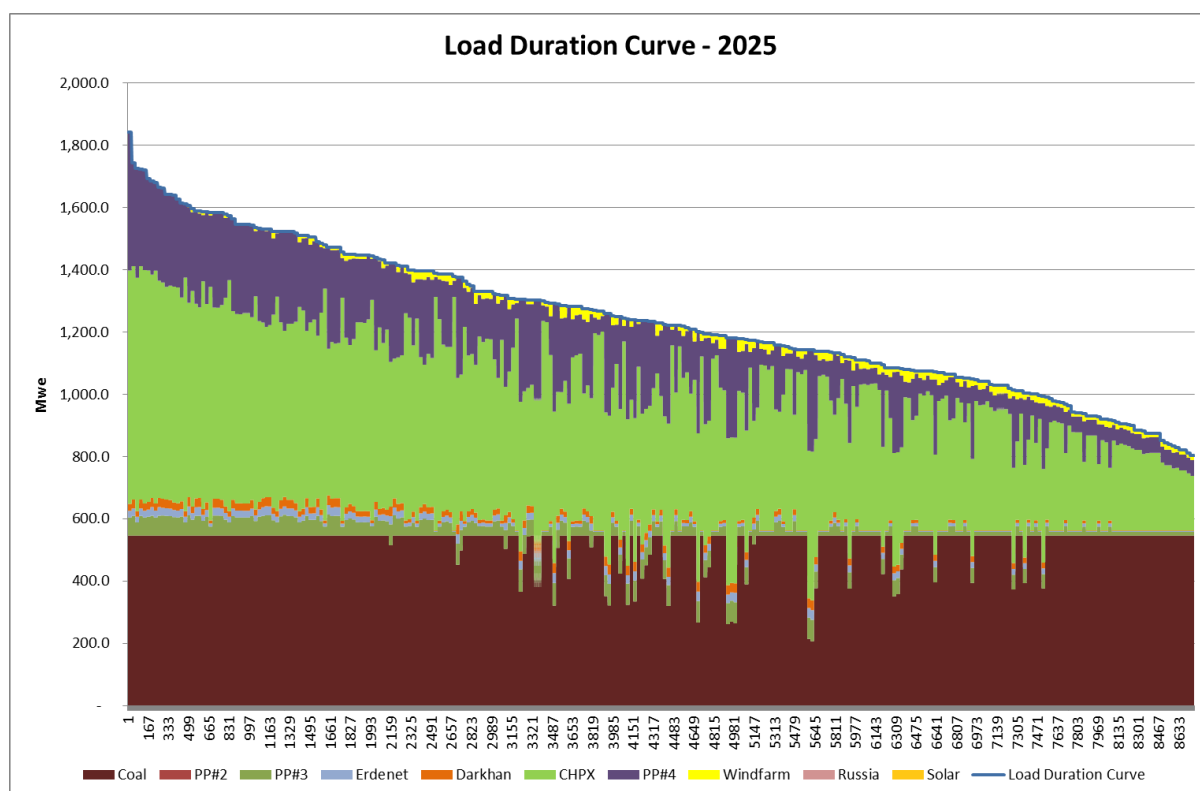


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX N: ELECTRICITY DISPATCH CURVES – Scenario 3B

Chart 1: CES Load Dispatch Curve - 2013

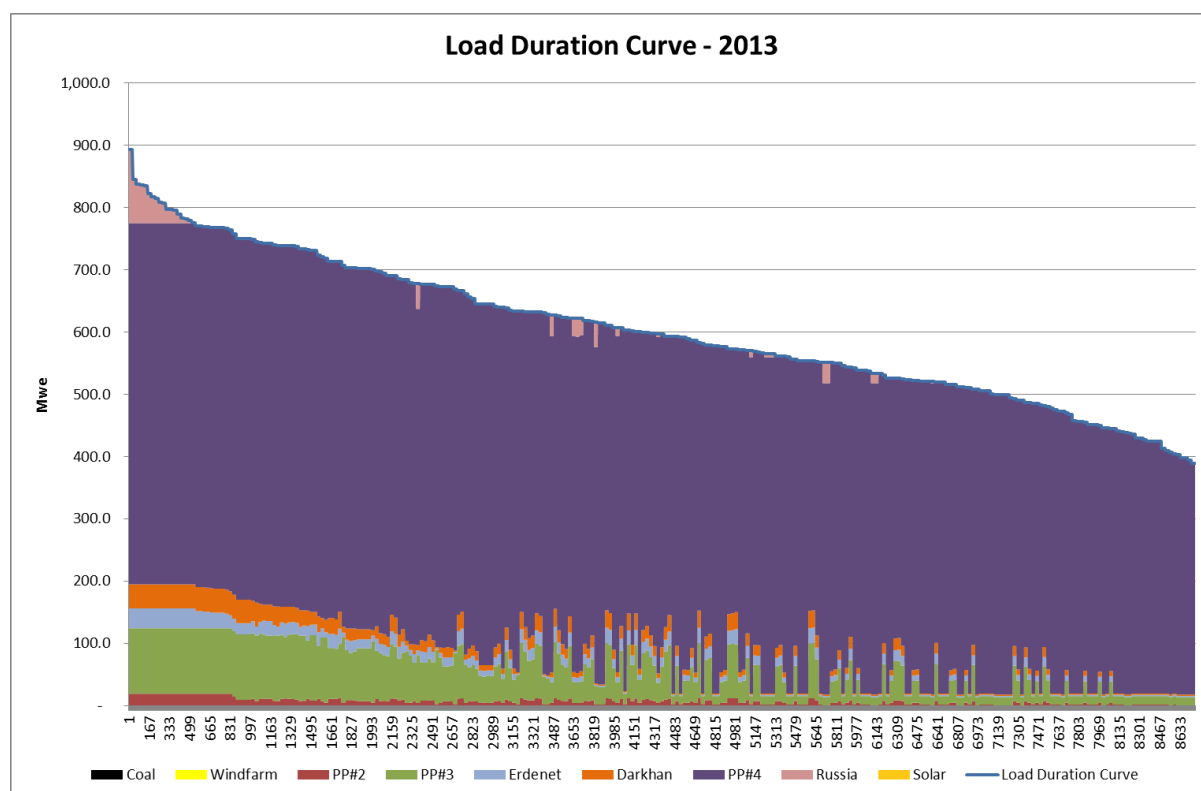


Chart 2: CES Load Dispatch Curve – 2014

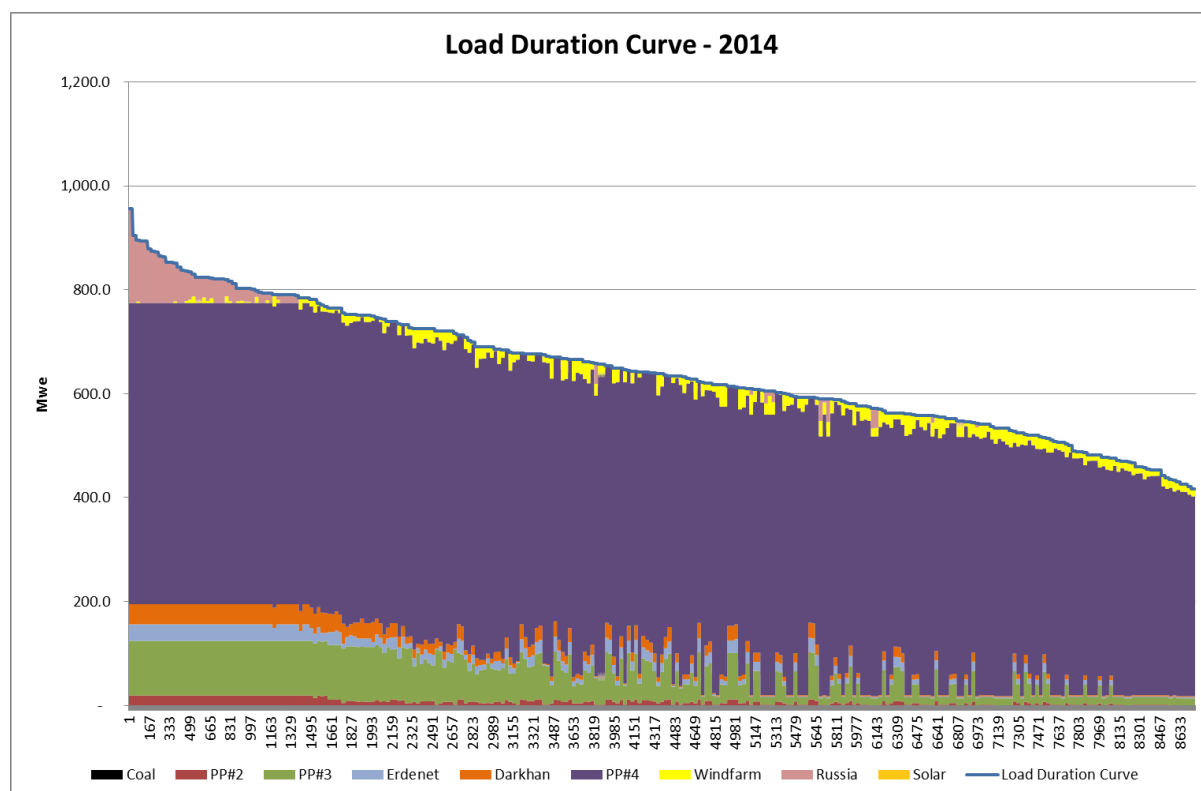


Chart 3: CES Load Dispatch Curve – 2015

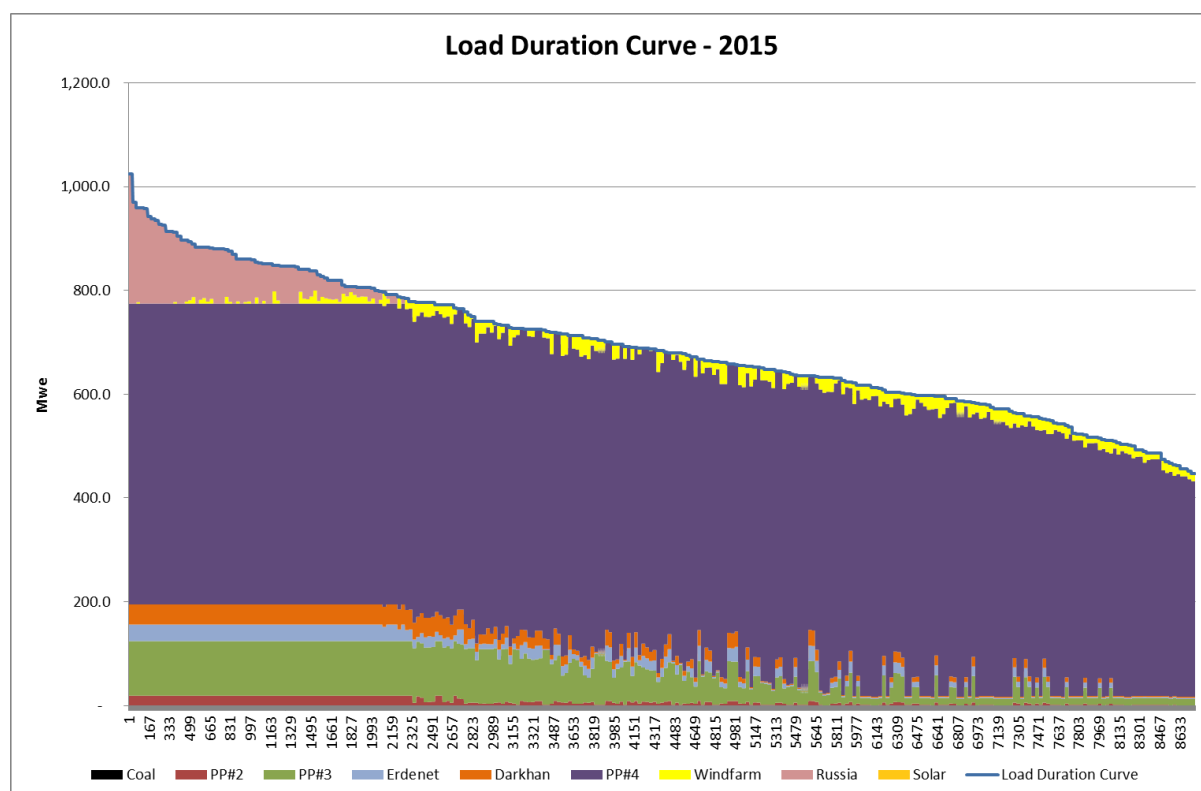


Chart 4: CES Load Dispatch Curve – 2016

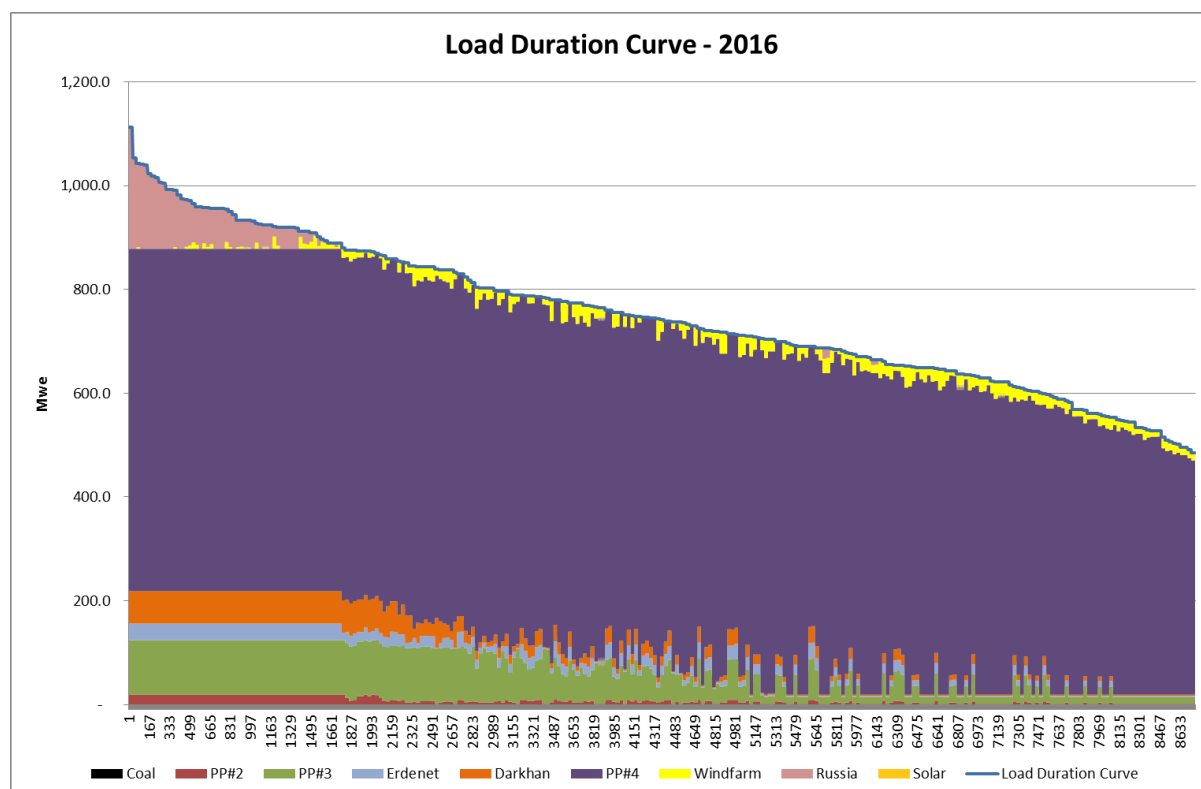


Chart 5: CES Load Dispatch Curve – 2017

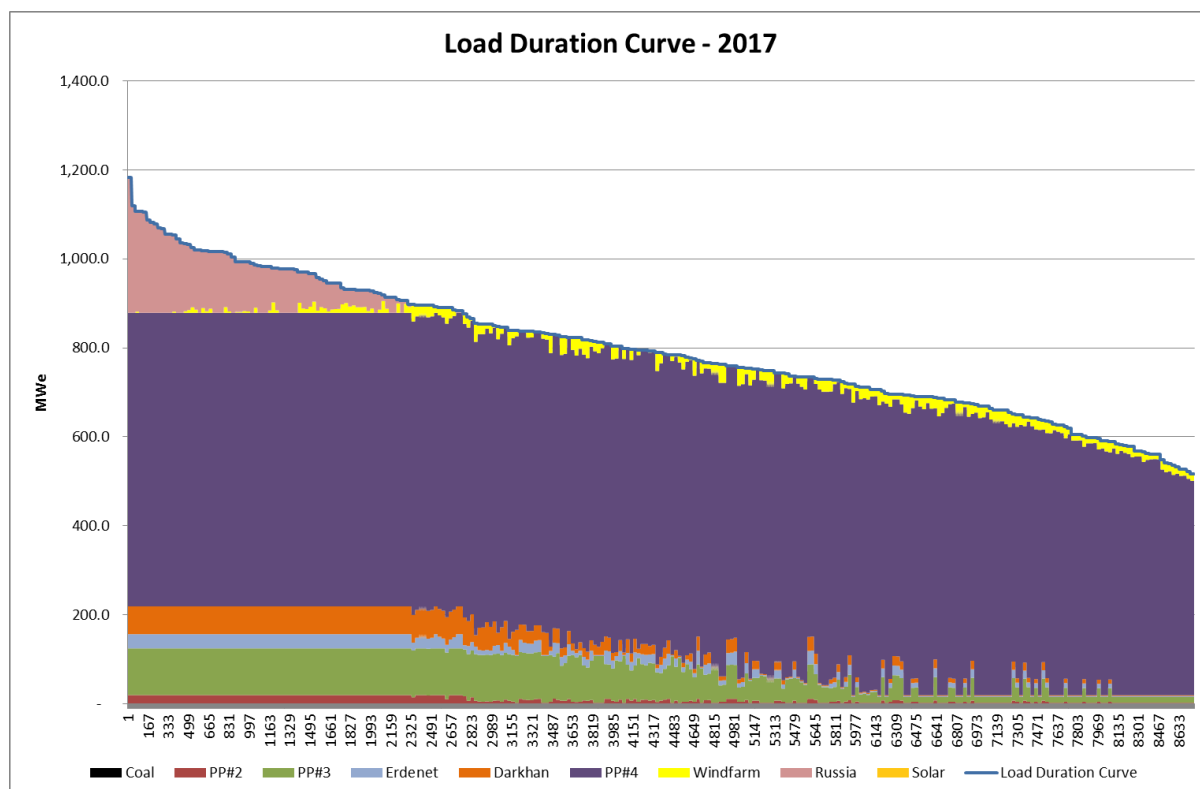


Chart 6: CES Load Dispatch Curve – 2018

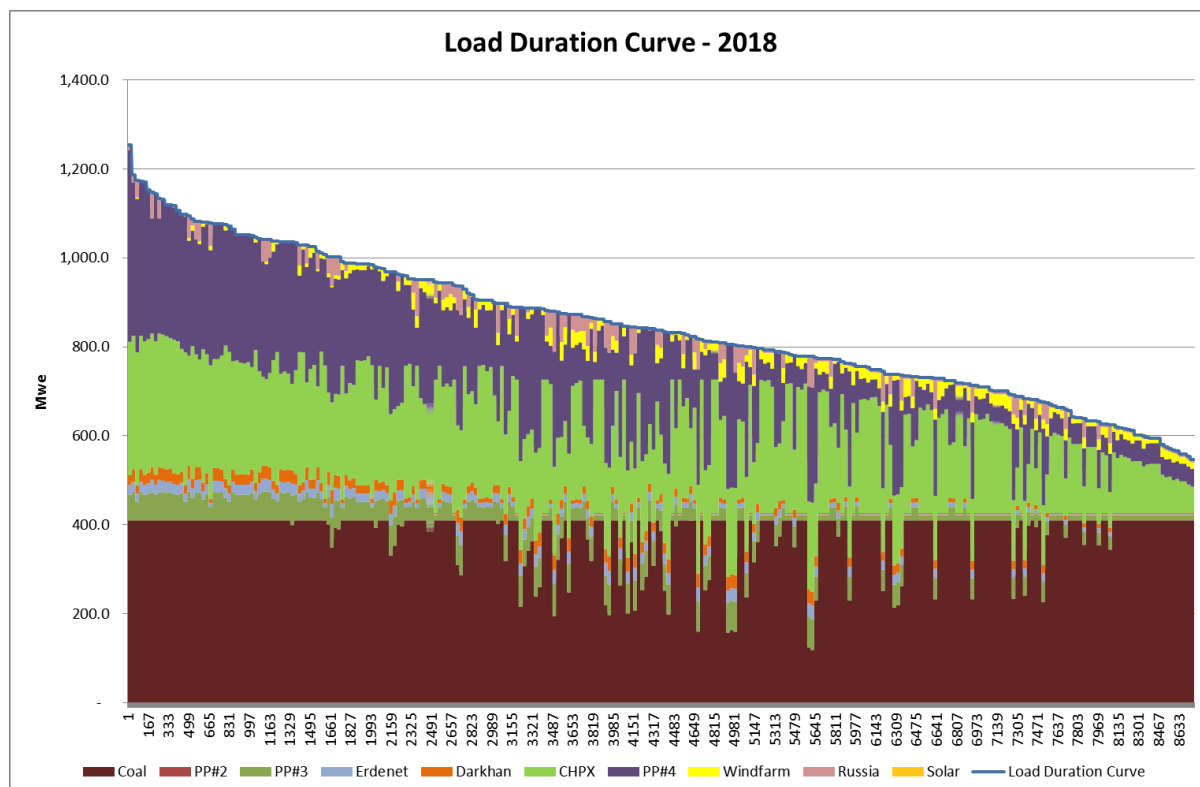


Chart 7: CES Load Dispatch Curve - 2019

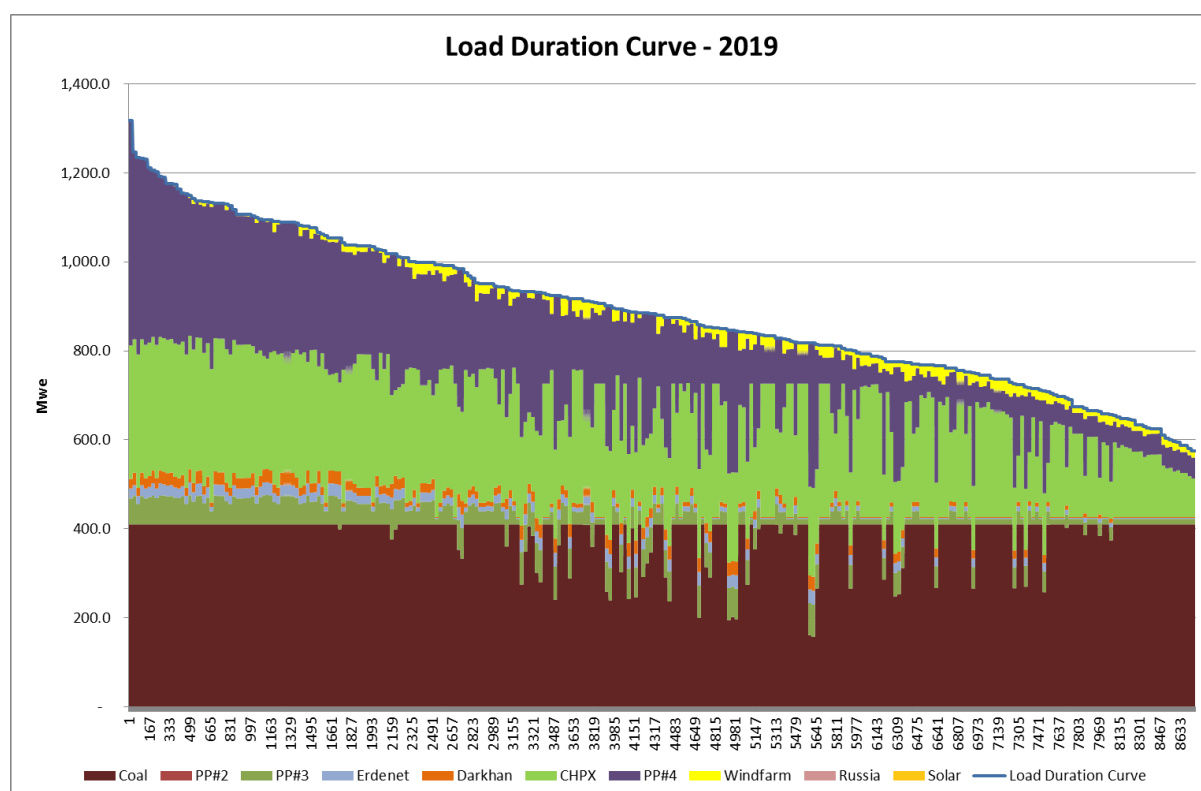


Chart 8: CES Load Dispatch Curve – 2020

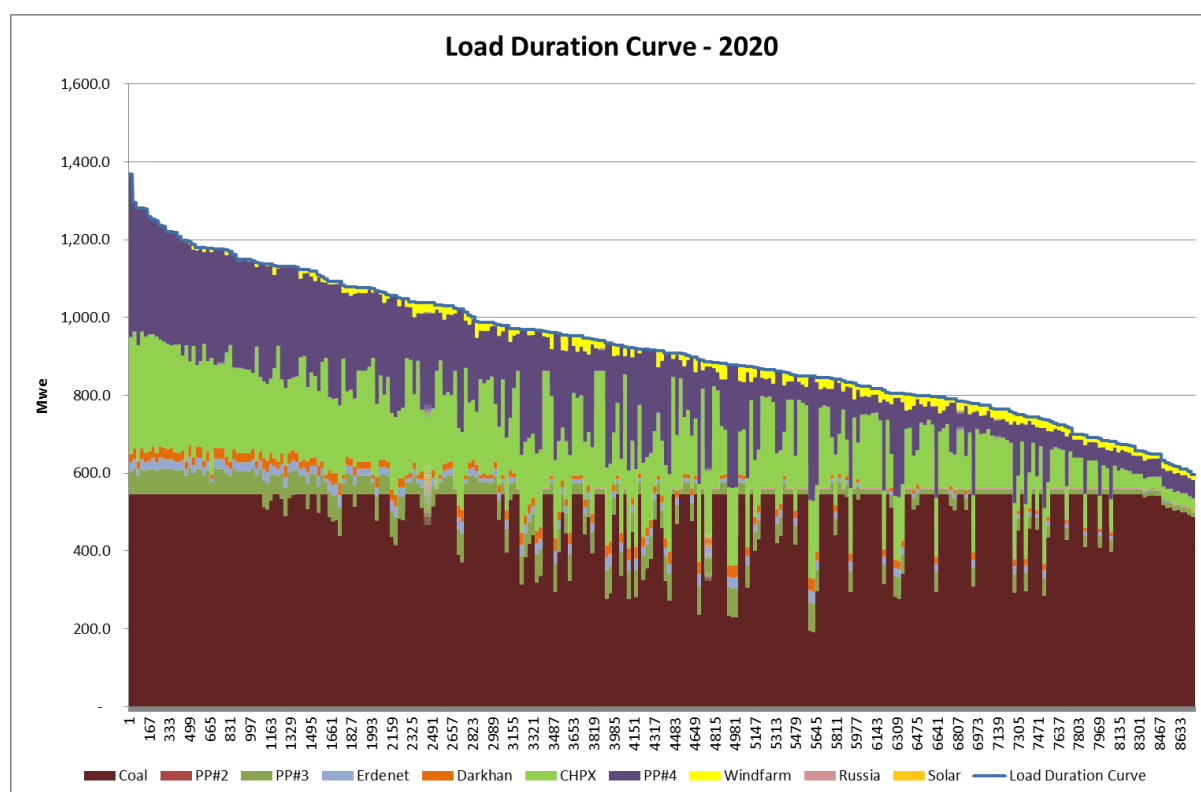


Chart 9: CES Load Dispatch Curve - 2021

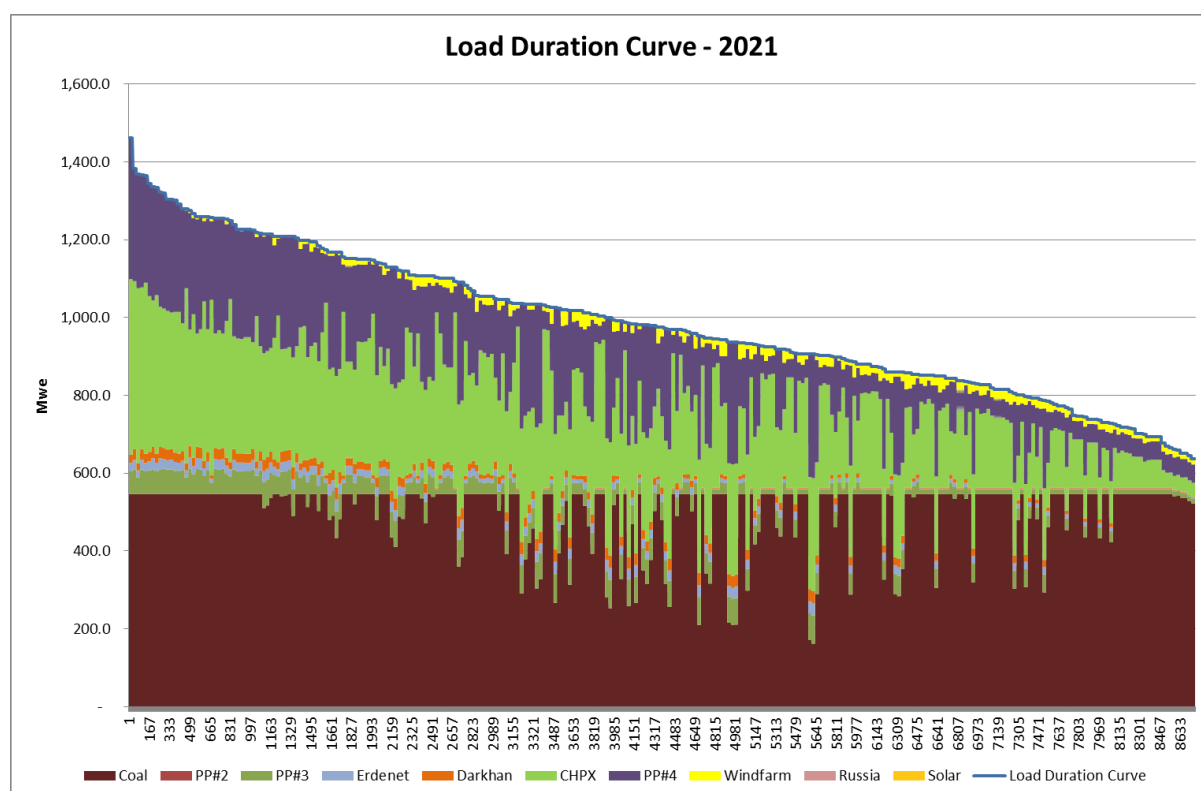


Chart 10: CES Load Dispatch Curve – 2022

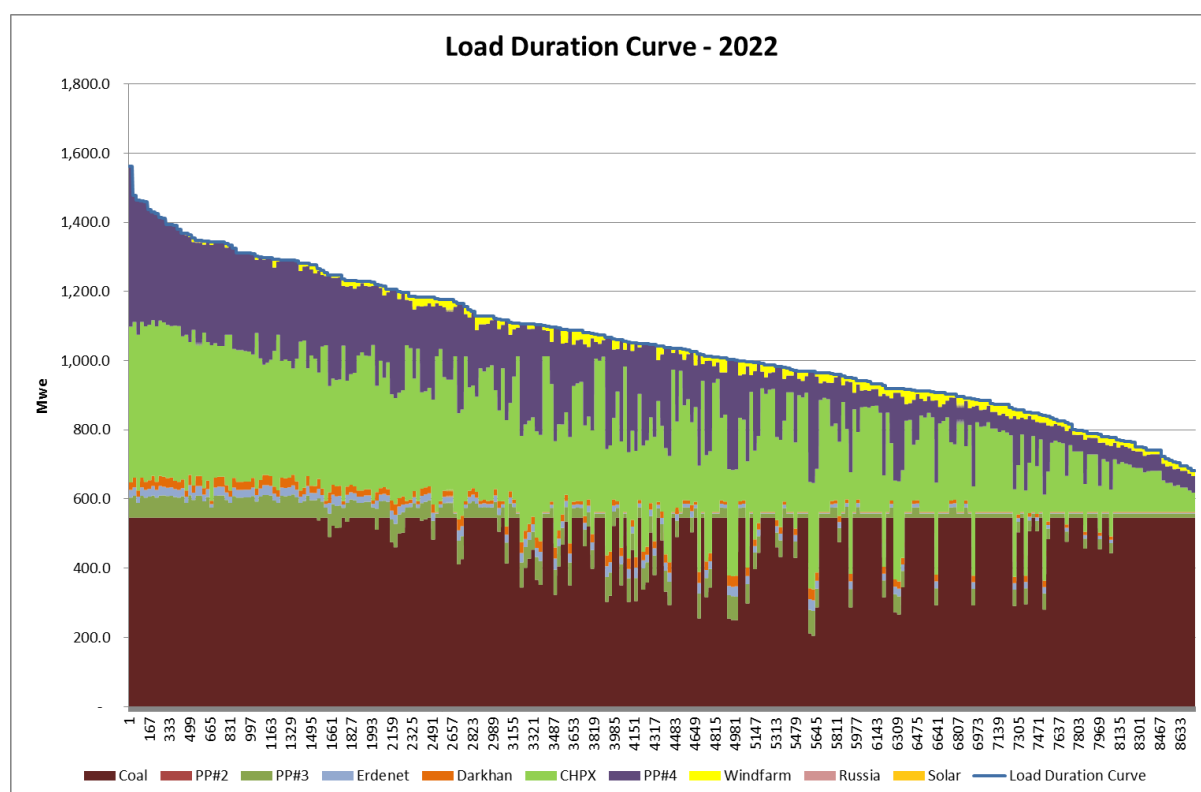


Chart 11: CES Load Dispatch Curve - 2023

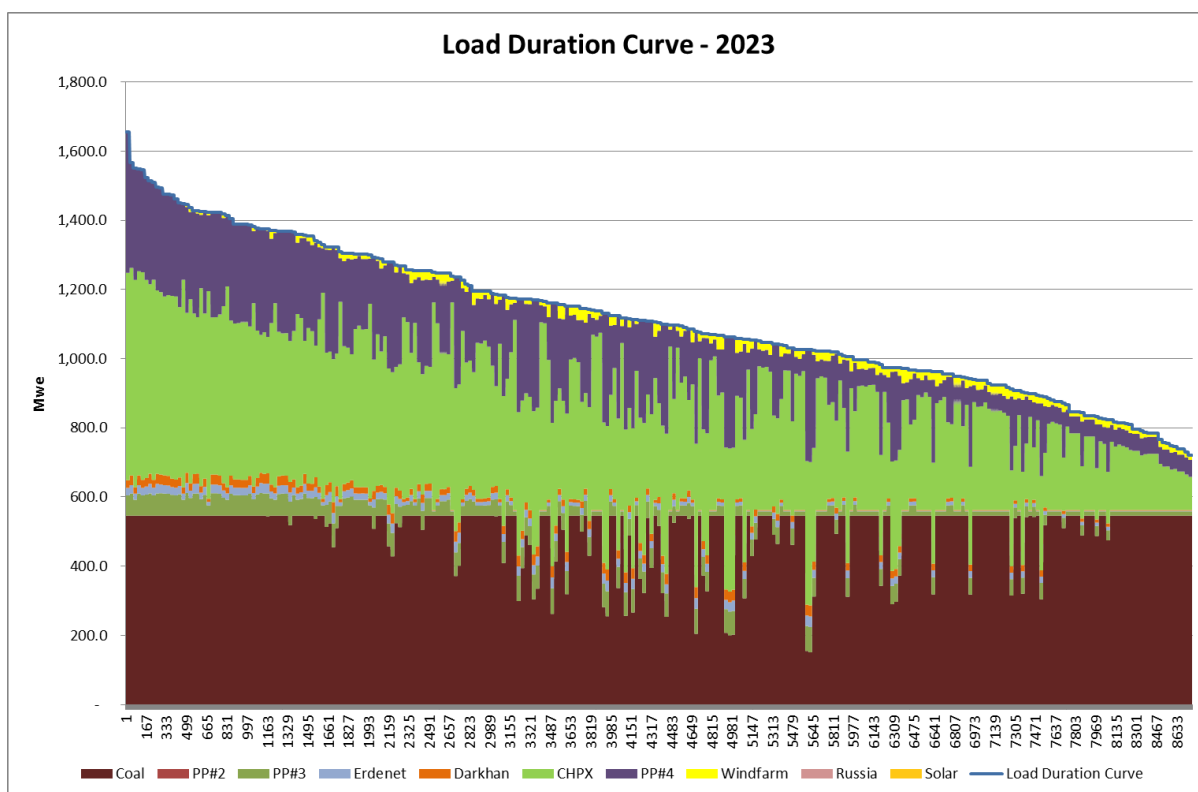


Chart 12: CES Load Dispatch Curve – 2024

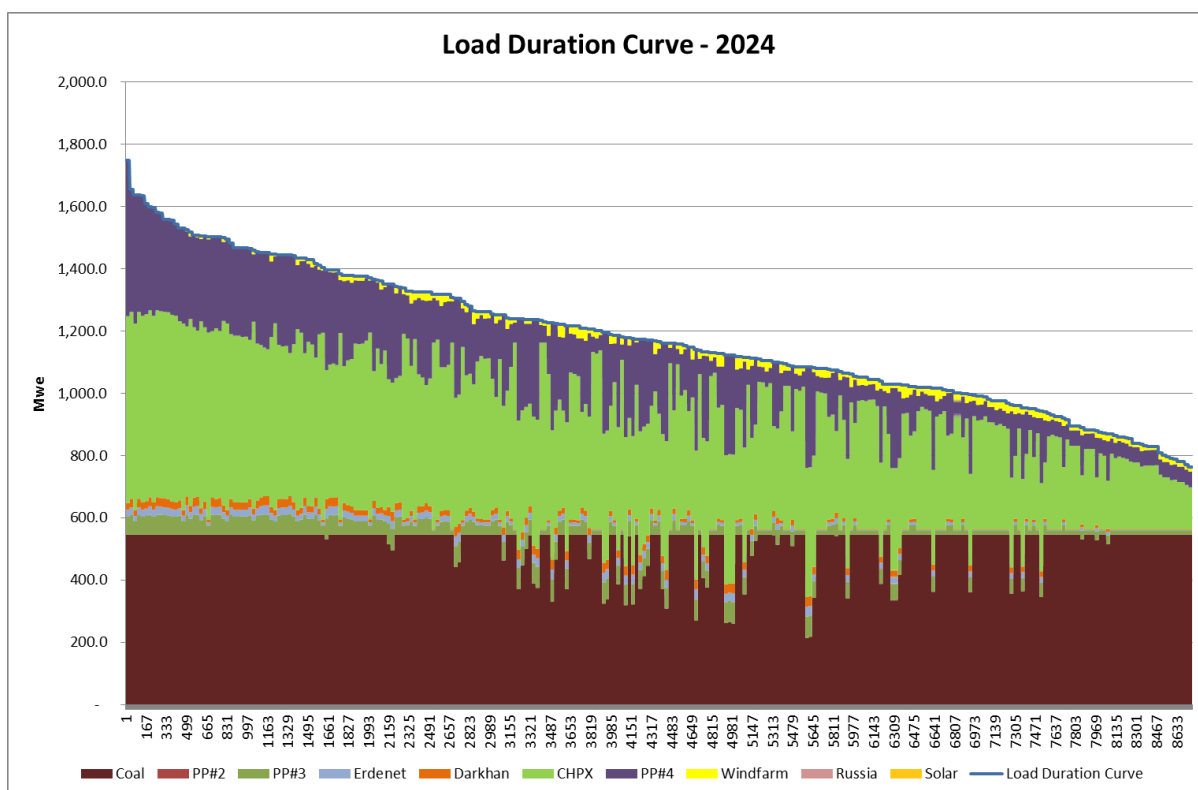
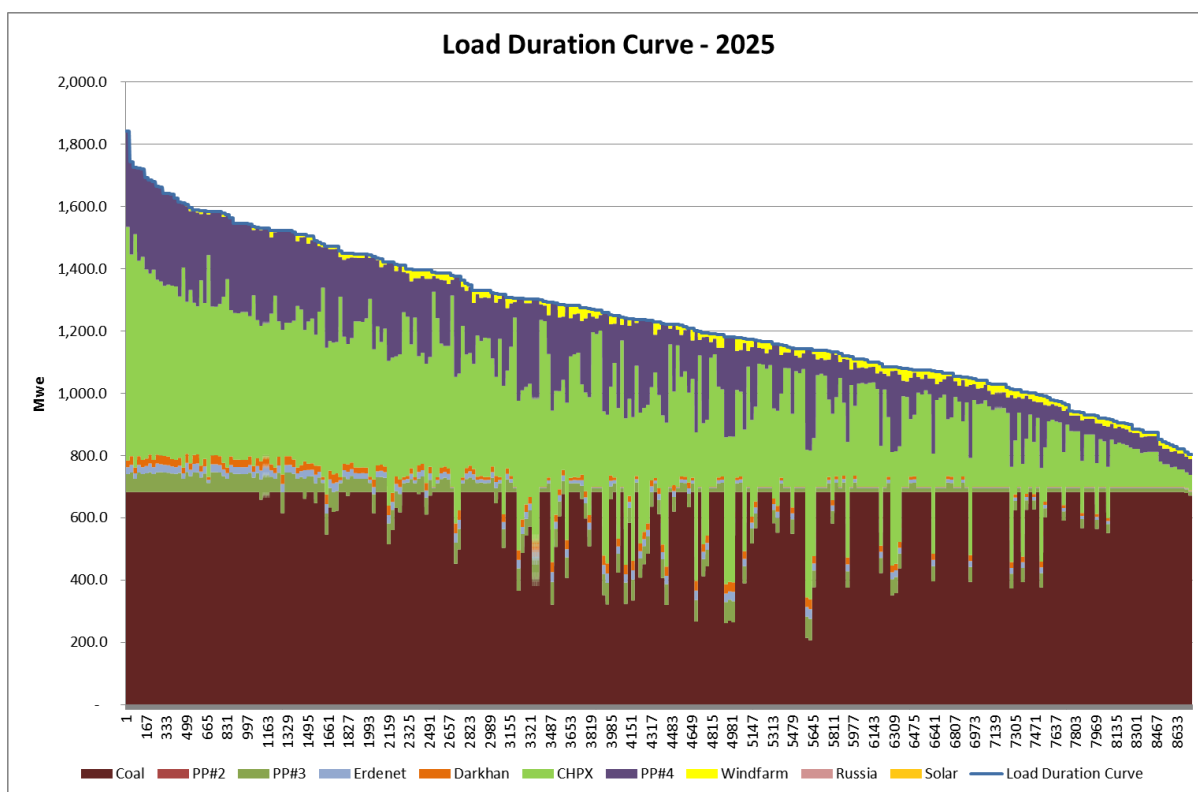


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX O: ELECTRICITY DISPATCH CURVES – Scenario 3C

Chart 1: CES Load Dispatch Curve - 2013

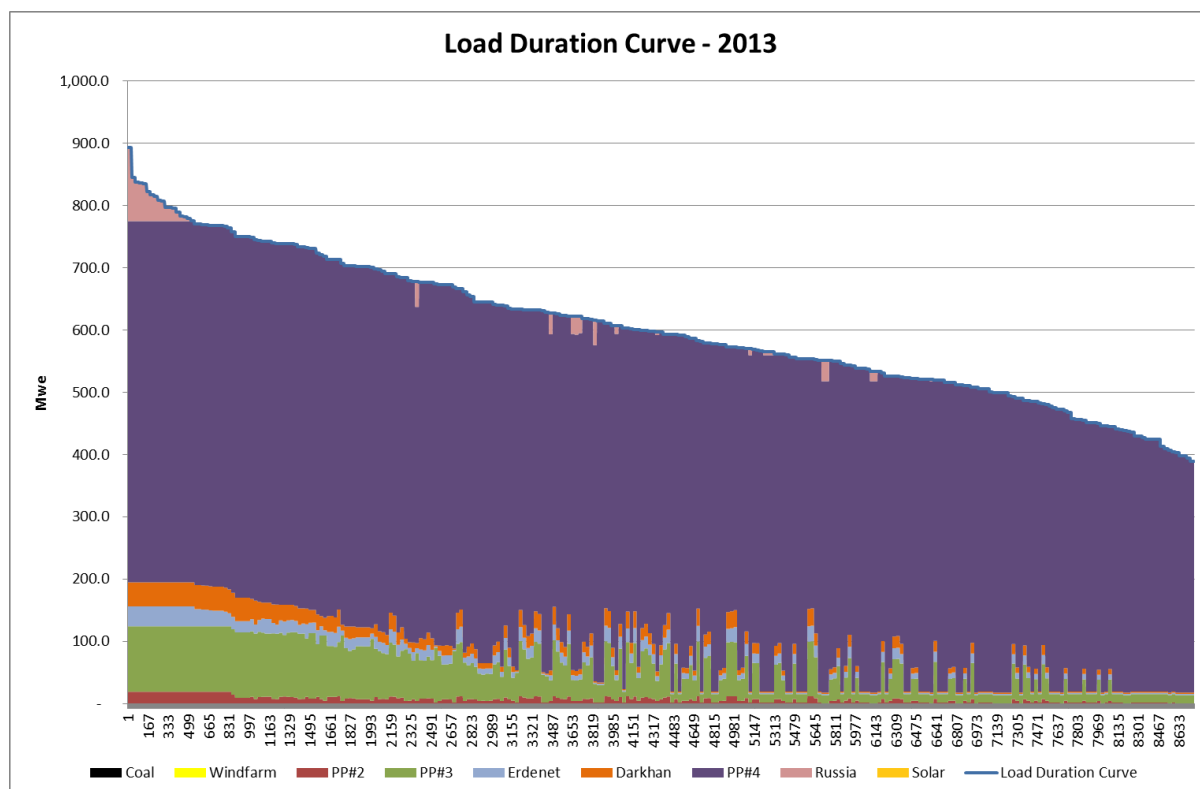


Chart 2: CES Load Dispatch Curve – 2014

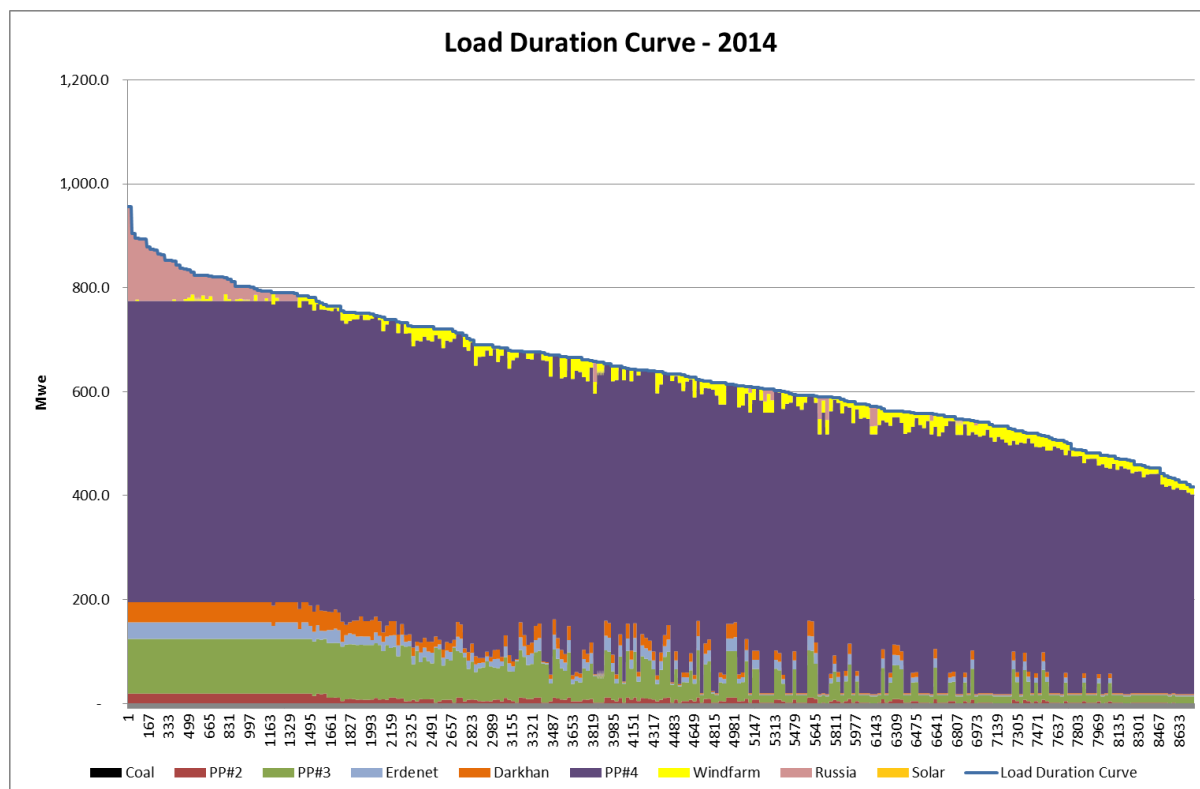


Chart 3: CES Load Dispatch Curve – 2015

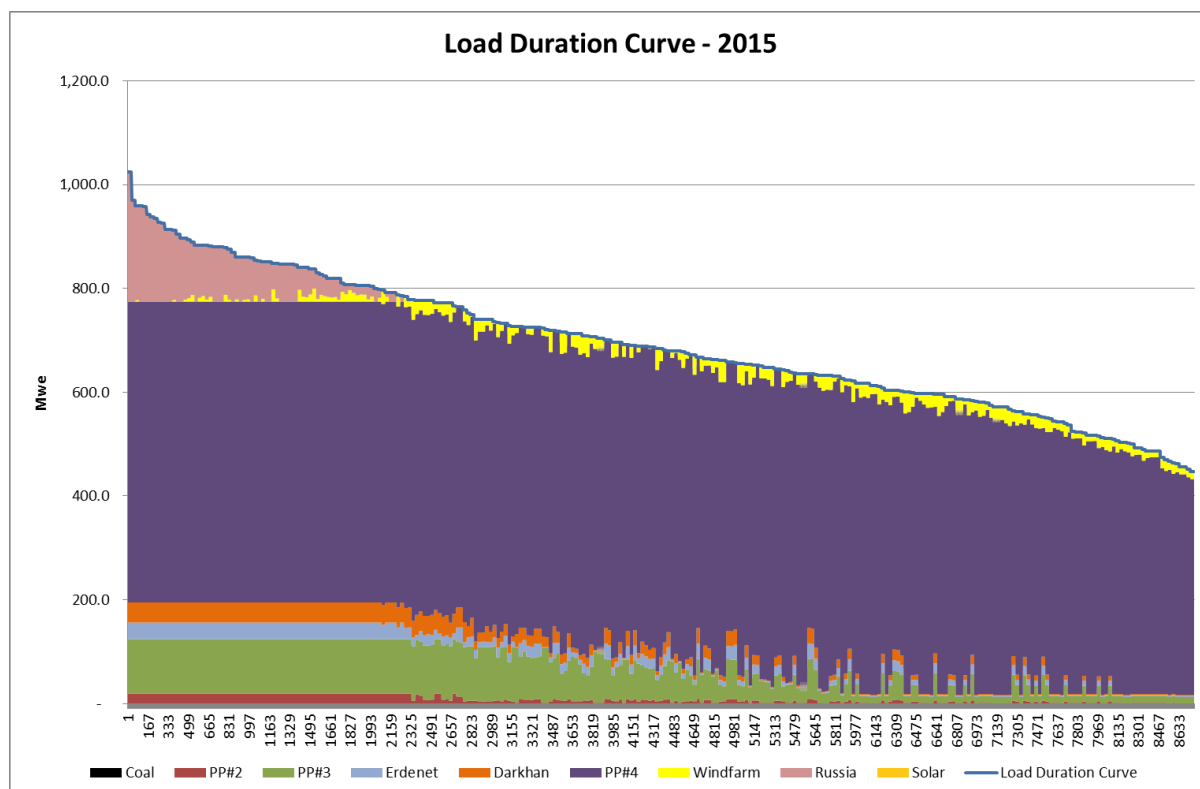


Chart 4: CES Load Dispatch Curve – 2016

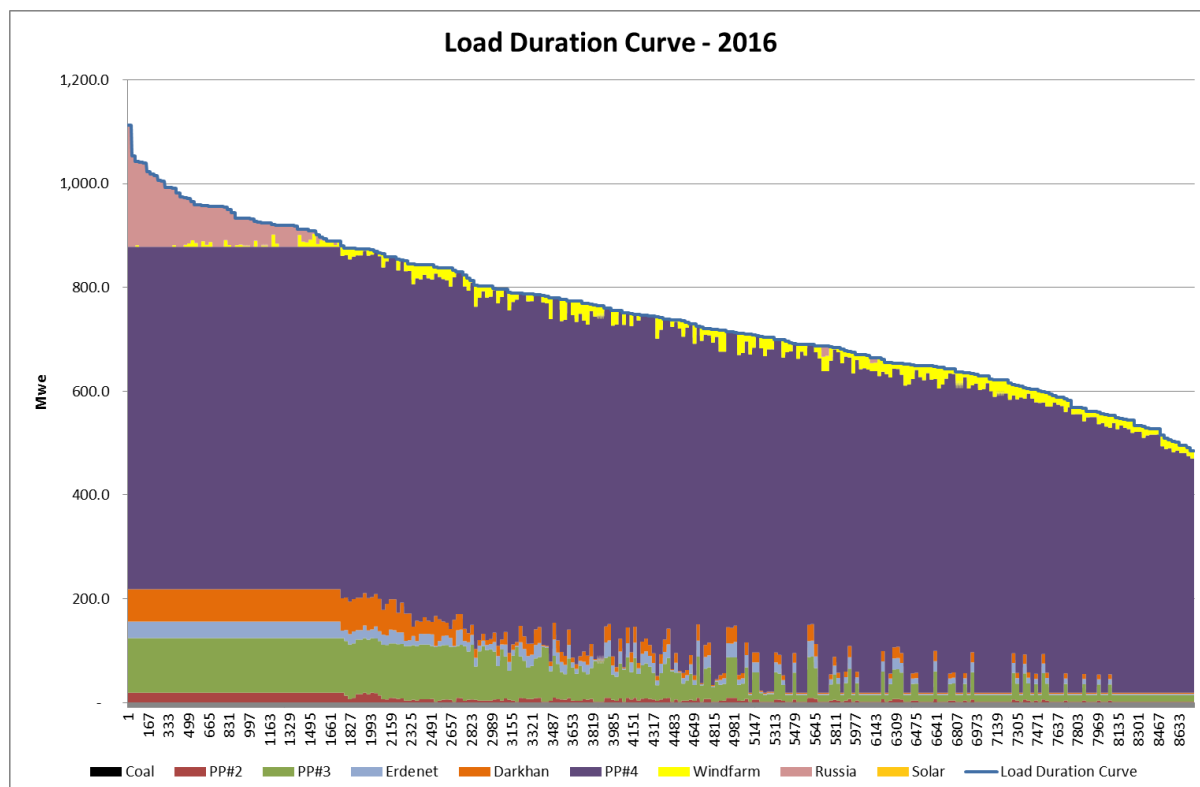


Chart 5: CES Load Dispatch Curve – 2017

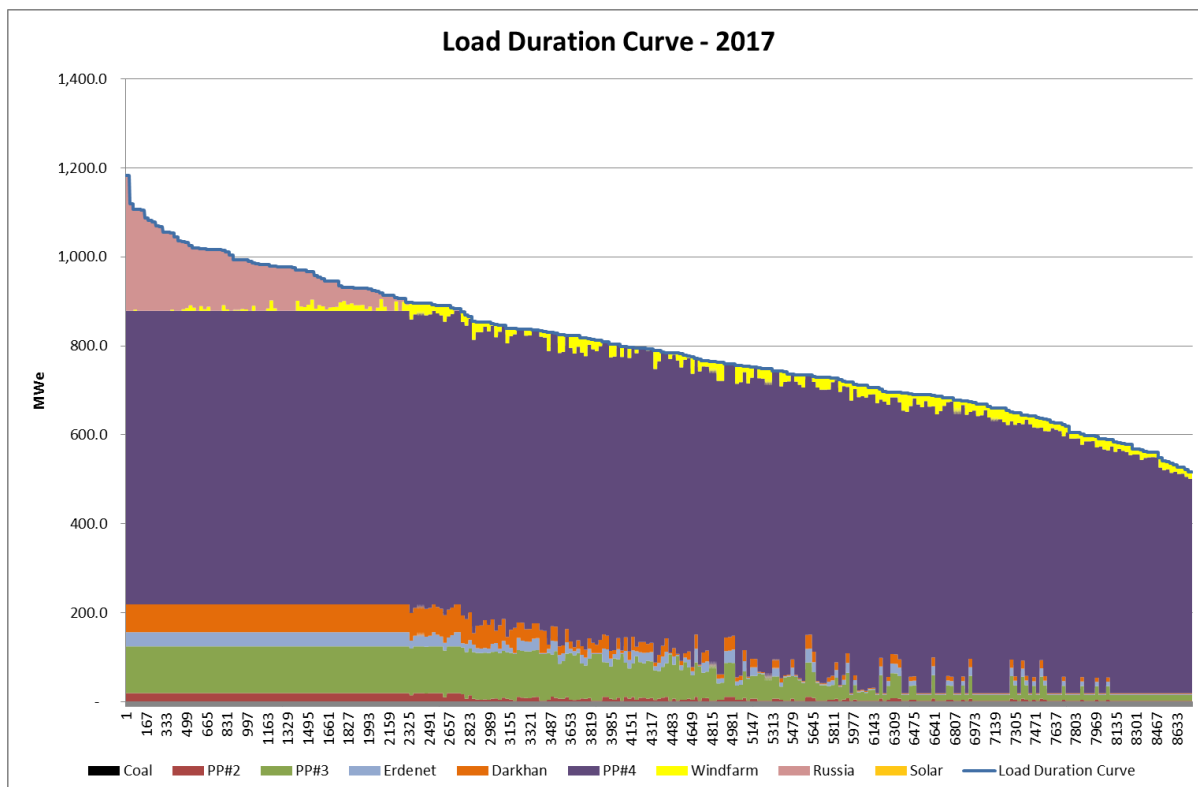


Chart 6: CES Load Dispatch Curve – 2018

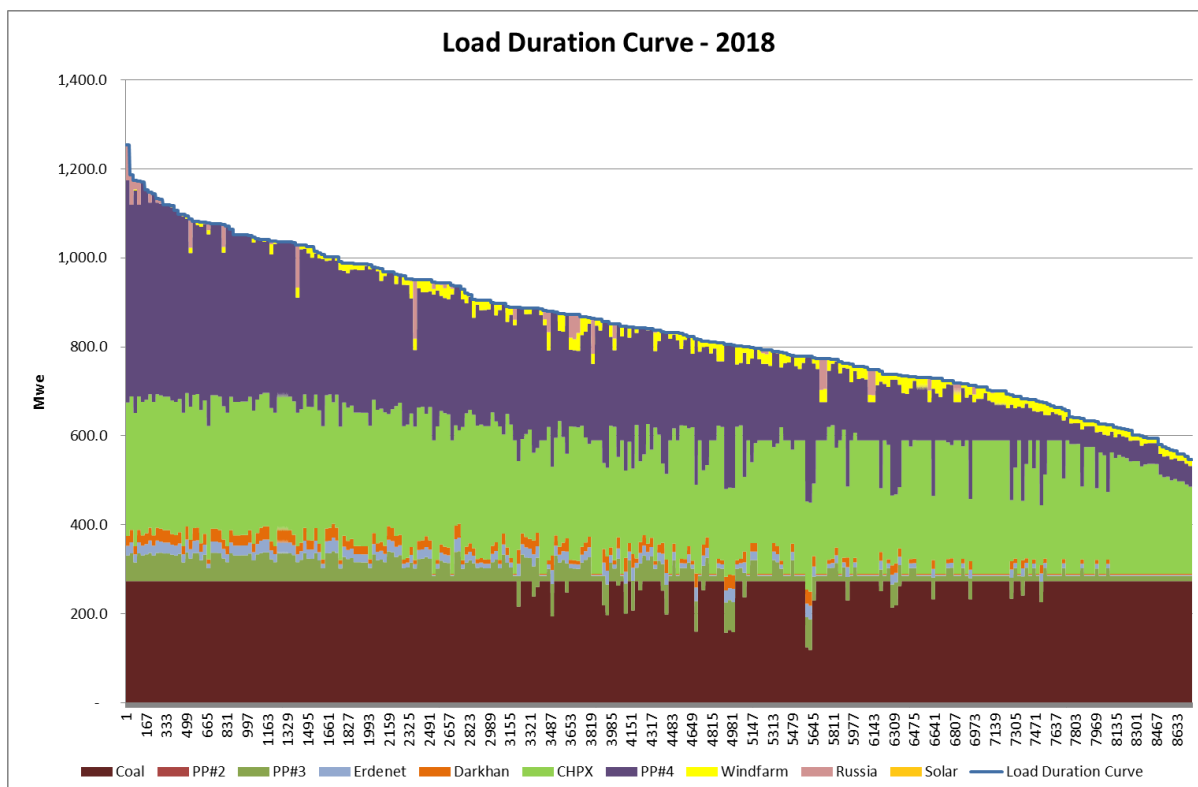


Chart 7: CES Load Dispatch Curve - 2019

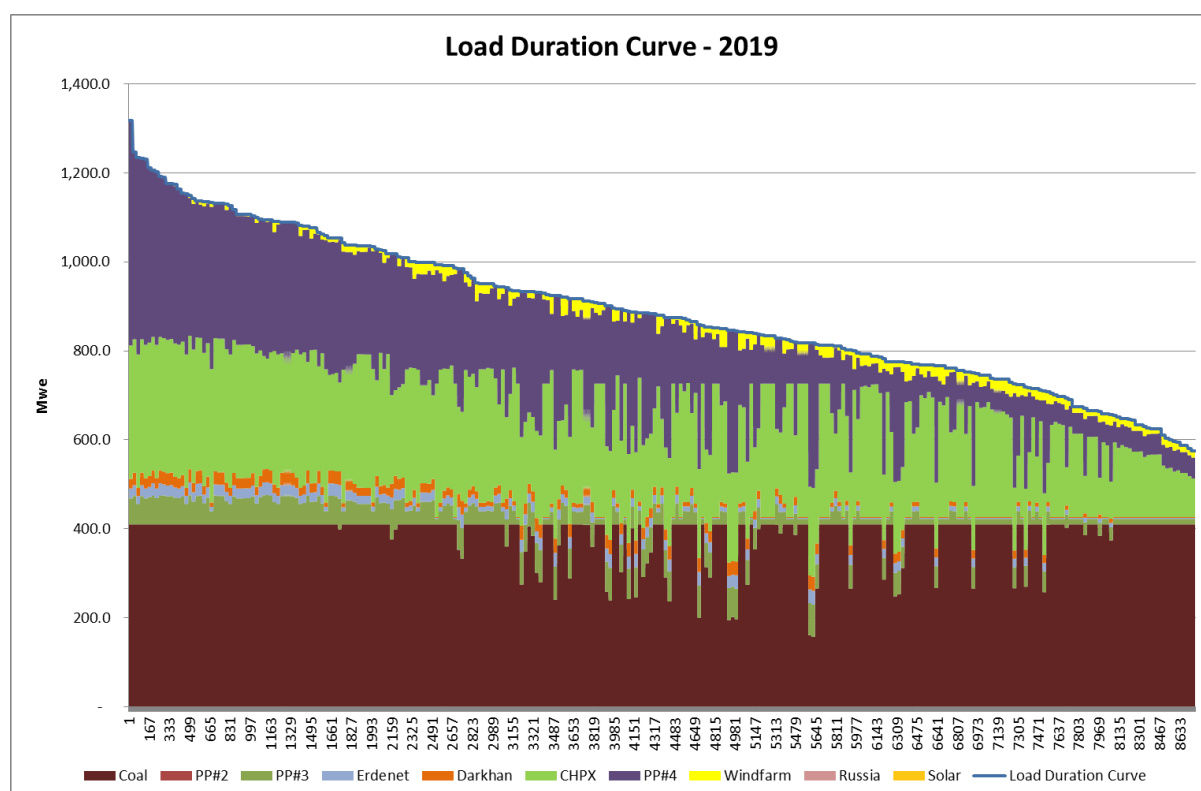


Chart 8: CES Load Dispatch Curve – 2020

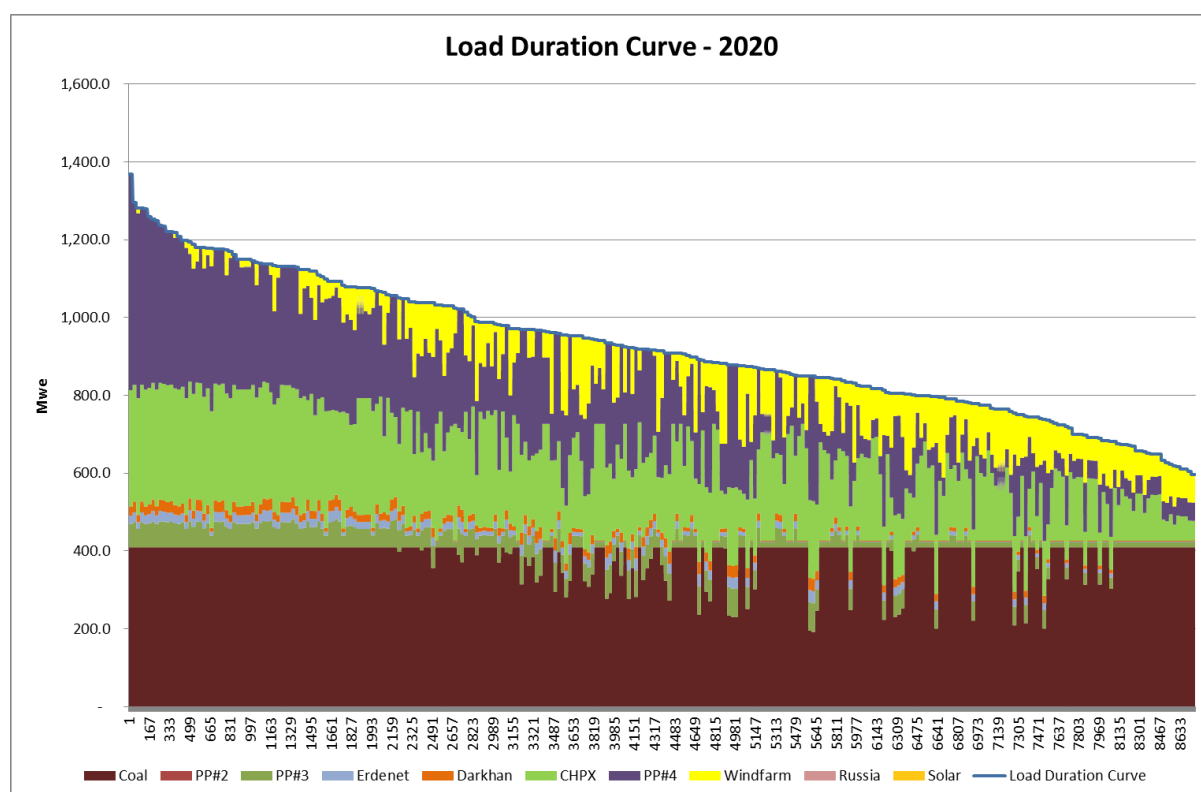


Chart 9: CES Load Dispatch Curve - 2021

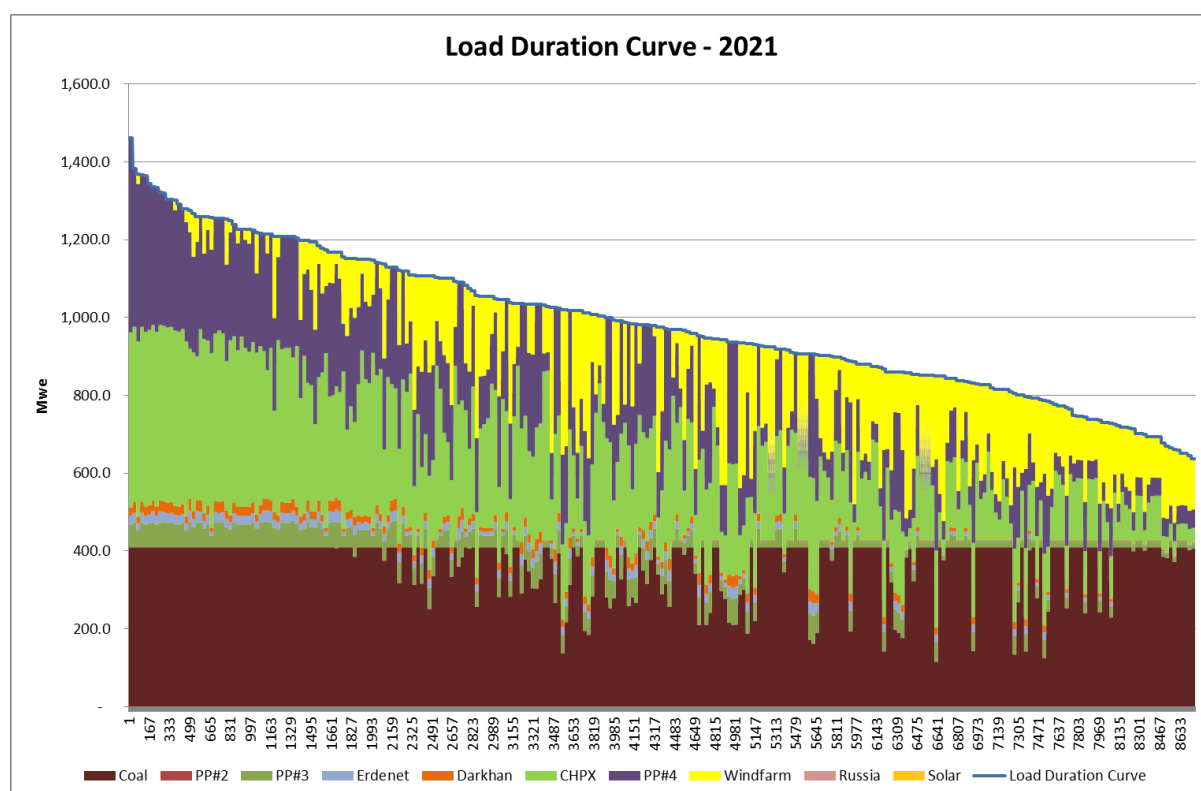


Chart 10: CES Load Dispatch Curve – 2022

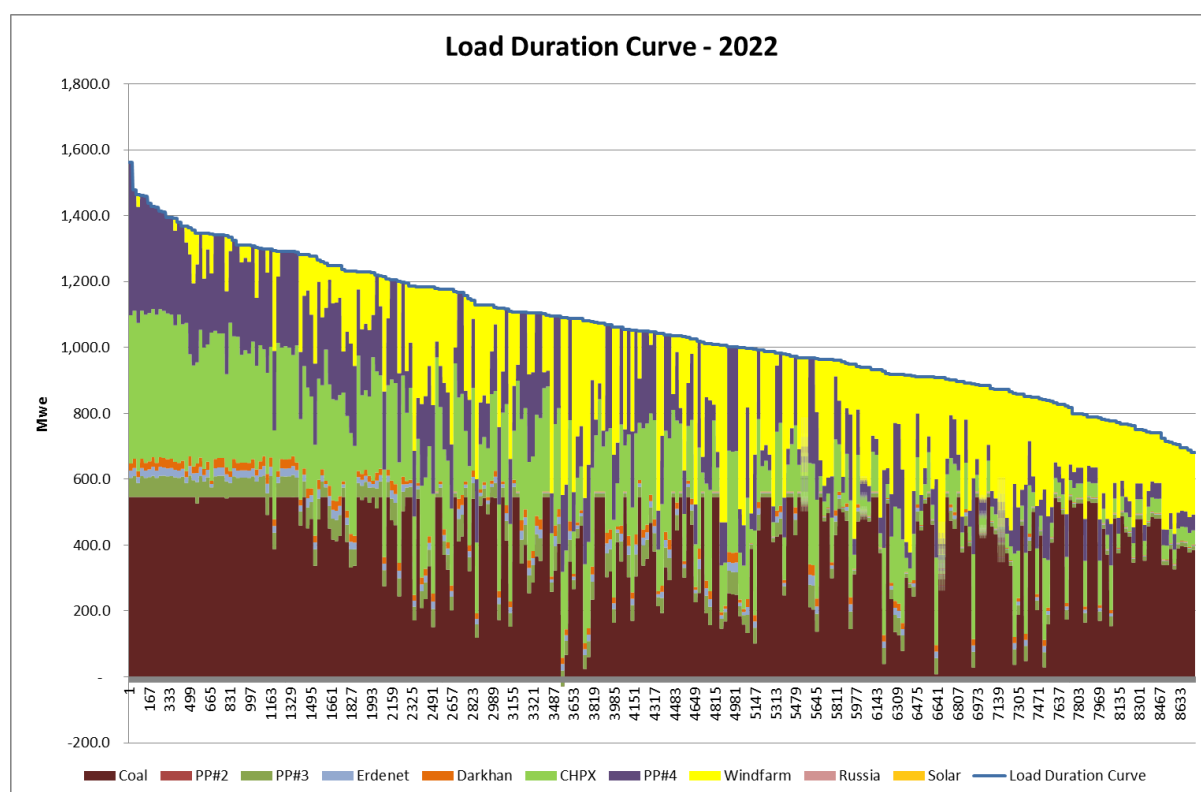


Chart 11: CES Load Dispatch Curve - 2023

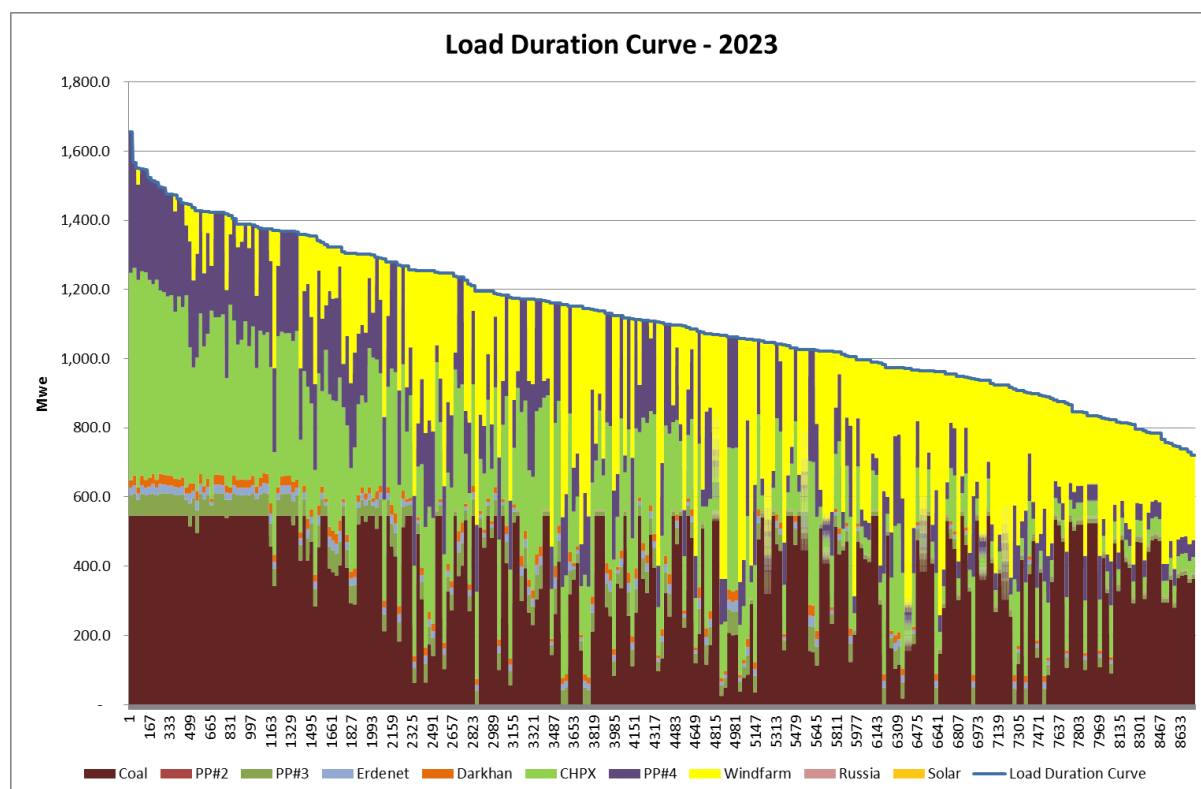


Chart 12: CES Load Dispatch Curve – 2024

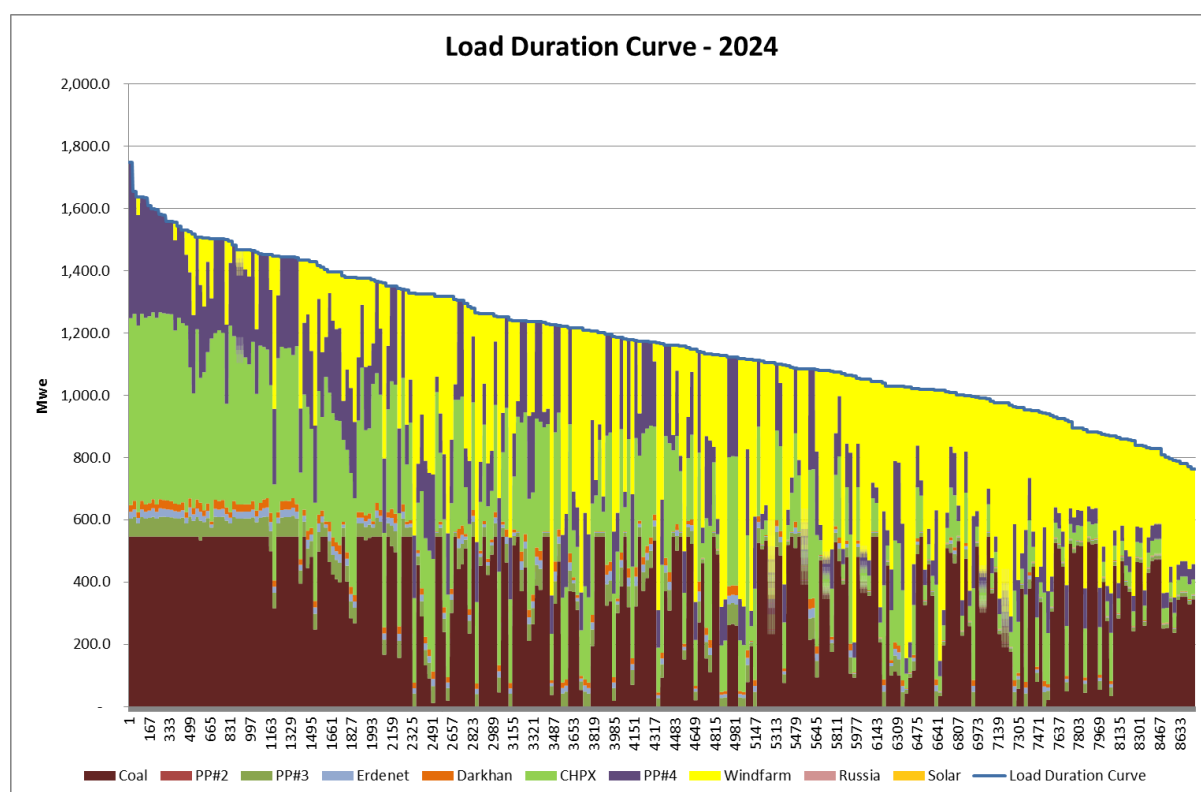
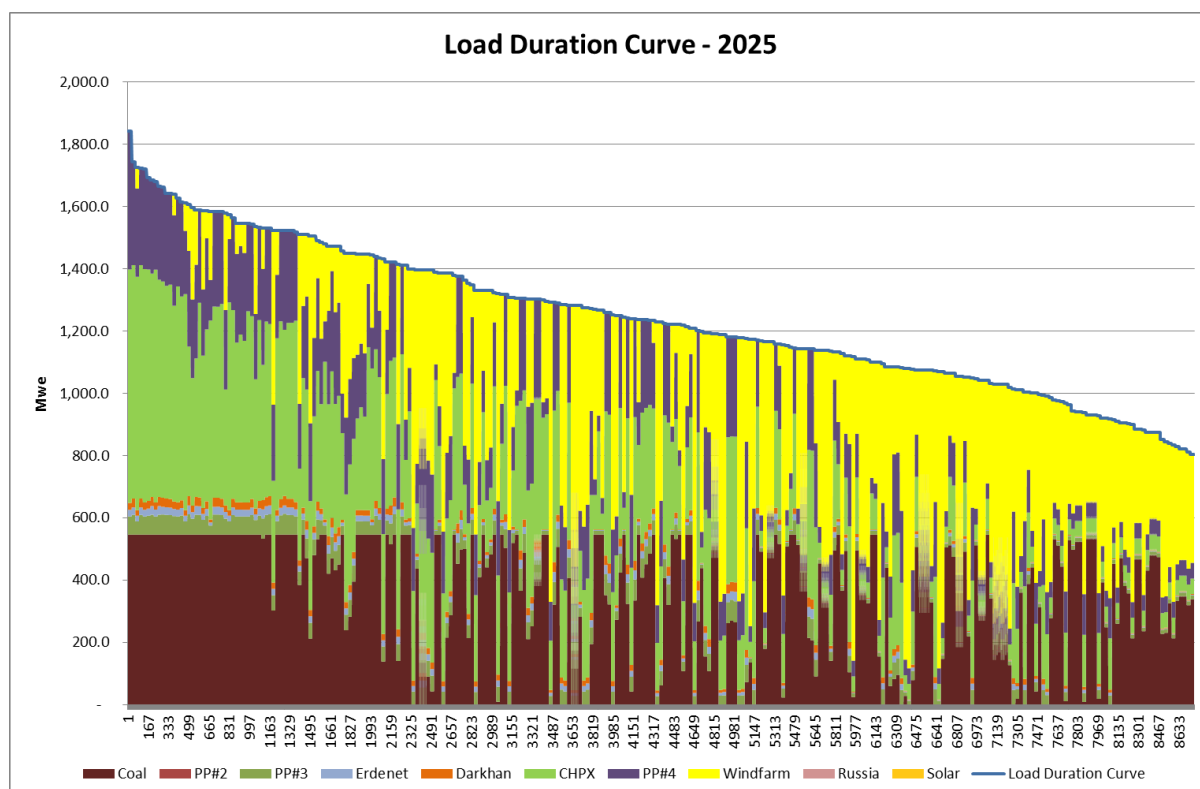


Chart 13: CES Load Dispatch Curve - 2025



APPENDIX P: ELECTRICITY DISPATCH CURVES – Scenario 4

Chart 1: CES Load Dispatch Curve - 2013

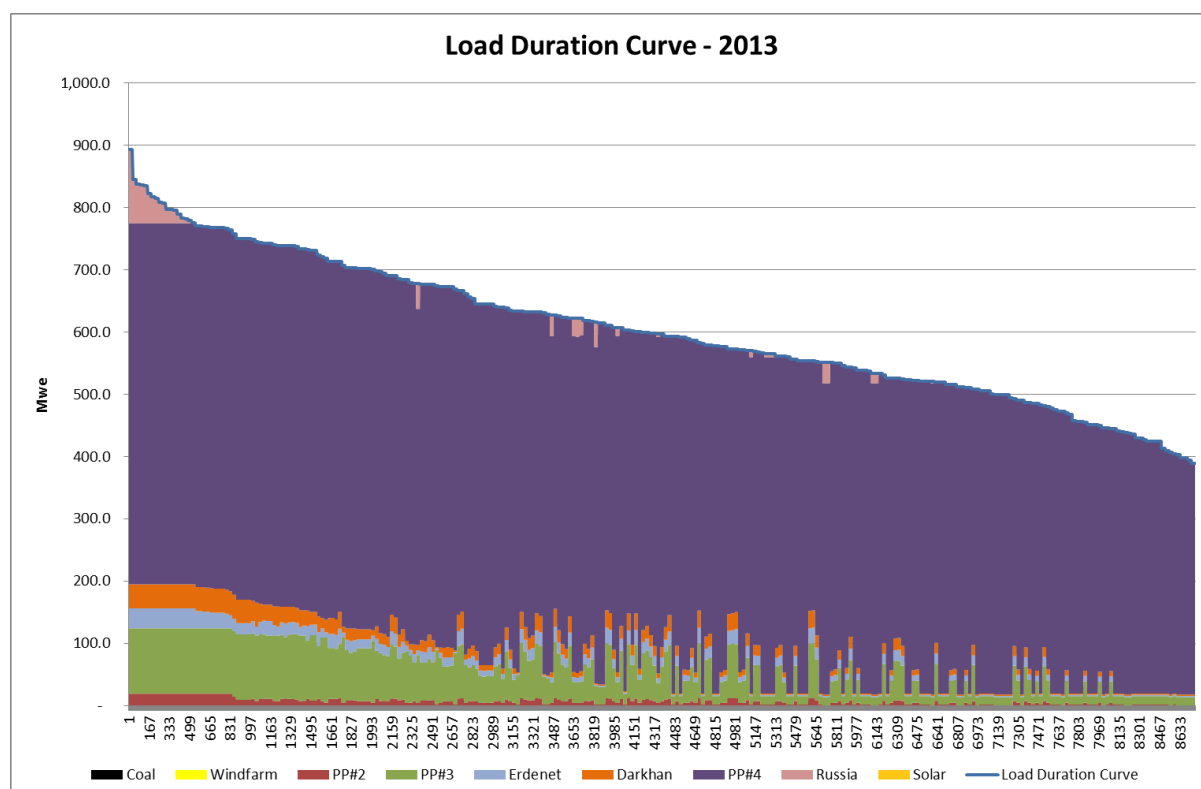


Chart 2: CES Load Dispatch Curve – 2014

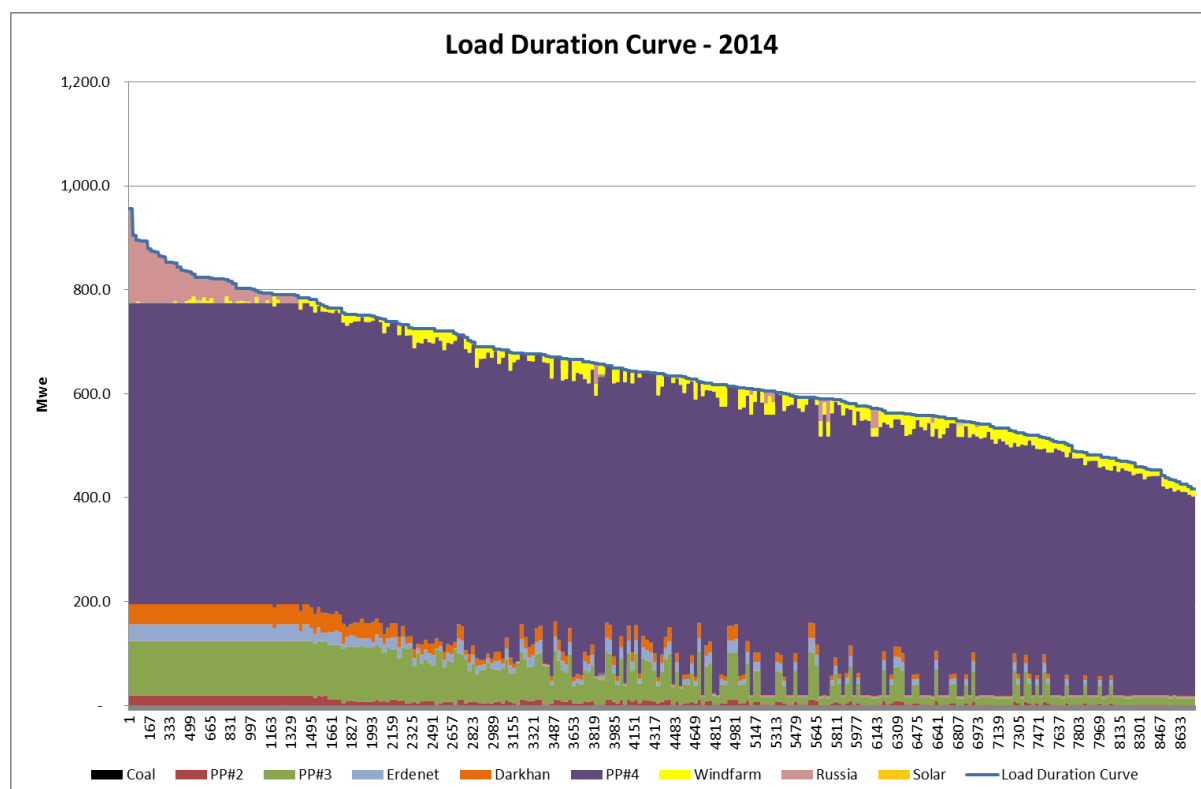


Chart 3: CES Load Dispatch Curve – 2015

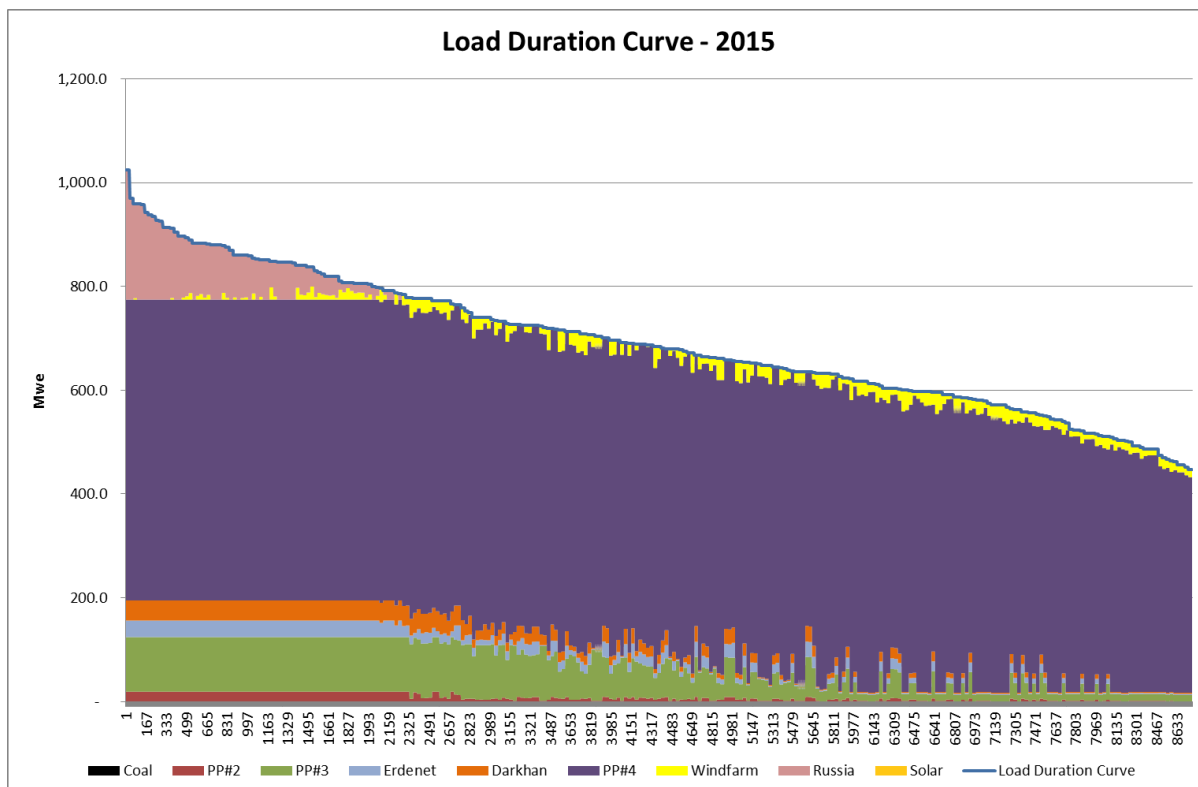


Chart 4: CES Load Dispatch Curve – 2016

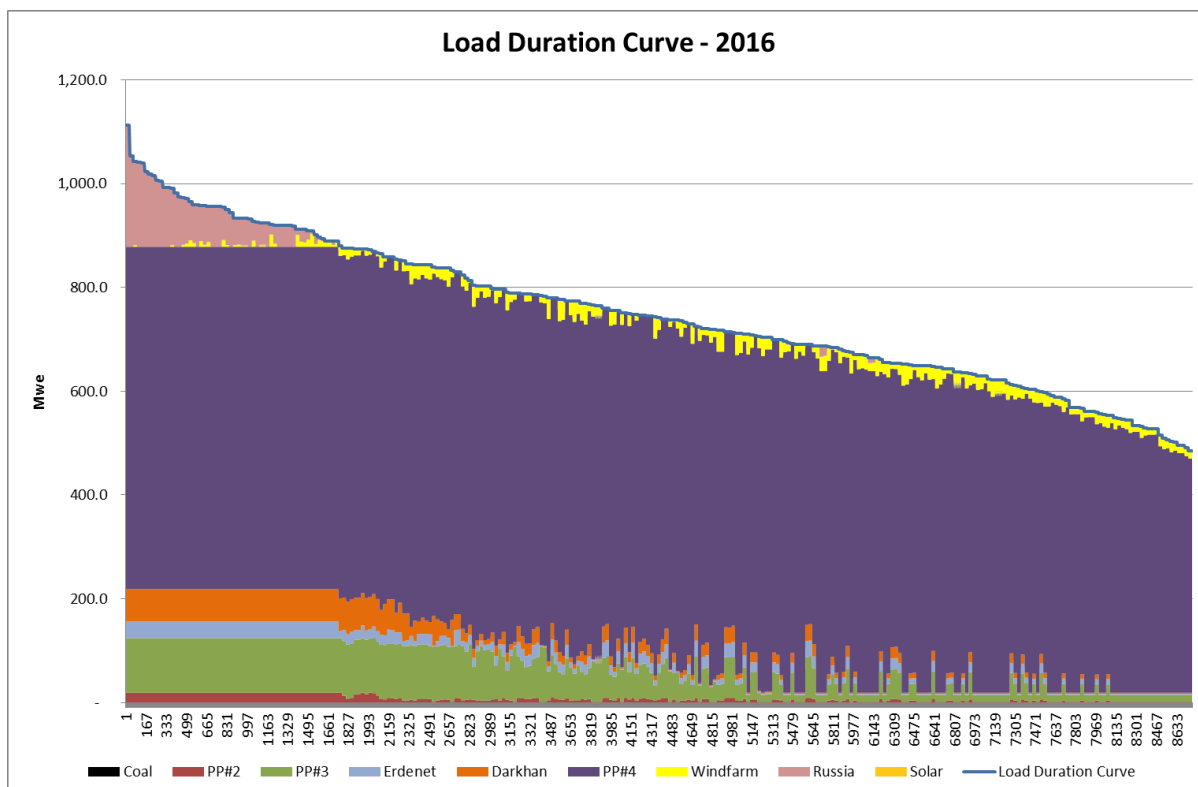


Chart 5: CES Load Dispatch Curve – 2017

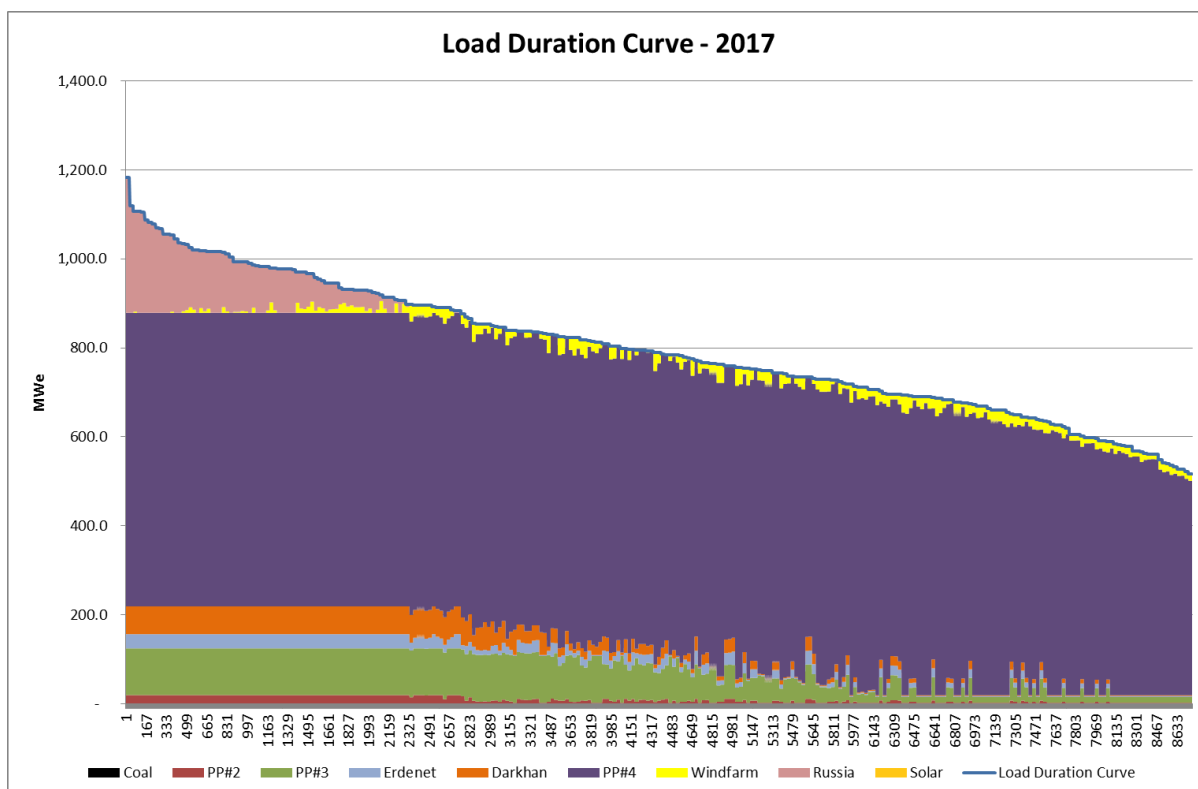


Chart 6: CES Load Dispatch Curve – 2018

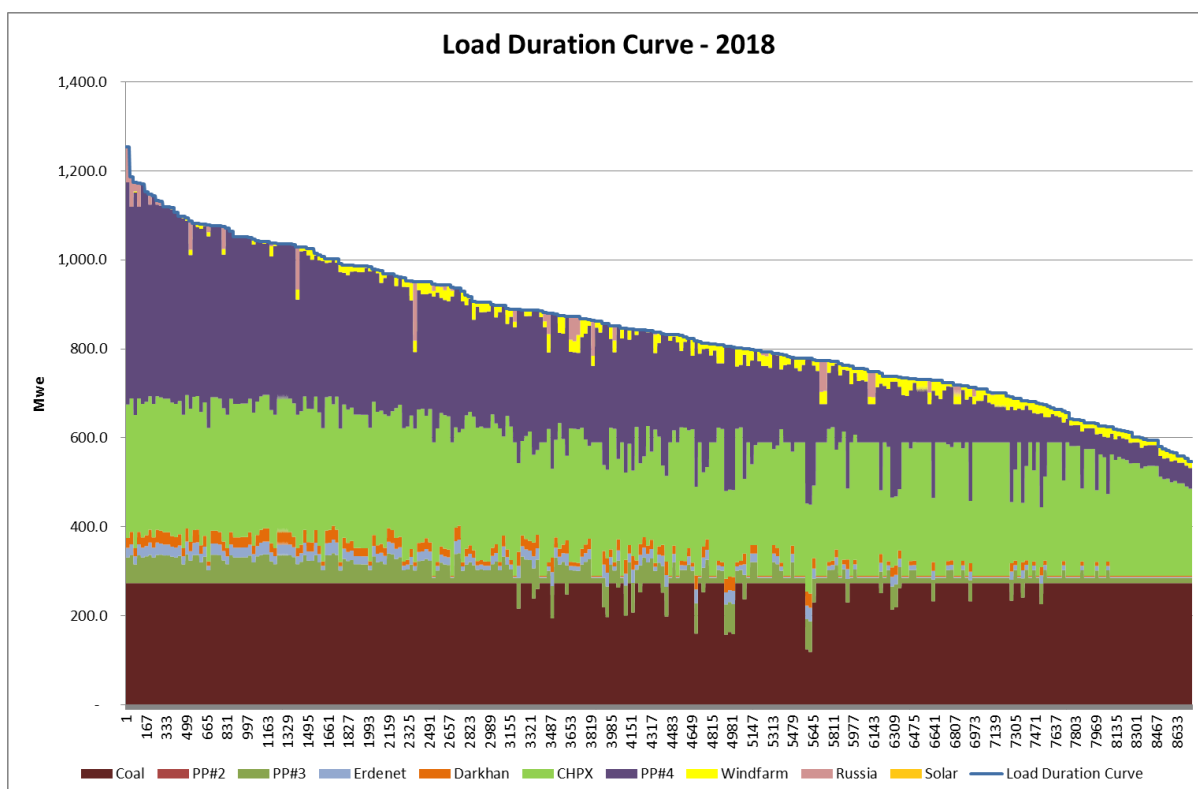


Chart 7: CES Load Dispatch Curve - 2019

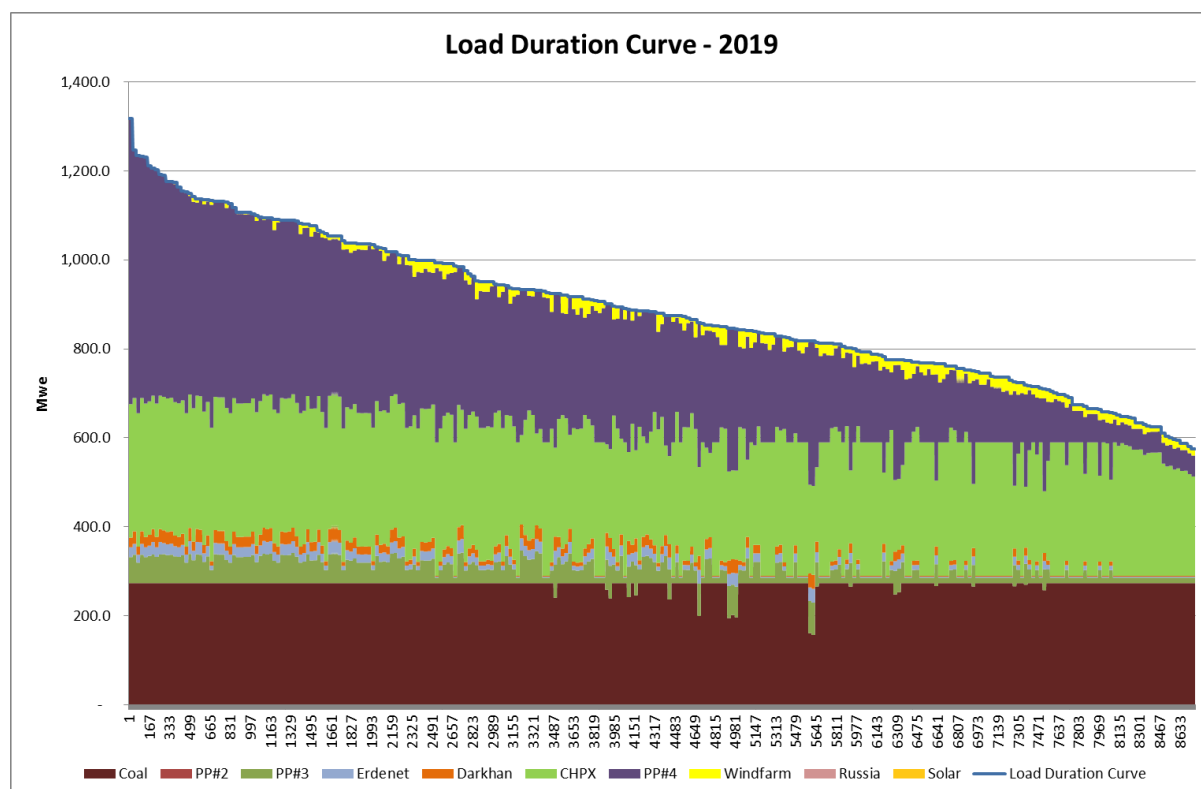


Chart 8: CES Load Dispatch Curve – 2020

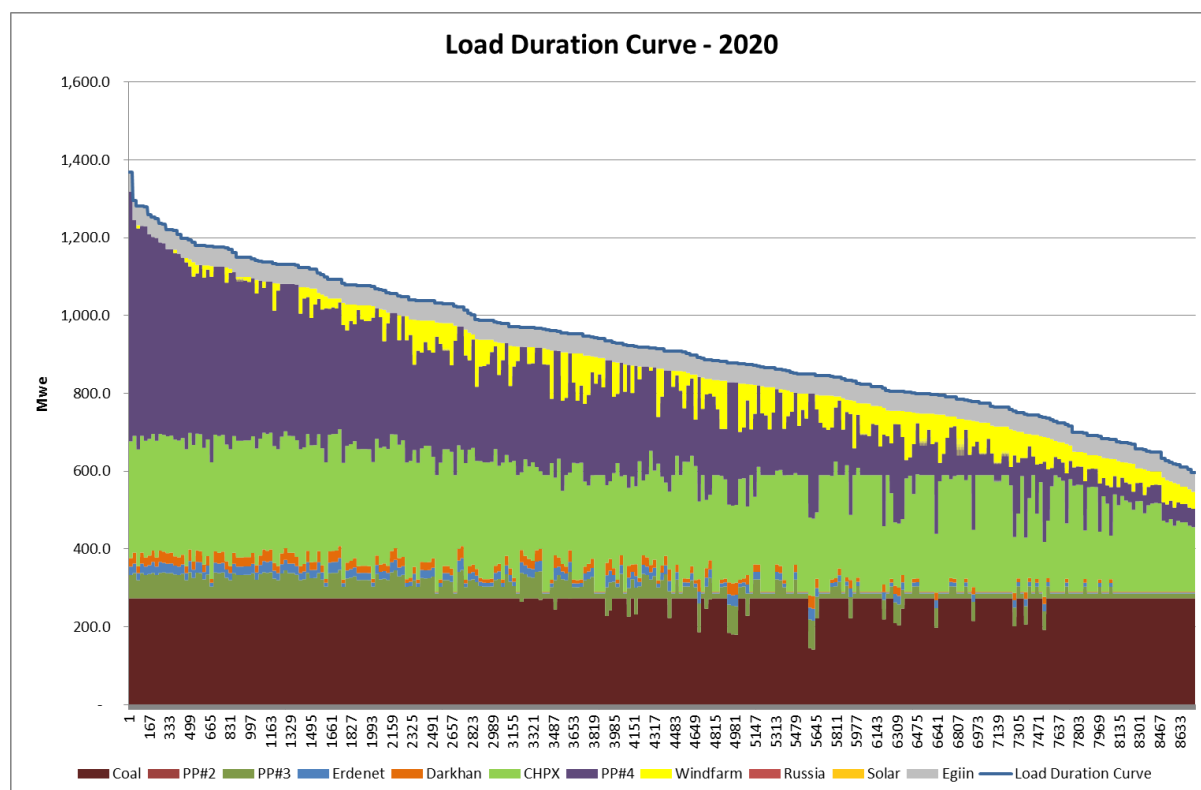


Chart 9: CES Load Dispatch Curve - 2021

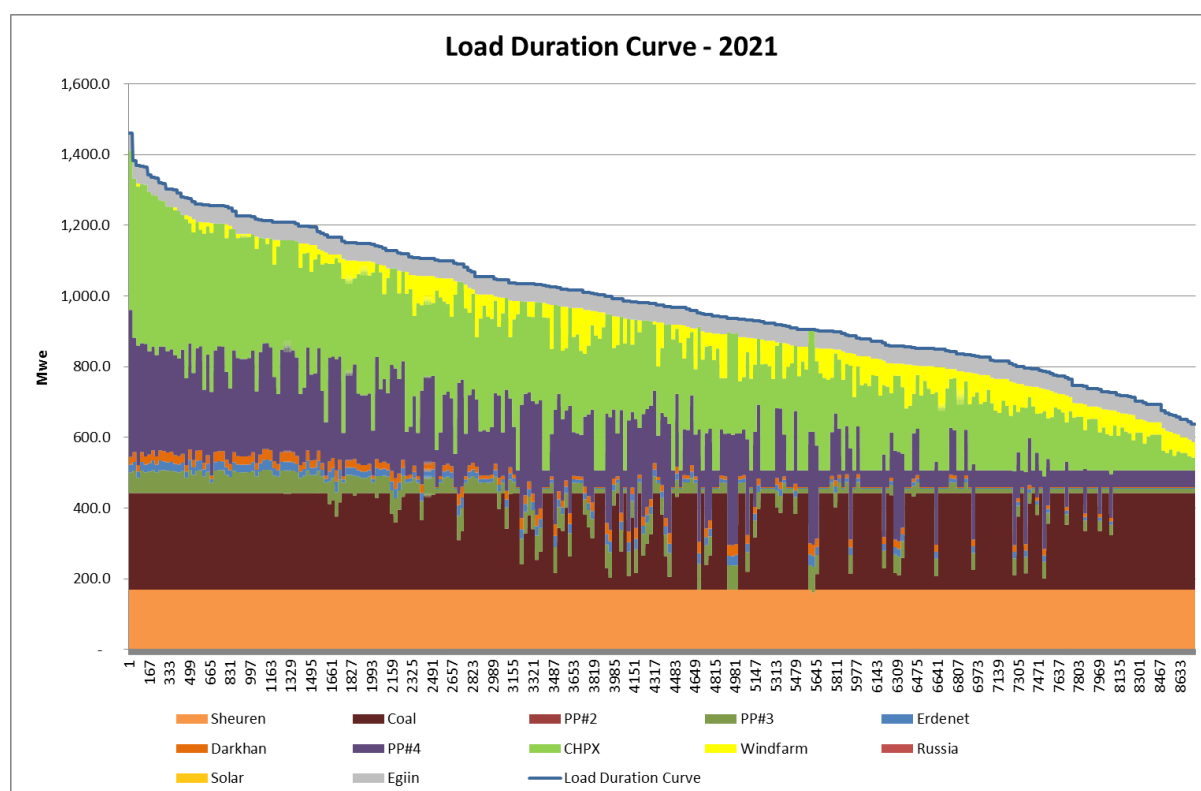


Chart 10: CES Load Dispatch Curve – 2022

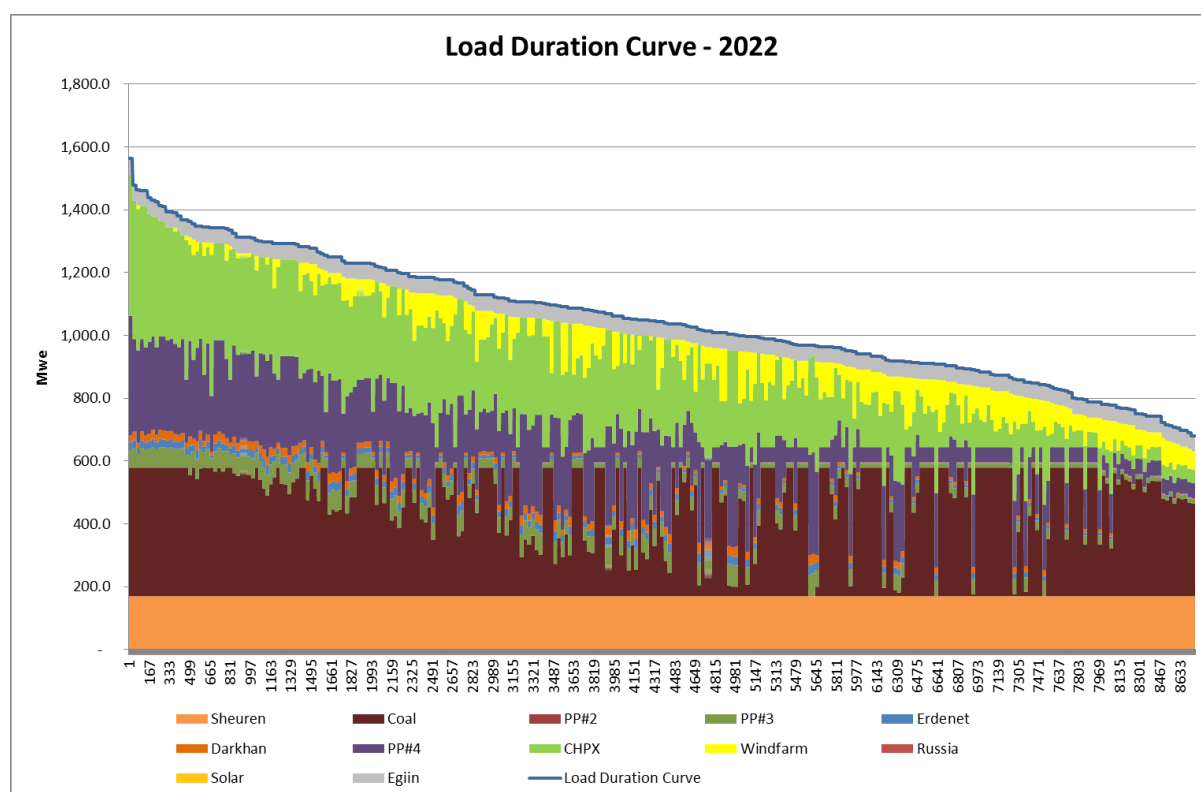


Chart 11: CES Load Dispatch Curve - 2023

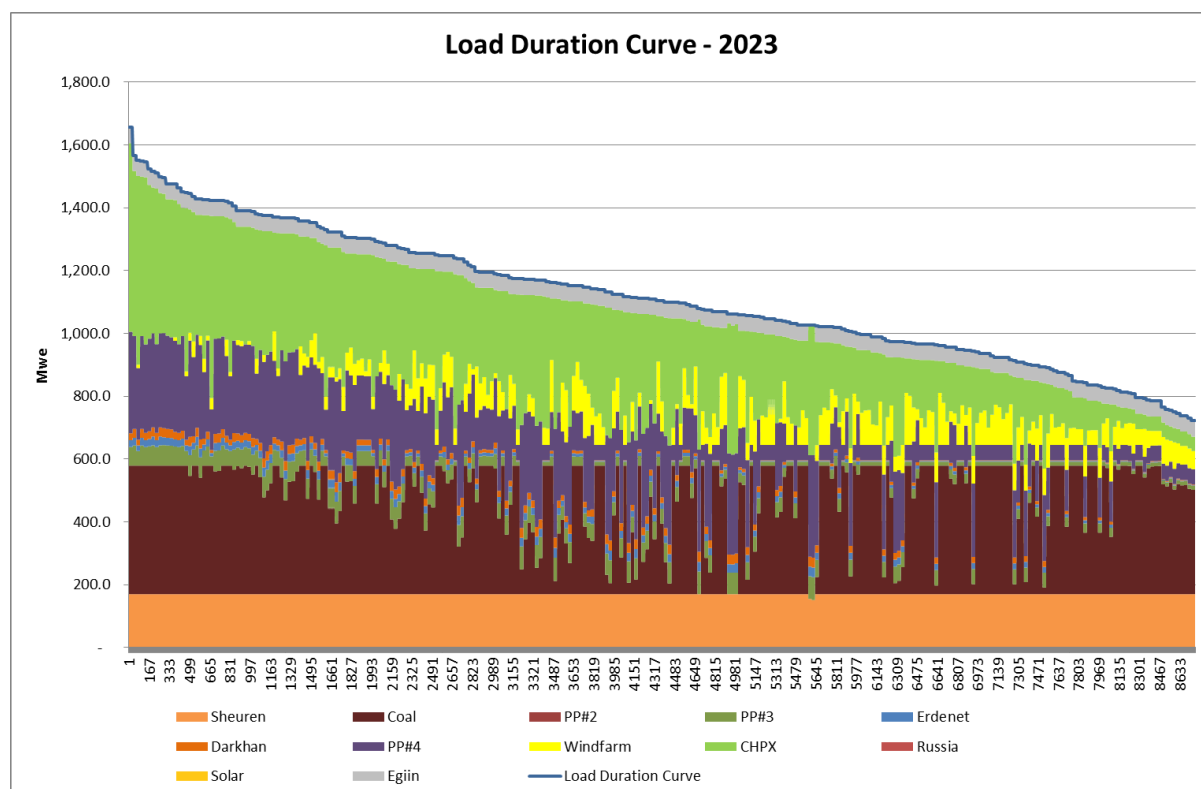


Chart 12: CES Load Dispatch Curve – 2024

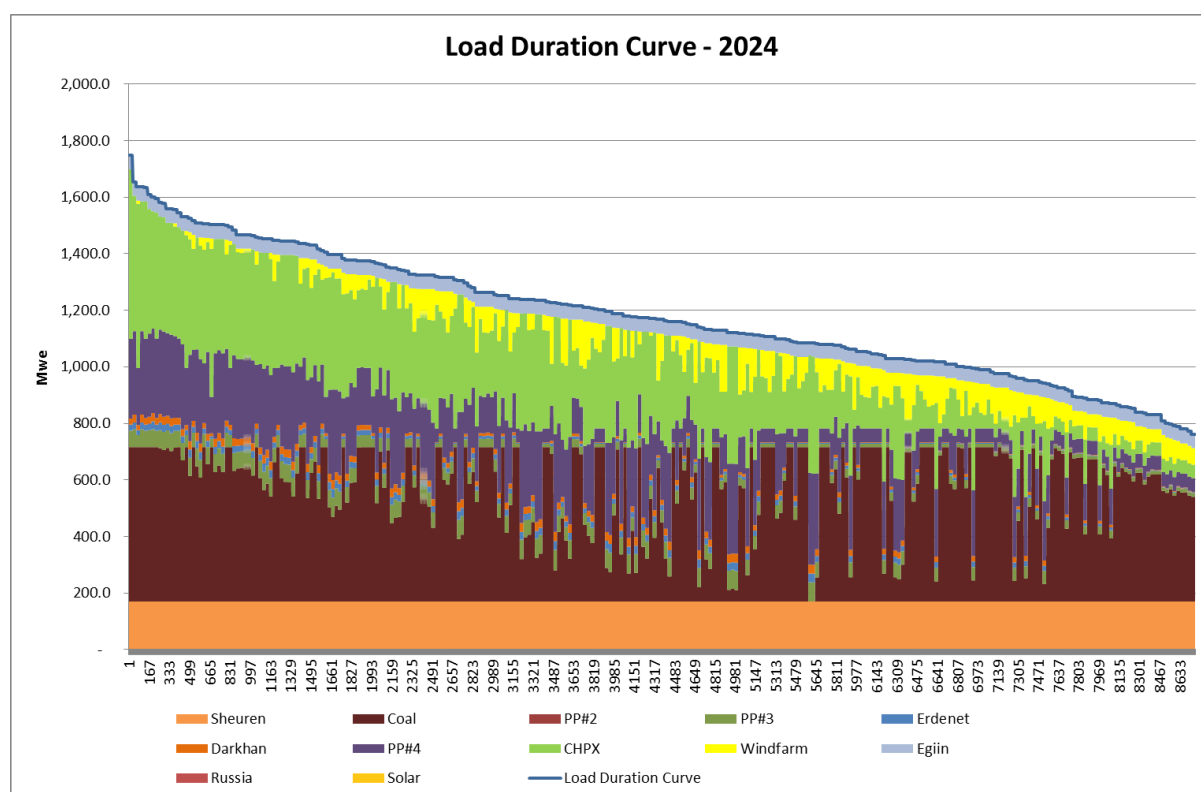


Chart 13: CES Load Dispatch Curve - 2025

