

**REPORT**  
**ON ANCILLARY SERVICES AND BALANCING MARKET OPERATIONS**  
**IN BOSNIA AND HERZEGOVINA FOR 2022**

Sarajevo, February 2023

## Abbreviations:

SERC – 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 licenced 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 2022

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 market of capacity reserve and balance energy was established for automatic and manual activation of frequency – aFRR and mFRR. Frequency containment reserve (FCR) was in this way distributed to BSPs in a regulated manner with adequate compensations to energy providers.

The reserve capacity market was established for aFRR and mFRR processes and the right to participate belong to those balancing service providers (BSPs) whose capacities satisfy the technical preconditions for providing the balancing services. The reserve capacity prices in 2022 were limited by relevant decisions made by the State Regulatory Electricity Commission (SERC). In case that the required scope of aFRR and mFRR capacity were not provided in the market, there was a possibility to procure the missing quantities. If providers had failed to deliver certain amount of aFRR and mFRR

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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

capacity, they would incur penalty in amount which was equal to 10% of the price cap for aFRR i.e. mFRR. 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 of control, and the procurement of mFRR was done separately for upward and downward control.

The required FCR capacity was allocated to BSPs in proportion to planned monthly generation. BSPs were obliged to provide the allocated FCR capacity with no compensation, 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 balance energy:

- The price for the balancing energy for upward mFRR is limited to 659.94 KM/MWh, i.e., to 989.46 KM/MWh, since 23 December 2022 when the SERC's new Decision has started to apply.
- The price for the balancing energy for downward mFRR is limited to -401.28 KM/MWh.
- 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.

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

## Balancing services in 2022

Table 1 presents specific values related to balancing services capacity in 2022. Image 1 graphically presents the share that the BSP had in providing specific balancing services and the share of undelivered capacity on an annual basis. Detailed monthly realization of capacity for some 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: Report on balancing capacities in BiH for the year 2022**

<b>Reserve capacity and capacity cost</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>
Required capacity	<i>MW</i>	13,00	28,16	47,23	196,00	68,00
Contracted capacity	<i>MW</i>	13,00	28,16	47,23	196,00	68,00
Capacity contracted at the market	<i>MW</i>	0,00	24,61	47,23	196,00	68,00
Price of contracted capacity	<i>KM/MW/h</i>	0,00	42,55	33,89	4,42	1,62
Contracted cost	<i>KM</i>	0	2.624.025	10.517.258	7.582.586	965.518
Delivered capacity	<i>MW</i>	13	8	23	104	56
Delivered capacity	<i>%</i>	100%	28%	49%	53%	82%
Capacity cost	<i>KM</i>	0	732.212	5.071.018	3.085.818	773.259
Unprovided capacity	<i>MW</i>	0	20	24	92	12
Penalty for unprovided capacity	<i>KM</i>	0	191.090	686.888	728.708	22.791

The table shows average capacity values presented in 1 hour.

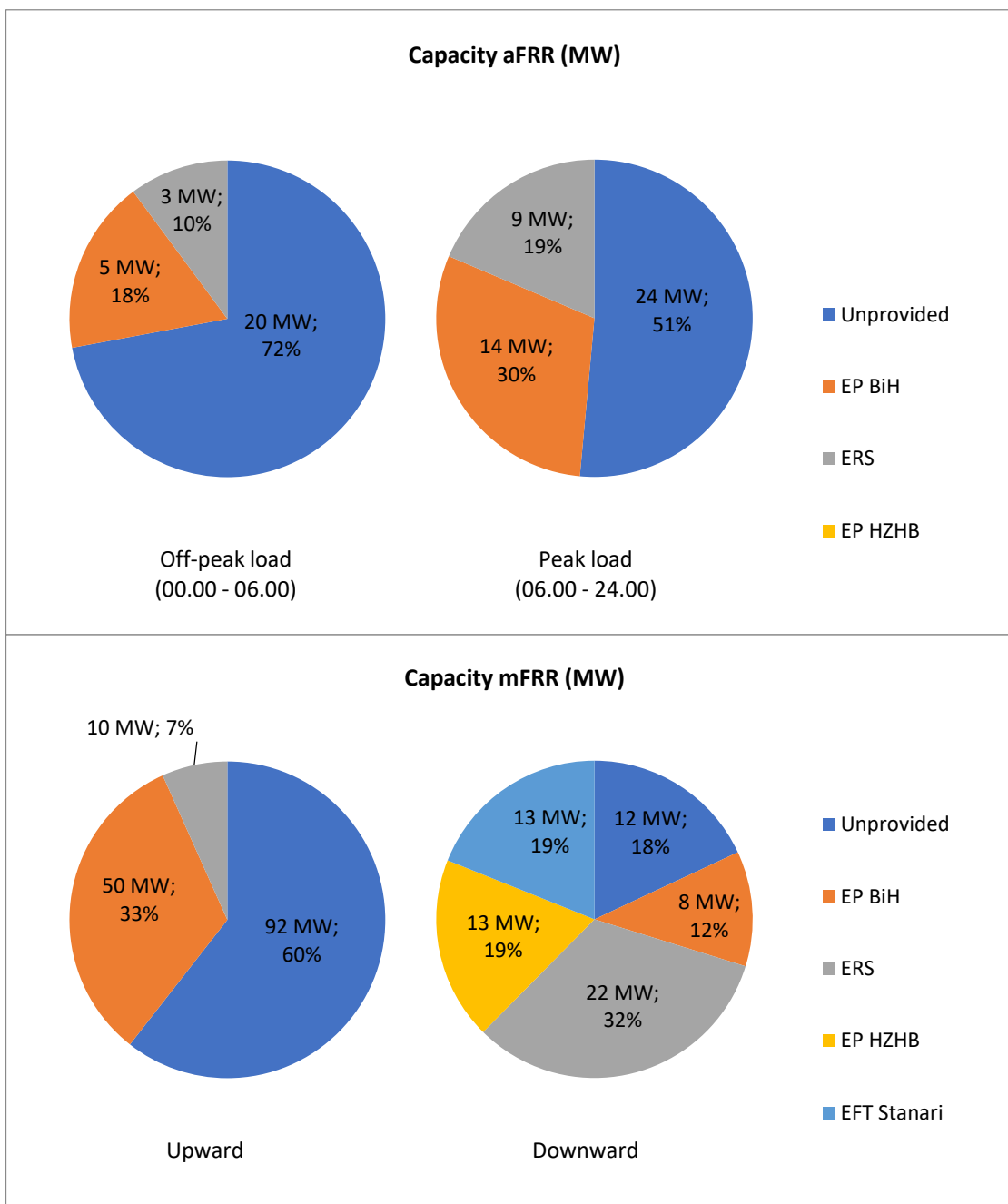
<b>BSP's share in delivered capacity</b>						
EP BiH	<i>MW</i>	5	5	14	50	8
EP BiH	<i>%</i>	38%	64%	62%	48%	14%
ERS	<i>MW</i>	5	3	9	10	22
ERS	<i>%</i>	37%	36%	38%	10%	40%
EP HZHB	<i>MW</i>	1	0	0	43	12
EP HZHB	<i>%</i>	11%	0%	0%	42%	22%
EFT	<i>MW</i>	2				13
EFT	<i>%</i>	13%				23%

The table shows average capacity values presented in 1 hour.

Poor availability of balancing capacities is obvious, specifically of aFRR capacity in off peak periods. This is due to bad energy situation caused by the war in Ukraine and high prices in the European Energy Exchanges and relatively low prices of balancing energy in BiH.

### Automatic frequency restoration – aFRR

In 2022 NOSBiH had an average of 8 MW of aFRR capacity in off peak load periods (from midnight until 6:00 am) which makes only 28% of required capacity and is significantly lower than in last year. In peak load periods (from 6:00 am until midnight) there was an average amount of 23 MW of aFRR capacity which makes 49% of the capacity required. The cost of aFRR capacity in 2022 amounted to 5.8 million KM. During the year three elektroprivredas with their regulation resources were registered as aFRR providers.



**Image 1: Share of BSPs in delivered balancing capacity in BiH in 2022**

**Manual frequency restoration – mFRR**

In 2022 NOSBiH had around 104 MW of upward mFRR capacity, i.e., 56 MW of downward mFRR capacity which makes 53%, i.e., 82% of required capacity.

The cost of delivered capacity amounted to over 3 million KM for upward mFRR and 0.7 million KM for downward mFRR. Balancing capacities were often missing in the BiH power system and this is associated with extremely high prices in electricity markets, i.e., participants' decision to trade energy through the bilateral market. For this reason at the end of the year SERC adopted the Decision on increased price caps for balancing energy.

During the year four companies had their registered facilities for providing mFRR balancing service.

**Table 2: Report on balance services in BiH for the year 2022**  
Frequency Containment Reserve - FCR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
Required capacity	MW	13	13	13	13	13	13	13	13	13	13	13	13,00	
Contracted capacity	MW	13	13	13	13	13	13	13	13	13	13	13	13,00	
Capacity contracted at the market	MW	0	0	0	0	0	0	0	0	0	0	0	0,00	
Price of contracted capacity	KM/MW	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Contracted cost	KM	0	0	0	0	0	0	0	0	0	0	0	0	
Delivered capacity	MW	13	13	13	13	13	13	13	13	13	13	13	13,00	
Delivered capacity	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100,00%	
Capacity cost	KM	0	0	0	0	0	0	0	0	0	0	0	0	
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.														
<b>BSP's share in delivered capacity</b>														
EP BiH	MW	5	5	4	5	5	4	5	6	6	5	5	5,00	
EP BiH	%												38%	
ERS	MW	5	5	5	4	5	6	5	4	5	4	5	4,84	
ERS	%												37%	
EP HZHB	MW	1	1	2	2	1	1	1	1	1	2	2	1,42	
EP HZHB	%												11%	
EFT Stanari	MW	2	2	2	2	2	2	2	2	2	0	2	1,74	
EFT Stanari	%												13%	

The table shows average capacity values presented in 1 hour.

**Table 3: Report on balance services in BiH for the year 2022**  
aFRR - off-peak load (00.00 - 06.00 hrs)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
Required capacity	31	30	30	29	25	26	28	28	27	26	28	30	28,16	105%
Contracted capacity	31	30	30	29	25	26	28	28	27	26	28	30	28,16	105%
Capacity contracted at the market	31	30	30	29	25	26	10	10	21	26	28	30	24,61	113%
Price of contracted capacity	42,49	42,48	42,48	42,47	42,51	42,52	42,84	42,84	42,58	42,47	42,47	42,48	42,55	100%
Contracted cost	245.005	214.114	235.781	221.715	197.664	198.981	223.098	223.098	206.955	206.495	214.065	237.055	2.624.025	104%
Delivered capacity	17	11	7	15	9	6	9	4	3	5	3	4	7,87	67%
Delivered capacity	56%	38%	22%	53%	37%	24%	31%	14%	10%	21%	12%	13%	27,93%	
Capacity cost	136,621	80,748	52,883	117,493	73,732	48,618	68,647	31,628	20,873	43,522	26,254	31,193	732.212	67%
Undelivered capacity	14	19	23	14	16	20	19	24	24	21	25	26	20,29	133%
Penalty for undelivered capacity	10,968	13,500	18,509	10,552	12,536	15,206	15,473	19,218	18,787	16,491	19,014	20,835	191,090	-133%
The table shows average capacity values and prices presented in 1 hour.														
<b>BSP's share in delivered capacity</b>														
EP BiH	14	10	3	13	5	3	2	2	2	1	3	2	5,00	52%
EP BiH	78%	90%	50%	86%	52%	48%	26%	59%	70%	24%	79%	48%	64%	
ERS	4	1	3	2	4	3	6	2	1	4	1	2	2,86	162%
ERS	22%	10%	50%	14%	48%	52%	74%	41%	30%	76%	21%	52%	36%	
EP H2HB	0	0	0	0	0	0	0	0	0	0	0	0	0,00	0%
EP H2HB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	

The table shows average capacity values presented in 1 hour



**Table 4: Report on balance services in BiH for the year 2022**  
aFRR - peak load (06:00 - 24:00 hrs)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21	
Required capacity	MW	52	51	49	47	42	45	47	45	42	45	50	52	47,23	107%
Contracted capacity	MW	52	51	49	47	42	45	47	45	42	45	50	52	47,23	107%
Capacity contracted at the market	MW	52	51	49	47	42	45	47	45	42	45	50	52	47,23	107%
Price of contracted capacity	KW/MW	34,32	34,18	33,64	33,48	33,01	34,29	34,43	34,29	34,06	33,30	33,73	33,87	33,89	96%
Contracted cost	KM	995.891	878.623	919.857	849.776	773.516	833.360	902.995	861.078	772.513	836.191	910.624	982.833	10.517.258	102%
Delivered capacity	MW	36	30	22	36	34	21	19	17	9	13	18	19	22,92	73%
Delivered capacity	%	69%	59%	45%	78%	81%	47%	41%	38%	21%	29%	36%	37%	48,52%	
Capacity cost	KM	692.597	522.218	410.866	655.815	628.013	382.519	363.178	321.028	152.752	247.920	326.086	368.027	5.071.018	69%
Undelivered capacity	MW	16	21	27	11	8	24	28	28	33	32	32	33	24,31	190%
Penalty for undelivered capacity	KM	38.071	45.781	64.891	24.478	18.710	55.423	66.380	66.548	77.449	76.507	74.618	78.032	686.888	-190%
The table shows average capacity values and prices presented in 1 hour.															
<b>BSP's share in delivered capacity</b>															
EP BiH	MW	23	15	12	27	28	12	10	10	6	6	9	10	14,13	61%
EP BiH	%	64%	52%	56%	75%	83%	58%	52%	58%	67%	42%	52%	53%	61,66%	
ERS	MW	13	14	10	9	6	9	9	7	3	8	9	9	8,79	190%
ERS	%	36%	48%	44%	25%	17%	42%	48%	42%	33%	58%	48%	47%	38,34%	
EP HZHB	MW	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

**Table 5: Report on balance services in BiH for the year 2022**  
mFRR upward

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21	
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	kWh/MWh	2,68	2,69	2,69	2,68	3,52	6,93	6,49	6,49	6,93	5,57	3,54	2,70	4,42	153%
Contracted cost	kWh	391.337	353.667	391.033	378.821	513.531	977.494	946.167	946.167	977.494	813.488	499.522	393.866	7.582.586	153%
Delivered capacity	MW	132	172	123	180	188	135	20	12	0	29	157	104	103,60	66%
Delivered capacity	%	68%	88%	63%	92%	96%	69%	10%	6%	0%	15%	80%	53%	52,86%	
Capacity cost	kWh	262.193	310.142	242.013	349.886	495.131	640.394	53.207	28.647	590	79.178	414.685	209.752	3.085.818	78%
Undelivered capacity	MW	64	24	73	16	9	61	176	184	196	167	39	92	92,43	234%
Penalty for undelivered capacity	kWh	42.649	14.588	49.028	10.140	5.914	39.481	117.600	123.407	126.828	111.929	25.208	61.934	728.708	-234%
The table shows average capacity values and prices presented in 1 hour.															
<b>BSPs share in delivered capacity</b>															
EP BiH	MW	59	71	64	69	112	38	20	12	0	24	98	35	49,89	92%
EP BiH	%	45%	41%	52%	38%	60%	28%	97%	100%	100%	82%	63%	34%	48,16%	
ERS	MW	12	12	9	12	15	54	0	0	0	0	3	6	10,25	50%
ERS	%	9%	7%	7%	7%	8%	40%	0%	0%	0%	0%	2%	6%	9,90%	
EP HZHB	MW	61	88	50	99	61	44	1	0	0	5	56	62	43,46	53%
EP HZHB	%	46%	51%	41%	55%	33%	32%	3%	0%	0%	18%	35%	60%	41,95%	
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.															

**Table 6: Report on balance services in BiH for the year 2022**  
mFRR downward

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
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	KM/MW	1,58	1,57	1,59	1,59	1,66	1,66	1,66	1,66	1,65	1,59	1,58	1,62	110%
Contracted cost	KM	80,084	71,931	80,422	77,717	83,774	81,288	83,774	83,774	81,288	83,664	77,717	965,518	110%
Delivered capacity	MW	60	56	54	60	59	57	59	55	36	59	55	55.63	97%
Delivered capacity	%	88%	82%	79%	89%	87%	84%	87%	80%	53%	86%	81%	81,81%	
Capacity cost	KM	68,855	58,006	61,628	67,553	72,403	67,739	72,900	66,387	37,901	71,201	61,643	67,044	107%
Undelivered capacity	MW	8	12	14	8	9	11	9	13	32	9	13	12.39	116%
Penalty for undelivered capacity	KM	1,324	1,687	2,248	1,162	1,372	1,653	1,331	2,073	4,826	1,480	1,969	1,666	-116%

The table shows average capacity values and prices presented in 1 hour.

<b>BSP's share in delivered capacity</b>																
EP BiH	MW	10	9	7	10	8	7	8	8	8	8	8	7	7	8,06	48%
EP BiH	%	16%	16%	14%	16%	14%	13%	14%	14%	22%	11%	12%	15%	15%	14,48%	
ERS	MW	22	22	23	23	23	22	24	19	17	28	21	23	22,40	80%	
ERS	%	38%	39%	44%	39%	39%	40%	36%	47%	48%	38%	39%	40,28%			
EP HZHB	MW	15	14	14	15	11	10	10	11	11	14	14	13	12,37	97%	
EP HZHB	%	24%	25%	26%	25%	18%	18%	18%	19%	29%	19%	26%	23%	22,23%		
EFT Stanari	MW	13	11	9	13	17	17	17	17	1	13	13	13	12,80		
EFT Stanari	%	22%	20%	16%	21%	29%	30%	29%	31%	2%	22%	24%	23%	23,01%		

The table shows average capacity values presented in 1 hour.

## Balancing market

In 2022, for the needs of balancing the power system of BiH 51 449 MWh of upward balancing energy was activated (injected energy) with average price of 555.71 KM/MWh. Almost equal amount of upward balancing energy was activated as in 2021, but at almost three times higher prices.

In 2022, activated downward balancing energy (energy takeover from the system) amounted to 41 811 MWh. Average price for this energy was 321.44 KM/MWh taking into account the energy with offered negative price as well. In 2022 around 10% more of downward balancing energy was activated than it was the case in 2021, but at 4.5 times higher prices than in 2021.

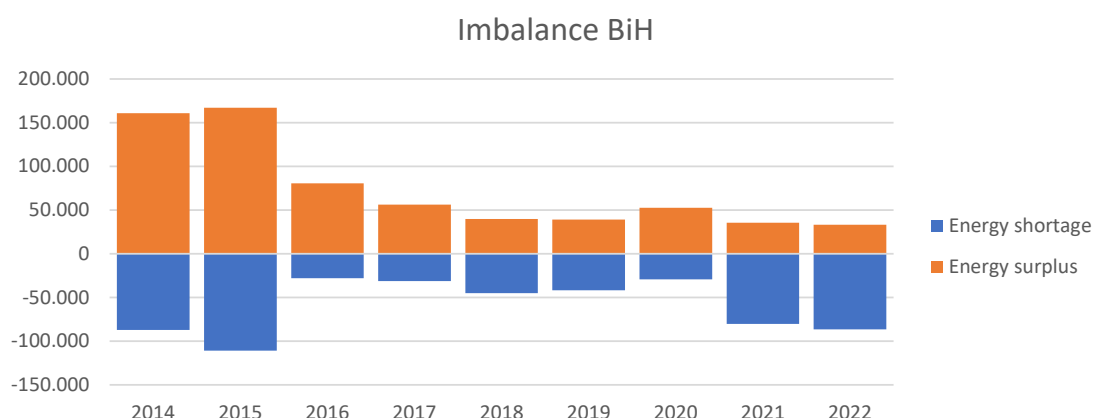
## Imbalance

There were 10 balance responsible parties (BRPs) active in BiH in 2022, not counting so called 'trading BRPs', i.e., the BRPs with no imbalance realized within BiH. Increase in number of BRPs in comparison to 6 BRPs in 2021 came as a result of introducing to the market the virtual power plants which included generation units based on renewable energy in BiH distribution systems. Average imbalance prices in 2022 were 439.64 KM/MWh for shortage and 306.01 KM/MWh for surplus of energy. These prices are three to four times higher than in last year and were moving in a wide range from -400.00 KM/MWh up to even 2 223.78 KM/MWh, depending on the energy situation. These extremely high prices of balancing energy were achieved on the basis of activated cross-border balancing energy in periods of extremely high prices of electricity in the Region and Europe.

According to data on activated balancing energy and realized imbalances it can be concluded that the year 2022 was characterized by more frequent cases of electricity shortage. Image 2 and Table 7 show the deviations of the Control Area BiH over the past few years.

**Table 7: Indicators of BiH deviations over the past five years**

Imbalance BiH		Energy shortage					Energy surplus				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Total	MWh	-45.062	-42.010	-29.318	-80.435	-86.765	39.814	38.864	52.587	35.417	33.014
Max. hourly	MW	-190	-186	-149	-742	-270	199	171	218	118	216



**Image 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 BiH Control Area, exempting the energy activated within BiH for the needs of other system operators.

**Table 8: Report on balancing market in BiH for the year 2022**

Engaged energy	2022												2022/21	2022/21	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec			
FCR upward	MMWh	332	243	310	319	253	285	291	278	296	270	349	357	3,585	
FCR downward	MMWh	212	280	239	259	267	196	211	210	229	308	208	187	2,805	
aFRR upward	MMWh	4,820	2,969	3,840	3,293	2,858	3,528	3,420	2,922	2,312	4,130	3,598	2,635	40,325	94%
aFRR downward	MMWh	4,619	4,720	2,473	5,251	4,803	2,593	3,289	2,495	868	1,152	2,337	3,749	38,348	103%
nFRR upward	MMWh	756	22	195	0	0	1,098	261	456	1,153	1,164	2,240	2,838	10,183	111%
nFRR downward	MMWh	0	69	9	35	14	0	0	0	190	0	317	0	635	108%
Balancing energy upward	MMWh	3,264	3,234	4,346	3,612	3,111	4,910	3,972	3,656	3,762	5,565	6,188	5,829	51,449	99%
Balancing energy downward	MMWh	5,069	5,069	2,721	5,545	5,084	2,789	3,410	2,705	1,161	1,460	2,862	3,936	41,811	110%
<b>Balancing cost and realized average prices</b>															
Upward - cost	KM	1,886,953	902,774	1,356,481	1,338,599	1,204,616	2,509,624	2,259,221	2,597,795	3,158,254	3,503,349	3,380,594	4,492,188	28,590,447	295%
Upward - average price	KM/MMWh	319,35	279,16	312,13	370,59	387,17	511,10	568,85	710,46	839,59	629,58	546,33	770,62	555,71	297%
Downward - cost	KM/MMWh	769,136	1,102,073	707,435	1,671,546	1,678,826	972,777	1,628,144	1,460,387	584,914	668,012	983,829	1,212,737	13,439,817	483%
Downward - average price	KM/MMWh	159,31	212,49	259,99	301,48	330,23	348,81	477,43	539,79	503,63	457,53	343,75	308,11	321,44	451%
<b>Imbalance BiH</b>															
Shortage - total	MMWh	4,281	2,249	5,380	2,802	2,342	6,651	8,144	8,764	14,232	11,284	8,383	12,251	86,765	108%
Shortage - max hourly	MMWh	49	68	54	52	59	145	98	209	266	172	78	270	270,00	36%
Surplus - total	MMWh	2,522	3,807	2,586	3,116	3,473	2,720	2,439	2,506	2,385	1,008	3,856	2,594	33,014	93%
Surplus - max hourly	MMWh	13	40	45	43	36	53	64	62	216	87	57	52	216,00	183%
Price shortage - average	KM/MMWh	282,27	282,19	314,41	382,05	386,74	428,87	588,56	531,46	510,65	582,99	481,27	490,03	439,64	261%
Price shortage - maximum	KM/MMWh	659,00	658,00	659,00	659,00	659,00	1,069,84	1,353,43	2,223,78	2,043,84	1,562,71	953,41	1,615,52	2,223,78	178%
Price surplus - average	KM/MMWh	143,82	168,87	212,31	286,35	273,10	301,85	418,88	428,61	369,49	443,94	287,44	324,58	306,01	393%
Price surplus - minimum	KM/MMWh	0,00	-200,00	-120,00	-50,00	-50,00	0,00	0,00	0,00	-50,00	0,00	-400,00	-45,00	-400,00	211%

## Transmission losses and FSkar process

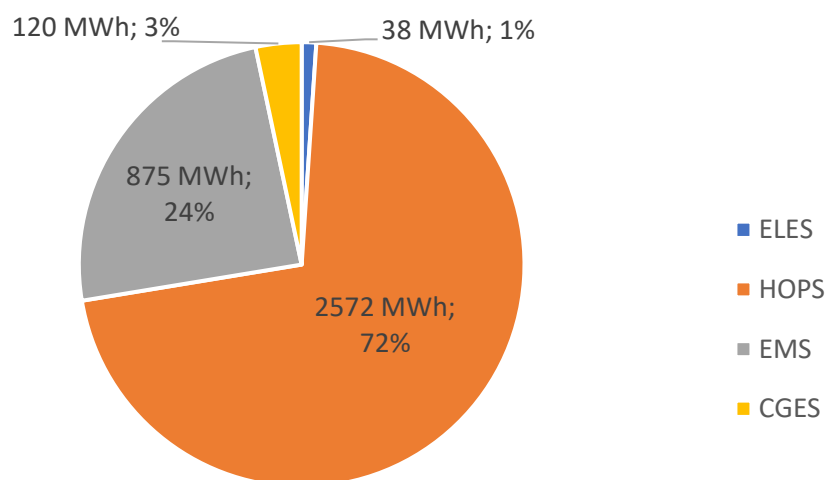
In 2022 energy to cover transmission system losses was procured through regulated procedures whereas service providers participated in the market in proportion to their consumption and per regulated price of 109.94 KM/MWh. Such regulated access was due to quite high prices of energy to cover losses as were provided through public procurement procedures. Total cost of this service in 2022 was 38 649 737 KM which is around 9% less in comparison to the year 2021 due to reduced transmission losses (Table 8).

The process of financial settlement of deviations between Control (LFC) Areas of Continental Europe – FSkar process, which includes unintended exchange, frequency containment process energy (FCR) and ramping period, was marked by extremely high prices of settlement energy. These high prices are the reflection of energy prices in Europe. On the basis on FSkar process, NOSBiH is due to pay over 32 million KM for the year 2022.

## Cross-border balancing energy exchange

On the basis of the Agreement on the provision of a joint reserve in the Slovenia-Croatia-Bosnia and Herzegovina Control block, the capacity of mFRR which was to be provided in 2021 within the BiH Control 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 9 shows the values of exchanged cross-border balancing energy in 2022 with the expenses included. Out of the total amount of 3 605 MWh of cross-border balancing energy the amount of 3 360 MWh was used in BiH while 245 MWh was BiH's help to other system operators. Image 3 shows the share of certain system operators 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 Fskar process for 2022**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21	
Losses	MWh	32.674	26.011	30.690	27.214	23.535	25.215	27.718	25.670	24.741	24.634	28.049	37.234	333.384	91%
Reference price	KM/MWh	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	101%
Cost	KM	3.826.792	3.279.510	3.358.557	2.925.064	2.474.200	2.453.641	3.055.013	2.916.378	3.116.029	3.169.240	3.552.161	4.523.151	38.649.737	91%
Cost Fskar	KM	920.791	-336.912	1.484.998	30.426	-370.207	2.182.776	3.620.527	5.785.860	7.899.113	3.667.795	2.141.468	5.421.267	32.447.904	353%

Compensations: "-" direction - acceptance, "+" direction - giving.

**Table 10: Report on cross-border balancing energy exchange for 2022**

Energy engaged in BiH for other TSOs needs	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
XB Exchange - Import	MWh						90		125				215	358%
Price Import Average	KM /MWh						79,99		-230,78				-100,69	67%
Cost Import	KM						7.199		-28.848				-21.649	240%
XB Exchange - Export	MWh		30										30	5%
Price Export Average	KM /MWh		656,00										656,00	188%
Cost Export	KM		19.680										19.680	10%

Engaged cross-border energy for BiH needs

XB Exchange - Import	MWh					125	100	320	1.073	560	150	1.032	3.360	149%
Price Import Average	KM /MWh					1.069,84	1.353,43	1.927,41	1.541,78	1.158,54	761,35	1.312,37	1.386,17	319%
Cost Import	KM					133.730	135.343	616.771	1.654.330	648.782	114.202	1.354.368	4.657.526	476%
XB Exchange - Export	MWh													
Price Export Average	KM /MWh													
Cost Export	KM													

## Conclusion

All required balancing services capacity for 2022, apart from FCR and aFRR capacity in off peak load periods, were procured in public procurement procedures mostly in the annual tender. Liabilities for providing FCR capacity were allocated to BRPs in a regulated manner. The price of balancing capacity was similar to the price in 2021, except for upward mFRR whose price was increased by more than 50%. In addition, realized prices of balancing capacities were significantly below the regulated price caps, except for the price of aFRR in off peak load periods.

In 2022 only 28% of required aFRR capacity was delivered during the night hours. We add here that the situation with provided balancing capacity was worse than in past years due to unfavourable energy situation in BiH and the neighbouring countries. Prevailing balancing services providers were three elektroprivreda companies.

Imbalance prices were in line with balancing energy prices and in average amounted to 439.64 KM/MWh for realized energy shortage, i.e., 306.01 KM/MWh for realized energy surplus being few times higher than in previous years as was the case with energy prices in European markets.

The cost in terms of losses was around 9% lower than it was in last year mostly due to lower losses in the system, with regulated prices remaining on level with last year.

In 2022 BiH power system often faced energy shortages which could not have been covered from its own balancing capacities, especially in second half of the year. At that times cross-border balancing energy was activated in amount of 3 360 MWh per quite high prices which in average amounted to 1 386.17 KM/MWh. Therefore, in 2022 for the needs of BiH around 50% more balancing energy was imported than in last year, but the total cost of this energy was almost 5 times higher. However, BiH helped neighbouring system operators with balancing energy in the total amount of 245 MWh.

An interesting fact for realization of energy balance in BiH for the year 2022 is the process of mutual financial settlement between Control (LFC) Areas of Continental Europe – Fskar. This settlement includes unintended exchange energy, frequency containment process energy (FCR) and ramping period. Previously this energy was settled through natural, energy compensations, but since 2021 these deviations from set and planned values have been settled financially. As the energy shortage was quite often in BiH power system and having in mind high prices in European Energy Exchanges, in accordance with FSkar process for realized shortage in 2022, BiH is due to pay the amount of over 32 million KM.

Taking into account the actual tariff for system services, on the basis of ancillary services and the balancing market the amount of 25.5 million KM of revenue was realized in 2022.

However, the year 2022 was specific for recovery from the COVID-19 pandemic, but the war in Ukraine caused large turbulence in energy markets. Significant increase in energy prices in European markets resulted with large increase in electricity price realized in BiH balancing market. At the end of the year SERC increased the price cap for balancing energy for manual frequency restoration to 989.46 KM/MWh.



## Addendum: Financial overview

Table 11: Financial balance - ancillary services and balancing energy in 2022

Control capacity														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
aFRR - capacity <i>KM</i>	-829.218	-602.966	-463.750	-773.308	-701.744	-431.136	-431.825	-352.656	-173.625	-291.442	-352.340	-399.220	-5.803.230	69%
aFRR - capacity - penalty <i>KM</i>	49.039	59.281	83.400	35.031	31.246	70.629	81.853	85.766	96.236	92.998	93.632	98.867	877.978	174%
mFRR upward - capacity <i>KM</i>	-262.193	-310.142	-242.013	-349.886	-495.131	-640.394	-53.207	-28.647	-590	-79.178	-414.685	-209.752	-3.085.818	78%
mFRR upward - capacity - penalty <i>KM</i>	42.649	14.588	49.028	10.140	5.914	39.481	117.600	123.407	126.828	111.929	25.208	61.934	728.708	234%
mFRR downward - capacity <i>KM</i>	-68.855	-58.006	-61.628	-67.553	-72.403	-67.739	-72.900	-66.387	-37.901	-71.201	-61.643	-67.044	-773.259	107%
mFRR upward - capacity - penalty <i>KM</i>	1.324	1.687	2.248	1.162	1.372	1.653	1.331	2.073	4.826	1.480	1.969	1.666	22.791	116%
<b>Total</b> <i>KM</i>	<b>-1.067.253</b>	<b>-895.556</b>	<b>-632.713</b>	<b>-1.144.415</b>	<b>-1.230.746</b>	<b>-1.027.507</b>	<b>-357.147</b>	<b>-236.443</b>	<b>15.774</b>	<b>-235.413</b>	<b>-707.859</b>	<b>-513.550</b>	<b>-8.032.830</b>	<b>66%</b>

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

Engaged energy														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
Upward <i>KM</i>	-1.886.953	-902.774	-1.356.481	-1.338.599	-1.204.616	-2.509.624	-2.259.221	-2.597.795	-3.158.254	-3.503.349	-3.380.594	-4.492.188	-28.590.447	295%
Downward <i>KM</i>	769.136	1.102.073	707.435	1.671.546	1.678.826	972.777	1.628.144	1.460.387	584.914	668.012	983.829	1.212.737	13.439.817	497%
<b>Total</b> <i>KM</i>	<b>-1.117.817</b>	<b>199.299</b>	<b>-649.046</b>	<b>332.948</b>	<b>474.210</b>	<b>-1.536.847</b>	<b>-631.077</b>	<b>-1.137.407</b>	<b>-2.573.340</b>	<b>-2.835.337</b>	<b>-2.396.765</b>	<b>-3.279.451</b>	<b>-15.150.631</b>	<b>216%</b>

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

Imbalance														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
Surplus <i>KM</i>	-216.603	-554.277	-677.241	-1.861.329	-1.717.304	-1.210.133	-1.364.558	-1.348.714	-526.858	-524.027	-511.323	-479.726	-10.992.093	136%
Shortage <i>KM</i>	2.978.632	1.790.463	2.882.973	2.036.214	1.498.364	4.745.942	7.159.567	7.196.920	13.287.485	12.498.241	9.727.971	12.107.919	77.910.690	235%
<b>Total</b> <i>KM</i>	<b>2.762.029</b>	<b>1.236.186</b>	<b>2.205.733</b>	<b>174.885</b>	<b>-218.940</b>	<b>3.535.808</b>	<b>5.795.009</b>	<b>5.848.206</b>	<b>12.760.626</b>	<b>11.974.214</b>	<b>9.216.649</b>	<b>11.628.194</b>	<b>66.918.597</b>	<b>266%</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	2022	2022/21
Losses	-3.826.792	-3.279.510	-3.358.557	-2.925.064	-2.474.200	-2.453.641	-3.055.013	-2.916.378	-3.116.029	-3.169.240	-3.552.161	-4.523.151	-38.649.737	91%
FSkar	-920.791	336.912	-1.484.998	-30.426	370.207	-2.182.776	-3.620.527	-5.785.860	-7.899.113	-3.667.795	-2.141.468	-5.421.267	-32.447.904	353%
<b>Total</b> <i>KM</i>	<b>-4.747.582</b>	<b>-2.942.599</b>	<b>-4.843.555</b>	<b>-2.955.490</b>	<b>-2.103.993</b>	<b>-4.636.417</b>	<b>-6.675.539</b>	<b>-8.702.239</b>	<b>-11.015.143</b>	<b>-6.837.036</b>	<b>-5.693.630</b>	<b>-9.944.418</b>	<b>-71.097.641</b>	<b>138%</b>

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

System service														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
<b>Total</b> <i>KM</i>	<b>5.200.784</b>	<b>4.480.700</b>	<b>4.868.393</b>	<b>4.241.161</b>	<b>3.891.317</b>	<b>3.855.063</b>	<b>4.202.864</b>	<b>4.163.315</b>	<b>4.018.404</b>	<b>4.299.781</b>	<b>4.561.777</b>	<b>5.118.431</b>	<b>52.901.990</b>	<b>99%</b>

Positive values are invoiced by NOSBIH and paid by market participants

Balance														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2022	2022/21
<b>Total</b> <i>KM</i>	<b>1.030.161</b>	<b>2.078.030</b>	<b>948.811</b>	<b>649.089</b>	<b>811.847</b>	<b>190.101</b>	<b>2.334.109</b>	<b>-64.568</b>	<b>3.206.322</b>	<b>6.366.209</b>	<b>4.980.172</b>	<b>3.009.205</b>	<b>25.539.486</b>	<b>335%</b>

Positive value - NOSBIH's surplus of assets