Explanatory note on the Italy North TSOs proposal for long-term cross-zonal capacity calculation in accordance with Article 10 of the Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a Guideline on Forward Capacity Allocation

February 2020

DISCLAIMER This document is released on behalf of the transmission system operators ("TSOs") of Italy North Region solely for the purposes of public consultation on the proposal on long-term cross-zonal capacity calculation in accordance with Article 10 of the Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on Forward Capacity Allocation (FCA). This version is a draft proposal and does not constitute a firm, binding or definitive TSOs' position on the content

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Introduction

This technical document sets out the main principles for the Coordinated Capacity Calculation Forward Capacity Allocation methodology (CCC-FCA methodology) using a statistical approach for long-term timeframe applied in the Italy North CCR. It contains a description of both the methodology and the calculation process in compliance with the Forward Capacity Allocation guideline (hereafter FCA).

General Principles

The principles by which the statistical cNTC approach were developed are:

- **Full compliance with FCA Guideline** – The approach offers a clear, transparent proposal easily understandable for the external world. It was developed with the objective to set up and realize an improvement of the current operational process for Long-term timeframes.
- **Network security** – The calculated figures must allow TSOs to effectively limit cross-border power exchange such that the relevant network security criteria are fulfilled. Since the TSOs are individually responsible for system security in their control areas, each TSO must have full control of the flow limits concerning its area.
- **Coordination and Maximization of trade opportunities** – The use of allocated NTC historical data, having been calculated in coordinated manner, and the cross zonal validation step make the proposal respecting the requirements of the FCA guideline to be coordinated.
- **Non-discriminatory and common** - The NTC statistical calculations for each bidding zone borders are done by the CCC considering the same allocated NTC historical data and applying the same calculation method.
- **Overall feasibility and compatibility between the long and short-term CC methodologies.** The statistical approach for Long Term timeframes, being based on reliable allocated NTC historical data considering the most updated information about the grid and calculated on daily basis with high accuracy, ensures simultaneous feasibility and compatibility between timeframes. Furthermore, LT capacities should not be higher than the calculated CACM capacities ensuring compatibility.

The proposed statistical approach is potentially **valid for both directions**: in import and export directions.

The proposed statistical approach is **FCA Guideline compliant** for which the overall calculation steps can be described as following (in compliance with FCA art. 23(1)):

- **Step 1:** collect all the historical data (allocated NTC values of the past years), convert all the samples to equivalent "full-grid" NTC values and order them in a duration curve;
- **Step 2:** depending on the statistical NTC to be determined, apply specific filter such as: planned outages, season, peak/off-peak, low consumption period, capacity curtailments, real time reductions and D-2 and ID processes fails;
- **Step 3:** fix a proper Risk Level for the selected data set (for example RL=5% => 95% of the computed and filtered NTC samples will be covered);

- **Step 4:** determine the yearly seasonal NTCs and deduct an additional Reliability Margin;
- **Step 5:** compute the hourly bilateral NTC profile by considering the hourly planned outage NTC reductions and/or low consumption profiles.

Statistical approach for import and export directions

For both the import and export directions, the TSOs of Italy North CCR will use both for yearly and monthly timeframes the statistical approach based on the last three years allocated NTC data for the computation. The approach leads to the definition of an hourly capacity both for yearly and monthly timeframes. Low consumption periods shall be regarded as Allocation Constraints and treated in the same way done for D-2 and ID capacity calculation. For the export direction, the dynamic constraints will be regarded as external constraints.

With regards to new grid investments the impact on the statistical results will be estimated through simplified rules, in line with FCA art. 23(1) (d), according to which TSOs shall define common rules to consider available information about new infrastructure as defined in Article 8.

High level business processes: Yearly and Monthly capacity calculation

The business process is described as follows:

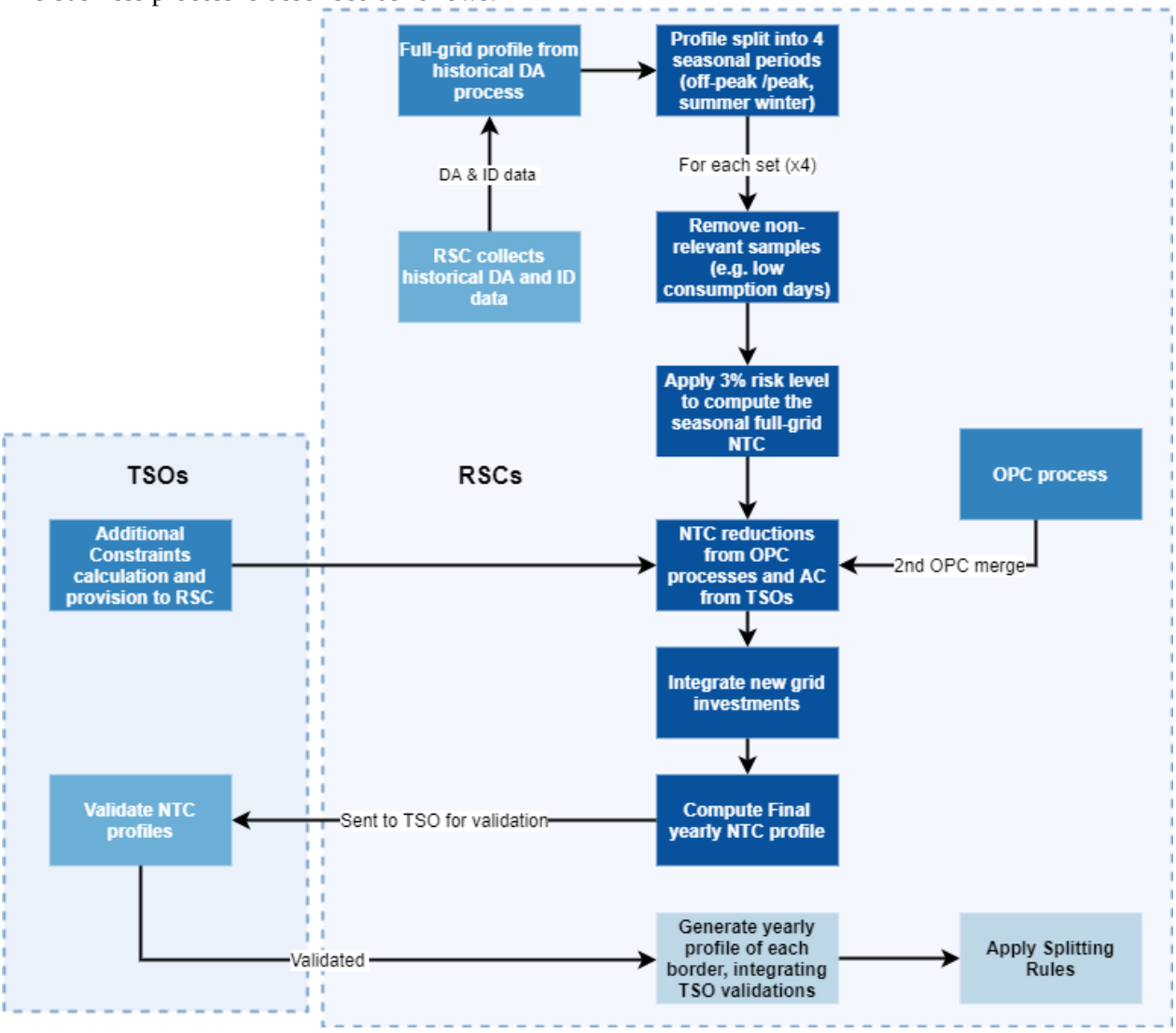

Figure 1: High-Level Business Process of the yearly capacity calculation

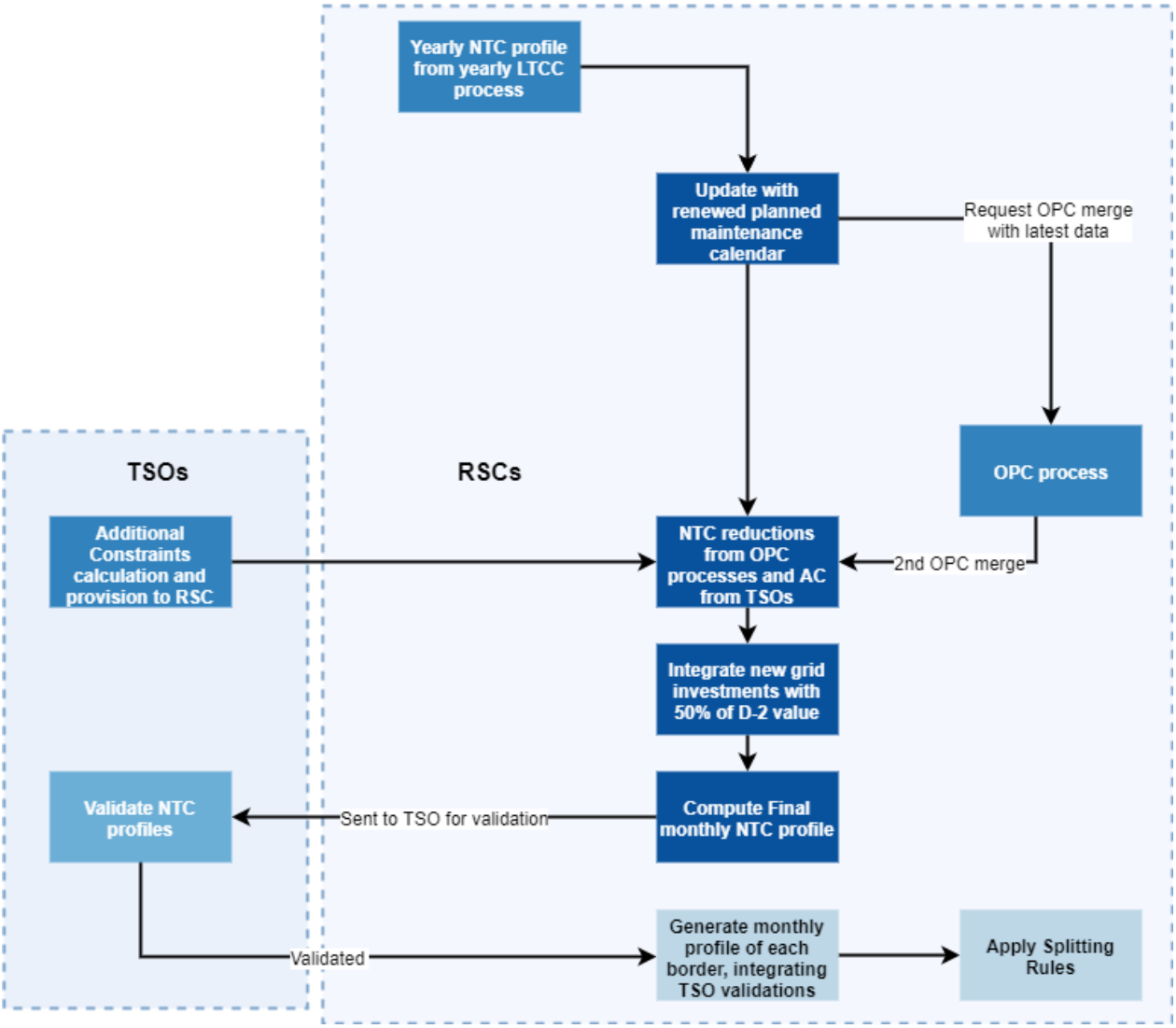

Figure 2: High-Level Business process of the monthly capacity calculation

Selection of historical day-ahead or intraday cross-zonal capacity data

Inputs needed for the selection of the historical data

In order to allow to the CCC to perform the relevant CCC-FCA process, the following relevant input data shall be gathered:

a) the allocated NTC time series of the past years for each border/direction of the TSOs of the Italy North Region and Technical Counterparties. In order to minimize the uncertainty in the allocated NTC timeseries, the most recent NTC sample coming from D-2 and ID capacity calculation processes will be considered for each historical market time unit;

b) the NTC reductions (maintenance and Allocation Constraint) time series of the past years for each Italy North and technical counterparty border/direction;

c) Commissioning date of new investments during the past years for each Italy North and technical counterparty border;

d) the real time reduction and capacity curtailment time series of the past years for each border/direction. Such data will be used for filtering out NTC samples affected by reduction in real time and curtailments (for which TSOs will assume that allocated capacity was not secure at all);

e) Additional information linked to the D-2 and ID capacity calculation processes such as red flags, triggering of export corner and process fails time series that will be considered as filtering parameters in the statistical analysis;

Selection of the historical data

After the needed inputs described in Article 5 have been gathered, the historical data selection can be applied and summarized as follow:

a) Create the historical hourly allocated NTC profile and matching each sample with the respective hourly NTC reductions (maintenance and Allocation Constraint) and the eventual real time reduction/curtailment, red flags and process fails linked to D-2 and ID processes;

b) Separate the historical allocated NTC profile for each season: Winter Peak, Winter off-peak, Summer Peak and Summer Off-Peak;

c) Apply the following filters on the created NTC profile in order to exclude non-relevant samples:

- Exclusion of non-representative NTC samples which may reflect problems in the calculations which lead to unrealistic results (e.g. D-2 cases in which, without presence of Allocation Constraint nor big amount of NTC reductions, wrong input data or problems in the calculation tool);
- Exclusion of samples with Allocation Constraints (Low Consumption Hours), high NTC reductions combinations (i.e. high presence of multiple planned outages), Validation applied during the D-2 process, affected by D-2 or ID process fail, Real Time Reductions and capacity curtailments and for the case of intraday NTC, if export corner was triggered in the intraday calculation;

d) Consider as time window to be used for statistical analysis always the last three years Y-3, Y-2 and Y-1 (e.g. for the yearly capacity profile determination of 2021 the historical data of 2018, 2019 and 2020 will be used; then for the profile determination of 2022 the historical data of 2019, 2020 and 2021, and so on).

Statistical analysis of historical data

Building of historical full-grid NTC duration curve

Before that the duration curve creation is done, a statistical analysis of historical data is achieved following the computation steps below:

1. The initial dataset for long-term capacity calculation is composed of historical cross zonal capacity values per border in both directions (import and export) as described in Article 5.

2. All NTC values which correspond to a non-representative hour in the Italy North CCR (i.e. Italian Low Consumption Periods, real time capacity reductions, capacity curtailment and capacity calculation process failed) are excluded from the dataset.
3. In order to make all NTC samples comparable in the statistic, the values are converted to full-grid values. The conversion is performed by adding to the final NTC the value of the daily NTC reductions corresponding to the outages planned for each hour of the past days:

$$NTC_{final,full-grid,h} = NTC_{final,h} + NTC_{daily\ reduction,h}$$

Where $NTC_{final,h}$= final Italy North NTC or bilateral NTC given to the market for the generic hour "h" and $NTC_{daily\ reduction,h}$ = total or bilateral daily NTC reduction for the generic hour "h" of the past years. In this way all the hourly NTC values theoretically refer to a grid without any outage (see Figure 3).

4. Once the full-grid NTC profile has been obtained, all the samples are ordered in a duration curve (from the lowest one to the highest one), thus creating seasonal full-grid NTCs curve as function of the selected risk level (see Figure 4).
5. The risk level is defined as the percentage of time where the actual NTC is lower than the determined value, i.e. in the timeframe of X% TSOs will not be able to guarantee the computed

NTC. When the risk level is higher, the chance increases the computed NTC values are not reached, being lower level of firmness.

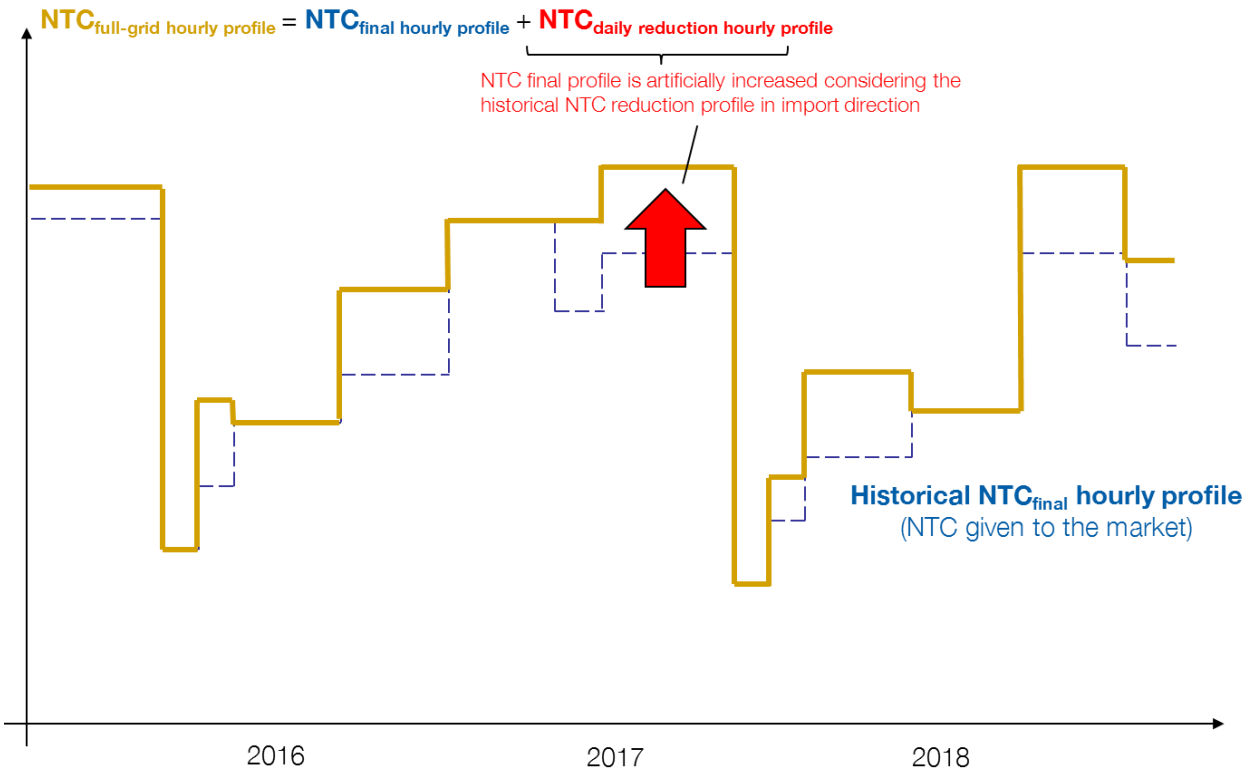

Figure 3: historical full-grid NTC hourly profile computation considering a time window 2016-2018

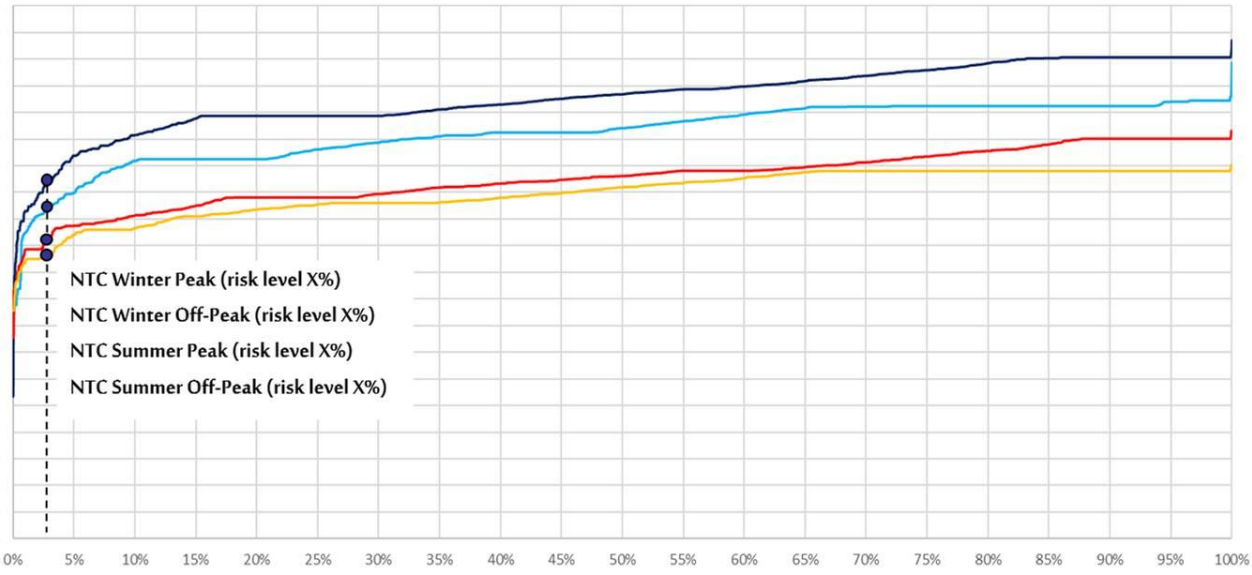

Figure 4: Duration Curve computed for the four seasonal periods

New grid investments

The new grid investments will be treated by taking into account NTC increase value already defined with a historical NTC reduction value for each New Grid Investment coming from the operational planning and D-2 process of the previous years considered for the statistical database. Samples before the commissioning date shall be treated as cases with "New Grid Investments out of service" for which the above-mentioned New Investments' NTC reductions has to be added on top of the final NTC given to the market (as already done for normal out of services cases to obtain the full-grid profile).

$$I_{\text{value}} = NTC_{red,new\ grid\ investment}$$

Treatment of Go Live of new grid elements for the yearly/monthly profile computation

Yearly profile computation: the New Investment Value(s) shall not be considered in the first year of commissioning.

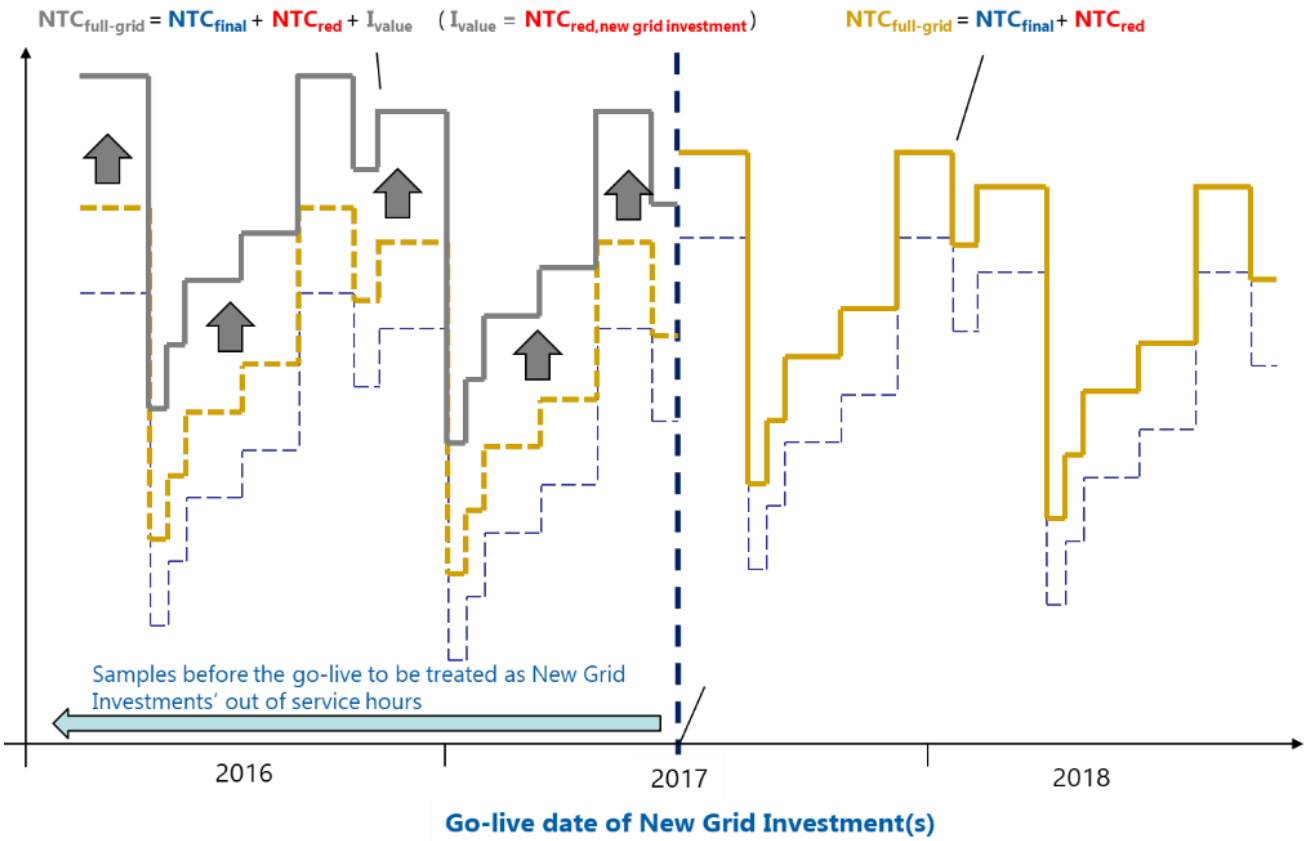

Figure 5: Treatment of Go-Live of New Grid Investment(s) in the historical data

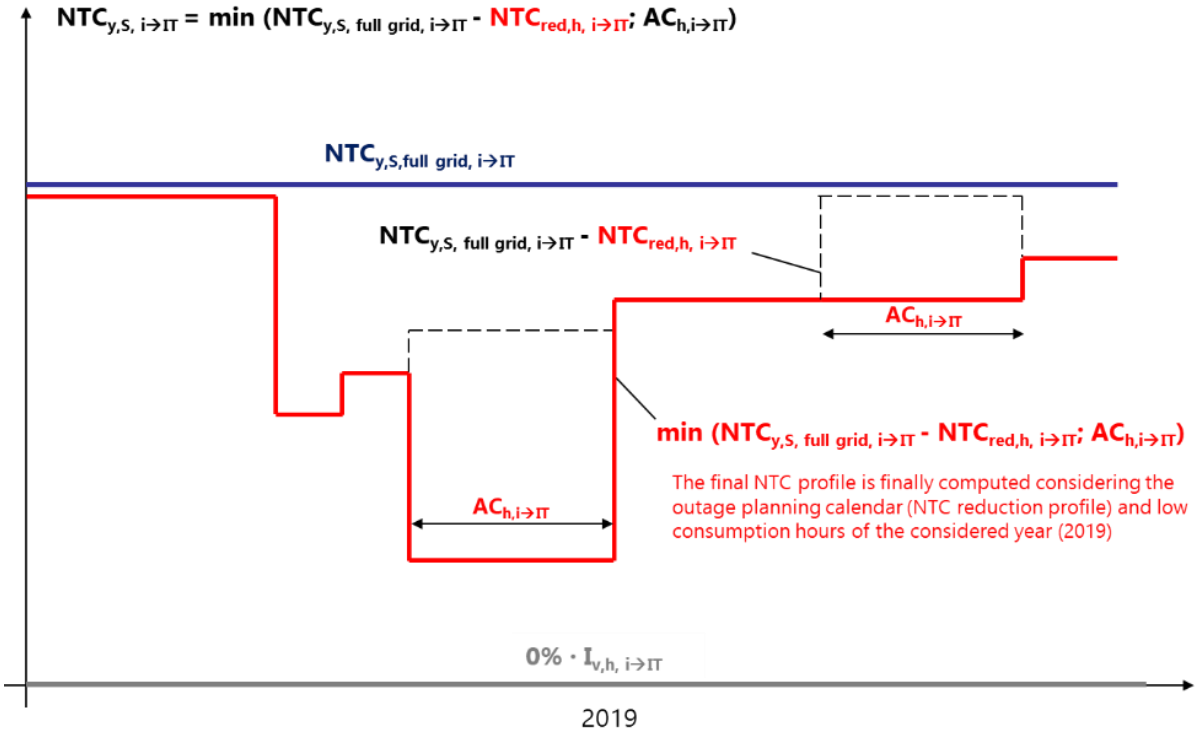

Figure 6: Treatment of Go Live of New Grid Investment(s) for the yearly profile computation.

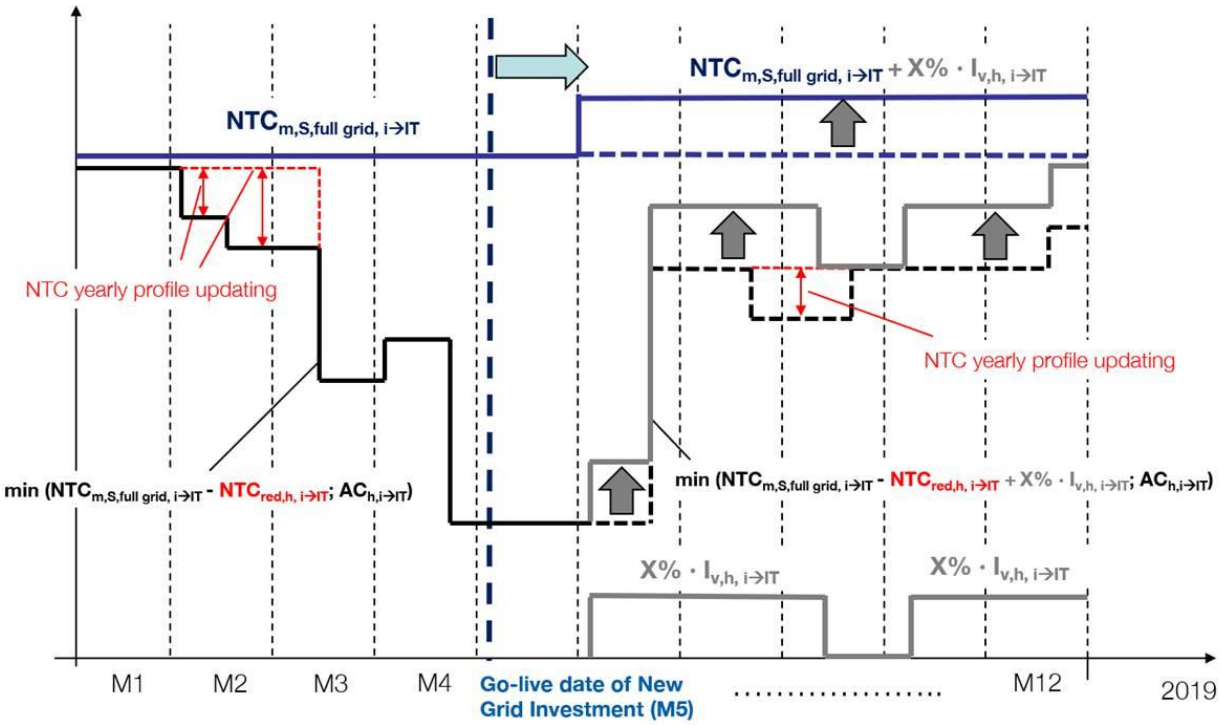

Figure 7: Treatment of Go Live of New Grid Investment(s) for the monthly profile computation

Monthly profile computation: the X% of the New Investment's Value shall be considered in the months after the commissioning until the end of such year. The monthly New Investment's value shall be a percentage of its respective NTC reduction value that should be available at that time (value already agreed among respective operational planning departments and already used during the D-2 processes of the previous weeks/months).

Chosen portion of X% for the consideration of the new investments is based on a rather conservative approach to ensure secure operation of the system in most of the timeframes considered. The New Investments' NTC reductions values originate from the operational planning and D-2 process of the previous considered years. Due to lack of historical values of the new grid investment, these values are not proven as secure in all situations to come since operational conditions could change radically in the future.

For all these reasons, the full values of the "New Investments' NTC reductions" that are obtained based on the historical data are considered as too risky for the direct implementation. Therefore, Italy North TSOs decided to use a reduced value of X% of the total NTC reductions, which can be considered as secure in the majority of the time despite the fact of high operational uncertainties and power system developments foreseen in the future. This limitation will only be considered in the monthly computation, meaning that the full capacity of the new grid investment will be fully considered in the D-2 & ID CC.

Reliability margin methodology

Since a statistical approach is considered to take properly into account uncertainties related to the long-term capacity calculation timeframes and NTC values are used for the statistics, Italy North TSOs do not apply any additional transmission reliability margin, since a reliability margin is already included in the NTC samples.

The yearly capacity calculation

The hourly NTC profile computation for the yearly timeframe

The hourly profile for the Bilateral NTCs is computed by considering the hourly bilateral NTC reductions profile of the hourly Low Consumption profile as follow:

$$NTC_{y,h,IT\to i} = \min\left(NTC_{y,full-grid,S,IT\to i} - NTC_{red,h,IT\to i}\ ;\ AC_{h,IT\to i}\right)$$

Where $NTC_{y,full-grid,S,IT\to i}$ = yearly "full grid" NTC of a generic border i and generic season/period S (value obtained from the duration curves after fixing the risk level), $NTC_{red,h,IT\to i}$ = NTC reduction value for the generic border i and hour h (which reflect the hourly outage planning) and $AC_{h,IT\to i}$ = Allocation Constraint planned for the generic border i and the generic hour h (see Figure 8).

For each hour, the NTC reduction values are determined taking into account the latest updates from the OPC process.

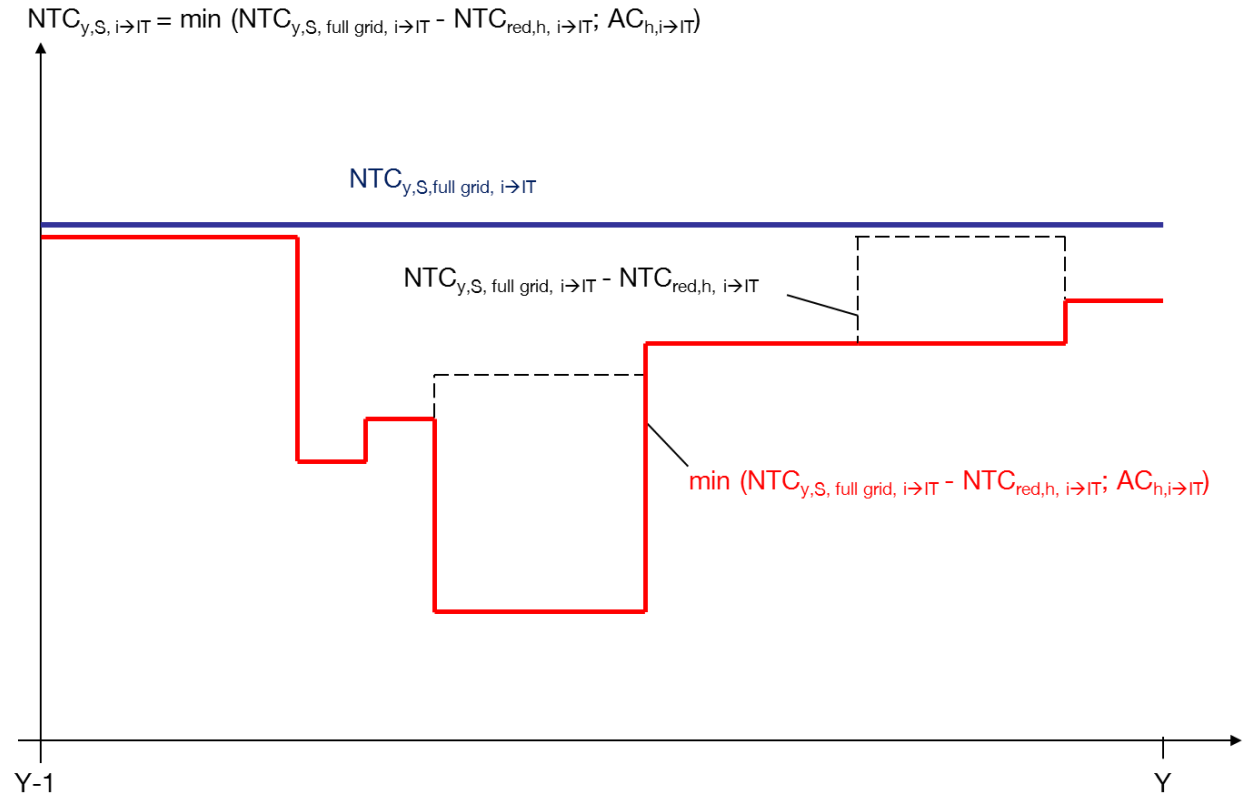

Figure 8: Example of bilateral NTC seasonal yearly product calculated by considering the bilateral "full grid" seasonal NTC (flat value for the entire season/period), the bilateral hourly NTC reductions and bilateral hourly Allocation Constraint profiles.

The hourly NTC profile modification for the yearly timeframe to consider the effect of new grid investments

Once the effect of a new grid investment is calculated for each season and border/direction, its respective investment value is added on top of hourly NTC import/export profiles that already consider maintenances and Allocation Constraints.

For each new investment a maintenance plan will be also considered in order to properly compute the new NTC profile for each border/direction also considering when such new elements will be out of service during the delivery period.

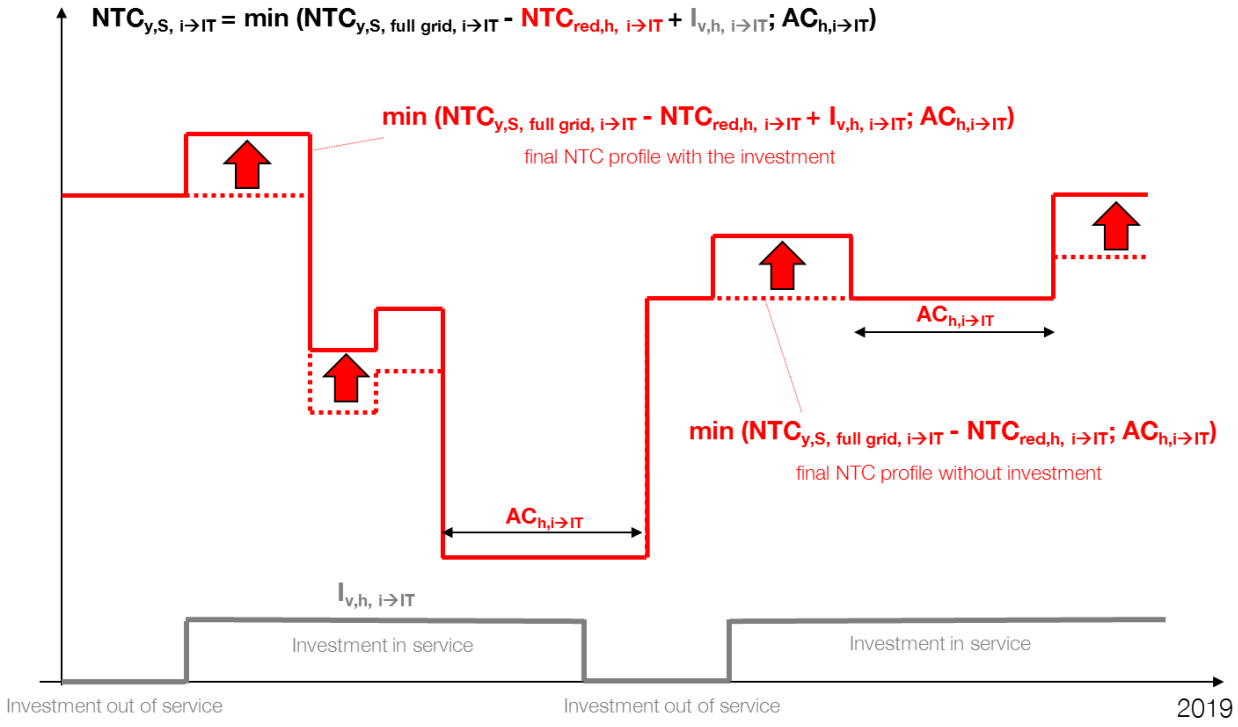

Figure 9 : Final NTC hourly profile computation

The monthly capacity calculation

The hourly NTC profile computation for the monthly timeframe

The monthly timeframe statistical methodology aims at updating the yearly NTC profile already described in the previous paragraphs. In other words, the monthly NTC profile will be calculated by considering:

a) The yearly seasonal "full-grid" NTC values: the monthly "full grid" NTC will be the value of the corresponding SEASONAL PERIOD already calculated in the yearly statistical methodology by fixing a proper risk level.

$$NTC_{m,full-grid,S,i\rightarrow IT} = NTC_{y,full-grid,S,i\rightarrow IT}$$

Where S= season Winter Peak/Off-Peak and Summer Peak/Off-Peak, $NTC_{y,full-grid,S}$ = seasonal full-grid NTC for a fixed risk level.

b) An updated version of planned maintenance calendar and related NTC bilateral reductions: in this way it is possible to update the previous yearly NTC profile by considering possible variations in the yearly planned and "extraordinary" out of service combinations.

$$NTC_{m,h,i\rightarrow IT} = NTC_{m,full-grid,S,i\rightarrow IT} - NTC_{red,h,i\rightarrow IT}$$

Where $NTC_{m,h,i\rightarrow IT}$ = hourly NTC profile obtained by deducting the hourly NTC reduction profile from the monthly "full-grid" NTC and $NTC_{red,h,i\rightarrow IT}$ = hourly NTC reduction profile.

c) Recalculated Allocation Constraints values based on most updated input data.

$$NTC_{m,h,i\rightarrow IT} = \min\left(NTC_{m,full-grid,S,i\rightarrow IT} - NTC_{red,h,i\rightarrow IT}\ ;\ AC_{h,i\rightarrow IT}\right)$$

Where $NTC_{m,full-grid,S,i\rightarrow IT}$ = monthly "full grid" NTC of the generic border and the generic season S, $NTC_{red,h,i\rightarrow IT}$ = hourly NTC reduction profile of the generic border (eventually updated in the monthly process) and $AC_{h,i\rightarrow IT}$ = hourly Allocation Constraint profile of the generic border

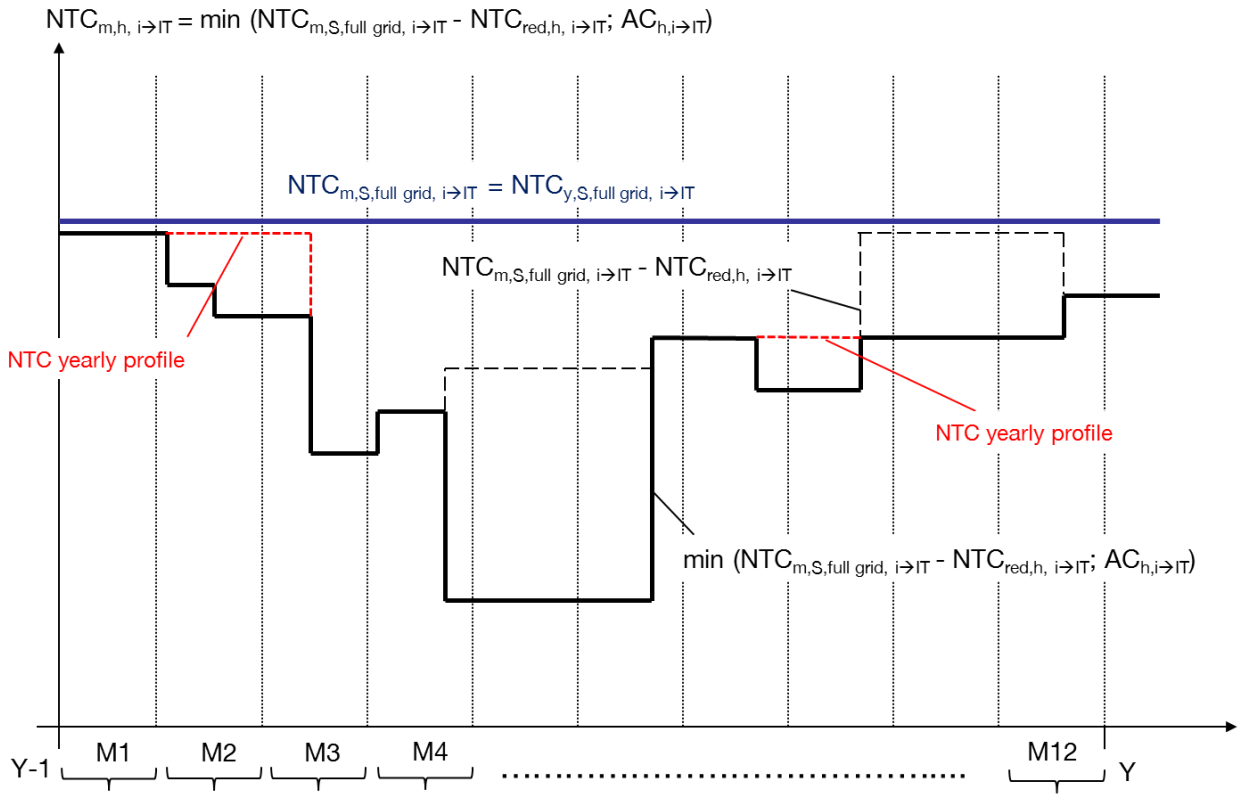

Figure 10: Example of bilateral NTC season/period monthly product calculated by considering the bilateral "full grid" season/period NTC (flat value for the entire winter peak period), the bilateral season/period NTC reductions (based on the updated monthly planned maintenance calendar) and the updated bilateral Low Consumption profile

Improved efficiency of statistical approach

According to FCA Regulation Art 10.4(b), the following requirements are set for using a statistical approach by the TSOs of the Italy North Region and Technical Counterparties:

I. Increase the efficiency of the capacity calculation methodology
II. Better take into account the uncertainties in long-term cross-zonal capacity calculation than the security analysis in accordance with paragraph 4(a)
III. Increase economic efficiency with the same level of system security

The following paragraphs list the main arguments in a qualitative manner to show a statistical approach is more beneficial than a scenario-based approach.

Initiating a process for creating satisfactory scenarios for Italy North would require significant resources and incur delays in the planning. The TSOs of the Italy North Region and Technical Counterparties would have to find an agreement with all ENTSO-E TSOs in order to create additional time stamps, which would be useful for the Italy North region. This would lead also to a higher effort of the ENTSO-E TSOs side.

As part of a preliminary experimentation exercise and using the common all TSOs' winter scenario for 2019, the models were found to be pre-congested. This resulted in problems with convergence of the load-flow analysis and to very low or even non-existing long-term capacities for the borders in Italy-North Region. As a consequence, a special process step for a base case quality improvement would be required in the LTCCM.

Likewise, the firmness of the capacities is important for the long-term capacities, ensuring a high level of firmness for a scenario-based approach would result in a high TRM/FRM value, which would result in lower capacities. Moreover, the scenario based approach would need to define a robust and statistically valid methodology for the TRM/FRM calculation since the reference scenarios, being specific and artificially created cases, do not cover all possible situations which may happen over long timeframes (e.g. all possible hours of a year/month and impossibility to have meaningful long term forecasts of variable such as renewable sources and load). Therefore, the TSOs of the Italy North Region and Technical Counterparties will need to define a statistical methodology for the TRM/FRM calculation regardless of the approach chosen. This has to be carried out in parallel with the scenario based process developments, thus increasing TSOs and RSCs' workload and leaving the scenario-based calculations without significant added value.

Finally, the scenarios are not fully representative for the Italy North region and they would not always capture all Italy North Region particularities (like different flow distribution on Italy North borders linked to the influence of the external CCRs).

Moreover, a statistical long-term CC approach would directly benefit from the better forecasts in the short-term process, each time an improvement on short-term CCM is implemented (based on the Day Ahead and Intra Day results).

A quantitative explanation will be incorporated in the final proposal submitted to Italy North NRAs.