

Nordic System Price

Methodology for calculation

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1. INTRODUCTION

European Market Coupling Operator AS (EMCO) calculates the Nordic System Price (System Price) which is an index reflecting the Nordic Day-ahead market for electricity. The Nordic System Price is used as underlying for trading in the derivatives market and is therefore regulated by the European Benchmark Regulation¹ (EU BMR).

EMCO is part of Nord Pool Group (Nord Pool) which consists of the parent company Nord Pool Holding AS and its two subsidiaries EMCO AS and Nord Pool AS and their respective subsidiaries.

The Nordic Day-ahead market is coupled with the European Day-ahead market through Single Day-ahead Coupling (SDAC) as defined in the CACM² regulation and related Methodologies. The System Price is calculated based on input data and results data which is also included or resulting from SDAC.

The System Price is a regulated data benchmark by virtue of point 24(a)(iv) of Article 3(1) of EU BMR.

With the current turnover in the derivatives market, The System Price is a non-significant benchmark as defined under point (27) of Article 3(1) of the EU BMR.

This document will be publicly available on Nord Pool's website.

1.1 Purpose and scope

The purpose of this document is to provide information to the market and to stakeholders on the methodology for calculating the System Price.

This includes description of input data, method of calculation and procedure for publication of the System Price. Furthermore, this document also describes fall-back methodology and procedures for calculating the System Price if in the very rear situation the normal calculation is not possible.

The documents give details of the internal review and approval of the methodology and describes the process in the event a material change of the methodology for calculating the System Price is needed.

1.2 Revisions

This document will be revised regularly and at least on an annual basis. In addition, it will be changed when needed and particularly when:

- There is evidence that the current strategy is not comprehensive enough
- There are updates to relevant regulations or guidance by relevant authorities
- There are organisational changes or other changes internally that requires updates
- New indexes are introduced, or turnover based on the index changes so that the index is no longer "non-significant"

¹ Regulation (EU) 2016/1011 of the European Parliament and of the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds and amending Directives 2008/48/EC and 2014/17/EU and Regulation (EU) No 596/2014

² Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management

2. DETERMINATION OF SYSTEM PRICE

This section sets forth the routines and processes related to calculation of the System Price.

2.1. THE RELATED DAY-AHEAD MARKET AND RELEVANT REGULATION

The basis for the calculation of the System Price is the Nordic Day-ahead wholesale market where buyers and sellers of electricity participate in a joint auction to match orders for delivery the following day. The Nordic Day-ahead market is coupled to other European Day-ahead markets via the Single Day-ahead Coupling (SDAC). Organization of the European Single Day-ahead Coupling is regulated under the Commission Regulation (EU) 2015/1221 of 21 July 2015 establishing a guideline on capacity allocation and congestion management. [Link to EU Regulation](#)

Single day-ahead coupling is the auctioning process where collected orders are matched, and cross-zonal capacity is allocated simultaneously for different bidding zones in the day-ahead market. Organization of the market coupling function, products that are available in the Day-ahead market and the price coupling algorithm are elements described in methodology documents that are subject to review and approval by European regulators and the Agency for the Cooperation of Energy Regulators (ACER).

Relevant documents:

- All NEMO proposal for the MCO Plan – 13th April 2017
- Methodology for the price coupling algorithm, the continuous trading matching algorithm and the intraday auction algorithm. – The Algorithm Methodology
- All NEMOs' proposal for products that can be taken into account by NEMOs in single day-ahead process in accordance with Article 40 of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a Guideline on Capacity Allocation and Congestion Management

The price coupling algorithm is the algorithm used in SDAC for simultaneously matching orders and allocating cross-zonal capacities. The algorithm that is currently in use; also known as the EUPHEMIA algorithm, is co-owned by EMCO and other power exchanges in Europe. EMCO has access to use the EUPHEMIA algorithm for calculating also the System Price.

The algorithm calculating the System Price shall, at all times, handle all functionality and products available for trading in the Nordic Day-ahead market and calculate the System Price based on the same principles as in SDAC – i.e. optimizing social welfare.

2.2. DEFINITION AND DESCRIPTION

The System Price is an unconstrained market clearing reference price for the Nordic region. The calculation is based on the same aggregated and anonymized orderbooks (OBK) for each of the Nordic bidding zones as are used in the calculation of Area prices in the SDAC.

In addition to the OBKs, hourly values of import and export flows of electricity to and from the areas neighbouring to the Nordic bidding zones are included in the calculation of the Nordic System Price. These flows are calculated in the SDAC calculation as planned flows day-ahead for each cable and

interconnector per hour. The volume of import or export is added as sales and purchase volumes to the sales and purchase bid curves respectively in the relevant bidding zones.

The System price is calculated for the Nordic region as if it is one zone by setting internal transmission capacities between the Nordic bidding zones to infinity.

The calculation is an optimization of social welfare – consumer surplus + producer surplus – of the orders for Day ahead in the bidding zones in Norway, Sweden, Denmark and Finland.

System price has since 4 February 2014 been calculated using the same algorithm as used in SDAC – EUPHEMIA.

The Nordic System Price shall always be based on the same orderbook as used for SDAC. This principle being relevant specifically in these situations:

1. SDAC results are rejected and full decoupling of SDAC is declared. This will be followed by a reopening of orderbooks and a subsequent recalculation of the Nordic Area Prices. The System Price will be recalculated based on the new orderbooks.
2. Activation of fall-back procedure where a volume weighted average of area prices is calculated as System Price – the calculation is based on the Area Prices for the same delivery date.
3. Activation of fall-back procedure where results from a reference day are used for both Area Prices and System Price. The reference day as defined in the Nordic Fall-back procedures³ for SDAC.

2.3. CURRENCY

The prices stated in the aggregated OBKs used for the calculation of the Nordic System Price is in EURO. The Nordic System Price is calculated and published in EURO.

An informal conversion of the published System price into the Nordic currencies NOK, SEK and DKK is also published. The currency rate for conversion into the local Nordic currencies is the same as the hedging currency for providing settlement in NOK, SEK and DKK for participants trading in the Nordic Day-ahead market via Nord Pool AS platform.

2.4. INPUT DATA FOR NORDIC SYSTEM PRICE

The input data used for the calculation of the System Price are the aggregated and anonymized order book files (OBKs) from all active NEMOs in the Nordic bidding zones.

The orderbooks may contain orders of all types made available for trading by market participants in the Day-ahead market in any of the Nordic bidding zones. The orderbooks contain single-hourly-orders aggregated into purchase and sales curves per bidding zones and anonymized individual block orders per bidding zone. All orders entered by market participants in the Nordic bidding zones and included in SDAC calculation shall also be included in the System Price calculation.

³ All TSOs of the Nordic Capacity Calculation Region amended proposal for fallback procedures in accordance with Article 44 of 'Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management'.

There may be one or more NEMOs designated in each bidding zone. The Nordic System Price calculation, as the Day-ahead area price calculation, shall include orderbooks from all NEMOs' OBKs from these bidding zones:

Country	Bidding zones⁴
Denmark	DK1 and DK2
Finland	FI
Norway	NO1, NO2, NO3, NO4 and NO5
Sweden	SE1, SE2, SE3 and SE4

Types of orders available to market participants in the Nordic Bidding zones:

- Single Hourly (SH) orders
- Block orders
 - Linked block orders
 - Exclusive groups of block orders
 - Flexible hourly orders.

The Nordic System Price calculation also includes currently the calculated planned flows per hour in MW from the SDAC calculation from the below connections. These values are forwarded from the Coordinator PMB to EMCO local PMB and System Price Plugin directly after SDAC calculation is finished. In the event of a new connection being added to SDAC, the flow on the new cable will be included in the System Price calculation.

Connection/cable	Bidding zones	Countries
NorNed Cable	NO2-NL	Norway-Netherlands
Cobra Cable	DK1-NL	Denmark-Netherlands
Jutland – Germany	DK1-DE	Denmark-Germany
Kontek Cable	DK2-DE	Denmark-Germany
Baltic Cable	SE4-DE	Sweden-Germany
SwePol Link	SE4-PL	Sweden-Poland
Baltic Link	SE4-LT	Sweden Lithuania
Estlink	FI-EE	Finland Estonia

Cables existing as of January 2020

Export and import to/from Russia is included indirectly in the SDAC calculation and thus also in System Price calculation via orders from participants utilizing capacity rights on the borders.

⁴ Division into bidding zones is decided by TSOs. Further description of the Nordic bidding zones may be found on TSO websites; Statnett, Svenska Kraftnät, Fingrid and Energinet.dk. System Price calculation will include all orderbooks from the four countries independent of division into bidding zones.

2.5. SYSTEM PRICE CALCULATION

For calculating the System Price, the EUPHEMIA algorithm matches energy demand and supply for all the 24 hours of the day at once. In this it includes the already calculated flow values per hour to and from the Nordic region as price independent purchase (if exporting) and price independent sale (if importing).

The main objective of the algorithm is to maximize the economic surplus/social welfare. i.e. the total market value of the Day-Ahead auction expressed as a function of the consumer surplus, and the supplier surplus. There will be no congestion rent in the System Price calculation as there are no transmission constraints considered.

The System Price calculation is an independent and separate calculation from the SDAC calculation but based on the same orderbooks. The calculation aims to optimize the matching of curves and selection of block order in the Nordic System Price area. Naturally the block selection at System Price is different from the selection of block orders activated in the SDAC calculation.

The principles in the optimization of welfare and selection of block orders is further described in the public description of the EUPHEMIA⁵ algorithm valid at any time.

<https://www.nordpoolgroup.com/globalassets/download-center/pcr/euphemia-public-description.pdf>

3. DAILY PROCEDURE FOR CALCULATION AND PUBLICATION

This section outlines the operational procedure for calculation of the Nordic System Price and explains also special procedures in the event of an unexpected process.

3.1. NORMAL PROCESS

The gate closure time for SDAC is set to 12:00 CET and the process of the SDAC calculation is started.

The Orderbooks submitted by NEMOs to the common system for SDAC is also made available for the local System Price Calculation at EMCO.

The calculation of the Nordic System Price is triggered automatically after the results from SDAC calculation is received – normally around 12:25 CET. Calculation normally completed within 1-2 minutes.

The Nordic System Price is published simultaneously as the area prices from the SDAC calculation. Normally at 12:42. After publication of prices, the area prices calculated in SDAC are subject to final validation by TSOs and stakeholders in Europe and are thus considered un-confirmed until a global confirmation of the validations is received. Thus, the Nordic System Price is considered un-confirmed also.

⁵ EUPHEMIA Public Description – Single Price Coupling Algorithm – 10th April 2019

If there is no rejection of the results, area prices from SDAC – and the Nordic System Price are confirmed normally around 12:51 CET.

3.2. DELAY

An abnormal process in SDAC may also cause delay in calculation and publication of the Nordic System Price as the result from SDAC is a prerequisite for the Nordic System Price calculation. All prices from the two calculations will be published as soon as they are ready with at least 2 minutes warning to the market.

An issue in the Nordic System Price calculation may cause delay to the publication of the Nordic System Price and the Nordic System Price may be published later than the publication of results from SDAC. The Nordic System Price will then be published with at least 2 minutes warning to the market.

3.3. REJECTION OF UN-CONFIRMED PRICES AFTER PUBLICATION

In the very rare event that SDAC results should be rejected, a full decoupling of the Day-ahead markets will be declared. Orderbooks will then be reopened and the Nordic market will follow procedures in the Nordic Fall-back solution.

A regional calculation⁶ of area prices will follow and subsequently a recalculation of the Nordic System Price based on the updated orderbooks.

In the event of SDAC decoupling, there will be no flow values for the cables and interconnectors between Nordic bidding zones and the neighboring areas in the Nordic System Price calculation. If the regional calculation also includes the Baltic region, flows calculated for Estlink and NordBalt will be included.

4. FALL-BACK SOLUTIONS FOR SYSTEM PRICE

4.1. NORDIC SYSTEM PRICE AS WEIGHTED AVERAGE OF AREA PRICES

In a situation where calculation of Nordic System Price is not possible, but the SDAC calculation has been completed successfully before 20:00 CET the day before delivery – a weighted average of the area prices may be calculated as a fall-back to the Nordic System Price.

If the situation shows that it is not technically possible to have a successful calculation of the System Price before 20:00, Operations and IT-on duty may advise to publish Nordic System Price as a weighted average of the area prices sooner than 20:00. Such decision will be taken by the Chief of Operation (COO).

⁶ Nordic Fallback procedure Article 2, point 2. a); 'Coupled region' means the capacity calculation region(s) which are held in case of SDAC decoupling. The coupled region shall at a minimum cover CCR Nordic and at a maximum cover both CCR Nordic and CCR Baltic once harmonized fallback procedures have been implemented in both CCRs and the requirements in Art 5(3) have been met.

The Nordic System Price per hour is then calculated as a weighted average of the available hourly bidding zone prices and the corresponding hourly area **sales** volumes. The import from neighboring areas are not included in the sales volume in the fall back calculation.

The System price for the day is calculated as an arithmetic average of the hourly System Prices.

4.2. USE OF PREVIOUS DAYS PRICE

In the very rare situation that no prices, neither from SDAC or the Nordic regional fall-back, have been successfully calculated at 20:00 CET in the evening on the day before delivery, previous days prices will be declared both for area prices and the Nordic System Price.

Previous day shall be understood as defined in the Day-ahead Market Regulations point 7.1.3.

[Nordic fall-back procedures for SDAC](#)

[Link to Nord Pool Day-ahead market regulation - point 7.1.3 on Auction Delay or failure](#)

5. MATERIAL CHANGES TO CALCULATION OF SYSTEM PRICE

Material changes to the methodology for calculating the Nordic System Price must be consulted with Stakeholders and with market parties.

Information about a change should be given at least 6 months before implementation.

Consultation document for change shall include a description of the change and the reason for the change. The consultation shall also indicate the effect the change may have to the calculation and publication of the Nordic System Price. The consultation period shall be at least 4 weeks.

In the event that material changes to the calculation of the Nordic System Price must be implemented sooner than the deadlines given above due to events outside of the control of EMCO, the change can be implemented sooner. In such event, EMCO shall give notice of the change as soon as possible.

In the event that changes to the area price calculation are implemented, the same change can be implemented in the calculation of the System Price without this being considered a material change of the System Price,

6. DISCLAIMER

This Nordic System Price methodology document is for information purposes only and is not a recommendation to engage in power trading activities. This Nordic System Price methodology document is provided "as is" without representation or warranty of any kind. Even though all reasonable care has been taken to ensure the accuracy or the content, EMCO and/or Nord Pool do not guarantee its accuracy or completeness. EMCO and/or Nord Pool will not be held liable for any loss or damage or any kind ensuing from using, trusting or acting on information provided in this Nordic System Price methodology document. All proprietary rights and interest in or connected with this Nordic System Price

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APPENDIX 1 – DEFINITIONS AND ABBREVIATIONS

Bidding zone	A bidding zone is the largest geographical area within which market participants are able to exchange energy without capacity allocation.
CACM	Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management
EUPHEMIA	EUPHEMIA stands for: EU Pan-European Hybrid Electricity Market Integration Algorithm. It is the SDAC algorithm.
EU BMR	Regulation (EU) 2016/1011 of the European Parliament and of the Council of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds and amending Directives 2008/48/EC and 2014/17/EU and Regulation (EU) No 596/2014
Exclusive groups	means a set of Block Orders nominated as an Exclusive Group Member that submits such Block Orders which shall be subject to the following conditions: (a) Subject to (b) below, only one Block Order in such Exclusive Group may be matched, or (b) If two or more of the Block Orders comprised in an Exclusive Group each have a Minimum Acceptance Ratio lower than 1.0, more than one of such Block Orders may be partially matched at an Acceptance Ratio equal to or higher than the Minimum Acceptance Ratio applicable to such Blocks, provided always that the sum of the Acceptance Ratios of all the partially matched Blocks shall not exceed 1.0.
Flexible hourly orders	Means an Order in the Auction market specifying which Energy volume a Participant would be willing to sell or buy at a specified order price limit and, where such Flexible order is also a block order, the number of hours comprised in such order and the range of delivery hours in respect of which the Block Order may be accepted in any non-specific delivery hour on the applicable delivery day,
Linked block orders	Means any block order which is designated as 'linked' in the Trading system, the activation of which is subject to Section 4.3.2 of the Day-ahead Market Regulations
MCO	Market Coupling Operation
NEMO	Nominated Electricity Market Operator
Nordic System Price Area	The sum of the Nordic bidding zones viewed as one area without internal grid congestions.

OBK	Orderbook
PMB	Price matcher Broker – common system and user interface for operation of the SDAC algorithm
SDAC	Single Day-ahead Coupling
Single hourly orders	An Order submitted to the Day-ahead market where a Participant states volumes to buy or sell at different price levels in a set of Price Steps defined for a specific Delivery Period. Each pair of price and volume is handled as a point on an Order Curve with linear interpolation between each pair.
Social welfare	Economic surplus; the sum of supplier surplus and the consumer surplus for the time period of the calculation i.e. 24 hours.
SP	System Price