



Nezavisni operator sistema u Bosni i Hercegovini  
Независни оператор система у Босни и Херцеговини  
Neovisni operator sustava u Bosni i Hercegovini  
Independent System Operator in Bosnia and Herzegovina

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**REPORT**  
**ON ANCILLARY SERVICES AND BALANCING MARKET**  
**IN BOSNIA AND HERZEGOVINA FOR 2023**

Sarajevo, February 2024

## Abbreviations:

SERC (DERK)	– State Electricity Regulatory Commission
NOSBiH	– Independent System Operator in Bosnia and Herzegovina
BSP	– Balancing Service Provider
ASP	– Ancillary Service Provider
BRP	– Balance Responsible Party
ENTSO-E	– European network of transmission system operators for electricity
EPBiH	– The utility JP Elektroprivreda Bosne i Hercegovine d.d. Sarajevo
EPHZHB	– The utility JP Elektroprivreda Hrvatske zajednice Herceg Bosne d.d. Mostar
ERS	– Mixed Holding Elektroprivreda of Republika Srpska, parent company, stk. company Trebinje
EFT Stanari	– EFT - Coal mine and Thermal Power Plant d.o.o. Stanari
EMS	– Elektromreža Srbije
CGES	– Electricity Transmission System of Montenegro
HOPS	– Croatian Transmission System Operator
ELES	– Elektro-Slovenija d.o.o. – Electricity Transmission System Operator in Slovenia
FSkar	– Financial Settlement of $K\Delta f$ , ACE and ramping period
FCP	– frequency containment process
FCR	– frequency restoration reserve
aFRR	– frequency restoration reserve with automatic activation
mFRR	– frequency restoration reserve with manual activation

## Introduction

Balancing energy market is a part of the wholesale energy market, and it comes after the bilateral energy market. Unlike the bilateral energy market whose participants in purchase or sale transactions may be any licensed market participant, in the balancing energy market it is obligatory to have independent system operator as one of the participants in the purchase/sale transaction.

Pursuant to the Law on Establishing Independent System Operator in BiH, NOSBiH is responsible for managing the balancing market in BiH which is defined as ‘the central market for electricity purchase and sale managed by NOSBiH with the purpose to maintain continuous balance of demand and supply in real time, as well as additional mechanisms conducted by NOSBiH in order to ensure system services. In addition, one of NOSBiH’s operations is to provide ancillary services which are defined by the Law on Establishing Independent System Operator in BiH as ‘all services, with the exception of electricity generation and transmission, which are delivered to NOSBiH with the purpose of providing the system services including, among others, regulation of frequency and reserve, reactive power, voltage regulation and a power plant capability to start up without an external electricity supply". Therefore, the balancing market and the mechanism of providing ancillary services are the ‘tools’ by which NOSBiH maintains the balance between generation, exchange, and consumption of electricity in real time, maintains required level of reserve for ancillary services of secondary and tertiary regulation and enables safe operations of the electric power system. Participation in the balancing market is regulated by an agreement which NOSBiH concludes with a power market participant in line with the Market rules.

## The main principles of the balancing in 2023

In Bosnia and Herzegovina, the Market rules entered into force on 1<sup>st</sup> January 2016 thus establishing the market principles in the balancing processes and in allocation of the balancing costs of the power system in BiH. With the purpose of improving processes in the balancing energy market the Market rules<sup>1</sup> were amended at the end of 2021 and the changed Market rules have started to apply as of 1<sup>st</sup> January 2022.

An organized balancing capacity and balancing energy market is established for frequency containment process (FCR) and frequency restoration process with automatic and manual activation– aFRR and mFRR.

The reserve capacity market was established for all processes and the right to participate belongs to those balancing service providers (BSPs) whose capacities satisfy the technical preconditions for providing the balancing services. The reserve capacity prices in 2023 were limited by relevant decisions made by the State Regulatory Electricity Commission (SERC). In case the required scope of reserve was not procured in the market, there was a possibility for a regulated distribution of missing quantities as an obligation to BSPs. If providers had failed to deliver a certain amount of aFRR and mFRR capacity, they would incur penalty in amount which was equal to 10% of the price cap for aFRR i.e. mFRR. The aFRR and mFRR reserve capacities were contracted on a monthly basis.

The reserved (contracted) capacity had to be offered at the balancing electricity market where power and electricity price were also offered in case of activation. At the daily balancing energy market mFRR, the right to participate also belonged to the bids without reserved capacity i.e. voluntary bids.

The procurement of aFRR was done symmetrically for positive and negative range, and the procurement of mFRR was done separately for upward and downward regulation.

The required FCR capacity for 2023. was entirely acquired in the market procedure. The procurement and service provision process are organized at the level of the calendar month. BSPs were obliged to

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<sup>1</sup> Market rules were issued by NOSBiH, adopted by SERC by its Decision no 04-28-9-202-2/21 as of 13 October 2021

provide the allocated FCR capacity, while the FCR energy is settled according to energy prices set by the FSkar process.

SERC's Decision on Determination of Coefficients and Price Caps for Ancillary Services as of 17 December 2021 and Decision on Amendments to the Decision as of 23 December 2022 determined hourly price caps<sup>2</sup> for control capacity and delivered balancing energy:

- The price for the balancing energy for upward mFRR is limited to 989.46 KM/MWh.
- The price for the balancing energy for downward mFRR is limited to -401.28 KM/MWh.
- The difference in prices of energy for upward and downward aFRR bids is limited to 40.00 KM/MWh.
- The price cap for aFRR amounts to 43.00 KM/MW/h.
- The price cap for mFRR upward capacity amounts to 9.00 KM/MW/h.
- The price cap for mFRR downward capacity amounts to 2.10 KM/MW/h.

Based on the balancing energy prices of activated aFRR and mFRR bids imbalance prices were determined, which were used for the calculation of imbalance costs of balance responsible parties (BRPs) in BiH. Imbalance prices were determined for each 15-minute imbalance settlement period according to the most expensive bid activated, for realized electricity deficit and surplus respectively.

## Balancing services in 2023

Table 1 presents specific values related to balancing capacities in 2023. Figure 1 graphically presents the share that BSPs have in providing specific balancing services as well as the share of undelivered capacity on an annual basis. Detailed monthly realization of capacity for different balancing services is shown in tables 2 - 6.

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<sup>2</sup> Price cap is determined by SERC – Decision on determination of coefficients and price caps for ancillary services

**Table 1: Balancing capacities in BiH for 2023**

		<b>Reserved capacity and cost of capacity</b>				
		<b>FCR</b>	<b>aFRR Off-peak load (00.00 - 06.00 hrs)</b>	<b>aFRR Peak load (06.00 - 24.00 hrs)</b>	<b>mFRR Upward</b>	<b>mFRR Downward</b>
Capacity needs	<i>MW</i>	14,00	29,00	47,41	196,00	68,00
Contracted capacity	<i>MW</i>	14,00	29,00	47,41	196,00	68,00
Capacity contracted at the market	<i>MW</i>	14,00	24,94	47,24	196,00	68,00
Price of contracted capacity	<i>KM/MW/h</i>	6,80	42,76	37,94	5,15	1,61
Contracted cost	<i>KM</i>	834.302	2.715.066	11.817.597	8.846.579	959.198
Delivered capacity	<i>MW</i>	14	14	28	164	58
Delivered capacity	<i>%</i>	100%	48%	58%	84%	85%
Capacity cost	<i>KM</i>	834.302	1.294.751	6.701.089	7.442.321	805.736
Undelivered service	<i>MW</i>	0	15	20	32	10
Penalty	<i>KM</i>	0	142.600	555.639	253.334	19.023

The table shows average capacity values presented in 1 hour resolution

<b>BSP's share in delivered capacity</b>						
EP BiH	<i>MW</i>	10	8	13	54	9
EP BiH	<i>%</i>	71%	56%	46%	33%	16%
ERS	<i>MW</i>	4	6	15	29	21
ERS	<i>%</i>	29%	44%	54%	18%	37%
EP HZHB	<i>MW</i>	0	0	0	81	13
EP HZHB	<i>%</i>	0%	0%	0%	49%	22%
EFT	<i>MW</i>	0			0	15
EFT	<i>%</i>	0%			0%	25%

The table shows average capacity values presented in 1 hour resolution

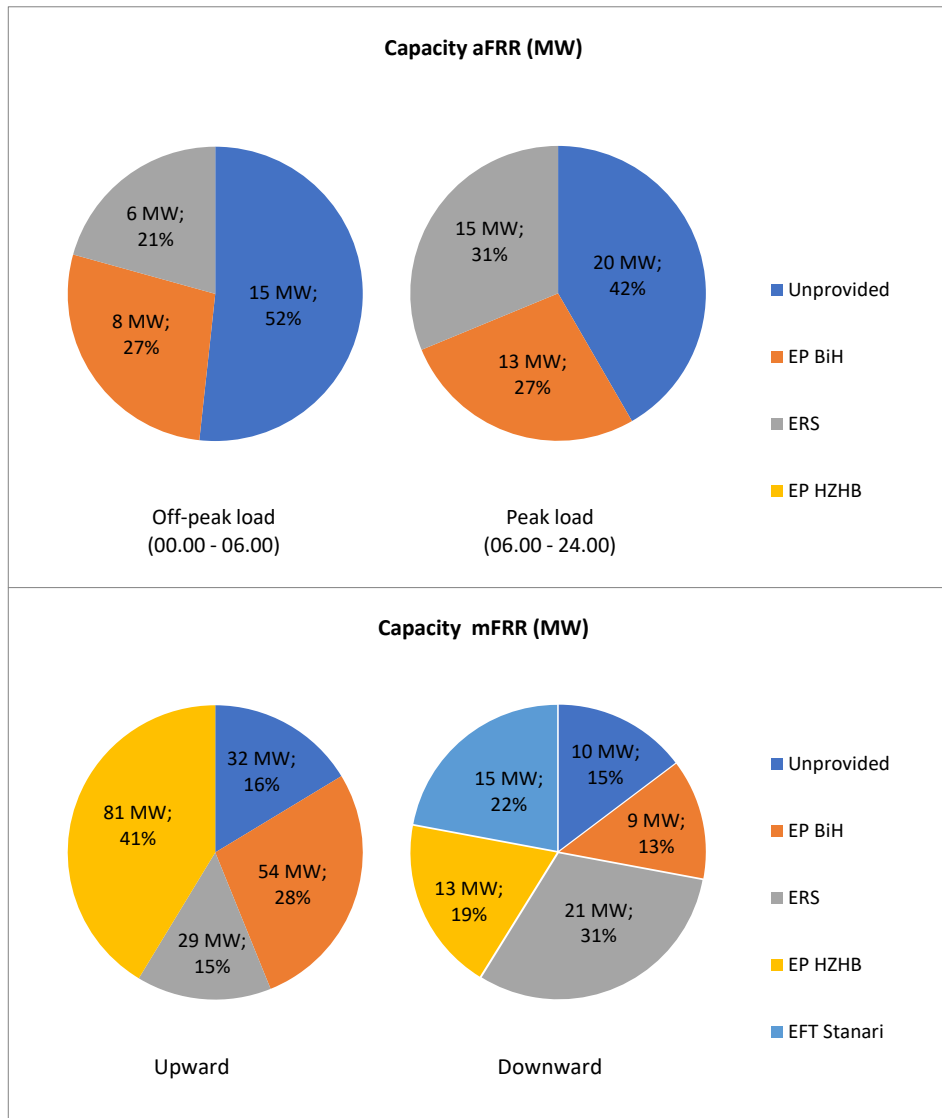
The data from this table indicate that in 2023 there was a partial stabilization and improvement of the situation on the balance market, compared to last year, which was characterized by the low availability of balancing capacities due to the unfavorable energy situation caused by the high prices on European electricity exchanges. Balancing energy prices are significantly lower than last year, although still significantly higher than in the period before the last disturbances on the energy market. Insufficient availability of balancing capacities at night, especially for downward regulation, is also present in 2023.

### Frequency Containment Process – FCP

From 2023, a market-based procedure for the procurement of frequency containment reserve (FCR) was introduced. BiH's obligation related to this reserve in 2023 is 14 MW and the capacity was contracted completely through the market procedure.

### Automatic frequency restoration reserve – aFRR

In 2023 NOSBiH had in average 14 MW of aFRR capacity in off peak hours (from midnight until 6:00 am). This is a significant increase compared to the previous year, but still at the level of 50% of the required capacity. In peak load periods (from 6:00 am until midnight) there was an average amount of 28 MW of aFRR capacity available, which makes 58% of the capacity required. The cost of aFRR capacity in 2023 amounted to approximately 8 million KM. During the year three public power utilities with their balancing resources were registered as aFRR providers.



**Figure 1: Share of BSPs in delivered balancing capacity in BiH in 2023**

### Manual frequency restoration reserve – mFRR

In 2023 NOSBiH had in average 164 MW of upward mFRR, and 58 MW of downward mFRR, which makes about 85% of required reserves. The cost of delivered capacity amounted to 7.4 million KM for upward mFRR and 0.8 million KM for downward mFRR. The availability of balancing capacity is significantly better compared to the previous year.

During the year four companies had their prequalified resources for providing mFRR balancing service.

**Table 2: Report on balancing services in BiH for 2023**  
Frequency Containment Reserve - FCR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Required capacity	MW	14	14	14	14	14	14	14	14	14	14	14	14,00	108%
Contracted capacity	MW	14	14	14	14	14	14	14	14	14	14	14	14,00	108%
Capacity contracted at the market	MW	14	14	14	14	14	14	14	14	14	14	14	14,00	
Price of contracted capacity	KM/MW	6,80	6,80	6,80	6,80	6,80	6,80	6,80	6,80	6,80	6,80	6,80	6,80	
Contracted cost	KM	70.859	64.001	70.763	68.573	70.859	68.573	70.859	70.859	68.573	70.954	68.573	70.859	834.302
Delivered capacity	MW	14	14	14	14	14	14	14	14	14	14	14	14,00	108%
Delivered capacity	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100,00%	100%
Capacity cost	KM	70.859	64.001	70.763	68.573	70.859	68.573	70.859	70.859	68.573	70.954	68.573	70.859	834.302
Undelivered capacity	MW	0	0	0	0	0	0	0	0	0	0	0	0,00	
Penalty for undelivered capacity	KM	0	0	0	0	0	0	0	0	0	0	0	0	
The table shows average capacity values presented in 1 hour resolution														
<b>BSP's share in delivered capacity</b>														
EP BiH	MW	10	10	10	10	10	10	10	10	10	10	10	10,00	200%
EP BiH	%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	
ERS	MW	4	4	4	4	4	4	4	4	4	4	4	4,00	83%
ERS	%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	
EP HZHB	MW	0	0	0	0	0	0	0	0	0	0	0	0,00	0%
EP HZHB	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
EFT Stanari	MW	0	0	0	0	0	0	0	0	0	0	0	0,00	0%
EFT Stanari	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
The table shows average capacity values presented in 1 hour resolution														

**Table 3: Report on balancing services in BiH for 2023**  
aFRR - off-peak load (00.00 - 06.00)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22	
Required capacity	MW	33	31	31	29	26	26	28	27	27	29	29	32	29,00	103%
Contracted capacity	MW	33	31	31	29	26	26	28	27	27	29	29	32	29,00	103%
Capacity contracted at the market	MW	30	30	30	29	26	26	10	10	21	29	29	30	24,94	101%
Price of contracted capacity	KW/MW	42,78	42,76	42,76	42,75	42,72	42,72	42,74	42,73	42,85	42,75	42,75	42,77	42,76	100%
Contracted cost	KM	262.567	222.709	245.245	223.137	206.581	199.917	222.577	214.579	208.233	231.815	223.137	254.569	2.715.066	103%
Delivered capacity	MW	10	17	15	14	14	19	13	15	11	11	17	12	13,83	176%
Delivered capacity	%	29%	54%	48%	47%	55%	72%	48%	56%	39%	37%	57%	38%	47,69%	
Capacity cost	KM	76.763	120.855	116.758	105.762	112.890	144.160	105.925	119.425	81.666	85.766	128.086	96.695	1.294.751	177%
Undelivered capacity	MW	23	14	16	15	12	7	15	12	16	18	12	20	15,17	75%
Penalty for undelivered capacity	KM	18.657	10.198	12.875	11.814	9.409	5.608	11.692	9.541	12.721	14.670	9.567	15.848	142.600	75%

The table shows average capacity values presented in 1 hour resolution

BSP's share in delivered capacity		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
EP BiH	MW	5	8	7	10	7	10	5	7	10	6	11	7	7,70	154%
EP BiH	%	56%	48%	47%	70%	51%	52%	40%	46%	92%	51%	68%	55%	56%	
ERS	MW	4	9	8	4	7	9	8	8	1	5	5	5	6,13	214%
ERS	%	44%	52%	53%	30%	49%	48%	60%	54%	8%	49%	32%	45%	44%	
EP HZHB	MW	0	0	0	0	0	0	0	0	0	0	0	0	0,00	
EP HZHB	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	

The table shows average capacity values presented in 1 hour resolution



**Table 4: Report on balancing services in BiH for 2023**  
aFRR - peak load (06:00 - 24,00 hrs)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Required capacity	52	51	51	46	41	43	46	44	43	48	50	54	47,41	100%
Contracted capacity	52	51	51	46	41	43	46	44	43	48	50	54	47,41	100%
Capacity contracted at the market	52	51	51	46	41	43	46	44	41	48	50	54	47,24	100%
Price of contracted capacity	38,26	38,17	38,17	37,65	37,14	37,73	38,07	37,85	38,53	37,87	37,74	37,99	37,94	112%
Contracted cost	1.110.275	981.137	1.086.281	935.118	849.622	876.042	977.248	929.260	894.591	1.014.299	1.019.077	1.144.648	11.817.597	112%
Delivered capacity	24	32	26	35	29	29	30	28	21	26	31	22	27,69	121%
Delivered capacity	46%	63%	52%	76%	71%	67%	65%	63%	49%	55%	61%	41%	58,41%	
Capacity cost	496.438	600.892	541.493	704.686	598.229	568.111	612.131	565.249	417.787	539.601	606.668	449.805	6.701.089	132%
Undelivered capacity	28	19	25	11	12	14	16	16	22	22	19	32	19,71	81%
Penalty for undelivered capacity	66.860	40.924	59.301	25.144	28.259	32.910	38.965	39.150	51.006	51.927	44.947	76.246	555.639	81%
The table shows average capacity values presented in 1 hour resolution														
<b>BSP's share in delivered capacity</b>														
EP BiH	11	13	8	20	14	12	13	11	14	12	17	8	12,64	89%
EP BiH	44%	42%	30%	56%	49%	38%	43%	40%	67%	47%	55%	37%	45,64%	
ERS	14	19	18	15	15	17	17	17	7	14	14	14	15,05	171%
ERS	56%	58%	70%	44%	51%	62%	57%	60%	33%	53%	45%	63%	54,36%	
EP HZHB	0	0	0	0	0	0	0	0	0	0	0	0	0,00	0%
EP HZHB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0,00%	
The table shows average capacity values presented in 1 hour resolution														

**Table 5: Report on balancing services in BiH for 2023**  
Upward mFRR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22	
Required capacity	MW	196	196	196	196	196	196	196	196	196	196	196	196,00	100%	
Contracted capacity	MW	196	196	196	196	196	196	196	196	196	196	196	196,00	100%	
Capacity contracted at the market	MW	196	196	196	196	196	196	196	196	196	196	196	196,00	100%	
Price of contracted capacity	KM/MW	3,96	3,96	3,96	4,11	4,33	6,07	6,98	7,11	7,11	6,07	4,11	3,96	5,15	117%
Contracted cost	KM	578.177	522.225	577.400	580.262	630.778	856.238	1.018.030	1.036.243	1.002.816	885.969	580.262	578.177	8.846.579	117%
Delivered capacity	MW	161	164	156	187	158	157	177	175	163	161	162	145	163,80	158%
Delivered capacity	%	82%	84%	79%	95%	81%	80%	90%	89%	83%	82%	83%	74%	83,57%	
Capacity cost	KM	477.010	441.663	460.988	548.664	486.572	693.852	931.596	933.920	852.445	715.891	471.769	427.952	7.442.321	241%
Undelivered capacity	MW	35	32	40	9	38	39	19	21	33	35	34	51	32,22	35%
Penalty for undelivered capacity	KM	23.332	19.123	26.897	6.050	25.119	25.335	12.649	13.931	21.153	23.565	22.196	33.986	253.334	35%
The table shows average capacity values presented in 1 hour resolution															
<b>BSPs share in delivered capacity</b>															
EP BiH	MW	64	65	66	76	69	57	29	30	30	59	59	43	53,94	108%
EP BiH	%	40%	40%	42%	41%	44%	36%	17%	17%	18%	37%	37%	30%	32,93%	
ERS	MW	24	23	18	45	26	17	36	38	27	31	37	28	29,08	284%
ERS	%	15%	14%	12%	24%	16%	11%	20%	22%	16%	19%	23%	19%	17,75%	
EP HZHB	MW	73	76	72	66	63	83	112	108	107	70,479195	66	74	80,78	186%
EP HZHB	%	45%	46%	46%	35%	40%	54%	63%	61%	65%	44%	41%	51%	49,31%	
EFT Stanari	MW	0	0	0	0	0	0	0	0	0	0	0	0	0,00	
EFT Stanari	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0,00%	
The table shows average capacity values presented in 1 hour resolution															

**Table 6: Report on balancing services in BiH for 2023**  
Downward mFRR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22		
Required capacity	MW	68	68	68	68	68	68	68	68	68	68	68	68,00	100%		
Contracted capacity	MW	68	68	68	68	68	68	68	68	68	68	68	68,00	100%		
Capacity contracted at the market	MW	68	68	68	68	68	68	68	68	68	68	68	68,00	100%		
Price of contracted capacity	KW/MW	1,60	1,60	1,60	1,60	1,62	1,62	1,62	1,62	1,62	1,60	1,60	1,61	99%		
Contracted cost	KW	80.791	72.972	80.682	78.185	82.130	79.481	82.130	82.130	79.481	82.241	78.185	80.791	959.198	99%	
Delivered capacity	MW	62	47	57	57	65	64	64	45	52	51	64	66	57,84	104%	
Delivered capacity	%	91%	69%	84%	83%	95%	94%	94%	66%	77%	75%	94%	98%	85,06%	0%	
Capacity cost	KW	72.424	48.364	66.866	62.970	77.731	74.634	77.291	52.670	59.950	60.634	73.252	78.950	805.736	104%	
Undelivered capacity	MW	7	21	11	12	3	4	4	23	16	17	4	2	10,32	83%	
Penalty for undelivered capacity	KW	1.079	3.006	1.696	1.883	540	630	615	3.607	2.408	2.676	639	244	19.023	83%	
The table shows average capacity values presented in 1 hour resolution																
<b>BSP's share in delivered capacity</b>																
EP BiH	MW	9	10	10	10	10	9	9	9	10	9	10	9	9	9,42	117%
EP BiH	%	14%	21%	18%	17%	15%	14%	14%	21%	18%	18%	15%	14%	16,28%		
ERS	MW	19	21	22	20	23	24	24	24	15	19	20	22	21,17	94%	
ERS	%	30%	45%	39%	36%	35%	38%	37%	53%	29%	38%	32%	34%	36,59%		
EP HZHB	MW	14	15	15	14	11	10	11	11	10	10	14	15	12,51	101%	
EP HZHB	%	23%	31%	25%	25%	17%	17%	17%	24%	20%	20%	22%	23%	21,62%		
EFT Stanari	MW	20	1	10	12	21	20	20	1	17	12	20	20	14,72	115%	
EFT Stanari	%	32%	3%	18%	22%	32%	31%	32%	3%	33%	24%	31%	30%	25,44%		

The table shows average capacity values presented in 1 hour resolution

## Balancing energy market

In 2023, for the purpose of power system balancing 45 040 MWh of upward balancing energy was activated (energy injection) with an average price of 244.80 KM/MWh. The total cost of this energy is significantly lower compared to the year 2022 due to smaller quantities and significantly lower average price of balance energy.

In 2023, activated downward balancing energy (energy takeover) amounted to 78 822 MWh. Average price for this energy was 114.78 KM/MWh considering the energy with offered negative price as well. Downward balance energy prices are also significantly lower compared to 2022 prices.

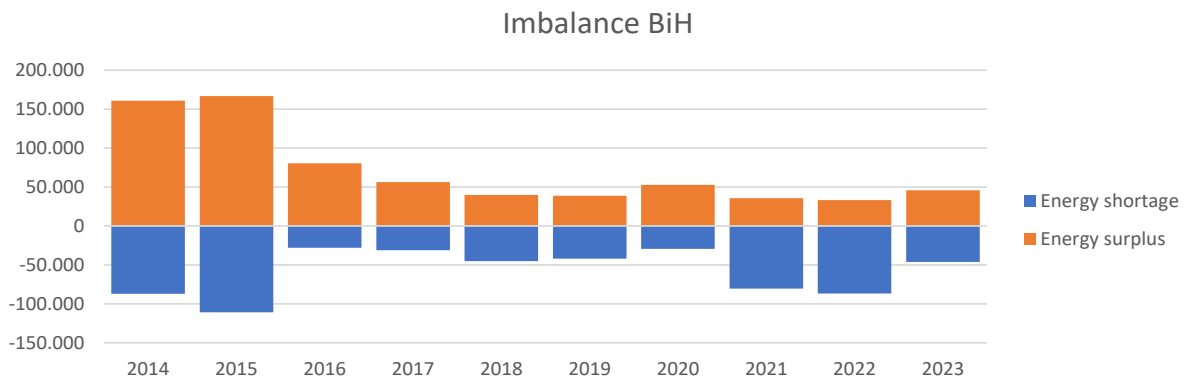
## Imbalance

There were 10 balance responsible parties (BRPs) active in BiH in 2023, not counting the so called 'trading BRPs', i.e., the BRPs with no imbalance realized within BiH. Average imbalance prices in 2023 were 205.31 KM/MWh for shortage and 78.09 KM/MWh for surplus of energy. These prices are significantly lower compared to last year. The imbalance price for the deficit is more than 50% lower than last year, while the imbalance price for the realized surplus is almost 75% lower than last year's price. These prices ranged from -400.00 KM/MWh up to 988.00 KM/MWh, depending on the energy situation, taking into account the activated cross-border balancing energy for the needs of the LFC area of BiH.

Figure 2 and Table 7 show the deviations of the Control Area BiH over the past few years.

**Table 7: Deviation of the BH LFC area for the last five years**

Imbalance BiH		Energy shortage					Energy surplus				
		2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Total	MWh	-42.010	-29.318	-80.435	-86.765	-46.142	38.864	52.587	35.417	33.014	45.672
Max. Hourly	MW	38.864	52.587	35.417	33.014	45.672	171	218	118	216	143



**Figure 2: Annual deviations of BiH Control Area**

Table 8 presents values of activated balancing energy, energy prices and relevant costs by taking into consideration cross-border activations for the needs of LFC BiH Control Area, exempting the energy activated within BiH for the needs of other system operators.

Table 8: Balancing market in BiH in 2023

Activated balancing energy															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22	
FCR upward	MWh	351	286	299	267	226	226	233	303	264	345	311	277	3.387	94%
FCR downward	MWh	240	265	476	482	405	329	360	290	382	289	283	287	4.086	146%
aFRR upward	MWh	3.755	4.104	2.247	3.410	2.966	2.216	2.497	3.960	3.093	5.641	2.305	1.677	37.870	94%
aFRR downward	MWh	4.776	4.919	7.996	6.360	7.146	7.130	6.912	5.173	3.754	2.840	9.381	7.895	74.282	194%
mFRR upward	MWh	603	42	169	178	472	0	0	511	195	1.199	182	235	3.786	37%
mFRR downward	MWh	56	0	48	5	131	0	0	68	0	0	13	133	454	71%
Balancing energy upward	MWh	4.709	4.432	2.715	3.855	3.664	2.442	2.729	4.773	3.552	7.185	2.798	2.189	45.043	88%
Balancing energy downward	MWh	5.072	5.184	8.519	6.848	7.682	7.459	7.272	5.531	4.136	3.129	9.676	8.315	78.822	189%
Cross-border balancing energy for the needs of CA BiH taken into account															
<b>Balancing energy cost and prices</b>															
Upward - cost	KM	2.185.673	1.125.677	617.454	827.026	883.083	417.171	342.445	885.641	683.822	2.021.836	583.136	452.859	11.025.824	39%
Upward - average price	KM/MWh	464,13	254,01	227,41	214,55	241,03	170,83	125,47	185,55	192,51	281,40	208,40	206,87	244,78	44%
Downward - cost	KM/MWh	#####	918.170,84	#####	958.238,09	864.838,05	856.662,41	572.475,20	369.116,76	340.440,65	477.504,84	923.369,51	613.987,24	9047198,25	67%
Downward - average price	KM/MWh	220,39	177,12	121,44	139,94	112,59	114,85	78,72	66,74	82,31	152,63	95,43	73,84	114,78	36%
<b>Imbalances of BiH LFC area</b>															
Shortage - total	MWh	6.745	4.117	4.041	3.076	2.510	3.274	2.518	3.737	4.000	5.241	3.942	2.942	46.142	53%
Shortage - max hourly	MWh	65	54	89	35	163	101	123	114	85	91	90	62	162,54	60%
Surplus - total	MWh	3.438	2.637	4.872	4.529	3.499	4.191	4.121	3.226	3.541	1.736	3.766	6.115	45.672	138%
Surplus - max hourly	MWh	74	143	43	52	53	58	59	77	76	55	50	49	142,84	66%
Price shortage - average	KM/MWh	382,89	265,70	191,39	223,57	210,26	194,49	143,77	143,29	150,29	239,66	185,06	136,96	205,31	47%
Price shortage - maximum	KM/MWh	988,00	900,00	800,00	700,00	700,00	540,00	250,00	950,00	950,00	950,00	750,00	950,00	988,00	44%
Price surplus - average	KM/MWh	157,50	108,33	73,35	98,46	86,96	48,32	34,00	41,47	65,55	112,67	66,53	45,74	78,09	26%
Price surplus - minimum	KM/MWh	-400,00	0,00	-50,00	-49,00	-400,00	-40,00	-40,00	-400,00	-40,00	-20,00	-50,00	-400,00	-400,00	100%

## Transmission losses and FSkar process

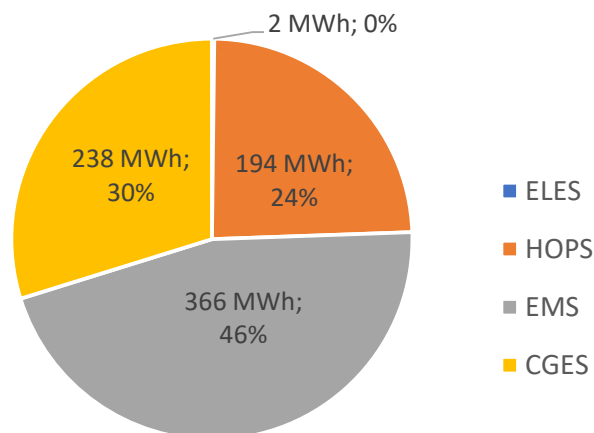
In 2023 energy to cover transmission losses was procured through regulated procedure whereas service providers participated in the market in proportion to their consumption and per regulated price of 109.94 KM/MWh. Such a regulated approach took place due to quite high prices of energy to cover losses as were provided through public procurement procedures. Total cost of this service in 2023 was 39.961 870,72 KM which is at the level of last year's value (Table 9).

The process of financial settlement of deviations between LFC Areas of Continental Europe – FSkar process includes unintended exchange, energy from the frequency containment process (FCR) and ramping period. On the basis of the FSkar process, NOSBiH is due to pay over 1.7 million KM for the year 2023, significantly less than the previous year.

## Cross-border balancing energy exchange

Based on the agreement on the joint balancing reserve in the Slovenia-Croatia-Bosnia and Herzegovina LFC block, the capacity of mFRR which was to be provided in 2023 within the BiH LFC area was 196 MW for upward regulation, and 68 MW for downward regulation. In 2017 Agreement on cross-border exchange of balancing energy was also signed with Serbian Transmission System Operator – EMS, and in 2018 the same Agreement was signed with the Transmission System Operator in Montenegro – CGES

Table 10 shows the values of exchanged cross-border balancing energy in 2023 with the expenses included. The exchanged energy in 2023 is almost entirely requested from other system operators. Figure 3 shows the share of neighboring TSOs in total cross-border exchange of balancing energy with BiH.



**Image 3: Cross-border exchange of balancing energy**

**Table 9: Report on transmission losses and cross-border settlement (FSkar) for 2023**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Losses														
<i>MWh</i>	36,435	28,240	31,211	26,784	29,456	27,313	25,888	24,498	21,102	23,357	29,196	31,908	335,389	101%
Reference price														
<i>KM/MWh</i>	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	109,94	100%
Cost														
<i>KM</i>	4.081.962	3.191.558	3.424.851	2.919.017	3.844.052	3.510.604	2.799.732	2.959.365	2.301.814	2.794.785	3.916.173	4.217.958	39.961.871	103%
Cost of FSkar														
<i>KM</i>	870.107	410.329	87.678	-69.479	-349.362	-46.644	-192.769	216.914	266.499	814.894	132.635	-410.071	1.730.731	5%

**Table 10: Report on cross-border balancing energy exchange for 2023**

XB energy - Connecting TSO NOSBiH														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023	2023/22
XB Exchange - Import														
<i>MWh</i>					1	25	130	73	39				267,833	125%
Average Price Import					-400,00	-400,00	-400,00	74,66	-400,01				-270,04	268%
<i>KM /MWh</i>														
Cost Import					-200	-10.000	-52.000	5.475	-15.600				-72.325	334%
<i>KM</i>														
XB Exchange - Export														
<i>MWh</i>						50					316		531	1770%
Average Price Export						570,01					941,69		797,13	122%
<i>KM /MWh</i>														
Cost Export						28.500					297.575		423.275	2151%
<i>KM</i>														
XB energy - Requesting TSO NOSBiH														
XB Exchange - Import													0	0%
<i>MWh</i>														
Average Price Import														
<i>KM /MWh</i>														
Cost Import													0	0%
<i>KM</i>														
XB Exchange - Export													1	
<i>MWh</i>					1									
Average Price Export					30,26								30,24	
<i>KM /MWh</i>														
Cost Export					30								30	
<i>KM</i>														

## Conclusions

All required balancing capacities for 2023, apart from FCR and aFRR capacity in off peak load periods, were procured in public procurement procedures, mostly in the annual tender. From 2023, FCR capacity is also procured through the market procedure.

In relation to the year 2022, similar prices of balancing capacities were realized for aFRR in the off-peak period (price close to the price-cap) and for mFRR down. However, the prices of balancing capacities for aFRR in the peak period and mFRR downwards are slightly higher than in 2022. Otherwise, the realized prices of balancing capacities are significantly below the regulated price-caps, except for the price of aFRR capacity in the off-peak period.

The worst availability of balancing capacities, as in previous years, was achieved for the aFRR service at night. In 2023, close to 50% of the required capacity was delivered. A slightly better availability was achieved for the aFRR reserve in periods of peak load, while the availability of the mFRR reserve up and down is around 85%. The dominant providers of balancing services are three public utilities with their own balancing capacities.

In contrast to balance capacities, the prices of balance energy in 2023 are significantly lower compared to 2022, which was characterized by extremely high energy prices. Balancing energy prices generally followed the prices on the electricity markets. In 2023, no cross-border balancing energy was activated for the needs of the LFC area of BiH. At the same time, NOSBiH, in accordance with its possibilities, delivered balancing energy to the neighboring system operators.

Imbalance prices were in line with balancing energy prices and on average amounted to 205.31 KM/MWh for realized energy shortage, i.e., 78.09 KM/MWh for realized energy surplus. The prices are significantly lower than last year but still significantly higher than the imbalance prices in the earlier period before the latest disturbances in the market.

The cost of energy to cover transmission losses is expected to be at the level of last year's value, considering the same energy price and a regulated approach to service procurement.

Balancing market stabilization in BiH can also be concluded based on realized deviations of the LFC area of BiH in 2023 compared to the earlier period. After two years period, positive and negative deviations are again below 50 GWh on an annual basis. Also, the financial settlement between system operators from the FSkar process amounts to only 5% of last year's value, which also supports the statement about the stabilization of conditions in the electric power system of BiH.

Considering the actual tariff for system services, based on ancillary services and the balancing market the amount of 16 million KM of revenue was realized in 2023.



## Appendix: Financial overview

Table 11: Financial balance - ancillary services and balancing energy in 2023

Balancing capacity														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
FCR - capacity	-70.859	-64.001	-70.763	-68.573	-70.859	-68.573	-70.859	-70.859	-68.573	-70.954	-68.573	-70.859	-834.302	
FCR - capacity - penalty	0	0	0	0	0	0	0	0	0	0	0	0	0	
aFRR - capacity <i>KM</i>	-573.202	-721.747	-658.251	-810.448	-711.119	-712.271	-718.055	-684.673	-499.452	-625.367	-734.754	-546.500	-7.995.840	137,78%
aFRR - capacity - penalty <i>KM</i>	85.518	51.122	72.175	36.958	37.668	38.518	50.656	48.691	63.727	66.598	54.515	92.094	698.239	79,53%
mFRR upward - capacity <i>KM</i>	-477.010	-441.663	-460.988	-548.664	-486.572	-693.852	-931.596	-933.920	-852.445	-715.891	-471.769	-427.952	-7.442.321	241,18%
mFRR upward - capacity - penalty <i>KM</i>	23.332	19.123	26.897	6.050	25.119	25.335	12.649	13.931	21.153	23.565	22.196	33.986	253.334	34,76%
mFRR downward - capacity <i>KM</i>	-72.424	-48.364	-66.866	-62.970	-77.731	-74.634	-77.291	-52.670	-59.950	-60.634	-73.252	-78.950	-805.736	104,20%
mFRR upward - capacity - penalty <i>KM</i>	1.079	3.006	1.696	1.883	540	630	615	3.607	2.408	2.676	639	244	19.023	83,47%
<b>Total</b> <i>KM</i>	<b>-1.083.567</b>	<b>-1.202.524</b>	<b>-1.156.099</b>	<b>-1.445.763</b>	<b>-1.282.954</b>	<b>-1.484.847</b>	<b>-1.733.881</b>	<b>-1.675.894</b>	<b>-1.393.132</b>	<b>-1.380.007</b>	<b>-1.270.997</b>	<b>-997.937</b>	<b>-16.107.602</b>	<b>200,52%</b>

Positive values are invoiced by NOSBIH and paid by BSP, negative values are paid by NOSBIH and invoiced by BSP

Balancing energy														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Upward <i>KM</i>	-2.185.673	-1.125.677	-617.454	-827.026	-883.083	-417.171	-342.445	-885.641	-683.822	-2.021.836	-583.136	-452.859	-11.025.824	38,56%
Downward <i>KM</i>	1.117.832	918.171	1.034.562	958.238	864.838	856.662	572.475	369.117	340.441	477.505	923.370	613.987	9.047.198	67,32%
<b>Total</b> <i>KM</i>	<b>-1.067.840</b>	<b>-207.506</b>	<b>417.108</b>	<b>131.212</b>	<b>-18.245</b>	<b>439.491</b>	<b>230.030</b>	<b>-516.525</b>	<b>-343.381</b>	<b>-1.544.331</b>	<b>340.233</b>	<b>161.128</b>	<b>-1.978.626</b>	<b>13,06%</b>

Positive values are invoiced by NOSBIH and paid by BSP, negative values are paid by NOSBIH and invoiced by BSP

Imbalances														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Surplus <i>KM</i>	-431.790	-283.358	-415.061	-662.601	-466.028	-252.864	-221.095	-77.403	-313.175	-208.717	-254.340	-253.213	-3.839.645	34,93%
Shortage <i>KM</i>	5.368.865	2.749.505	1.616.367	1.947.820	2.642.364	1.857.517	1.104.607	2.416.328	1.751.403	4.278.528	2.223.417	1.516.111	29.472.831	37,83%
<b>Total</b> <i>KM</i>	<b>4.937.074</b>	<b>2.466.147</b>	<b>1.201.306</b>	<b>1.285.219</b>	<b>2.176.335</b>	<b>1.604.654</b>	<b>883.512</b>	<b>2.338.925</b>	<b>1.438.228</b>	<b>4.069.811</b>	<b>1.969.077</b>	<b>1.262.898</b>	<b>25.633.186</b>	<b>38,31%</b>

Positive values are invoiced by NOSBIH and paid by BSP, negative values are paid by NOSBIH and invoiced by BSP

Losses and FSkar														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
Losses <i>KM</i>	4.081.962	3.191.558	3.424.851	2.919.017	3.844.052	3.510.604	2.799.732	2.959.365	2.301.814	2.794.785	3.916.173	-4.217.958	-39.961.871	103,39%
FSkar <i>KM</i>	-870.107	-410.329	-87.678	69.479	349.362	46.644	192.769	-216.914	-266.499	-814.894	-132.635	410.071	-1.730.731	5,33%
<b>Total</b> <i>KM</i>	<b>-4.952.069</b>	<b>-3.601.887</b>	<b>-3.512.529</b>	<b>-2.849.538</b>	<b>-3.494.690</b>	<b>-3.463.960</b>	<b>-2.606.963</b>	<b>-3.176.279</b>	<b>-2.568.313</b>	<b>-3.609.678</b>	<b>-4.048.808</b>	<b>-3.807.887</b>	<b>-41.692.602</b>	<b>58,64%</b>

Positive values are invoiced by NOSBIH and paid by BSP, negative values are paid by NOSBIH and invoiced by BSP

System tariff														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
<b>Total</b> <i>KM</i>	<b>4.994.633</b>	<b>4.500.961</b>	<b>4.418.238</b>	<b>4.135.677</b>	<b>3.716.589</b>	<b>3.454.857</b>	<b>3.999.686</b>	<b>3.994.464</b>	<b>3.699.246</b>	<b>3.998.926</b>	<b>4.343.055</b>	<b>4.907.109</b>	<b>50.163.442</b>	<b>94,82%</b>

Positive values are invoiced by NOSBIH and paid by market participants

Financial balance														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2023	2023/22
<b>Total</b> <i>KM</i>	<b>2.828.231</b>	<b>1.955.190</b>	<b>1.368.024</b>	<b>1.256.807</b>	<b>1.097.035</b>	<b>550.196</b>	<b>772.383</b>	<b>964.692</b>	<b>832.647</b>	<b>1.534.721</b>	<b>1.332.560</b>	<b>1.525.312</b>	<b>16.017.799</b>	<b>62,72%</b>

Positive value - NOSBIH account credited