

# Simulation of Capacity Weighted Distance Reference Price Methodology for calculation of gas transmission tariffs in Serbia and Ukraine

Gas



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# Final Report

for Calculation of Transmission Tariffs for Serbia and Ukraine with Capacity  
Weighted Distance Reference Price Methodology

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## LIST OF ABBREVIATIONS

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ACER	Agency for the Cooperation of Energy Regulators
CAPEX	Capital Expenses
CP	Contracting Party
CWD	Capacity Weighted Distance
DSO	Distribution System Operator
EC	European Commission
EnC	Energy Community
ENTSOG	European Network of Transmission System Operators for Gas
EU	European Union
IP	Interconnection Point
ITC	Inter-TSO Compensation
MS	Member State
NRA	National Regulatory Authority
OPEX	Operation and Maintenance Cost
RPM	Reference Price Methodology
TAR NC	Network Code on Harmonised Transmission Tariff Structures for Gas
TSO	Transmission System Operator

## 1 INTRODUCTION AND OBJECTIVES

The main objective of this project is to contribute to understanding of the effects of the Tariff Network Code (TAR NC)<sup>1</sup> implementation on the existing gas transmission tariffs in two selected Energy Community (EnC) Contracting Parties (CPs), Serbia and Ukraine. Proper understanding of the possibilities delivered by the TAR NC should help all regulators to prepare for the legislative and regulatory challenges ahead in the field of gas transmission tariff setting.

Serbia and Ukraine were chosen to be involved in this project, as these two CPs have already introduced entry-exit tariff systems for calculation of gas transmission tariffs, in line with the Energy Community *acquis communautaire* ('acquis'), and in particular Regulation (EC) No 715/2009 and Directive 2009/73/EC. The adoption and implementation of network codes and guidelines developed on European Union (EU) level in context with the Third Energy Package is also a central part of Gas Action 2020 of EnC.

The TAR NC was adopted in 2017 March by the European Commission (EC), after long discussion and consultation with the European Network of Transmission System Operators for Gas (ENTSOG) and the Agency for the Cooperation of Energy Regulators (ACER). The deadline for implementation of all rules included in the Network Code is 31 May 2019 for all EU Member States (MSs), however some parts of the regulation are already in force.

The Energy Community Secretariat aims to provide support to the CPs' national regulatory authorities in the implementation of the TAR NC. This project, in line with this aim is focused on developing country-specific models for the two chosen CPs, taking into account the specificities of the individual markets. The project provides the regulators of Serbia and Ukraine with a simulation of the default capacity weighted distance (CWD) reference price methodology (RPM) for calculation of gas transmission tariffs, while trying to identify the key issues and challenges regarding the TAR NC implementation for these two countries.

The results of the simulation were also presented for other regulators from EnC CPs and Observes countries, and a fruitful discussion was held regarding different methods and solutions for transmission tariff calculation in line with the TAR NC. The results will be circulated among other CPs afterwards to foster the efficient implementation of the rules in all countries.

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<sup>1</sup> COMMISSION REGULATION (EU) 2017/460 of 16 March 2017 establishing a network code on harmonised transmission tariff structures for gas

## 2 METHODOLOGY

### 2.1 REFERENCE PRICE METHODOLOGIES IN THE TAR NC

The concept of entry-exit system was introduced by Regulation (EC) No 715/2009<sup>2</sup>. With this change, transmission costs are no longer directly associated to specific routes, revenues come from the capacity booking on entry and exit points, and it is the responsibility of the transmission system operator (TSO) to transport gas from one point to another in the most efficient way.

The main idea of RPM in the Tariff Network Code is to provide a guidance on transmission tariff calculation that ensures cost reflectivity and predictability, while using predefined cost drivers. Consistency and transparency are key requirements for all RPMs, and consultation with market participants on the applied RPM is obligatory.

The document sets out the following definitions regarding the reference price and the reference price methodology (Article 3):

*‘reference price’ means the price for a capacity product for firm capacity with a duration of one year, which is applicable at entry and exit points and which is used to set capacity-based transmission tariffs;*

*‘reference price methodology’ means the methodology applied to the part of the transmission services revenue to be recovered from capacity-based transmission tariffs with the aim of deriving reference prices;*

In order to ensure the above mentioned principles the TAR NC sets a given RPM, the capacity weighted distance (CWD) as a counterfactual. When a regulator chose to use any other RPMs, this should serve as a basis of comparison. This way transmission tariffs need to be calculated with this method in case of all applied RPMs, so the understanding of this method is of utmost importance in the implementation process.

The RPM provides the reference price, which is the price of the yearly, firm capacity product for all entry and exit points of the system. The reserve prices of shorter term, seasonal and interruptible products can be calculated afterwards, based on the reference prices. The calculation of these latter prices is out of the scope of this project, thus this report will concentrate on CWD reference price calculations.

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<sup>2</sup> REGULATION (EC) No 715/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005

## 2.2 THE CAPACITY WEIGHTED DISTANCE REFERENCE PRICE METHODOLOGY

In case of the CWD methodology, the cost drivers for the calculation are distance and capacity. The logic of this RPM is to distribute all costs among network points in a cost-reflective way, taking into account both the location of the point in the system, and the booked capacity on all points.

The logic behind the usage of capacity weighted distance values is based on the ‘gas does not stay in the system’ principle. For all entry points the total capacity booking (the amount of gas to be injected into the system at that point) is “distributed” among the exit points proportionately to their booked capacity values. The full distance that the gas flows in the system can be calculated by using the (booked) capacity weighted distances between the given entry point and all exit points. The same applies for exit points: the gas going out from the system should have come from one of the entry points, thus the total length of the route the gas was transported on can be calculated as the capacity weighted distance between the given exit point and all entry points.

At the end we arrive to cost-reflective tariffs for all entry and exit points, taking into account how much the gas should be transported inside the system to realize the level of flows foreshadowed by the bookings on all entry and exit points.

## 2.3 INPUTS FOR THE CALCULATION

The TAR NC sets out detailed calculation guidelines, including the list of inputs (Article 8):

*1. The parameters for the capacity weighted distance reference price methodology shall be as follows:*

*(a) the part of the transmission services revenue to be recovered from capacity-based transmission tariffs;*

*(b) the forecasted contracted capacity at each entry point or a cluster of entry points and at each exit point or a cluster of exit points;*

*(c) where entry points and exit points can be combined in a relevant flow scenario, the shortest distance of the pipeline routes between an entry point or a cluster of entry points and an exit point or a cluster of exit points;*

*(d) the combinations of entry points and exit points, where some entry points and some exit points can be combined in a relevant flow scenario;*

*(e) the entry-exit split referred to in Article 30(1)(b)(v)(2) shall be 50/50.*



In order to generate these inputs a detailed representation of the system and a precise forecast of capacity booking is needed. This latter is a rather complicated exercise, which is out of the scope of this work.

(a): when no flow-based tariff element is applied – which is the base case in the TAR NC – as a typical approach the total (transmission related) allowed revenue (in non-price cap regimes) or target revenue (for price cap regimes) can be used as point ‘a’.

(b): the forecasted contracted capacity for each point should include all bookings in the relevant year, meaning the non-yearly capacity products should be summed up with the yearly ones, and also firm and interruptible products should be covered. During this process the length of the different products should be taken into account, and the sum of the booked capacity from the different types of products should be calculated in a common measurement unit (e.g. kWh/h/year). The TAR NC is not clear on whether the short term multipliers, seasonal factors and the adjustment factor in case of the interruptible capacity products should be taken into account when summing up the total capacity or not. These factors do have an influence on the revenue, but the total booked capacity (as a cost driver) can be interpreted as simply the sum of the bookings from the given products, taking into account product length.<sup>3</sup> In this project, we applied this latter approach, as short term multiplier and seasonal factor calculation was not in the scope of this project.

(c) and (d): these two points cover the preparation of the so-called Distance Matrix. This includes all entry points (as rows) and exit points (as columns), and each element of the matrix shows the pipeline distance between the two points in its row and column. The TAR NC emphasizes that instead of airline distance, pipeline distance should be used as cost driver in case of the CWD counterfactual, but in a modified CWD the former can also be applied as cost driver. It should be noted, however, that in case these two approaches lead to very different distance matrices (e.g. in case of the Austrian gas transmission system) the usage of airline distance should be clearly justified.

(e): The entry-exit split stands for the distribution of total income between entry and exit points, thus how much (what percentage) of total revenue comes from the bookings on entry points and from exit points. In the CWD counterfactual this value is 50%-50%, but again, a modified CWD with different entry-exit split can be applied as an RPM.

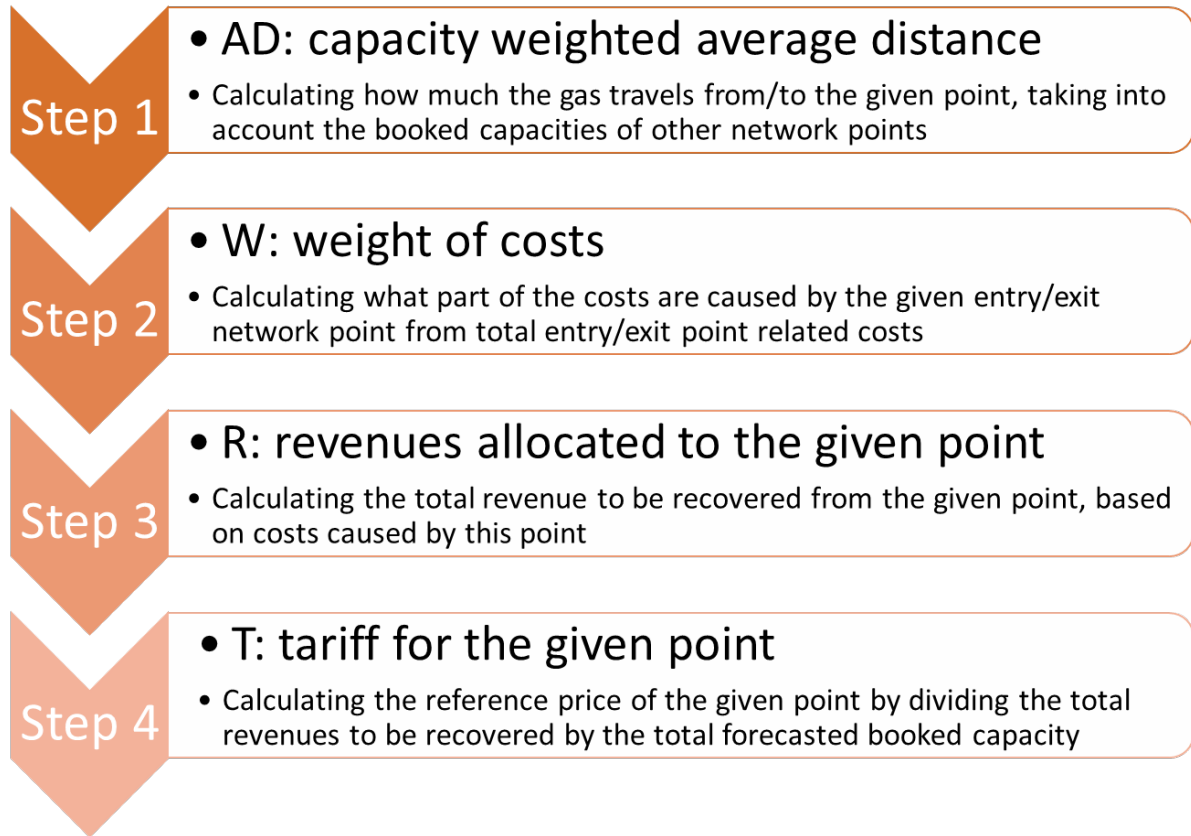
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<sup>3</sup> In the ENTSOG Implementation Document (ENTSOG, 2017, see footnote 5) and the attached calculations the short-term multipliers are taken into account when the total booked capacity is calculated as the input of the RPM, however, the seasonal factors are not included in this calculation.



## 2.4 CALCULATION METHOD

Figure 1: Steps of the Capacity Weighted Distance Reference Price Methodology



source: REKK

The calculation - as represented on Figure 1 - includes the following steps. Notations follow the TAR NC (Article 8).

**Step 1 - AD:** Calculation of capacity weighted average distance between each entry point and all exit points and each exit point and all entry points. To arrive to this value, for each entry point the sum of the products of capacity at each exit point and the distance from the given entry point to each exit point should be divided by the sum of capacities at each exit point. For exit points the sum of the products of capacity at each entry point and the distance from the given exit point to each entry point should be divided by the sum of capacities at each entry point.

**Step 2 - W:** Calculation of the weight of cost for each entry point and for each exit point. Weights represent the part of cost caused by each entry point from the total costs generated by entry points, and similarly to exit points, the part of cost caused by each exit point from the total costs generated by exit points. The sum of weights for all entry points (and for all exit points) is 1. The weight is calculated for each entry (exit) point as the product of its booked capacity and its capacity weighted average distance (calculated in Step 1), divided

by the sum of the products of the booked capacity and the capacity weighted average distance values for each entry (exit) points.

**Step 3 - R:** Calculation of the part of revenue to be recovered from the given point. With the help of the entry-exit split first the total (transmission related) revenue to be recovered from capacity based entry (exit) tariffs should be calculated. This is the product of the total revenue and the entry (exit) split. Once we arrived to these values, the amount of revenue to be recovered from each entry (exit) point should be calculated as the product of the weight of the given point and the total entry (exit) revenues.

**Step 4 - T:** Calculation of the reference price. Once we arrived to the total revenue that should be recovered from the given point (in a cost-reflective way, thus taken into account the distance and capacity booking as cost drivers) the reference price can be derived by dividing the revenue to be recovered from the given point by the total capacity booking on the given point.

### 2.4.1 Clustering

Before the calculation is started some points can be put together in clusters, and then treated as one point in the calculation. The reference price for all points in the cluster will be the same as the reference price of the cluster. The reason for applying clustering can be simplicity, in some cases lack of data, or the aim of applying the same tariff for a group of points (e.g. all domestic exit points). There are two options for choosing points to be put in the same cluster: points within the vicinity of each other can be put to the same cluster; or (some) points in a homogenous group<sup>4</sup> can be put to one cluster. Entry and exit points can not be put into the same cluster. The forecasted booked capacity of the cluster is the sum of the forecasted booked capacity values of all points included in the cluster.

## 2.5 ADJUSTMENT POSSIBILITIES

The Tariff Network Code includes different adjustment possibilities after the calculation of the reference prices, but still before the calculation of the reserve prices of the non-yearly products. This way we can arrive to modified reference prices, that will be the basis for the calculation of the reserve prices of other products.

The TAR NC mentions three special types of network point, that could be treated differently: the entry points from and exit points to storage facilities, the entry points from LNG facilities and entry/exit points from/to infrastructure developed with the purpose of ending isolation. In case of these points special discounts are legitimate. For storage points, TAR NC states that at

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<sup>4</sup> A homogenous group of points as defined in Article 3 is: “‘homogeneous group of points’ means a group of one of the following types of points: entry interconnection points, exit interconnection points, domestic entry points, domestic exit points, entry points from storage facilities, exit points to storage facilities, entry points from liquefied natural gas facilities (hereinafter, referred to as ‘LNG facilities’), exit points to LNG facilities and entry points from production facilities;”

least 50% discount should be given to avoid double charging. However, if a storage facility competes with an interconnection point this discount is non obligatory. In case of LNG and isolation ending points the TAR NC is silent about the level of discount. The reason behind the discount is the promotion of security of supply.

The Tariff Network Code introduces three further adjustment possibilities: benchmarking, equalization and rescaling. These are defined in the following way (Article 6):

*(a) benchmarking by the national regulatory authority, whereby reference prices at a given entry or exit point are adjusted so that the resulting values meet the competitive level of reference prices;*

*(b) equalisation by the transmission system operator(s) or the national regulatory authority, as decided by the national regulatory authority, whereby the same reference price is applied to some or all points within a homogeneous group of points;*

*(c) rescaling by the transmission system operator(s) or the national regulatory authority, as decided by the national regulatory authority, whereby the reference prices at all entry or all exit points, or both, are adjusted either by multiplying their values by a constant or by adding to or subtracting from their values a constant.*

This project covers equalisation (only for Serbia); clustering, rescaling and the discount at storage entry and exit points for both countries. Thus details regarding these techniques are provided in the following sections (for details on clustering see 2.4.1).

### **2.5.1 Equalization**

Equalization can be applied in similar situations as clustering. Some typical reasons for equalization: avoid cross-subsidies, especially regarding cross-system and intra-system uses; encourage the use of assets that offer security of supply; enhance the stability of prices and flows; foster retail and wholesale market competition; for simplicity and transparency; or the simple desire to avoid price differences within homogeneous groups of points.

When applying equalization for some or all points in a homogenous group (see definition in footnote 4) the same reference prices are derived for all these points. This method is always applied after (ex-post) the reference price calculation, and before the reserve price calculation. After Step 3 (as defined in 2.4), when the total revenues to be recovered at each point have already been calculated these revenues should be summed up and divided by the sum of total booked capacity for all points equalization is intended to be applied to. The reference price calculated this way will be the uniform tariff for all these points.

### **2.5.2 Discount at storage points**

In line with the TAR NC in our calculation a 50% discount is applied for all storage entry and exit points. This way – ceteris paribus – the total expected revenue (bookings multiplied by reference prices for all points) decreases, so in order to avoid under-recovery rescaling is applied after the discounts are in place.

### **2.5.3 Rescaling**

Rescaling is used for adjusting the reference prices in order to avoid under/over-recovery, or to eliminate negative or zero prices. There are two ways to carry out this adjustment. One is the multiplicative rescaling, the other is the additive rescaling. In case of the first all reference prices are multiplied with a certain value. This way the relative percentage differences between the reference prices can be kept. The additive rescaling changes these relative differences, however, it can solve the problem of zero or negative prices. Both ways the level of expected revenue can be assured to be equal to the allowed/target revenue.

## 3 CALCULATION FOR SERBIA

### 3.1 CALCULATION SCENARIOS

In case of the Serbian system four different calculations were carried out. The reason for that is that there are two TSO systems in the country, functioning separately. First the calculation was carried out for these systems the way they work in the present. For the larger system equalization was compared to clustering in case of domestic exit points. For the regulator it was important to have the same tariffs for all domestic exit points, regardless of their location and capacity, so both approaches were applied, where this criterium could be met. As a fourth variant, reference prices were calculated for a possible future situation: the merger of the two systems. In this case also the inter-TSO compensation (ITC) mechanism was applied.

**Table 1: Calculation Scenarios for Serbia**

	TSOs included	Clustering for domestic exit points	Clustering for production entry points	ITC applied
Scenario 1	TSO 1	yes	yes	no
Scenario 2	TSO 1	no, equalization instead	yes	no
Scenario 3	TSO 2	yes	no production points	no
Scenario 4	TSO 1 and TSO 2	yes	yes	yes

*source: REKK*

### 3.2 INPUTS FOR THE CALCULATION

All input data were provided by the National Regulatory Authority (NRA) - in cooperation with the TSOs -, however, calculations with the original numbers will not be publicly available due to sensitivity of the data.

For Serbia total allowed revenues (sum of total Capital Expenses (CAPEX) and Operation and Maintenance Cost (OPEX)) for 2018 was used as input. In agreement with the NRA flow-based tariff element was not calculated, all costs should be recovered from the capacity bookings.

In the system of TSO 1 (Transportgas) there are 176 domestic exit points, one exit Interconnection Point (IP), one IP entry, one storage exit and one storage entry point. For production entry points a cluster was assumed in all calculations. Domestic exit points were treated separately only in Scenario 2, in all other cases the domestic exit cluster was used. One of the domestic exit points is an entry point to the system of TSO 2.

In the system of TSO 2 (Yugorosgaz) there is only one IP entry (that is an exit point from the system of TSO 1), and domestic exit points are put into one cluster. This way the calculation is very simple, as the capacity weighted average distance for all points (clusters) is simply the distance between the two points (clusters), as the distance matrix has only one element.

In the merged system the point in between the two TSOs disappear, and the members of the domestic cluster are changed: all domestic exit points of TSO 1 but the exit point to TSO 2 remains in the cluster, and all domestic exit points from the system of TSO 2 go into this new domestic exit cluster. In this case it is important to know precisely how much of the capacity of the new domestic exit cluster is allocated to TSO 1 and to TSO 2, as this data is essential for calculating the inter-TSO compensation. IP entry and exit points of TSO 1 remains in the system, so as storage points, and the cluster of the production entry points. Distance values between points and clusters should be recalculated according to the new situation.

When calculating distances between points and clusters there are different possibilities to apply. TAR NC does not state any specific rules on distance calculation regarding clustering, only says, that pipeline distance should be used (instead of airline distance). In the ENTSOG Implementation Document (ENTSOG, 2017)<sup>5</sup> several approaches are presented. A focal point can be picked (e.g. the point with the highest capacity), and distances can be calculated from and to that point when cluster distances are calculated. This approach was used in case of the production entry cluster. The other way is to calculate the “capacity weighted middle of the cluster” – using geographical coordinate data -, and then calculate distances between this virtual middle point and the rest of the system. This approach was used for the domestic exit clusters in all cases.

For capacity forecasts yearly and monthly capacity booking data was converted from m<sup>3</sup>/day to MWh/h/year (using the following conversion: 1 m<sup>3</sup> (NCV, 15/15) = 10,26 kWh (GCV, 25/0) ).

In some cases the forecasted booking for given points was zero. This would lead to an unsolvable calculation (dividing by zero at Step 4). In the Tariff Network Code there is no clear guidance for such situations, however, in the Implementation Document (ENTSOG, 2017), two possibilities are outlined. One is to leave out the point entirely from the calculation – this is only suggested when the TSO and the regulator are sure, there will be no booking on the given point (e.g. because of technical reasons, or because of a later commissioning date). The other way is to define a reference price for the given point, for that three options are outlined: one is to leave out the point from the calculation, but at the end apply the tariff of a neighbouring point (from the same type, entry/exit); the second is to cluster the given point with other points (for details see 2.4.1), while the third option is the application of a small positive value instead of zero. This way the calculation can be carried out without any difficulty. In our calculations, for

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<sup>5</sup> ENTSOG, 2017: Implementation Document for the Network Code on Harmonised Transmission Tariff Structures for Gas, Second Edition, September 2017, [https://www.entsog.eu/public/uploads/files/publications/Tariffs/2017/TAR1000\\_170928\\_2nd%20Implementation%20Document\\_High-Res.pdf](https://www.entsog.eu/public/uploads/files/publications/Tariffs/2017/TAR1000_170928_2nd%20Implementation%20Document_High-Res.pdf)

both Serbia and Ukraine, this last option was applied, using a 0.01 MWh/h/year forecasted booked capacity value for points with 0 forecasted capacity booking.

### **3.3 RESULTS OF THE CALCULATION**

For sensitivity reasons detailed results for reference price calculation is not included in this report, but the main findings, and comparison of the different scenarios are presented below. The calculation with “dummy” inputs can be found in Annex I for all four scenarios.

#### **3.3.1 Results for TSO 1: comparison of clustering and equalization**

In this subsection the results of Scenario 1 and Scenario 2 are compared. In case of the first all domestic exit points of TSO 1 were put into one cluster, and were treated as one point in the calculation. The distance between the cluster and the other points of the system was calculated as the distance between the virtual middle point of the cluster (calculated as the capacity weighted middle, from geographical coordinates and capacity data) and the other points of the system. In case of Scenario 2 all 176 domestic exit points were included in the calculation separately, with their own capacity booking forecast<sup>6</sup> and their own distances from all other network points.

In both cases once the original reference prices were calculated the 50% discount on storage points was applied. After that, the expected revenue was lower than the allowed revenue, thus rescaling was applied to get back to the adequate level of revenues. Rescaling was applied for entry points and exit points separately, to keep the 50-50% entry-exit split. Rescaling factors were between 1.02 and 1.07 in all cases, and were higher for entry points (probably as a result of much higher capacity booking forecasts for the storage entry point than for the storage exit point). In Scenario 2 equalisation was carried out after rescaling, as this adjustment does not change the level of total expected revenues. So after the rescaled tariffs were calculated the total expected revenue and the total forecasted booked capacity were summed up for all domestic exit points. We arrived to the equalized tariff through dividing the total expected revenue by the total booked capacity. There was only a slight difference between the equalized domestic exit tariffs in Scenario 2 and the tariff received from the clustering approach in Scenario 1 for the domestic exit points – around 6% -, but tariffs on other points changed more significantly. This might be the result of the high share of capacity booking on domestic exit points compared to total booking: a small change in the tariff of these points means relatively high share of revenue recovery reallocation to other points. The highest percentage difference between the two scenarios was around 20%.

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<sup>6</sup> Capacity booking forecasts were not available separately for all points, so in the calculation it was assumed that the total booking on domestic exit points is distributed among the points proportionately to their technical capacities. Thus the same booking level was applied to all points.



### **3.3.2 Results for the merged system: ITC and comparison with the non-merged systems**

In this subsection the results of Scenario 4 are compared to the results of Scenario 1 and Scenario 3. In the latter two reference prices were calculated according to the current situation, thus the two TSO systems are treated separately, while Scenario 4 calculated with the merged system, that might be a future development on the Serbian market.

Changes in tariffs for the points included in the system of TSO 1 are between 0.1% and 14%, and again higher for points with lower capacity booking forecasts. Tariffs for TSO 2 can only be compared on domestic exit points – as the other point disappears with the merger -, and are more than 2 times higher in the merged case. The reason is that after the merger all domestic exit points are put to one cluster, and capacity booking on the domestic exit points of TSO 1 is much higher, thus the tariff of this new cluster is therefore much closer to the original tariff of the domestic exit cluster of TSO 1 than to the original domestic exit tariff of TSO 2.

When calculating the ITC as a first step the reference prices are calculated in the merged system. For that the total allowed/target revenue is set as the sum of this values in case of the separate TSO calculations. Using the distance matrix for the merged system and the same capacity booking forecasts as used in Scenario 1 and Scenario 3 we arrive to the tariffs of the merged system. From these tariffs the expected revenue of the TSOs can be calculated separately, taking into account which point belongs to which TSO. In the analysed situation the new domestic exit cluster includes points of both TSOs. Even if there is one uniform tariff for all points in the cluster, the expected revenue from the cluster can be divided between the two TSOs proportionally to the forecasted capacity bookings on the domestic exit points belonging to TSO 1 and TSO 2. In this situation TSO 2 only owns domestic exit points, so this will be the only revenue it is expected to receive. TSO 1 also expects revenues from the IPs, the storage points and the production entry cluster. After calculating the total expected revenues for both TSOs we can compare them to the original allowed/target revenues. Most of the cases there will be a difference. The ITC is the transfer from one TSO to the other, that compensates for this difference.

In this particular calculation TSO 2 had to pay compensation to TSO 1, as in the merged system higher expected revenue would be allocated to TSO 2 than its original allowed revenue. The reason is the much higher domestic exit tariff, as TSO 2 only owns domestic exit points after the merger. The logic of this calculation guarantees that the surplus in case of one of the TSOs is the same amount as the deficit in case of the other.

## 4 CALCULATION FOR UKRAINE

Similarly to the Serbian case detailed results of the calculation are not presented in this section, due to sensitivity of the data. The focus is on input related challenges, and a short section is dedicated to aggregated results.

### 4.1 INPUTS FOR THE CALCULATION

Forecasted booking and allowed revenue data were provided by the National Regulatory Authority (NRA), however, calculations with the original numbers will not be publicly available because of sensitivity of the data. For the distance matrix no data was available from the TSO (not even provided to the NRA), so it was decided to create a rough estimate regarding distance values based on information publicly available on the TSO's website.

The Ukrainian system is large and complicated, with over 2000 network points, thus clustering was very useful to make the calculation more simple. It was applied for storage entry points, storage exit points, domestic exit points (exits to consumers of TSO and of the distribution system operator (DSO) together), production entry points and in case there were more IPs between the same two countries one virtual IP (or a cluster for the given IPs) was assumed.

Capacity booking is different in case of IPs and domestic points in Ukraine, so for some of the points only forecasted flow data was available, no capacity booking forecasts. In these cases 100% capacity usage ratio was assumed, and the level of booking needed for the realisation of the forecasted flows was calculated accordingly.

In order to create a distance matrix with lack of data on exact pipeline and point locations airline distance was estimated based on the map of the system published on the website of the Ukrainian TSO. This method is not in line with the requirements of the TAR NC, however without distance values the calculation could not be carried out. Thus keeping in mind the deficiencies of this approach the distance matrix was calculated on an airline distance basis.

In case of the Romanian border the existing virtual IP was used as the focal point of the cluster. For the border points with Russia, Belarus and Moldova the geographical middle point approach was used<sup>7</sup>. In case of the domestic exit points no data was available on the location of these points, thus the geographical middle of the country was picked as the middle of the cluster. For production points and storage entry and exit points a dominant point (the one with the highest capacity) was chosen as the focal point of the cluster.

For entry-exit split the NRA suggested 30-70%, that resulted in much higher exit tariffs than entry tariffs. Though the TAR NC provides flexibility in specifying the entry-exit split, a detailed justification is needed when other than 50-50% - defined as counterfactual – is chosen.

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<sup>7</sup> The MD-UA entry point was not included in the calculation.

Allocating more costs to exit points and less to entries was one of the past practices that brought to life the detailed TAR NC rules regarding cost reflectivity.

## **4.2 RESULTS OF THE CALCULATION**

As a result of the 30-70% entry-exit split there was a significant difference between the average level of entry and exit tariffs. The lowest tariff in both cases was the reference price of the storage cluster, as the 50% discount – in line with the TAR NC – was applied in the Ukrainian case as well. Rescaling factors were between 1.01 and 1.04, and were higher in case of exit points probably as a result of the high exit split. After rescaling the highest entry tariff was around 6.5 times higher than the lowest one, while in case of the exit tariffs this multiplier was around 2.3. The average of exit tariffs was almost 4 times higher than the average of entry tariffs, this would have gone down to 1.7 in case of the application of an 50-50% entry-exit split.

## 5 CONCLUSIONS

There are several issues regarding the reference price calculation that is not clearly defined in the Tariff Network Code. In most of the cases this provides some flexibility for NRAs when calculating tariffs. Guidance on these possibilities can usually be found in the Implementation Document published by ENTSOG, however, there are still cases when the NRA should decide what and how to choose from these approaches.

What is clearly stated in the Network Code is that transparency and cost-reflectivity should always be on the first place, thus whatever approach is chosen, justification is especially important.

The aim of this work was on one hand to provide a guidance on the calculation of reference prices with the CWD reference price methodology, that is set in the regulation as the counterfactual, and on the other hand for the NRAs to gain experience in such decision making when they face situations with multiple solution possibilities.

Some of these above mentioned issues are connected to lack of information (on bookings, on location data, etc.), while others are more technical, calculation related ones (such as the case of 0 capacity booking forecasts). In this project NRAs also had the possibility to compare the results of different decisions, such as equalization or clustering, while the effect of possible future developments (e.g. market merger) could also be observed through the different calculation scenarios for Serbia.

In this study we tried to collect all these experiences to make it available for other regulators in EnC CPs and Observer countries, and we highlighted the most important decision points, challenges and collected possible solutions. We hope this report will be a useful guidance for the implementation of the Tariff Network Code.

**ANNEX 1. EXCEL CALCULATION FOR SERBIA**

**ANNEX 2. EXCEL CALCULATION FOR UKRAINE**