IGCC Opportunity Price Desctiption – Compiled from all IGCC Member TSOs

This document consolidates the IGCC Annex 3 descriptions provided by participating Transmission System Operators (TSOs). Each section reflects the respective national implementation of the calculation methodology for the IGCC Values of Avoided aFRR Activation (VoAAA), including pricing principles, activation logic, and settlement specifics.

The purpose of this compilation is to provide a transparent and structured overview of the different approaches applied across TSOs within the IGCC framework. While all TSOs operate under the common objective of quantifying avoided aFRR activation costs, the methodologies applied at national level may differ due to variations in market design, regulatory requirements, and technical implementation.

This compilation serves as a reference for understanding methodological differences, supporting cross-TSO alignment discussions, and enabling further analysis of harmonisation opportunities within the IGCC and PICASSO context.

As the settlement and calculation of IGCC Values of Avoided aFRR Activation remain the responsibility of the respective national TSOs any questions or clarifications regarding specific methodologies or results should be addressed directly to the concerned TSO.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF 50HERTZ

Valid as of 01 January 2025

Basic Information	
IGCC Participating Member(s)	50Hertz Transmission GmbH
Invoicing Task Operator	JAO

Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing (pay as bid for non-AOF volumes) based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	1s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	When connected to PICASSO: real time. When disconnected: D+1,
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Usually 6th Working day after delivery

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

1. **Connected with PICASSO:**

The 50Hertz cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case 50Hertz is connected with PICASSO.
In case 50Hertz is disconnected, a German CBMP will be used as IGCC VoAAA for 50Hertz in case at least one German TSO is connected with PICASSO.

2. **Disconnected from PICASSO:**

The local marginal price (LMP) for aFRR will be used as IGCC VoAAA for a respective MTU in case all German TSOs are disconnected from PICASSO

Based on the Participation file, the settlement entity of the aFRR Platform will identify the MTUs, for which a disconnection took place and will use the respective price.

3. **Formula:**

$$VoAAA_{Exp,50Hertz,MTU} = VoAAA_{Imp,50Hertz,MTU} = \begin{cases} CBMP_{aFRR,50Hertz,MTU} & where\ 50Hertz\ is\ connected\ with\ PICASSO \\ LMP_{aFRR,DE,MTU} & where\ Germany\ is\ disconnected\ from\ PICASSO \\ CBMP_{aFRR,DE,MTU} & else \end{cases}$$

with:

$CBMP_{aFRR,50Hertz,MTU}$	*aFRR cross border marginal price available for 50Hertz either for positive or negative direction in MTUs where 50Hertz is connected with PICASSO*
$CBMP_{aFRR,DE,MTU}$	*German aFRR cross border marginal price determined in MTUs where 50Hertz is disconnected from and at least one German TSO is connected with PICASSO*
$LMP_{aFRR,DE,MTU}$	*aFRR local marginal price determined for German TSOs in MTUs where Germany is disconnected from PICASSO*
$P_{corr,IGCC,50Hertz,MTU}$	*IGCC correction value for 50Hertz in the respective MTUs*

TEMPLATE B: IGCC VALUES OF AFRR AVOIDED ACTIVATION TEMPLATE, *APPLICABLE FROM 18/03/2025*

Basic Information	
IGCC Participating Member(s)	IPTO Independent Power Transmission Operator ("ADMIE")
Invoicing Task Operator	JAO

Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing (pay as bid for non-AOF volumes)
Accounting period for aFRR energy? (15min/ 60min)	1 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Until Thursday of week W+1 (where Settlement Week W is defined as the time period between Monday, at 00:00 CET and the following Monday at 00:00 CET)

Calculation of IGCC Values of avoided aFRR

1. **Connected with the aFRR Platform:**

The cross border marginal price (CBMP) will be used for the calculation of the IGCC VoAAA. Since the CBMP is available on a second resolution, the weighted average of the CBMP will be used to calculate the IGCC VoAAA in 15 min resolution. The weight will be the IGCC correction value.

The calculation will be performed automatically by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by IPTO for these delivery periods, can be neglected.

2. **Disconnected from the aFRR Platform:**

The Local Marginal Price (LMP) will be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min), the resulting IPTO VoAAA will be the weighted average of the following:

- the CBMP for the time periods connected with the aFRR Platform and
- the LMP for the time periods not connected with the aFRR Platform.

The weight will be the IGCC correction value.

The settlement entity of the aFRR Platform will identify the time periods, where a disconnection took place. The IGCC VoAAA, submitted by IPTO, shall be used for these time periods. In case a disconnection took place for less than 15min within a given delivery period, the data submitted by IPTO shall be used for the whole delivery period.

An example of the calculation logic for the disconnected case is provided in the following table:

timestamp	Status connection with aFRR Platform	IN Pcorr IPTO	LMP	CBMP	Pcorr x LMP; Pcorr x CBMP
0:01:00	connected	20	NA	40	800
0:01:04	connected	20	NA	60	1200
0:01:08	connected	20	NA	40	800
0:01:12	connected	50	NA	100	5000
....	..	...	...	...	
0:05:00	connected	-50	NA	10	-500
0:05:04	connected	-50	NA	10	-500
0:05:08	connected	-50	NA	15	-750
0:05:12	connected	-50	NA	10	-500
...	...	...	...	...	
0:10:00	disconnected	10	90	NA	900
0:10:04	disconnected	10	80	NA	800
0:10:08	disconnected	10	50	NA	500
0:10:12	disconnected	15	90	NA	1350
...	...	...	...	...	
0:15:00	disconnected	-20	5	NA	-100
0:15:04	disconnected	-20	10	NA	-200
0:15:08	disconnected	-20	10	NA	-200
0:15:12	disconnected	-50	10	NA	-500
...	...	...	...	...	
Sum IN+	disconnected	45			3550
Sum IN-	disconnected	-110			-1000
Sum IN+	connected	110			7800
Sum IN-	connected	-200			-2250
VoAAApos (import)		**73,23**			
VoAAAneg (export)		**10,48**			

If there was no aFRR energy activation in negative or positive direction at time periods where IPTO is disconnected from the aFRR Platform, the IGCC Value of avoided aFRR is determined as an average of the first aFRR bids prices in the local merit order list in each direction.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF AMP

Valid as of 1st January 2025

Basic Information	
IGCC Participating Member(s)	Amprion GmbH
Invoicing Task Operator	JAO

Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing (pay as bid for non-AOF volumes) based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	1s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	When connected to PICASSO: real-time. When disconnected: D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Usually 6th Working day after delivery

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

1. **Connected with PICASSO:**

The Amprion cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case Amprion is connected with PICASSO.

In case Amprion is disconnected, a German CBMP will be used as IGCC VoAAA for Amprion in case at least one German TSO is connected with PICASSO.

2. **Disconnected from the aFRR Platform:**

The local marginal price (LMP) for aFRR will be used as IGCC VoAAA for a respective MTU in case all German TSOs are disconnected from PICASSO.

Based on the Participation file, the settlement entity of the aFRR Platform will identify the MTUs, for which a disconnection took place and will use the respective price.

3. **Formula:**

$$VoAAA_{Exp,AMP,MTU} = VoAAA_{Imp,AMP,MTU}$$
$$= \begin{cases} CBMP_{aFRR,AMP,MTU} & where\ Amprion\ is\ connected\ with\ PICASSO \\ LMP_{aFRR,DE,MTU} & where\ Germany\ is\ disconnected\ from\ PICASSO \\ CBMP_{aFRR,DE,MTU} & else \end{cases}$$

with:

$CBMP_{aFRR,AMP,MTU}$	*aFRR cross border marginal price available for Amprion either for positive or negative direction in MTUs where Amprion is connected with PICASSO*
$CBMP_{aFRR,DE,MTU}$	*German aFRR cross border marginal price determined in MTUs where Amprion is disconnected from and at least one German TSO is connected with PICASSO*
$LMP_{aFRR,DE,MTU}$	*aFRR local marginal price determined for German TSOs in MTUs where Germany is disconnected from PICASSO*
$P_{corr,IGCC,AMP,MTU}$	*IGCC correction value for Amprion in the respective MTUs*

IGCC VALUE OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF APG

Valid as of 01 January 2025

TABLE 1: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF APG

Basic Information	
IGCC Participating Member(s)	Austrian Power Grid AG
Invoicing Task Operator	JAO
Summarized information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal Pricing
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	10th Working day following the month of delivery
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	10th Working day following the month of delivery

Commented [B11]: Usually the 5th, but as sometimes corrections are done in the second validation process, it could happen that the amounts are adjusted till the 10th

Calculation of IGCC Values of avoided aFRR

The IGCC values of avoided upward and downward aFRR activations are determined by the activated aFRR energy. This is done separately for upward and downward energy. For both IGCC import and IGCC export they are calculated as the quantity-weighted average of the CBMP of all IGCC members.

If there was no aFRR energy activation neither for upward nor downward direction, the aFRR energy price that would have been paid for the first activated bid in the Austrian merit order list in the respective direction (respectively in case of aFRR cooperation the first activated bid in the common merit order list of the cooperation) is taken as the IGCC Values of aFRR Avoided Activation.

In case of disconnection from PICASSO, APG uses the Austrian merit order list and the pay-as-bid method. The IGCC value of avoided aFRR activations, in this case, is calculated locally.

$$C_{i,IMP} = \frac{M_{aFRR\_pos,i}}{aFRR_{pos,i}}$$

$$C_{i,EXP} = \frac{M_{aFRR\_neg,i}}{aFRR_{neg,i}}$$

TABLE 2: DESCRIPTION OF VARIABLES

Variable	Description	Unit	Sign
$aFRR_{pos,\ i}$	Amount of activated positive aFRR energy for the IGCC settlement period$_i$.	[MWh]	Always positive.
$aFRR_{neg,\ i}$	Amount of activated negative aFRR energy for the IGCC settlement period$_i$.	[MWh]	Always positive.
$C_{i,Imp}$	Resulting IGCC Value of aFRR Avoided Activation of APG for IGCC import for the IGCC settlement period$_i$.	[€/MWh]	Positive values means APG pays for activation of positive aFRR energy. Negative value means APG is paid for activation of positive aFRR energy.
$C_{i,Exp}$	Resulting IGCC Value of aFRR Avoided Activation of APG for IGCC export for the IGCC settlement period$_i$.	[€/MWh]	Positive value means APG is paid for activation of negative aFRR energy. Negative value means APG pays for activation of negative aFRR energy.
$M_{aFRR\_pos,\ i}$	Total costs for positive aFRR energy deliveries of APG for the IGCC settlement period$_i$.	[€]	Positive value means APG has costs. Negative value means APG receives payment.
$M_{aFRR\_neg,\ i}$	Total costs for negative aFRR energy deliveries of APG for the IGCC settlement period$_i$.	[€]	Positive value means APG receives payment. Negative value means APG has costs.

Template B: IGCC Values of aFRR Avoided Activation Template

Basic Information	
IGCC Participating Member(s)	AS "Augstsprieguma tikls"
Invoicing Task Operator	JAO

Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	no
Separate pricing of positive and negative aFRR energy (yes or no)	yes
Negative prices for positive aFRR energy possible?	yes
Negative prices for negative aFRR energy possible?	yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	following month
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Month following the delivery

Calculation of IGCC Values of avoided aFRR

For each IGCC settlement period, the IGCC Values of avoided aFRR are determined separately for imports and exports as follows:

- **IGCC import** = local UP aFRR price, if available; otherwise VoAA UP
- **IGCC export** = local DOWN aFRR price, if available; otherwise VoAA DOWN.

Determination of local aFRR prices:

If local aFRR activation has occurred, the local aFRR price is calculated as a weighted average of the activated aFRR energy in the respective direction:

- **Local UP aFRR price** = total settlement amount of activated UP aFRR energy [EUR] / total activated UP aFRR energy [MWh]

- **Local DOWN aFRR price** = total settlement amount of activated DOWN aFRR energy [EUR] / total activated DOWN aFRR energy [MWh]

Determination of VoAA fallback prices:

If no local aFRR activation has occurred in the respective direction, a VoAA fallback price is applied:

- **VoAA UP price** = lowest price of UP energy bids available in the relevant MTU (considering aFRR and mFRR bids)

- **VoAA DOWN price** = greatest price of DOWN energy bids available in the relevant MTU (considering aFRR and mFRR bids)

Examples for calculation of IGCC VoAAA:

Local UP aFRR price, EUR/MWh	Local DOWN aFRR price, EUR/MWh	VoAA UP price, EUR/MWh	VoAA DOWN price, EUR/MWh	IMPORT VoAAA, EUR/MWh	EXPORT VoAAA, EUR/MWh
100	20	50	40	**100**	**20**
-	-	50	40	**50**	**40**
100	-	50	40	**100**	**40**
-	20	50	40	**50**	**20**

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ČEPS

Valid as of 1 January 2025

Basic Information	
IGCC Participating Member(s)	ČEPS, a.s.
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing (pay as bid for non-AOF volumes)
Accounting period for aFRR energy? (15min/ 60min)	15 min (ISP 15 min)
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Preliminary possible to determine in D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	4th Working day of the 4th month after the month of delivery[1].

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

3. **Connected with the aFRR Platform:**

The ČEPS's cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case ČEPS is connected with PICASSO.

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The calculation will be performed automatically by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by ČEPS for these delivery periods, can be neglected.

4. **Disconnected from the aFRR Platform:**

[1] The deadline is changing with actual Business Terms of OTE available on www.ote-cr.cz

The local marginal price (LMP) shall be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min), the resulting CEPS VoAAA will be weighted average of following:

- the CBMP for the time periods connected with the aFRR Platform and
- the LMP for the time periods not connected with the aFRR Platform.
- The weight will be the IGCC correction value.

The settlement entity of the aFRR Platform will identify the time periods, where a disconnection took place. The IGCC VoAAA, submitted by ČEPS in 15 min resolution, shall be used for these time periods.

An example of the calculation logic for the partial disconnection case is provided in the following table:

	Status connection with aFRR Platform	IN Pcorr CZ	LMP	CBMP	Dot product
30.11.2024 0:00:01	connected	20	NA	50	1000
30.11.2025 0:00:02	connected	20	NA	50	1000
30.11.2025 0:00:03	connected	20	NA	50	1000
30.11.2025 0:00:04	connected	20	NA	50	1000
....	..	...	...	...	...
30.11.2025 0:05:01	connected	-50	NA	10	-500
30.11.2025 0:05:02	connected	-50	NA	10	-500
30.11.2025 0:05:03	connected	-50	NA	10	-500
30.11.2025 0:05:04	connected	-50	NA	10	-500
...	...	...	...	...	...
30.11.2025 0:10:01	disconnected	-10	5	NA	-50
30.11.2025 0:10:02	disconnected	-10	5	NA	-50
30.11.2025 0:10:03	disconnected	-10	5	NA	-50
30.11.2025 0:10:04	disconnected	-10	5	NA	-50
...	...	...	...	...	...
30.11.2025 0:14:56	disconnected	40	90	NA	3600
30.11.2025 0:14:57	disconnected	40	90	NA	3600
30.11.2025 0:14:58	disconnected	40	90	NA	3600
30.11.2025 0:14:59	disconnected	40	90	NA	3600
Sum IN+	disconnected	160			14400
Sum IN-	disconnected	-40			-200
Sum IN+	connected			80	4000
Sum IN-	connected			-200	-2000
IGCC VoAAApos		**76,67**			
IGCC VoAAAneg		**9,17**			

If there was no aFRR energy activation in negative or positive direction, the IGCC Value of avoided aFRR is determined as an average of the first aFRR bids prices in the Czech merit order list in each direction.

Template B: IGCC Values of aFRR Avoided Activation Template

Basic Information	
IGCC Participating Member(s)	Elering AS
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merid order list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	yes
Separate pricing of positive and negative aFRR energy (yes or no)	no
Negative prices for positive aFRR energy possible?	yes
Negative prices for negative aFRR energy possible?	yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	10th calendar day of the following month
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	10th calendar day of the following month

Calculation of IGCC Values of avoided aFRR

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

1. Connected with the aFRR platform:

The Estonian cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case Elering is connected with PICASSO. The calculation will be performed

automatically by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by Elering for these delivery periods, can be neglected.

2. Disconnected from the aFRR platform:

The VoAAA calculated by Elering shall be used for both IGCC import and exports, calculated as the arithmetic average of the lowest priced upward aFRR bid and highest priced downward aFRR bid, which are available in the local merit order list (LMOL).

Examples for calculation of IGCC Values of avoided aFRR

Lowest priced available upward aFRR bid from LMOL, EUR/MWh:	Highest priced available downward aFRR bid from LMOL, EUR/MWh:	VoAAA, EUR/MWh:
50	-10	20

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ELES

TABLE 3: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ELES

Basic Information	
IGCC Member(s)	ELES, Ltd.
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list[2]
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Pay-as-bid
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of Values of avoided aFRR? (D+1/ following month/ etc.)	8th BD of the month following the delivery
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	20th CD of the month following the delivery

Calculation of IGCC values of avoided aFRR activation

In Slovenia the calls for aFRR energy are made based on “merit-order-list” activation and delivered energy bids are settled on a “pay as bid” principle.

The IGCC values of avoided aFRR activation are determined separately for positive and negative aFRR energy per each accounting period (i.e. 15 minutes).

In import direction the IGCC value of avoided aFRR activation is calculated as the quantity-weighted average price of upward activated aFRR energy in the respective accounting period. Similar in export direction the IGCC value of avoided aFRR activation is calculated as the quantity-weighted average price of downward activated aFRR energy in the respective accounting period.

If there was no aFRR energy activation neither for negative nor positive direction, the aFRR energy price that would have been paid for the first activated bid in the Slovenian merit order list in the respective direction is taken as the IGCC Values of aFRR Avoided Activation.

[2] Switch from “pro-rata” to “merit-order-list” aFRR-activation was made on 27th January 2020.

$$C_{Imp,i} = \frac{M_{aFRR\_pos,i}}{aFRR_{pos,i}}$$

$$C_{Exp,i} = \frac{M_{aFRR\_neg,i}}{aFRR_{neg,i}}$$

TABLE 4: DESCRIPTION OF VARIABLES

Variable	Description	Unit	Sign
$aFRR_{pos,\ i}$	Amount of activated positive aFRR energy for the IGCC settlement period *i*.	[MWh]	Always positive.
$aFRR_{neg,\ i}$	Amount of activated negative aFRR energy for the IGCC settlement period *i*.	[MWh]	Always positive.
$C_{Imp,i}$	Resulting IGCC Value of aFRR Avoided Activation of ELES for IGCC import for the IGCC settlement period *i*.	[€/MWh]	Positive value means ELES pays for activation of positive aFRR energy. Negative value means ELES is paid for activation of positive aFRR energy.
$C_{Exp,i}$	Resulting IGCC Value of aFRR Avoided Activation of ELES for IGCC export for the IGCC settlement period *i*.	[€/MWh]	Positive value means ELES is paid for activation of negative aFRR energy. Negative value means ELES pays for activation of negative aFRR energy.
$M_{aFRR\_pos,\ i}$	Total costs for positive aFRR energy deliveries of ELES for the IGCC settlement period *i*.	[€]	Positive value means ELES has costs. Negative value means ELES receives payment.
$M_{aFRR\_neg,\ i}$	Total costs for negative aFRR energy deliveries of ELES for the IGCC settlement period *i*.	[€]	Positive value means ELES receives payment. Negative value means ELES has costs.

Examples for calculation of IGCC values of avoided upward and downward aFRR activations

Example for Slovenian IGCC Value of aFRR Avoided Activation determination for one settlement period i:

TABLE 5: EXAMPLES FOR IGCC VALUES OF AVOIDED AFRR ACTIVATIONS

Example for IGCC value of avoided aFRR activation in import			
	aFRR energy amount in MWh	Price in €/MWh	Costs in €
Bid 1	1	80	80
Bid 2	2	110	220
Bid 3	17	140	2.380
Sum	20		2.680
IGCC value of avoided aFRR activation in €/MWh	134,00		

Example for IGCC value of avoided aFRR activation in export			
	aFRR energy amount in MWh	Price in €/MWh	Revenues[3] in €
Bid 1	1	10	10
Bid 2	3	0	0
Bid 3	26	-35	-910
Sum	30		-900
IGCC value of avoided aFRR activation in €/MWh	-30,00		

3 Negative revenues are costs.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ELIA

Basic Information	
IGCC Participating Member(s)	Elia
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Month following the delivery (M+1)
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Month following the delivery (M+1)

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

5. **Connected with the aFRR Platform:**

The cross border marginal price (CBMP) for the Elia LFC Area will be used for the calculation as IGCC VoAAA for the respective MTU (4s) in case Elia is connected to the aFRR Platform.

The CBMP value will be automatically provided by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by Elia for these delivery periods, can be neglected.

6. Disconnected from the aFRR Platform:

In case Elia is not connected to the aFRR Platform, the local marginal price (LMP) be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min). The resulting ELIA VoAAA will be weighted average of following:

- the CBMP for the time periods connected with the aFRR Platform and
- the LMP for the time periods not connected with the aFRR Platform.
- The weight will be the IGCC correction value.

The settlement entity of the aFRR Platform will identify the time periods where a disconnection took place. The IGCC VoAAA, submitted by Elia, shall be used for these time periods. In case a disconnection took place for less than 15min within a given delivery period, the data submitted by Elia shall be used for the whole delivery period.

An example of the calculation logic for the disconnected case is provided in the following table:

	Status connection with aFRR Platform	IN Pcorr ELIA	LMP	CBMP	Pcorr x LMP; Pcorr x CBMP
30.11.2021 0:00	connected	20	NA	50	1000
30.11.2021 0:00	connected	20	NA	50	1000
30.11.2021 0:00	connected	20	NA	50	1000
30.11.2021 0:00	connected	20	NA	50	1000
....	..	...	...	...	...
30.11.2021 0:05	connected	-50	NA	10	-500
30.11.2021 0:05	connected	-50	NA	10	-500
30.11.2021 0:05	connected	-50	NA	10	-500
30.11.2021 0:05	connected	-50	NA	10	-500
...	...	...	...	...	...
30.11.2021 0:10	disconnected	-10	5	NA	-50
30.11.2021 0:10	disconnected	-10	5	NA	-50
30.11.2021 0:10	disconnected	-10	5	NA	-50
30.11.2021 0:10	disconnected	-10	5	NA	-50
...	...	...	...	...	...
30.11.2020 0:14	disconnected	40	90	NA	3600
30.11.2020 0:14	disconnected	40	90	NA	3600
30.11.2020 0:14	disconnected	40	90	NA	3600
30.11.2020 0:14	disconnected	40	90	NA	3600
Sum IN+	disconnected	160			14400
Sum IN-	disconnected	-40			-200
Sum IN+	connected	80			4000
Sum IN-	connected	-200			-2000
VoAAApos		**76,67**			
VoAAAneg		**9,17**			

If there was no IGCC exchange with the Elia LFC area in negative or positive direction for a full quarter hour, the IGCC Value of avoided aFRR is determined as an average of the first aFRR bids prices in the Belgian merit order list in each direction.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ENDK

TABLE 6: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ENDK

Basic Information	
IGCC Participating Member(s)	Energinet.dk
Summarized information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	rginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15min (based on 1s values)
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Real time
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Real time

Calculation of IGCC Values of avoided aFRR

Energinet determines the IGCC VoAAA based on the 1s settlement price for aFRR as determined by the LFC. The settlement price *C* is determined by comparing the local marginal price in the LFC area (LMP) and the cross-border marginal price (CBMP) determined by PICASSO. When local activations and activations determined by PICASSO are in the same direction, the highest price sets the settlement price. In

cases where local activations and activations determined by PICASSO are in opposite directions, the LMP dictates the CBMP.

$$\boldsymbol{C_{AREA,UP,1s}} = \boldsymbol{MAX}(\boldsymbol{LMP_{AREA,UP,1s}}, \boldsymbol{CBMP_{AREA,UP,1s}})$$

$$\boldsymbol{C_{AREA,DOWN,1s}} = \boldsymbol{MIN}(\boldsymbol{LMP_{AREA,Down,1s}}, \boldsymbol{CBMP_{AREA,Down,1s}})$$

VoAAA is calculated as the volume weighted settlement price based on settled volumes locally $\boldsymbol{V}$.

$$\boldsymbol{VoAAA_{AREA,direction,15min}} = \frac{\sum_{\boldsymbol{15min}}(\boldsymbol{C_{AREA,direction,1s}} * \boldsymbol{V_{AREA,direction,1s}})}{\sum_{\boldsymbol{15min}} \boldsymbol{V_{AREA,direction,1s}}}$$

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF ESO

Valid as of 01 April 2025

Basic Information	
IGCC Participating Member(s)	ESO EAD
Invoicing Task Operator	JAO

Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	4s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	12th day of the month following the delivery
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	12th day of the month following the delivery

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

1. **Connected with PICASSO:**

The ESO cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU in case ESO is connected with PICASSO.

2. **Disconnected from PICASSO:**

The local marginal price (LMP) for aFRR will be used as IGCC VoAAA for a respective MTU in case ESO is disconnected from PICASSO.

If there was no aFRR energy activation in negative or positive direction at time periods where ESO is disconnected from the aFRR Platform, the IGCC Value of avoided aFRR is determined as the first aFRR bids prices in the local merit order list in each direction.

Based on the Participation file, the settlement entity of the aFRR Platform will identify the MTUs, for which a disconnection took place and will use the respective price.

IGCC VoAAA are calculated in Bulgarian currency (BGN) and are converted into EUR according to Bulgarian National Bank exchange rates, published on www.bnb.bg.

3. **Formula:**

$$VoAAA_{Exp,ESO,MTU} = VoAAA_{Imp,ESO,MTU}$$
$$= \begin{cases} CBMP_{aFRR,ESO,MTU} & where\ ESO\ is\ connected\ with\ PICASSO \\ LMP_{aFRR,ESO,MTU} & where\ ESO\ is\ disconnected\ from\ PICASSO \end{cases}$$

with:

$CBMP_{aFRR,ESO,MTU}$	*aFRR cross border marginal price available for ESO either for positive or negative direction in MTUs where ESO is connected with PICASSO*
$LMP_{aFRR,ESO,MTU}$	*aFRR local marginal price determined for ESO in MTUs where disconnected from PICASSO*
$P_{corr,IGCC,ESO,MTU}$	*IGCC correction value for ESO in the respective MTUs*

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATION

Basic Information	
IGCC Member(s)	Croatian Transmission System Operator Plc.
Invoicing TSO	Regular IGCC member

Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Pay-as-bid
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of IGCC Opportunity Prices? (D+1/ following month/ etc.)	Prices are determined on D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+2

Calculation of IGCC values of avoided aFRR activation

The Croatian IGCC Opportunity Prices are calculated separately for IGCC import and IGCC export.

In Croatia, the activation of aFRR energy is performed according to a merit-order-list (MOL) based on submitted balancing energy bids.

Although the balancing market is organized on a market-based principle, part of the aFRR capacity is still provided by a dominant service provider under regulated conditions. For this regulated share, the service provider is subject to price constraints defined by regulatory rules.

All balancing energy bids, including those from the dominant service provider, are placed on the same merit-order list and are activated according to the merit-order principle. However, bids corresponding to the regulated volume must respect the regulated pricing limits defined for that provider.

Determination of IGCC Opportunity Prices

Within this framework, IGCC Opportunity Prices are determined based on activated aFRR

energy.

The IGCC Opportunity Price for both IGCC import and IGCC export is calculated as the quantity-weighted average price of activated aFRR energy in the respective direction within the IGCC settlement period in Croatia.

If no aFRR activation occurs in the respective direction during the settlement period, the IGCC Opportunity Price is defined as the price of the first available bid in the Croatian merit-order list for that direction.

The calculation formulas are defined as follows:

$$C_{IMP,i} = \frac{M_{aFRR_{pos},i}}{aFRR_{pos,i}}$$

$$C_{EXP,i} = \frac{M_{aFRR_{neg},i}}{aFRR_{neg,i}}$$

Variable	Description	Unit	Sign
$aFRR_{pos,\ i}$	Amount of activated positive aFRR energy for the IGCC settlement period "I".	[MWh]	Always positive.
$aFRR_{neg,\ i}$	Amount of activated negative aFRR energy for the IGCC settlement period "I".	[MWh]	Always positive.
$C_{i,Imp}$	Resulting IGCC Value of avoided aFRR of HOPS for IGCC import for the IGCC settlement period "i".	[€/MWh]	Positive values means HOPS pays for activation of positive aFRR energy. Negative value means HOPS is paid for activation of positive aFRR energy.
$C_{i,Exp}$	Resulting IGCC Value of avoided aFRR of HOPS for IGCC export for the IGCC settlement period "i".	[€/MWh]	Positive value means HOPS is paid for activation of negative aFRR energy. Negative value means HOPS pays for activation of negative aFRR energy.
$M_{aFRR\_pos,\ i}$	Total costs for positive aFRR energy deliveries of HOPS for the IGCC settlement period "i".	[€]	Positive value means HOPS has costs. Negative value means HOPS receives payment.
$M_{aFRR\_neg,\ i}$	Total costs for negative aFRR energy deliveries of HOPS for the IGCC settlement period "I".	[€]	Positive value means HOPS receives payment. Negative value means HOPS has costs.

Examples for calculation of IGCC Opportunity Prices under market conditions:

Example for IGCC Opportunity Price for import			
	aFRR activated energy amount [MWh]	Price [€/MWh]	Costs [€]
Bid 1	25	75	1.875
Bid 2	50	85	4.250

Bid 3	20	90	1.800
∑	95	/	7.925

IGCC Opportunity Price €/MWh	83,421

Example for IGCC Opportunity Price for import			
	aFRR activated energy amount [MWh]	Price [€/MWh]	Costs [€]
Bid 1	10	-25,00	-250
Bid 2	20	-30,00	-600
Bid 3	15	-35,00	-525
∑	45	/	-1.375

IGCC Opportunity Price €/MWh	-30,556

Regulated price constraint for the dominant service provider

Although all balancing energy bids are activated according to the merit-order-list principle, the dominant service provider is obligated to provide a certain share of aFRR capacity under regulated conditions.

For this regulated volume, the provider is subject to price constraints defined by regulatory rules, which limit the price that can be submitted for balancing energy bids.

The regulated price limits are defined based on the average Day-Ahead market price (D-1) of local markets relevant for the Croatian control area.

The regulated price limits are determined as follows:

$$C_{aFRR+,i} = C_{CROPEX,D-1,i} + 0{,}4 \cdot \left|C_{CROPEX,D-1,i}\right|$$

$$C_{aFRR-,i} = C_{CROPEX,D-1,i} - 0{,}4 \cdot \left|C_{CROPEX,D-1,i}\right|$$

Template B: IGCC Values of aFRR Avoided Activation Template

Basic Information	
IGCC Participating Member(s)	Litgrid
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merid order list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	yes
Separate pricing of positive and negative aFRR energy (yes or no)	no
Negative prices for positive aFRR energy possible?	yes
Negative prices for negative aFRR energy possible?	yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	10th calendar day of the following month
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	10th calendar day of the following month

Calculation of IGCC Values of avoided aFRR

Volume for avoided activation is determined by Picasso platform provided data, 4sec optimisation cycle data, summed to 15min intervals, for up and down directions. NordPool day ahead market LT market price is used for void activation both up and down volumes.

Examples for calculation of IGCC Values of avoided aFRR

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TEMPLATE B: IGCC VALUES OF AFRR AVOIDED ACTIVATION TEMPLATE

Basic Information	
IGCC Participating Member(s)	MAVIR ZRt.
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	pay-as-bid
Accounting period for aFRR energy? (15min/ 60min)	15 min.
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	no
Separate pricing of positive and negative aFRR energy (yes or no)	yes
Negative prices for positive aFRR energy possible?	yes
Negative prices for negative aFRR energy possible?	yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+3

Calculation of IGCC Values of avoided aFRR

The IGCC Values of avoided upward and downward aFRR activations are determined separately for IGCC import and IGCC export deliveries by the activated aFRR energy in the respected direction. The IGCC Values of avoided aFRR for both IGCC import and IGCC export are determined as the quantity-weighted average of aFRR energy costs billed for the respected direction within the settlement period in Hungary.

If there was no aFRR energy activation in negative or positive direction, the aFRR energy price that would have been paid for the first activated bid in the Hungarian merit order list in the respective direction is taken as the IGCC Values of avoided aFRR.

$$C_{i,IMP} = \frac{M_{aFRR\_pos,i}}{aFRR_{pos,i}}$$

$$C_{i,EXP} = \frac{M_{aFRR\_neg,i}}{aFRR_{neg,i}}$$

Variable	Description	Unit	Sign
$aFRR_{pos,\ i}$	Amount of activated positive aFRR energy for the IGCC settlement period$_i$.	[MWh]	Always positive.
$aFRR_{neg,\ i}$	Amount of activated negative aFRR energy for the IGCC settlement period$_i$.	[MWh]	Always positive.
$C_{i,Imp}$	Resulting IGCC Value of avoided aFRR of MAVIR for IGCC import for the IGCC settlement period $_i$.	[€/MWh]	Positive values means MAVIR pays for activation of positive aFRR energy. Negative value means MAVIR is paid for activation of positive aFRR energy.
$C_{i,Exp}$	Resulting IGCC Value of avoided aFRR of MAVIR for IGCC export for the IGCC settlement period$_i$.	[€/MWh]	Positive value means MAVIR is paid for activation of negative aFRR energy. Negative value means MAVIR pays for activation of negative aFRR energy.
$M_{aFRR\_pos,\ i}$	Total costs for positive aFRR energy deliveries of MAVIR for the IGCC settlement period$_i$.	[€]	Positive value means MAVIR has costs. Negative value means MAVIR receives payment.
$M_{aFRR\_neg,\ i}$	Total costs for negative aFRR energy deliveries of MAVIR for the IGCC settlement period$_i$.	[€]	Positive value means MAVIR receives payment. Negative value means MAVIR has costs.

Examples for calculation of IGCC Values of avoided aFRR

Example for one IGCC settlement period of a day:

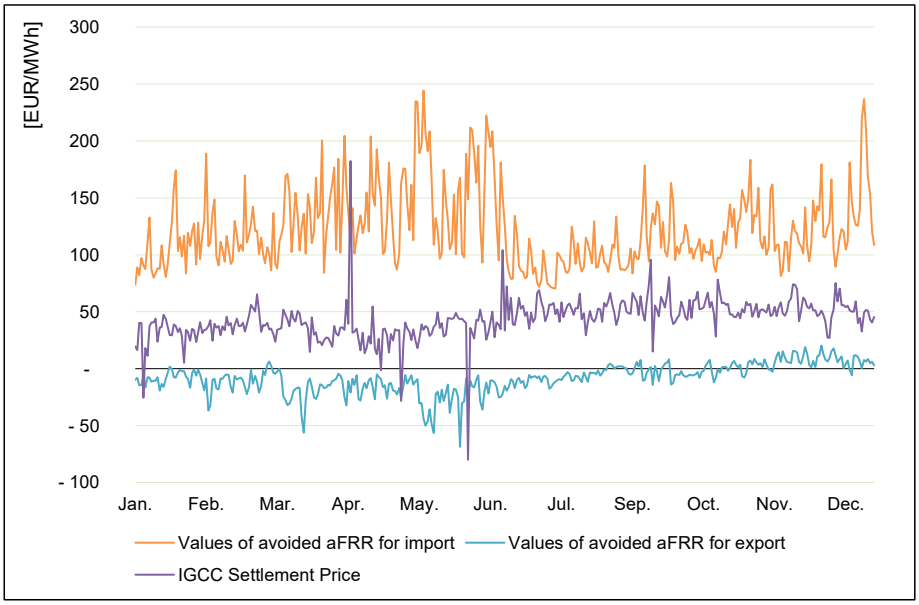
Example for IGCC Value of avoided aFRR for import			
	aFRR energy amount in MWh	Price in €/MWh	Costs in €
Bid 1	30	80	2400
Bid 2	200	100	20000
Bid 3	5	110	550
Sum ($aFRR_{pos}$ and M_{aFRR_pos})	235		22950

IGCC Value of avoided aFRR €/MWh	97,660

Example for IGCC Value of avoided aFRR for export			
	aFRR energy amount in MWh	Price in €/MWh	Revenues[4] in €
Bid 1	30	15	450
Bid 2	200	-8	-1600
Bid 3	5	-50	-250
Sum ($aFRR_{neg}$ and M_{aFRR_neg})	235		-1400

IGCC Value of avoided aFRR €/MWh	-5,957

Example of Values for avoided aFRR preceding accession to IGCC based on real data



[4] Negative revenues are costs.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF PSE

TABLE 7: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF PSE

Basic Information	
IGCC Participating Member(s)	PSE S.A.
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	When connected to PICASSO: no When disconnected: yes
Separate pricing of positive and negative aFRR energy (yes or no)	When connected to PICASSO: yes When disconnected: no
Negative prices for positive aFRR energy possible?	yes
Negative prices for negative aFRR energy possible?	yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	When connected to PICASSO: real time. When disconnected: prices are determined in D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+15

Calculation of IGCC Values of avoided aFRR

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

1. **Connected to PICASSO:**

The PSE cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case PSE is connected with PICASSO.

The CBMP value will be automatically provided by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by PSE for these delivery periods, can be neglected.

2. **Disconnected from PICASSO:**

The IGCC Values of avoided aFRR are the same for IGCC import and IGCC export. The value of avoided aFRR is equal to the Polish aFRR balancing energy price corresponding to the marginal system price at the Polish balancing market calculated according to the grid code approved by the Polish NRA. The Polish marginal system price results from the integrated scheduling process and refers to each

accounting period equal to one quarter of an hour taking into account the net value of IGCC exchange within this period. .

Examples for calculation of IGCC Values of avoided aFRR

Examples for IGCC Values of avoided aFRR are included in the table:

TABLE 8: EXAMPLES FOR IGCC VALUES OF AVOIDED AFRR ACTIVATIONS

Time unit	Volume of avoided aFRR		IGCC Values of avoided aFRR		IGCC Values of avoided aFRR	
	Export	Import	Export	Import	Export	Import
	[MWh]	[MWh]	[PLN/MWh]	[PLN/MWh]	[EUR/MWh]	[EUR/MWh]
00:00-00:15	25,267	0,639	554,730	554,730	130,823	130,823
00:15-00:30	37,007	0,126	571,910	571,910	134,875	134,875
00:30-00:45	41,887	0,000	483,130	483,130	113,938	113,938
00:45-01:00	29,136	0,000	474,490	474,490	111,900	111,900
01:00-01:15	34,273	0,000	471,390	471,390	111,169	111,169
01:15-01:30	27,434	0,000	441,790	441,790	104,188	104,188
01:30-01:45	27,982	0,000	429,280	429,280	101,238	101,238
01:45-02:00	41,123	0,000	435,540	435,540	102,714	102,714
02:00-02:15	82,484	0,000	440,510	440,510	103,887	103,887
02:15-02:30	41,197	0,000	431,390	431,390	101,736	101,736

Prices to be published on PSE's website not later than in D+4:
https://www.pse.pl/dane-systemowe/funkcjonowanie-kse/raporty-dobowe-z-pracy-kse/kompensowanie-niezbilansowan-imbalance-netting

IGCC Values of avoided aFRR are calculated in Polish currency and are converted into Euro with "current average exchange rates of foreign currencies" of National Bank of Poland - included in "Middle exchange rates archive – table A":
http://www.nbp.pl/homen.aspx?c=/ascx/ArchAen.ascx

3. **Formula:**

$$VoAAA_{Exp,PSE,MTU} = VoAAA_{Imp,PSE,MTU} = \begin{cases} CBMP_{aFRR,PSE,MTU} & where\ PSE\ is\ connected\ with\ PICASSO \\ VoAAA_{aFRR,PSE,MTU} & where\ PSE\ is\ disconnected\ from\ PICASSO \end{cases}$$

with:

$CBMP_{aFRR,PSE,MTU}$	*aFRR cross border marginal price available for PSE either for positive or negative direction in MTUs where PSE is connected with PICASSO*
$VoAAA_{aFRR,PSE,MTU}$	*aFRR price* of *upward/downward aFRR activation determined by PSE for each quarter of an hour and used in case PSE is disconnected from the platform*

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF RE, APPLICABLE SINCE 17/06/2025

TABLE 9: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF RE

Basic Information	
IGCC Participating Member(s)	RE
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	**Marginal pricing** When connected to PICASSO, 4 sec. PICASSO prices are used. In the case of disconnection from Picasso, the QH weighted average upward and downward prices are used. **Fallback approach** If aFRR activation market is cancelled and backup prorrata scheme is applied: VoAAA are based on the mFRR aggregated bid curves for each direction (upward/downward).
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Energy values of avoided aFRR will be matched with IGCC at D+1. REE opportunity prices will be determined <= 8th BD of M+1.

Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+1

Calculation of IGCC Values of RE avoided upward and downward aFRR activations

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

1. **Connected with PICASSO**

The RE cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case RE is connected with PICASSO.

2. **Disconnected from PICASSO:**

In case RE is disconnected from the aFRR platform, the IGCC Value of avoided upward and downward aFRR activations of RE is equal to the weighted average price:

- of the upward aFRR activation for the quarter hour, for IGCC import;
- Of the downward aFRR activation for the quarter hour, for IGCC export.

Based on the participation files, the settlement entity of the aFRR Platform will identify the time periods where a disconnection took place.

Back up procedure in case of turning back to fallback prorrata activation

In case of application of fallback, turning back to back-up prorrata activation, it implies the automatic disconnection from Picasso. In that case, the IGCC Value of avoided upward and downward aFRR activations in the case of RE are determined using the economic information coming from the upward/downward aggregated mFRR energy Spanish upward/downward bid curves.

TEMPLATE B: IGCC VALUES OF AFRR AVOIDED ACTIVATION TEMPLATE

Basic Information	
IGCC Participating Member(s)	REN
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Pro-rata
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	Yes
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Following Month
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	7 months following the delivery

Calculation of IGCC Values of avoided aFRR

The IGCC Values of avoided aFRR are determined by the activated aFRR energy and separately for IGCC import and IGCC export deliveries.

The IGCC Values of avoided aFRR for both IGCC import and IGCC export are determined as the quantity-weighted average of aFRR energy costs billed for the respective direction within the settlement period.

If there is no aFRR price for negative or positive direction, the value to be considered as the IGCC Values of avoided aFRR will be the hourly Day-ahead Market Price in the Portuguese area.

Variable	**Description**	**Unit**	**Sign**
$P_{aFRRpos,\ i}$	Price for positive aFRR for the settlement period *i*	[€/MWh]	Mostly positive but it can be negative

$P_{aFRRneg,\ i}$	Price for negative aFRR for the settlement period *i*	[€/MWh]	Mostly positive but it can be negative
$P_{Market,\ i}$	Day-ahead Market Price in the Portuguese area for the settlement period *i*	[€/MWh]	Mostly positive but it can be negative
$C_{i,Imp}$	Resulting IGCC Value of avoided aFRR activation for import from IGCC for the settlement period *i* (price for IGCC Settlement Price calculation)	[€/MWh]	Mostly positive but it can be negative
$C_{i,Exp}$	Resulting IGCC Value of avoided aFRR activation for export to IGCC for the settlement period *i* (price for IGCC Settlement Price calculation)	[€/MWh]	Mostly positive but it can be negative

Positive if REN pays for activation of positive aFRR energy and negative if REN is paid for activation of negative aFRR energy

$$C_{i,Imp} = \begin{cases} P_{aFRR\_pos,i} & if\ P_{aFRR\_pos,i}\ exists \\ P_{Market,i} & if\ P_{aFRR\_pos,i}\ doesn't\ exist \end{cases}$$

$$C_{i,Exp} = \begin{cases} P_{aFRR\_neg,i} & if\ P_{aFRR\_neg,i}\ exists \\ P_{Market,i} & if\ P_{aFRR\_neg,i}\ doesn't\ exist \end{cases}$$

Examples for calculation of IGCC Values of avoided aFRR

Date hour	Participant	Variables						
		aFRR energy costs[5] [€]	Energy[6] [MWh]	P_{aFRR_pos} [€/MWh]	P_{aFRR_neg} [€/MWh]	P_{Market} [€/MWh]	C_{Imp} [€/MWh]	C_{Exp} [€/MWh]
Example 1: D1 QH1	P1	500	-25	40	20	30	40	20
	P2	1000	-50					
	P3	-400	10					
Example 2: D2 QH2	P1	400	-20	--	20	30	30	20
	P2	600	-30					
	P3	200	-10					
Example 3: D3 QH3	P1	-2000	40	50	--	30	50	30
	P2	-2500	50					
Example 4: D4 QH4	--	--	--	--	--	30	30	30

For this examples we assume the hourly Day-ahead Market Price in the Portuguese area is 30€/MWh.

[5] Positive if REN pays for activation of positive aFRR energy and negative if REN is paid for activation of negative aFRR energy

[6] Positive for activation of positive aFRR energy and negative for activation of negative aFRR energy

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF RTE

TABLE 10: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF RTE

Basic Information	
IGCC Participating Member(s)	RTE
Summarized Information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy (yes or no)	Yes
Negative prices for positive aFRR energy possible?	Yes
Negative prices for negative aFRR energy possible?	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	When connected to PICASSO: real time. When disconnected: month following the delivery
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Month following the delivery

Calculation of IGCC Values of avoided upward and downward aFRR activations

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

3. **Connected with PICASSO:**

The RTE cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case RTE is connected with PICASSO.
The CBMP value will be automatically provided by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by RTE for these delivery periods, can be neglected.

4. **Disconnected from the aFRR Platform:**

In case RTE is disconnected from the aFRR platform, the IGCC Value of avoided upward and downward aFRR activations of RTE is equal to the weighted average price:

- of the upward aFRR activation for the quarter hour, for IGCC import;
- Of the downward aFRR activation for the quarter hour, for IGCC export.

Based on the participation files, the settlement entity of the aFRR Platform will identify the time periods where a disconnection took place. The IGCC VoAAA, submitted by RTE, shall be used for these time periods.

The table below illustrates how the IGCC Value of avoided aFRR of RTE is defined when disconnected from the platform:

TABLE 11: EXAMPLES FOR IGCC VALUES OF AVOIDED AFRR ACTIVATIONS

15-min intervals	Weighted average price of upward aFRR activation (€/MWh)	IGCC Value of aFRR Avoided Activation - import (€/MWh)	Weighted average price of downward aFRR activation (€/MWh)	IGCC Value of aFRR Avoided Activation – export (€/MWh)
00:00-00:15	31.78	31.78	-16.34	-16.34
00:15-00:30	134.45	134.45	23.67	23.67
00:30-00:45	151.18	151.18	18.12	18.12
00:45-01:00	3.64	3.64	1.56	1.56
01:00-01:15	31.24	31.24	-15.67	-15.67
01:15-01:30	123.92	123.92	116.34	116.34
…	…	…		

5. **Formula:**

$$VoAAA_{Exp,RTE,MTU} = VoAAA_{Imp,RTE,MTU}$$
$$= \begin{cases} CBMP_{aFRR,RTE,MTU} & where\ RTE\ is\ connected\ with\ PICASSO \\ WAP_{aFRR,RTE,MTU} & where\ RTE\ is\ disconnected\ from\ PICASSO \end{cases}$$

with:

$CBMP_{aFRR,RTE,MTU}$	*aFRR cross border marginal price available for RTE either for positive or negative direction in MTUs where RTE is connected with PICASSO*
$WAP_{aFRR,RTE,MTU}$	*aFRR weighted average price of upward/downward aFRR activation determined by RTE for each MTUs and used in case RTE is disconnected from the platform*

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF SEPS

Valid as of 1 January 2025

Basic Information	
IGCC Participating Member(s)	Slovenska elektrizacna prenosova sustava, a.s. (SEPS)
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	4 s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+2

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

6. **Connected with the aFRR Platform:**

   SEPS's cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case SEPS is connected with PICASSO.

   The calculation will be performed automatically by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by SEPS for these delivery periods, can be neglected.

7. **Disconnected from the aFRR Platform:**

The local marginal price (LMP) shall be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min), the resulting SEPS VoAAA will be weighted average of following:

- the CBMP for the time periods connected with the aFRR Platform and
- the LMP for the time periods not connected with the aFRR Platform.
- The weight will be the IGCC correction value.

The settlement entity of the aFRR Platform will identify the time periods, where a disconnection took place. The IGCC VoAAA, submitted by SEPS in 15 min resolution, shall be used for these time periods.

An example of the calculation logic for the disconnected case is provided in the following table:

	Status connection with aFRR Platform	IN Pcorr SEPS	LMP	CBMP	Pcorr x LMP; Pcorr x CBMP
30.11.2021 0:00:00	connected	20	NA	50	1000
30.11.2021 0:00:04	connected	20	NA	50	1000
30.11.2021 0:00:08	connected	20	NA	50	1000
30.11.2021 0:00:12	connected	20	NA	50	1000
....	..	...	...	...	...
30.11.2021 0:05:00	connected	-50	NA	10	-500
30.11.2021 0:05:04	connected	-50	NA	10	-500
30.11.2021 0:05:08	connected	-50	NA	10	-500
30.11.2021 0:05:12	connected	-50	NA	10	-500
...	...	...	...	...	...
30.11.2021 0:10:00	disconnected	-10	5	NA	-50
30.11.2021 0:10:04	disconnected	-10	5	NA	-50
30.11.2021 0:10:08	disconnected	-10	5	NA	-50
30.11.2021 0:10:12	disconnected	-10	5	NA	-50
...	...	...	...	...	...
30.11.2020 0:14:00	disconnected	40	90	NA	3600
30.11.2020 0:14:04	disconnected	40	90	NA	3600
30.11.2020 0:14:08	disconnected	40	90	NA	3600
30.11.2020 0:14:12	disconnected	40	90	NA	3600
Sum IN+	disconnected	160			14400
Sum IN-	disconnected	-40			-200
Sum IN+	connected	80			4000
Sum IN-	connected	-200			-2000
VoAAApos		**76,67**			
VoAAAneg		**9,17**			

If there was no aFRR energy activation in negative or positive direction, the first aFRR bid price in the local merit order list in the respective direction is used as the IGCC Value of avoided aFRR Activation.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF SWISSGRID

Basic Information	
IGCC Participating Member(s)	Swissgrid AG
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Pay as bid
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Month following the delivery (M+1)
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Month following the delivery (M+1)

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

7. <u>Connected with the aFRR Platform:</u>

The cross border marginal price (CBMP) will be used for the calculation of the IGCC VoAAA. Since the CBMP is available on a second resolution, the weighted average of the CBMP will be used to calculate the IGCC VoAAA in 15 min resolution. The weight will be the IGCC correction value.

The calculation will be performed automatically by the settlement entity of the aFRR Platform and the IGCC VoAAA, submitted by Swissgrid for these delivery periods, can be neglected.

8. <u>Disconnected from the aFRR Platform:</u>

The bid prices will be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min), the CBMP (or the bid price for Non AOF volumes) will be used for the period connected with the aFRR Platform within the given delivery period.

- As a first step, the weighted average price among all activated bids for a given second will be calculated. The weight will be the volume of activation.
- Based on these prices, the weighted average of a whole 15 min period will be calculated. The weight will be the satisfied demand of CH.

The settlement entity of the aFRR Platform will identify the time periods, where a disconnection took place. The IGCC VoAAA, submitted by Swissgrid, shall be used for these time periods. In case a disconnection took place for less than 15min within a given delivery period, the data submitted by Swissgrid shall be used for the whole delivery period.

An example of the calculation logic for the disconnected case is provided in the following table:

	Status connection with aFRR Platform	Activated aFFR energy in CH	Price for the compensation of BSPs in CH (weighted average among all market participants, taking into account clearing price and/or bid price)	Satisfied demand of CH	(Price x satisfied demand)
30.11.2021 0:00:01	connected	30	50	20	1000
30.11.2021 0:00:02	connected	30	50	20	1000
30.11.2021 0:00:03	connected	30	50	20	1000
30.11.2021 0:00:04	connected	30	50	20	1000
....	..	...	...	...	...
30.11.2021 0:05:01	connected	-70	10	-50	-500
30.11.2021 0:05:02	connected	-70	10	-50	-500
30.11.2021 0:05:03	connected	-70	10	-50	-500
30.11.2021 0:05:04	connected	-70	10	-50	-500
...	...	...	...	...	...
30.11.2021 0:10:01	disconnected	-20	5	-20	-100
30.11.2021 0:10:02	disconnected	-20	5	-20	-100
30.11.2021 0:10:03	disconnected	-20	5	-20	-100
30.11.2021 0:10:04	disconnected	-20	5	-20	-100
...	...	...	...	...	...
30.11.2020 0:14:56	disconnected	84	90	84	7560
30.11.2020 0:14:57	disconnected	84	90	84	7560
30.11.2020 0:14:58	disconnected	84	90	84	7560
30.11.2020 0:14:59	disconnected	84	90	84	7560
Sum aFRR+				416	34240
Sum aFRR-				-280	-2400
Pigcc+		**82.31**			
Pigcc-		**8.57**			

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TTG

Valid as of 22 June 2022

Basic Information	
IGCC Participating Member(s)	TenneT TSO GmbH
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing (pay as bid for non-AOF volumes) based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	1s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Usually 6th Working day after delivery

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

8. **Connected with the aFRR Platform:**

The cross border marginal price (CBMP) will be used for the calculation of the IGCC VoAAA. Since the CBMP is available on a second resolution, the weighted average of the CBMP will be used to calculate the IGCC VoAAA in 15 min resolution. The weight will be the IGCC correction value.

The calculation will be performed automatically by the settlement entity of the aFRR Platform.

9. Disconnected from the aFRR Platform:

The local marginal price (LMP) will be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min) the resulting TTG VoAAA will be the weighted average of the following:

- the CBMP will be used for the 4 seconds periods, connected with the aFRR Platform (the weight for CBMP will be the correction signal) and
- LMP for the 4 seconds periods, not connected with the aFRR Platform (the weight for LMP will be the correction signal).

The settlement entity of the aFRR Platform will identify the time periods, for which a disconnection took place.

10. Formula:

$$OP_{Exp,TTG,qh} = \begin{cases} 0 & \text{, where } \max\left(P_{corr,IGCC,RZ,OC}, 0\right) = 0 \\ \dfrac{\sum_{OC} \max\left(P_{corr,IGCC,RZ,OC}, 0\right) * MP_{aFRR,RZ,OC}}{\sum_{OC} \max\left(P_{corr,IGCC,RZ,OC}, 0\right)} & , else \end{cases}$$

$$OP_{Imp,TTG,qh} = \begin{cases} 0 & \text{, where } \min\left(P_{corr,IGCC,RZ,OC}, 0\right) = 0 \\ \dfrac{\sum \min\left(P_{corr,IGCC,RZ,OC}, 0\right) * MP_{aFRR,RZ,OC}}{\sum \min\left(P_{corr,IGCC,RZ,OC}, 0\right)} & , else \end{cases}$$

$$MP_{aFRR,TTG,qh} = \begin{cases} MP_{aFRR,RZ,neg,OC}\ , & where\ MP_{aFRR,RZ,pos,OC} = NULL \\ MP_{aFRR,RZ,pos,OC}\ , & else \end{cases}$$

with:

$MP_{aFRR,TTG,OC}$	*aFRR MP (Marginal Price) in LFC area TTG per Optimization Cycle (OC) and per Direction (Imp, Exp). MP corresponds to the CBMP for these LFC area. If the LFC area is not connected to the aFRR Platform a national Marginal Price (Local Marginal Price) will be used instead of the CBMP.*
$P_{corr,IGCC,TTG,OC}$	*IGCC correction value used in TTG's LFC*
qh	*Each quarter of an hour from which OC is a part*

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TTN

TABLE 12: IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TTN

Basic Information	
IGCC Participating Member(s)	TenneT TSO B.V.
Summarized information on aFRR energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Marginal pricing
Accounting period for aFRR energy? (15min/ 60min)	15 minutes
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)[7]	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of Values of avoided aFRR? (D+1/ following month/ etc.)	D+1; 10.00 CET
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	D+1

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The Dutch IGCC values of avoided upward and downward aFRR activations do NOT depend on the connection status with the aFRR platform[8].

The Dutch IGCC values of avoided upward and downward aFRR activations are derived from the price of activated aFRR bids. This means that the last activated FRR bid determines the FRR price for all suppliers. These FRR prices are published the following Working day. There is only either a positive or a negative price for suppliers of FRR energy. If, however, activation in a ¼ hour occurs in both directions, prices are therefore also calculated, published and invoiced in both directions. These prices then constitute the Values of avoided aFRR. When no activation of FRR has occurred in a ¼ h period, then the midprice will be the Value of Avoided aFRR Activation, that is: the average of the lowest upward regulation bid and the highest downward regulation bid.

[7] Negative prices for upward regulation is not forbidden and thus possible; however, this situation has not occurred so far.
[8] In accordance with RfC_IGCC-0082-M-Enable the standard use of locally determined VoAAA in IGCC settlement for specific TSOs

See below three examples of the constitution of the imbalance prices, respectively upward regulation, downward regulation and no regulation:

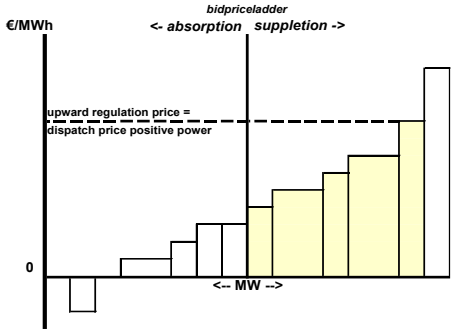


FIG. 1 UPWARD REGULATION

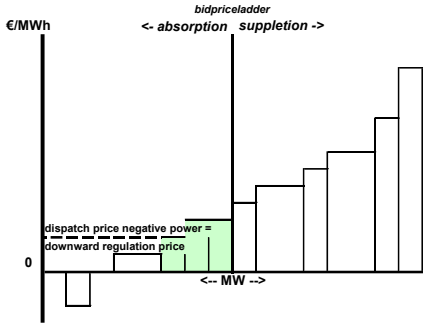


FIG. 2 DOWNWARD REGULATION

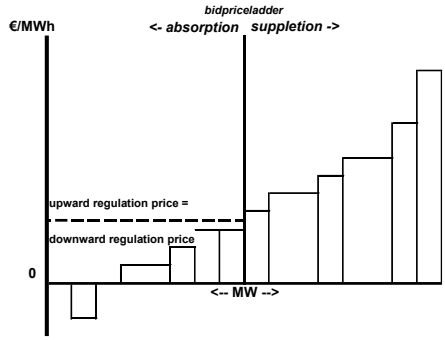


FIG. 3 NO REGULATION

IGCC VALUE OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TERNA

Basic Information	
IGCC Member(s)	Terna SpA
Invocing entity	TenneT TSO GmbH
Summarized information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit Order when connected to PICASSO, Pro-rata when not connected
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other)	Other (details below)
Accounting period for aFRR energy? (15min/ 60min)	15 minutes
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	D+1
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Following month

Calculation of IGCC Values of avoided aFRR

After the connection to aFRR Platform, the criterion that Terna will adopt to calculate IGCC values of avoided upward and downward aFRR activations will take into account the three scenarios described below, in order to reflect all the possible situations that could occur during upward and downward aFRR activations.

- 1st case – Terna cannot send its offers to aFRR Platform: the price will be the weighted average of local upward / downward activations prices of the bids not yet converted into standard products;
- 2nd case – Terna is regularly connected to aFRR Platform: the price will be the weighted average of prices which are obtained as maximum between PICASSO CBMPs and the bids price;

- 3rd case – Terna sends its offers to aFRR Platform but there is no feedback from the Platform (real time disconnection from the Platform): the price will be the wheighted average price of local bid prices after the conversion into standard products.

The weigths for each case are detailed in the corresponding formulas below.

Cases 2 and 3 may occur both during the same settlement period.

In addition, also import and export energy volumes exchanges between Terna and its neighboring TSOs will be taken into account.

The components which will be used to calculate values of avoided upward and downward aFRR activations, related to each case described above, will be computed in the following ways :

Variable	Description	Unit	Sign / source
$aFRR_{pos;i;k}$	Positive activated aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$.	[MWh]	Always positive.
$aFRR_{neg;i;k}$	Negative activated aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$.	[MWh]	Always positive.
$P_{pos;i;k}$	aFRR enery price for the positive offered aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$.	[€/MWh]	Always positive (Terna pays for activation of positive aFRR energy).
$P_{neg;i;k}$	aFRR energy price for the negative offered aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$.	[€/MWh]	Always positive (Terna is paid for activation of negative aFRR energy).
$C_{i;ImpLocalActivations}$	Resulting IGCC Value of aFRR Avoided Activation of Terna for IGCC import for the IGCC settlement $period_i$, calculated on local upward activations volumes and prices (1st connection case described above)	[€/MWh]	Positive (Terna pays for activation of positive aFRR energy).
$C_{i;ExpLocalActivations}$	Resulting IGCC Value of aFRR Avoided Activation of Terna for IGCC export for the IGCC settlement $period_i$, calculated on local downward activations volumes and prices (1st connection case described above)	[€/MWh]	Positive (Terna is paid for activation of negative aFRR energy).
$aFRR_{pos;i;k;s}$	Positive activated aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$ referred to the local Offer $step_s$	[MWh]	Always positive.
$aFRR_{neg;i;k;s}$	Negative activated aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$ referred to the local Offer $step_s$	[MWh]	Always positive.
$P_{pos;i;k;s}$	aFRR enery price for the positive offered aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$ referred to the local Offer $step_s$	[€/MWh]	Always positive (Terna pays for activation of positive aFRR energy).
$P_{neg;i;k;s}$	aFRR energy price for the negative offered aFRR energy from $supplier_k$ for the aFRR energy accounting $period_i$ referred to the local Offer $step_s$	[€/MWh]	Always positive (Terna is paid for activation of negative aFRR energy).

$C_{i;ImpConnected}$	Resulting IGCC Value of aFRR Avoided Activation of Terna for IGCC import for the IGCC settlement period$_i$., calculated on the maximum price between CBMP and local upward Offer step prices (2nd and 3rd connection cases described above)	[€/MWh]	Positive or Negative (Terna pays for activation of positive aFRR energy).
$C_{i;ExpConnected}$	Resulting IGCC Value of aFRR Avoided Activation of Terna for IGCC export for the IGCC settlement period$_i$., calculated on the maximum price between CBMP and local downward Offer step prices (2nd and 3rd connection cases described above)	[€/MWh]	Positive or Negative (Terna is paid for activation of negative aFRR energy).
$CBMP_{upward;i}$	Cross Border Marginal Price for upward activations of aFRR energy from aFRR Platform for the aFRR energy accounting period$_i$	[€/MWh]	Positive or negative
$CBMP_{downward;i}$	Cross Border Marginal Price for downward activations of aFRR energy from aFRR Platform for the aFRR energy accounting period$_i$	[€/MWh]	Positive or negative
$PCORR_{upward;i}$	Volume of the upward activations, for the aFRR energy accounting period$_i$ and relating to the TSO Terna in case of not perfect netting. In case of perfect netting (Buy and Sell prices equal) is the volume of the imported (from other TSOs to Terna) energy	[MWh]	Positive or negative

$PCORR_{downward;i}$	Volume of the downward activations, for the aFRR energy accounting period$_i$ and relating to the TSO Terna in case of not perfect netting. In case of perfect netting (Buy and Sell prices equal) is the volume of the exported (from Terna to other TSOs) energy	[MWh]	Positive or negative

The following formulas take into account all the cases which could occur in a settlement period. Of course, only some of the components could be used for the same settlement period, depending on the connection status of Terna with aFRR Platform and on PCORR volumes activated.

- **1st case – local upward and downward activations prices:**

$$C_{i;ImpLocalActivations} = \frac{\sum_k^{all\ LocalActivations}\left[P_{pos;i;k} * aFRR_{pos;i;k}\right]}{\sum_k^{all\ LocalActivations}\left[aFRR_{pos;i;k}\right]}$$

$$C_{i;ExpLocalActivations} = \frac{\sum_k^{all\ LocalActivations}\left[P_{neg;i;k} * aFRR_{neg;i;k}\right]}{\sum_k^{all\ LocalActivations}\left[aFRR_{neg;i;k}\right]}$$

- **2nd and 3rd cases – maximum price between local Offer Steps prices and the CBMP coming from the Platform:**

$$C_{i;ImpConnected} = \frac{\sum_{k;s}^{Connected}\left[CBMP_{upward;i} * aFRR_{pos;i;k;s}\right] + \sum_{k;s}^{NotConnected}\left[P_{pos;i;k;s} * aFRR_{pos;i;k;s}\right] - \sum\ \left[CBMP_{upward;i} * PCORR_{upward;i}\right]}{\sum_{k;s}\left[aFRR_{pos;i;k;s}\right] - \sum\ \left[PCORR_{upward;i}\right]}$$

$$C_{i;ExpConnected} = \frac{\sum_{k;s}^{Connected}\left[CBMP_{downward;i} * aFRR_{neg;i;k;s}\right] + \sum_{k;s}^{NotConnected}\left[P_{neg;i;k;s} * aFRR_{neg;i;k;s}\right] + \sum\ \left[CBMP_{downward;i} * PCORR_{downward;i}\right]}{\sum_{k;s}\left[aFRR_{neg;i;k;s}\right] + \sum\ \left[PCORR_{downward;i}\right]}$$

EXAMPLES FOR CALCULATION OF IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS

Examples for Terna IGCC Values of aFRR Avoided Activation determination for one IGCC settlement period – case 1:

Example for IGCC Value of aFRR Avoided Activation for import			
	aFRR energy amount in MWh	Local Price in €/MWh	Costs in €
Bid 1	100	100	10.000
Bid 2	40	110	4.400
Bid 3	20	120	2.400
Sum	160		16.800
IGCC Value of aFRR Avoided Activation €/MWh	105		

Example for IGCC Value of aFRR Avoided Activation for export			
	aFRR energy amount in MWh	Local Price in €/MWh	Costs in €
Bid 1	20	25	500
Bid 2	40	28	1.120
Bid 3	10	30	300
Sum	70		1.920
IGCC Value of aFRR Avoided Activation €/MWh	27,42		

Examples for Terna IGCC Values of aFRR Avoided Activation determination for one IGCC settlement period – cases 2 and 3:

Example for IGCC Value of aFRR Avoided Activation for import				
	aFRR energy amount in MWh	Offered Price in €/MWh	CBMP	Costs in €
Step 1	100	100	115	11.500
Step 2	40	110	115	4.600
Step 3	20	120	115	2.300
PCORR	10		115	1.150
Sum	150			17.250
IGCC Value of aFRR Avoided Activation €/MWh	115			

Example for IGCC Value of aFRR Avoided Activation for export				
	aFRR energy amount in MWh	Offered Price in €/MWh	CBMP	Costs in €
Step 1	100	80	70	7.000
Step 2	40	60	70	2.800
Step 3	20	50	70	1.400
PCORR	10		70	700
Sum	170			11.900
IGCC Value of aFRR Avoided Activation €/MWh	70			

IGCC VALUE OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TERNA IN CASE OF NO DEMAND

In case there is no aFRR demand for a certain direction in a Settlement Period, Terna's IGCC values of aFRR Avoided Activation are:

- For upward energy : the minimum energy price of the procured upward on first offer step of aFRR;
- For downward energy : the maximum energy price of the procured downward on first offer step of aFRR.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TEL

Valid as of June 2024, after aFRR merit order implementation

Basic Information	
IGCC Participating Member(s)	C.N.T.E.E. Transelectrica S.A.
Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	15 min
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	Prices are determined after each settlement period (15 minutes) and published within 30 minutes
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	M+6

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with the aFRR Platform:

11. **<u>Connected with the aFRR Platform:</u>**

The cross border marginal price (CBMP) will be used for the calculation of the IGCC VoAAA. Since the CBMP is available on a second resolution, the weighted average of the CBMP will be used to calculate the IGCC VoAAA in 15 min resolution. The weight will be the IGCC correction value.

The calculation will be performed automatically by the settlement entity of the aFRR Platform.

12. **Disconnected from the aFRR Platform:**

The local marginal price (LMP) will be used for the calculation of the IGCC VoAAA. In case of a partial disconnection for a given delivery period (15 min), the resulting VoAAA will be weighted average of following:

- the CBMP will be used for the 4 seconds periods connected with the aFRR Platform (the weight for CBMP will be the correction signal) and
- LMP for the 4 seconds periods not connected with the aFRR Platform (the weight for LMP will be the correction signal).

The settlement entity of the aFRR Platform will identify the time periods, where a disconnection took place. The IGCC VoAAA, submitted by Transelectrica, shall be used for these time periods. In case a disconnection took place for less than 15min within a given delivery period, the data submitted by Transelectrica shall be used for the whole delivery period

An example of the calculation logic for the disconnected case is provided in the following table:

	Status connection with aFRR Platform	IN Pcorr TEL	LMP	CBMP	Pcorr x LMP; Pcorr x CBMP
30.11.2021 0:00:00	connected	20	NA	50	1000
30.11.2021 0:00:04	connected	20	NA	50	1000
30.11.2021 0:00:08	connected	20	NA	50	1000
30.11.2021 0:00:12	connected	20	NA	50	1000
....	..	...	...	...	...
30.11.2021 0:05:00	connected	-50	NA	10	-500
30.11.2021 0:05:04	connected	-50	NA	10	-500
30.11.2021 0:05:08	connected	-50	NA	10	-500
30.11.2021 0:05:12	connected	-50	NA	10	-500
...	...	...	...	...	...
30.11.2021 0:10:00	disconnected	-10	5	NA	-50
30.11.2021 0:10:04	disconnected	-10	5	NA	-50
30.11.2021 0:10:08	disconnected	-10	5	NA	-50
30.11.2021 0:10:12	disconnected	-10	5	NA	-50
...	...	...	...	...	...
30.11.2020 0:14:00	disconnected	40	90	NA	3600
30.11.2020 0:14:04	disconnected	40	90	NA	3600
30.11.2020 0:14:08	disconnected	40	90	NA	3600
30.11.2020 0:14:12	disconnected	40	90	NA	3600
Sum IN+	disconnected	160			14400
Sum IN-	disconnected	-40			-200
Sum IN+	connected	80			4000
Sum IN-	connected	-200			-2000
VoAAApos		**76,67**			
VoAAAneg		**9,17**			

If there was no aFRR energy activation in negative or positive direction, the first aFRR bid price in the Romanian merit order list in the respective direction is used as the IGCC Value of avoided aFRR.

IGCC VALUES OF AVOIDED UPWARD AND DOWNWARD AFRR ACTIVATIONS OF TRANSNETBW (TBW)

Valid as of 01 January 2025

Basic Information	
IGCC Participating Member(s)	TransnetBW GmbH
Invoicing Task Operator	JAO

Summarized Information on aFRR Energy pricing	
aFRR activation methodology? (pro-rata/ merit-order-list)	Merit-order-list
Pricing of aFRR energy? (pay-as-bid/ marginal pricing/ fixed price/ other) Connected with aFRR Platform	Marginal pricing (pay as bid for non-AOF volumes)
Pricing of aFRR energy? Fall back in case of disconnection from the aFRR-Platform	Marginal pricing (pay as bid for non-AOF volumes) based on local MOL
Accounting period for aFRR energy? (15min/ 60min)	1s
Netting of positive and negative aFRR energy deliveries over accounting period? (yes/no)	No
Separate pricing of positive and negative aFRR energy? (yes/no)	Yes
Negative prices for positive aFRR energy possible? (yes/no)	Yes
Negative prices for negative aFRR energy possible? (yes/no)	Yes
Usual determination of IGCC Values of avoided aFRR? (D+1/ following month/ etc.)	When connected to PICASSO: real time. When disconnected: D+1,
Final amounts (not possible to change them) of aFRR energy deliveries are known? (Month following the delivery/ etc.)	Usually 6th Working day after delivery

Calculation of IGCC Values of avoided aFRR Activation (VoAAA)

The IGCC values of avoided upward and downward aFRR activations depend on the connection status with PICASSO:

1. **Connected with PICASSO:**

The TransnetBW cross border marginal price (CBMP) for aFRR will be used as IGCC VoAAA for a respective MTU (4s) in case TransnetBW is connected with PICASSO.
In case TransnetBW is disconnected, a German CBMP will be used as IGCC VoAAA for TransnetBW in case at least one German TSO is connected with PICASSO.

2. **Disconnected from PICASSO:**

The local marginal price (LMP) for aFRR will be used as IGCC VoAAA for a respective MTU in case all German TSOs are disconnected from PICASSO

Based on the Participation file, the settlement entity of the aFRR Platform will identify the MTUs, for which a disconnection took place and will use the respective price.

3. **Formula:**

$$VoAAA_{Exp,TBW,MTU} = VoAAA_{Imp,TBW,MTU}$$
$$= \begin{cases} CBMP_{aFRR,TBW,MTU} & where\ TBW\ is\ connected\ with\ PICASSO \\ LMP_{aFRR,DE,MTU} & where\ Germany\ is\ disconnected\ from\ PICASSO \\ CBMP_{aFRR,DE,MTU} & else \end{cases}$$

with:

$CBMP_{aFRR,TBW,MTU}$	*aFRR cross border marginal price available for TransnetBW either for positive or negative direction in MTUs where TransnetBW is connected with PICASSO*
$CBMP_{aFRR,DE,MTU}$	*German aFRR cross border marginal price determined in MTUs where TransnetBW is disconnected from and at least one German TSO is connected with PICASSO*
$LMP_{aFRR,DE,MTU}$	*aFRR local marginal price determined for German TSOs in MTUs where Germany is disconnected from PICASSO*
$P_{corr,IGCC,TBW,MTU}$	*IGCC correction value for TransnetBW in the respective MTUs*