

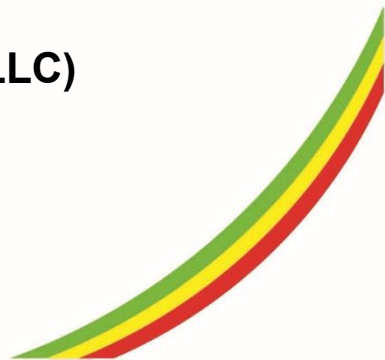
“Energy regulation- 20” conference

DISPATCHING, OPERATION PLANNING



Kh.Bold-Erdene (Consulting Engineer in Mongolia, “NDC” SO LLC)

**Ulaanbaatar
17th of November, 2021**



Content



Electricity
production and consumption

Key responsibilities of the “National Dispatching Center” LLC are ensuring reliability and stability of the energy system nationwide, computing the most economical efficient and optimal system operation schedule as well as pursuing the schedule, dispatching electricity and heat energy supply of consumers continuously 24 hours a day, and balancing supply and demand.

Installed capacity of Central region's integrated power system (GRIPS)

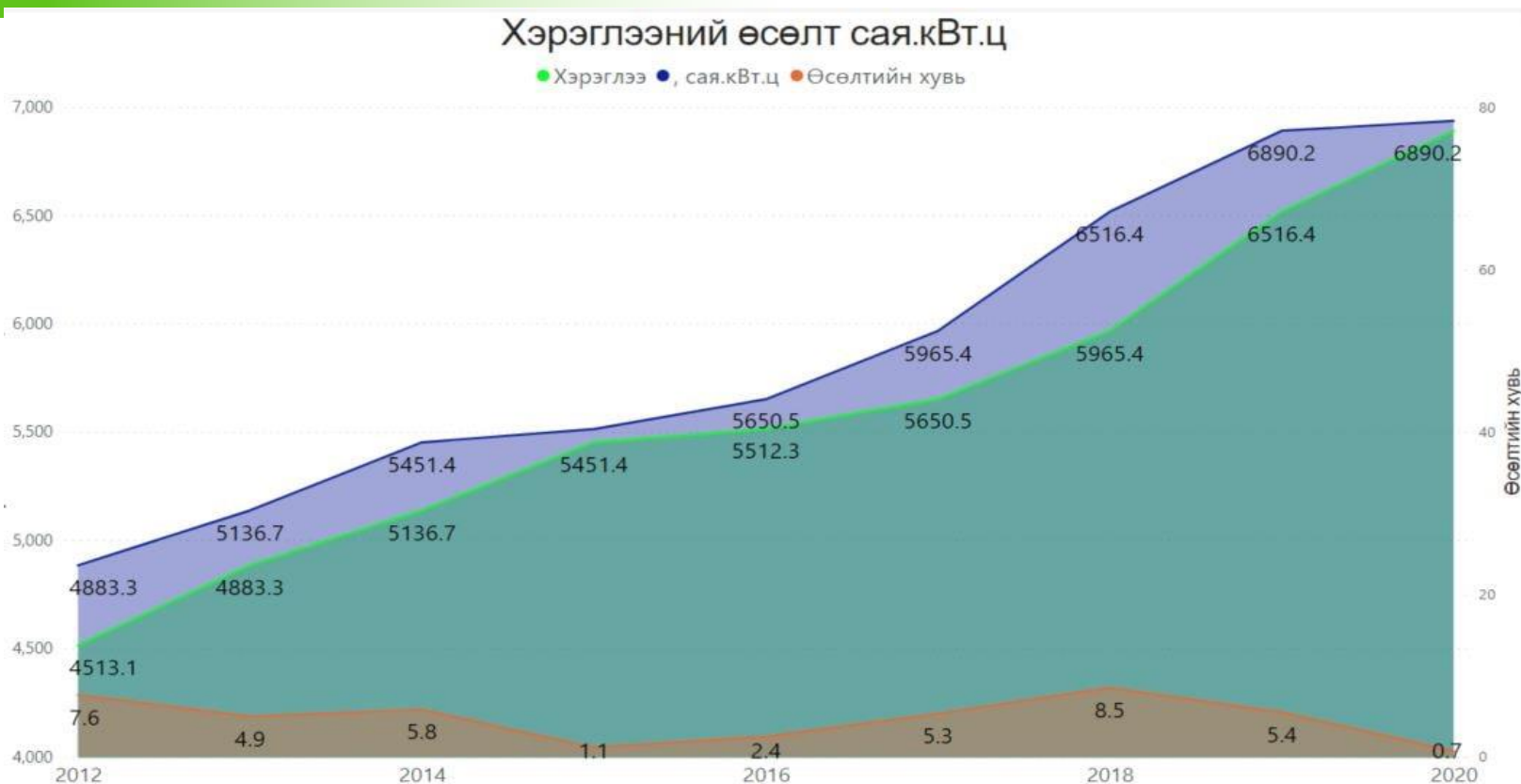


The installed capacity of the CRIPS is currently 1476.8 MW. Of this, 83.4% or 1231.8 MW can be attributed to combined heat and power plants and 16.6% or 245 MW to renewable energy sources. Thereof, the capacity of wind power plants has reached 155 MW and solar power plants 90 MW.



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Electricity supply and demand of CRIPS



On average, electricity consumption has increased by 300 million kWh or by 4.8% annually. .

When renewable energy sources have not been integrated to the system, 92.7% of the total consumption was supplied by CHPPs and 7.3% by import. Since 2013, with the integration of renewable energy sources to the system, the domestic distribution has increased from 92.7 to 96.9%, and imported energy provides 3.1 to 7.3% of the demand.

Share of generation sources in the peak demand of CRIPS



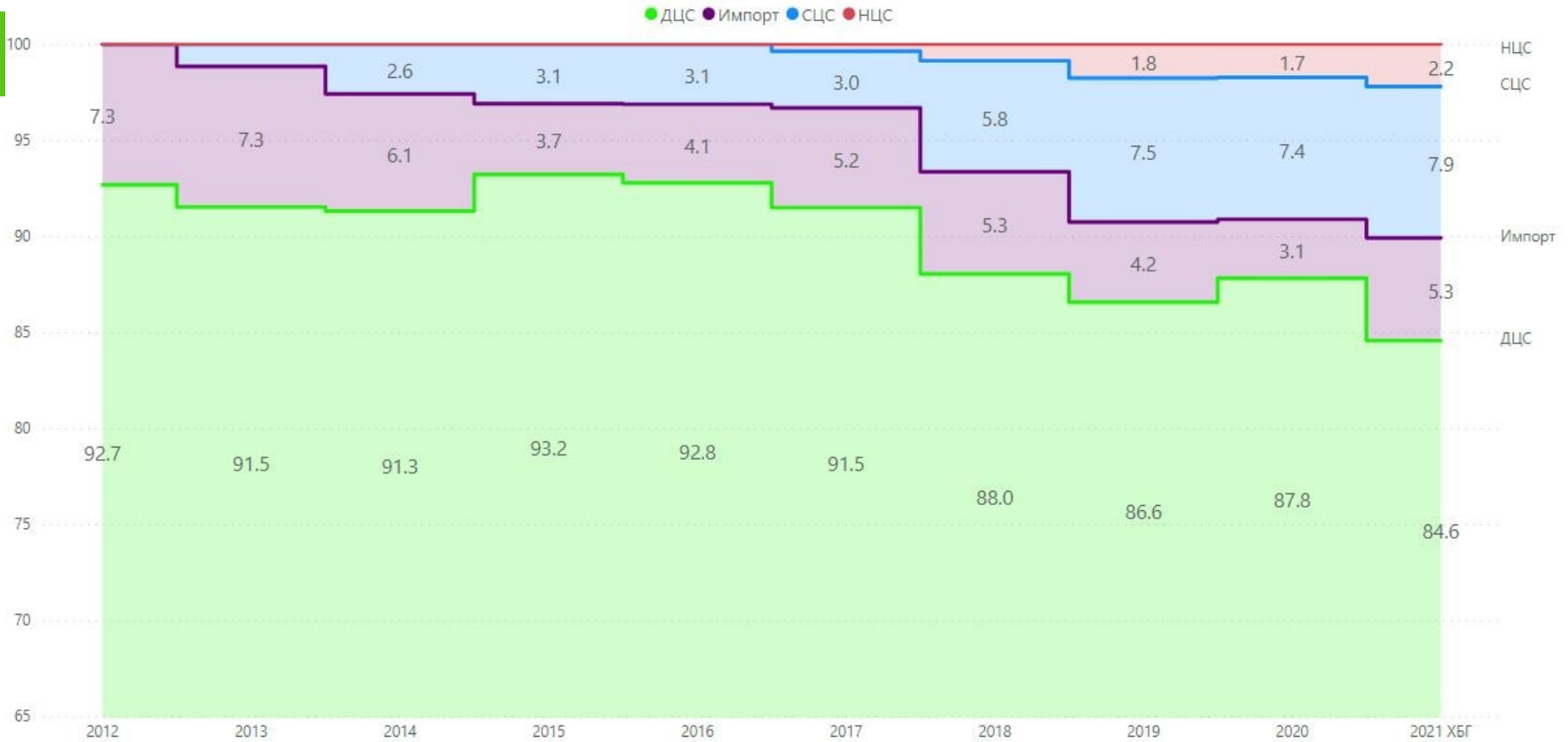
Peak loads have increased by 40-60 MW or by 5% per year on average.

Solar power plants do not contribute to the winter peak load generation, while wind power plants account for 0.2 to 10.2% of the system peak load.



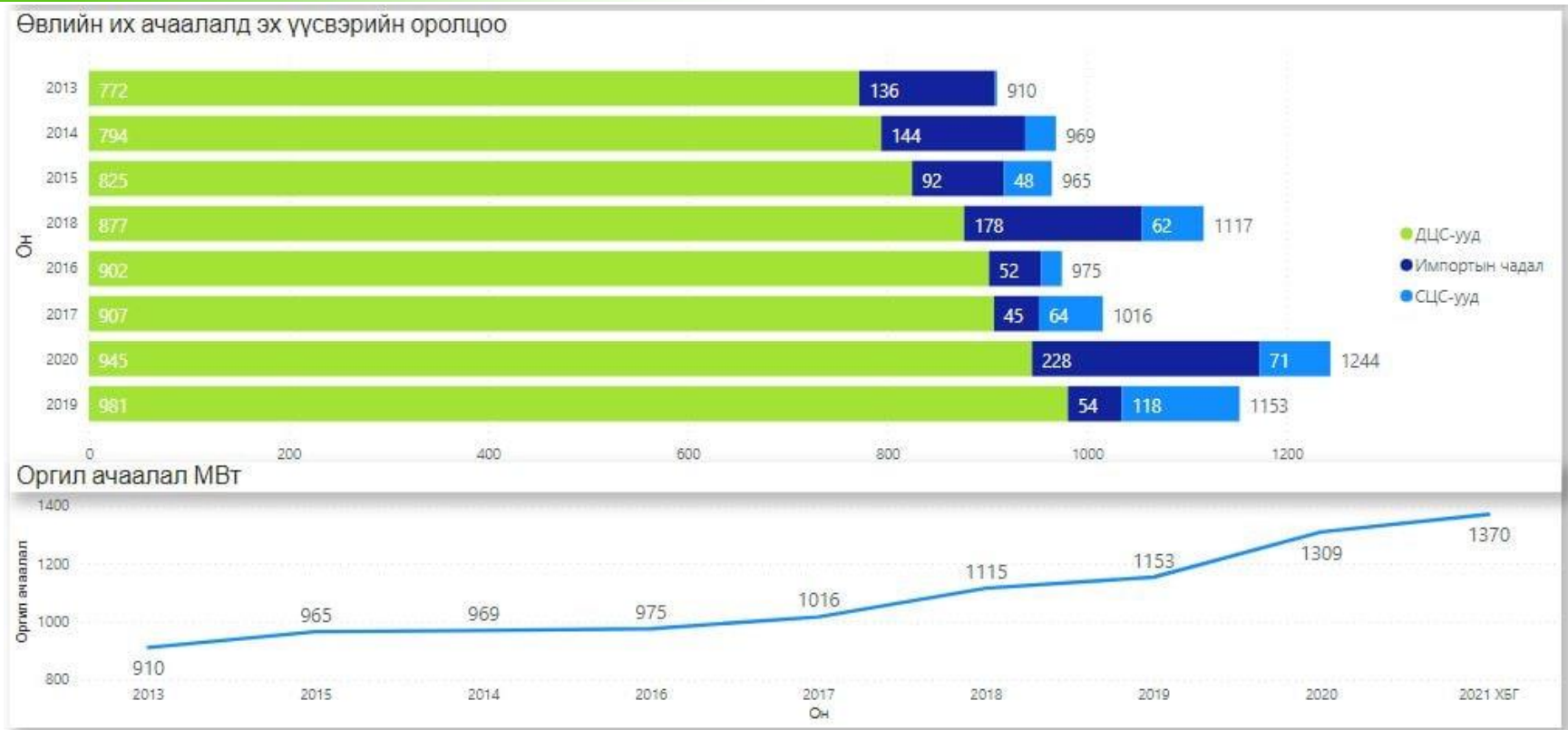
DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Эх үүсвэрүүдийн оролцоо (хувь)



When renewable energy sources have not been integrated to the system, 92.7% of the total consumption was supplied by CHPPs and 7.3% by import electricity. Since 2013, with the integration of renewable energy sources to the system, the domestic distribution has increased from 92.7 to 96.9%, and imported energy provides 3.1 to 7.3% of the demand.

Share of generation sources in CRIPS's peak demand



The share of generation sources involved in supplying winter peak loads, looks as follows: CHPPs - 72.2%, imported energy - 17.4%, wind power plants - 5.4%, and SPPs - 0%.



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Daily load profile in CRIPS

	1 cap	2 cap	3 cap	4 cap	5 cap	6 cap	7 cap	8 cap	9 cap	10cap	11cap	12cap
1:00	0.78	0.79	0.77	0.77	0.78	0.81	0.82	0.79	0.73	0.75	0.75	0.78
2:00	0.74	0.75	0.73	0.73	0.74	0.76	0.77	0.74	0.70	0.72	0.73	0.75
3:00	0.72	0.73	0.71	0.71	0.71	0.73	0.74	0.72	0.68	0.70	0.71	0.73
4:00	0.71	0.72	0.70	0.70	0.70	0.71	0.73	0.70	0.67	0.70	0.71	0.72
5:00	0.70	0.71	0.70	0.69	0.69	0.70	0.71	0.69	0.67	0.70	0.70	0.72
6:00	0.70	0.71	0.70	0.70	0.69	0.70	0.71	0.69	0.67	0.71	0.71	0.72
7:00	0.71	0.73	0.72	0.73	0.73	0.73	0.73	0.71	0.71	0.74	0.73	0.75
8:00	0.75	0.77	0.76	0.77	0.78	0.78	0.78	0.77	0.77	0.80	0.79	0.79
9:00	0.80	0.82	0.82	0.84	0.86	0.87	0.87	0.86	0.84	0.86	0.84	0.84
10:00	0.86	0.88	0.88	0.91	0.94	0.95	0.95	0.94	0.91	0.91	0.89	0.89
11:00	0.90	0.91	0.91	0.94	0.97	1.00	1.00	0.99	0.93	0.92	0.90	0.91
12:00	0.91	0.91	0.91	0.94	0.97	1.00	1.00	0.99	0.93	0.91	0.90	0.91
13:00	0.90	0.90	0.90	0.92	0.95	0.99	0.99	0.98	0.91	0.90	0.89	0.90
14:00	0.89	0.89	0.88	0.91	0.94	0.98	0.98	0.97	0.90	0.89	0.88	0.89
15:00	0.88	0.87	0.87	0.90	0.93	0.97	0.98	0.96	0.90	0.88	0.88	0.88
16:00	0.88	0.87	0.86	0.90	0.92	0.96	0.97	0.96	0.89	0.88	0.88	0.89
17:00	0.89	0.87	0.87	0.90	0.93	0.96	0.97	0.96	0.90	0.90	0.91	0.93
18:00	0.94	0.90	0.89	0.92	0.95	0.97	0.98	0.97	0.92	0.94	0.96	0.98
19:00	1.00	0.96	0.94	0.95	0.97	0.98	0.98	0.98	0.96	1.00	1.00	1.00
20:00	0.99	1.00	1.00	0.98	0.98	0.98	0.97	0.98	1.00	1.00	0.98	0.98
21:00	0.95	0.97	0.99	1.00	1.00	0.97	0.97	1.00	0.99	0.96	0.94	0.94
22:00	0.92	0.94	0.95	0.98	1.00	0.99	0.98	0.98	0.93	0.91	0.91	0.92
23:00	0.89	0.91	0.90	0.93	0.96	0.97	0.97	0.94	0.88	0.87	0.87	0.88
0:00	0.84	0.85	0.83	0.84	0.87	0.89	0.90	0.86	0.80	0.80	0.81	0.83

Daily peak-load:

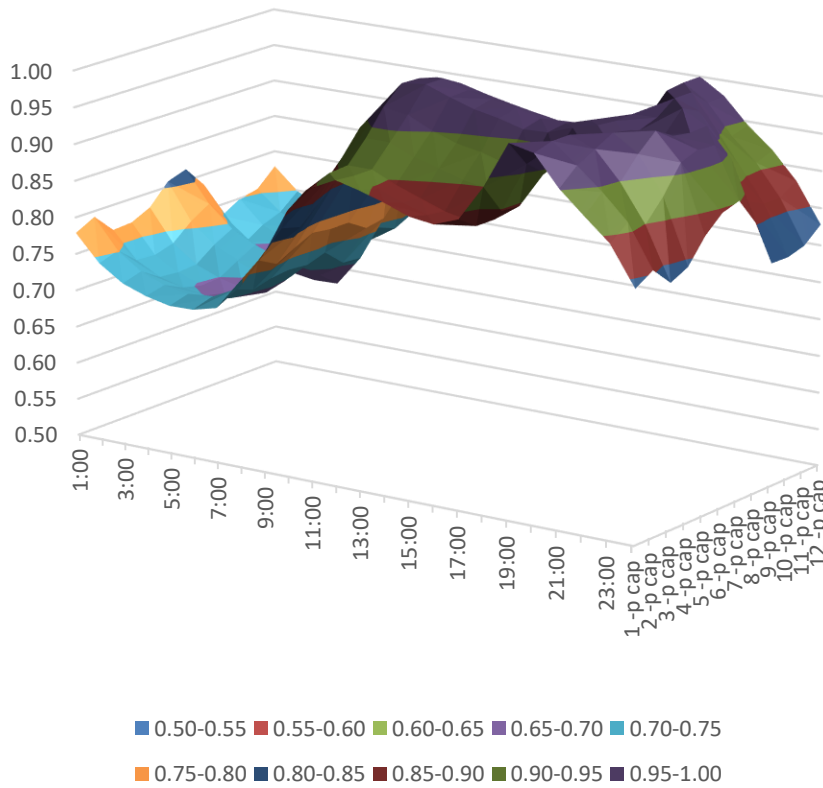
- Winter: 7 pm;
- Spring, autumn:
8.00-9.00 pm;
- Summer: 11-12 am

Duration of night low-load:

- Winter: 1-8 hours
- Summer: 1-7 hours



Daily load profile in CRIPS



	Даваа	Мягм.	Лхг.	Пүрэв	Баас.	Бямба	Ням
1:00	0.75	0.74	0.74	0.73	0.76	0.78	0.79
2:00	0.70	0.70	0.69	0.69	0.71	0.73	0.74
3:00	0.68	0.68	0.68	0.67	0.69	0.71	0.71
4:00	0.67	0.68	0.66	0.66	0.69	0.69	0.69
5:00	0.67	0.67	0.66	0.66	0.68	0.68	0.69
6:00	0.67	0.67	0.66	0.67	0.68	0.68	0.69
7:00	0.70	0.70	0.69	0.69	0.71	0.69	0.70
8:00	0.75	0.75	0.75	0.75	0.76	0.72	0.71
9:00	0.81	0.82	0.81	0.81	0.83	0.76	0.76
10:00	0.87	0.88	0.87	0.88	0.90	0.84	0.82
11:00	0.90	0.91	0.89	0.90	0.93	0.89	0.89
12:00	0.91	0.93	0.89	0.91	0.94	0.89	0.91
13:00	0.90	0.89	0.90	0.90	0.92	0.90	0.90
14:00	0.89	0.89	0.87	0.90	0.90	0.90	0.89
15:00	0.88	0.88	0.88	0.88	0.89	0.89	0.89
16:00	0.87	0.88	0.87	0.87	0.88	0.87	0.87
17:00	0.89	0.88	0.88	0.88	0.89	0.88	0.87
18:00	0.93	0.92	0.90	0.91	0.92	0.92	0.91
19:00	1.00	1.00	0.99	0.98	1.00	0.99	0.99
20:00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
21:00	0.96	0.97	0.96	0.96	0.97	0.96	0.97
22:00	0.91	0.92	0.92	0.92	0.93	0.92	0.93
23:00	0.87	0.87	0.88	0.88	0.89	0.89	0.88
0:00	0.81	0.81	0.81	0.82	0.83	0.83	0.83



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Share of CHPPs in the supply

CHPPs' distribution to SB for the first 10 months of 2021, in thousand kWh

Plant	planned for 2021	performance for 2021	Difference	Percentage	performance for 2020	performance for 2020-2021	
						Difference	Percentage
CHPP-2	102,543.999	104,440.446	1,896.4	101.8%	104,896.383	-455.9	-0.4%
CHPP-3	674,176.000	730,178.219	56,002.2	108.3%	674,552.123	55,626.1	8.2%
CHPP-4	2,827,901.856	3,131,735.981	303,834.1	110.7%	2,841,304.381	290,431.6	10.2%
DCHPP	229,326.736	200,476.302	-28,850.4	87.4%	231,988.024	-31,511.7	-13.6%
ECHPP	186,678.920	156,980.566	-29,698.4	84.1%	98,597.730	58,382.8	59.2%
EFCHPP	212,057.800	222,544.212	10,486.4	104.9%	205,728.996	16,815.2	8.2%
DzCHPP	24,169.840	13,183.536	-10,986.3	54.5%	19,095.888	-5,912.4	-31.0%
Ukhaa Khudag	27,905.100	32,027.754	4,122.7	114.8%	24,097.524	7,930.2	32.9%
CHPP total	4,284,760.250	4,591,567.016	306,806.8	7.2%	4,200,261.049	391,306.0	9.3%

In the first 10 months of 2021, electricity demand increased by 692.3 million kWh or 14.3% compared to the same period of the previous year. To cover this increase, CHPPs provided 402.8 million kWh of energy, or 58.2% of total consumption growth.

Share of RES in the supply

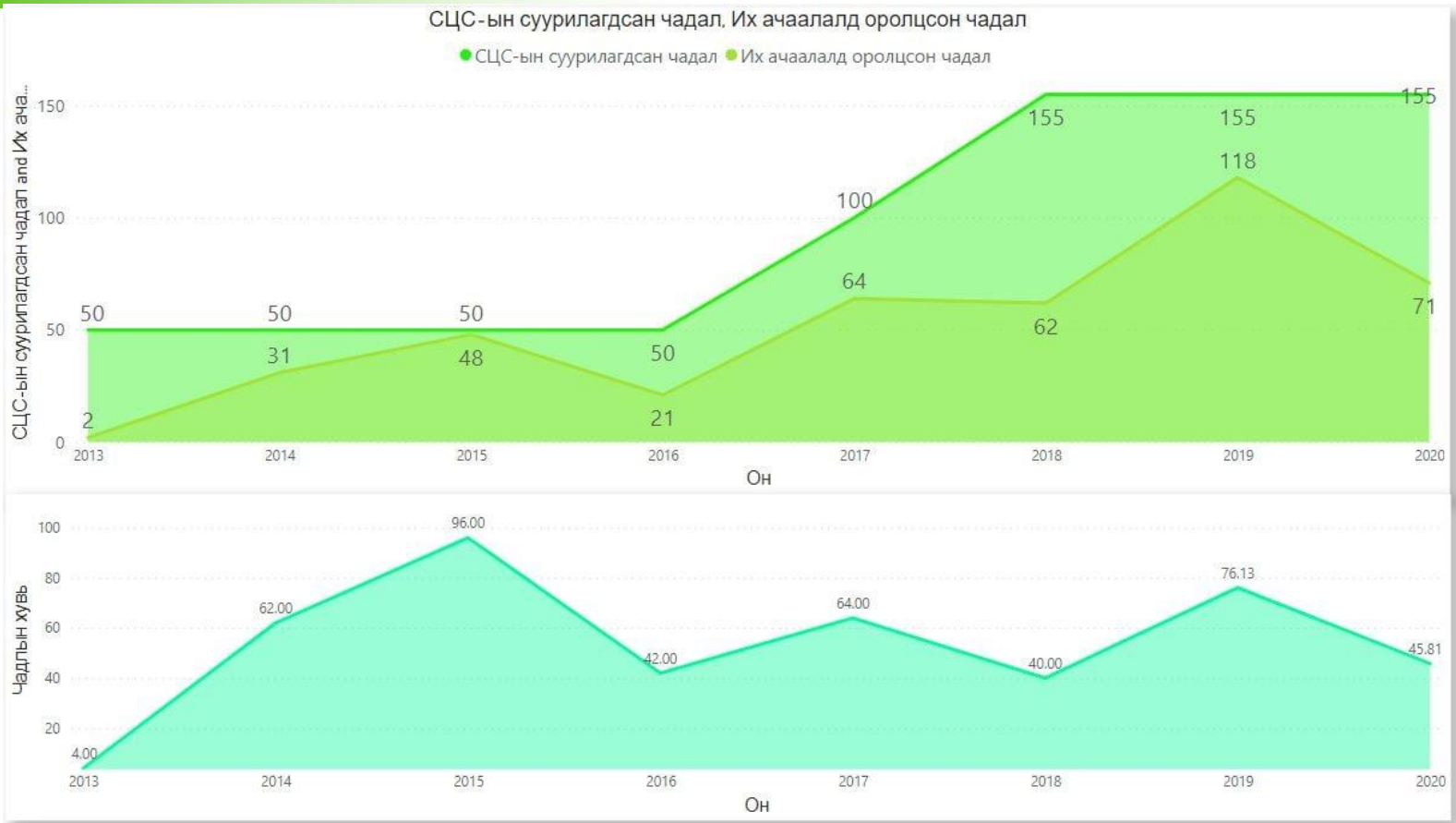
Capacity and percentage of installed capacity of RES contributed to the winter peak demand

Parameter	2013	2014	2015	2016	2017	2018	2019	2020	Дундаж
Installed capacity of WPP	50	50	50	50	100	155	155	155	
Delivered capacity during the high-load time	2	31	48	21	64	62	118	71	52.1
Percentage of the delivered capacity during the high-load time	4%	62%	96%	42%	64%	40%	76%	45.8%	53.7%

Available, generated and not delivered electricity volume by WPPs in the first 10 months of 2021, thousand kWh

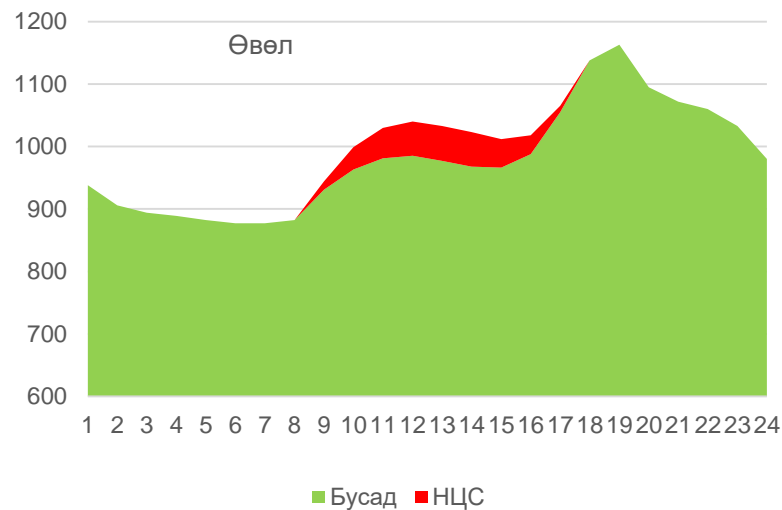
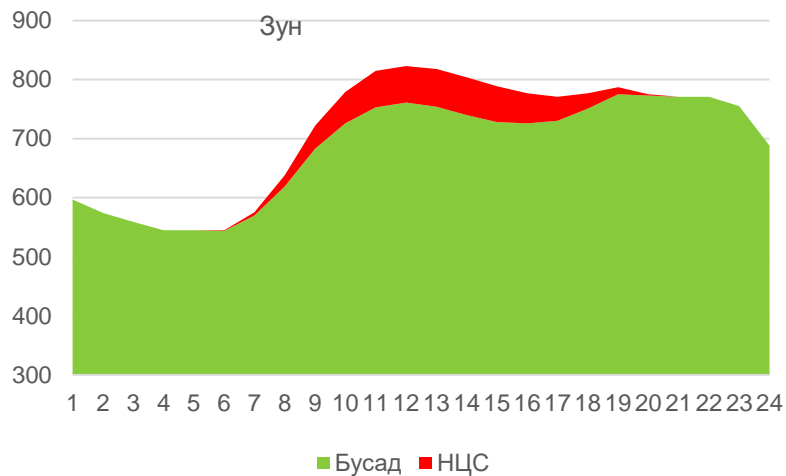
ЦЛЦ	Generated volume	Available volume	Not delivered volume	
Salkhit WPP	143,287.91	154,362.91	4,063.89	2.6%
Tsetsi WPP	155,427.03	182,066.93	24,416.01	13.4%
Sainshand WPP	163,327.01	203,473.80	38,633.97	19.0%
Total	462,041.95	539,903.64	67,113.88	12.4%

Share of RES in the supply



Since 2013, WPP have contributed to the winter high-load of the system with 4.0% to 96.0% of their installed capacity, or an average of 53.7%.

Share of RES in the supply



Due to seasonal weather conditions, solar power plants operate between 6 am and 8 pm in summer and 9 am to 5 pm in winter

Impact of RES to the system's operation

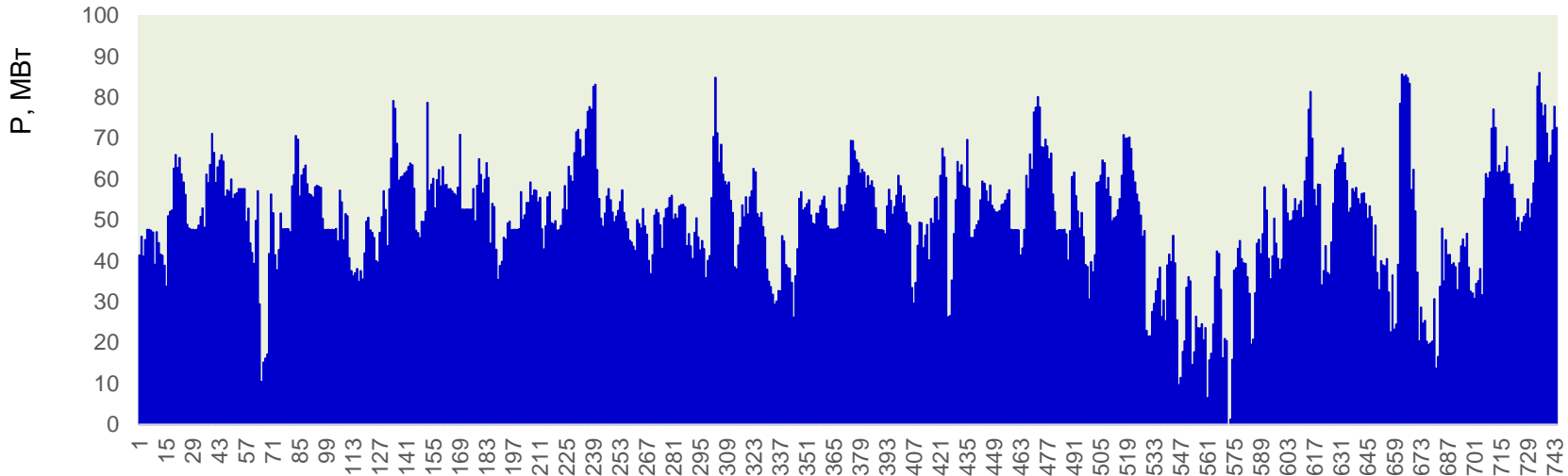


Figure. Fluctuations in the monthly load curve caused by RES

- According to deviation of the performance and the planning sent 12 hours ahead by WPPs and SPPs, the planning certainty is in the range of 30%....55%.
- This accounts for 41.4% in the deviation of the imported electricity.
- Each of the 50 MW WPPs operated at an average of 40-48 MW per hour fluctuation, while each of the 10 MW SPPs operated at an average of 9 MW per hour fluctuation.



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Dispatching

Plant	"+" violation	"-" violation	"+" instruction	"-" instruction
CHPP-2	1.84	509.74	906.78	340.06
CHPP-3	-	1,534.84	3,961.00	1,268.31
CHPP-4	878.00	8,945.16	90,000.75	16,943.24
DCHPP	8.53	266.14	1,849.25	176.23
ECHPP	-	221.31	1,297.31	169.14
EFCHPP	-	276.20	1,353.36	455.91
DaCHPP	-	129.44	318.39	332.91
Salkhit WPP	7.41	38,927.26	12,166.72	688.43
Tsetsii WPP	79.34	40,023.20	7,590.64	808.76
Sainshand WPP	-	38,900.10	17,108.94	1,621.83
DSPP	1,705.88	3,333.38	7.40	-
Monnaran SPP	2,952.00	2,243.55	-	-
Gegeen SPP	2.14	2,748.33	65.61	621.06
Bukhug SPP	4,864.80	1,728.74	14.16	-
Sumber SPP	1,326.46	2,389.14	72.18	-
Disert solar SPP	-	12,367.45	184.52	1,225.43
Ukhaa Khudag PP	67.61	436.70	539.11	343.10
Total	11,894.01	154,980.66	137,436.10	24,994.40

Evaluation of generating facilities operating in the CRIPS in terms of following the daily operation's schedule and dispatcher's instruction is carried out in accordance with the "Procedure for evaluating the performance of the dispatcher's schedule".



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Dispatching

Mongh	Sum of CHPPs	Sum of RESs	Sum of Distribution Licensees	Total
1	2.580	3,131.302	3,971.593	7,105.475
2	601.171	3,219.004	2,590.191	6,410.366
3	211.000	3,690.816	2,935.668	6,837.484
4	188.692	3,121.907	2,341.089	5,651.688
5	3.536	5,690.039	4,612.497	10,306.072
6	668.726	5,837.138	7,364.158	13,870.022
7	3,184.386	6,636.516	4,060.546	13,881.448
8	328.728	5,712.141	12,817.220	18,858.089
9	784.662	6,529.492	5,960.172	13,274.326
10	654.382	4,276.789	6,039.141	10,970.312
Total	6,627.863	47,845.144	52,692.273	107,165.280

In connection with charges for deviation from scheduled electricity import volume pursuant to the electricity import agreement from Russian Federation to CRIPS and in order to Increase the responsibility of licensees for electricity generation, transmission and distribution placing orders for energy consumption and generation and obligated to follow dispatch schedule, and to bill deviations from scheduled electricity import, “Billing procedure for deviations from scheduled electricity import” are effective.



DISPATCHING, SCHEDULING OF SYSTEM OPERATION

Conclusion

- In order to solve existing problems in the energy sector a flexible, maneuverable, large scale energy generation source (e.g. Hydro PP) must be integrated in the system and operated in parallel;
- The shortages in CRIPS applies not only electricity supply, but also heating energy supply of cities with central heating system and in terms of Heat plants. Therefore, construction of new CHPPs and Heat plant, overhauling and extension of existing plants are inevitable;
- High-maneuverable pumped storage power plant shall be put into operation. Having such a balancing and backup power plant will reduce electricity import during evening peak hours. The power plant can be charged during the night low-load hours by putting additional capacity of existing power plants in to operation;
- It is necessary to be more precise with generation prognosis of wind and solar sources and reduce deviations between generation proposals and actual performance.

Thank you for the attention!

