

Transmission tariff calculation for Ukraine, using the Capacity Weighted Distance (CWD) reference price methodology

Energy Transparency Week

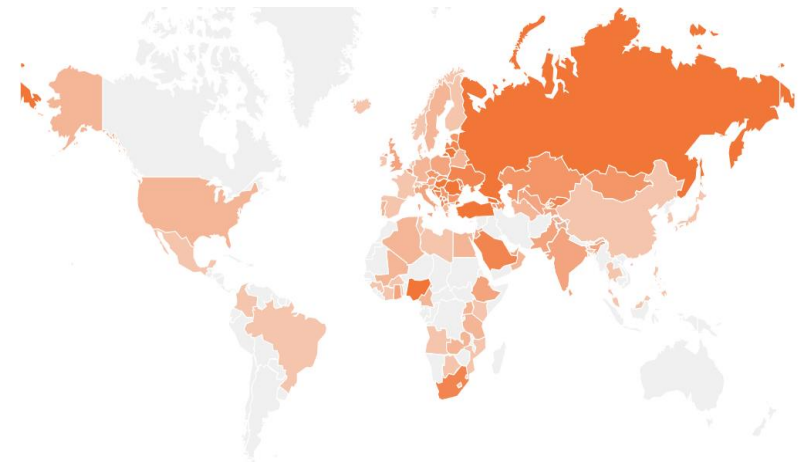
Kyiv

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- Introduction
- Reference price methodology in the TAR NC
- The Capacity Weighted Distance Reference price methodology
- Input related issues in case of Ukraine
- Calculation for Ukraine

- 20 full-time researchers
 - Electricity
 - Natural gas
 - District heating
 - Renewable energy
 - Water economics
- Applied research and consulting
 - Gas and electricity market modelling, Central Eastern European (CEE) focus
 - Market participants, regulators and TSOs in CEE region
 - Strong cooperation with European Commission
- Training activities
 - More than 2000 students enrolled to trainings facilitated by REKK and ERRA since 2004
 - Global coverage – besides Europe regulators and industry experts from Africa, Middle East and Central Asia
- Think Tank activities
 - Conferences and workshops with a CEE market focus



- The aim of the TAR NC is to oblige NRAs to set:
 - Cost-reflective
 - Non-discriminatory
 - Objective
 - Transparenttransmission tariffs.
- TAR NC would like to diminish distortive tariffs, that can lead to cross-subsidization between the different network users, or hinder cross-border trade.
- It also aims to facilitate transparency and predictability of tariffs, through publication and consultation requirements.
- The main goal is to the same as in case of other Network Codes: foster efficient market functioning.

- TAR NC sets the following definitions:
- „‘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”

- TAR NC does not set one particular Reference Price Methodology (RPM) to apply. It specifies the requirements for such methodologies: the aim and the possible adjustments within the RPM.
- But TAR NC requires a comparison of the resulting indicative reference prices to those derived from the clearly defined capacity weighted distance (‘CWD’) counterfactual.
- „Where the proposed reference price methodology is other than the capacity weighted distance reference price methodology, the latter should serve as a counterfactual for comparison with the proposed reference price methodology.”
 - CWD reference prices should be calculated anyway!
 - This is why calculation of reference prices are carried out using this methodology

- When calculating with CWD we assume that the share of the allowed revenue to be collected from each entry or exit point should be proportionate to its contribution to the cost it causes
- Cost drivers in this case are capacity and distance between a given entry point and all exit points or a given exit point and all entry points
 - Gas does not „stay” in the system, if it goes in, it should go out somewhere, and also the other way around
- The resulting tariff would be uniform per unit of capacity and distance („€/kWh/h/km”)
- However, tariffs are calculated in the measurement unit: €/kWh/h(/y)

- Inputs for the calculation:
 - the part of the transmission services revenue to be recovered from capacity-based transmission tariffs
 - the combinations of entry points and exit points, where some entry points and some exit points can be combined in a relevant flow scenario
 - where entry points and exit points can be combined in a relevant flow scenario, the shortest distance between an entry point or a cluster of entry points and an exit point or a cluster of exit points
 - 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
 - the entry-exit split shall be 50/50 (in case of the CWD counterfactual, but it can be modified for the chosen RPM)

- Steps of calculation:

- The capacity weighted average distance for each entry point (or each cluster of entry points) and for each exit point (or each cluster of exit points)

$$AD_{En} = \frac{\sum_{all\ Ex} CAP_{Ex} \times D_{En,Ex}}{\sum_{all\ Ex} CAP_{Ex}}$$

$$AD_{Ex} = \frac{\sum_{all\ En} CAP_{En} \times D_{En,Ex}}{\sum_{all\ En} CAP_{En}}$$

- The weight of cost for each entry point and for each exit point

$$W_{c,En} = \frac{CAP_{En} \times AD_{En}}{\sum_{all\ En} CAP_{En} \times AD_{En}}$$

$$W_{c,Ex} = \frac{CAP_{Ex} \times AD_{Ex}}{\sum_{all\ Ex} CAP_{Ex} \times AD_{Ex}}$$

- ▶ the part of the transmission services revenue to be recovered from capacity-based transmission tariffs at each entry point and for each exit point

$$R_{En} = W_{c,En} \times R_{\Sigma En}$$

$$R_{Ex} = W_{c,Ex} \times R_{\Sigma Ex}$$

- ▶ reference price at each point

$$T_{En} = \frac{R_{En}}{CAP_{En}}$$

$$T_{Ex} = \frac{R_{Ex}}{CAP_{Ex}}$$

- Unique solution is guaranteed, no optimization is needed
- ▶ that is not the case in some other reference price methodologies, presented in the Framework Guidelines earlier (e.g. Matrix or Virtual Point based)

- Which points should be clustered?
- How to calculate the distances between clusters and network points?
- How to translate all values into the appropriate measurement units?
- How to take into account the different lengths of different products when aggregating booked capacities?
- What to do with points where capacity booking data is not available, only flow data?
- How to forecast bookings (and/or flows)?

- Typical approach for clustering:
 - Domestic exit points
 - Production entry points
 - Storage entry points
 - Storage exit points
- IPs separately (but clustering is also possible, if e.g. there are more pipelines from the same country)
- For Ukraine:
 - Entry points/clusters: **PL-UA; HU-UA; SK-UA; RU-UA total; BY-UA total;**
Storage entry total Production entry total
 - Exit points/clusters: **UA-SK; UA-HU; UA-PL; UA-RO total; UA-MD total;**
Storage exit total Domestic exit (TSO+DSO)

- Two main approaches:
 - Calculating the distances from „the middle of the cluster”
 - (Capacity weighted) average of the distances in the cluster can be calculated from all other network points
 - (Capacity weighted) middle of the cluster can be found: geographical middle point can be located using longitude and latitude values of the points in the cluster. Distances then can be calculated between this „virtual middle point” and the other network points
 - Choosing a focal point in the cluster (e.g. production point with very high capacity), and calculate distances between this point and other network points

- More than 2000 network points, clustering is necessary
- Data was not received from the TSO, simplified approach was used:
 - Airline distances are used instead of pipeline distances (based on the map on Ukrtransgaz website)
 - If there is a Virtual IP, it is used as the focal point (RO)
 - If there are more border points with the same country but no VIP, geographical middle is used (RU, BY, MD)
 - Focal point is chosen for storage entry and exit cluster: Bilche-Volytsko-Uherske storage (very high capacity)
 - Focal point is chosen for production entry points: Poltava
 - For domestic exit cluster, the „middle of the country” is used (as there were no data on their locations).

Distance matrix

		Entry						
		PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
Exit	UA-SK	101	201	0	401	501	305	701
	UA-HU	102	0	301	402	502	205	702
	UA-PL	0	202	302	403	503	105	703
	UA-RO	103	203	303	404	504	601	704
	UA-MD	104	204	304	405	505	602	705
	Storage exit total	105	205	305	406	506	0	706
	Domestic exit (TSO+DSO)	50	50	50	50	50	50	50

MD-UA direction was not included in the calculation due to missing information

- Last year's booked capacity values are used as best estimate
- All bookings are translated to MWh/h/year:
 - For yearly booking simply conversion from original measurement unit
 - For shorter term products product length should be taken into account:
 - e.g.: 1000 MWh/h/month January monthly booking translates to $1000 \cdot (31/365)$
= 84.93 MWh/h/year
- Where only flow data is available, 100% usage of bookings is assumed, and flows are converted to capacity
 - e.g.: 8760 MWh/year flow is translated to $8760/8760 = 1$ MWh/h/year capacity

Calculation for Ukraine

$$AD_{En} = \frac{\sum_{all\ Ex} CAP_{Ex} \times D_{En,Ex}}{\sum_{all\ Ex} CAP_{Ex}}$$

$$AD_{Ex} = \frac{\sum_{all\ En} CAP_{En} \times D_{En,Ex}}{\sum_{all\ En} CAP_{En}}$$

Distance matrices		Exit						
		UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
Entry	PL-UA	101	102	0	103	104	105	50
	HU-UA	201	0	202	203	204	205	50
	SK-UA	0	301	302	303	304	305	50
	RU-UA total	401	402	403	404	405	406	50
	BY-UA total	501	502	503	504	505	506	50
	Storage entry total	305	205	105	601	602	0	50
	Production entry total	701	702	703	704	705	706	50
MWh/h/y								
CAP En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total	
	50 000.00	60 000.00	70 000.00	80 000.00	0.01	90 000.00	100 000.00	
CAP Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)	
	100000.00	90000.00	80000.00	70000.00	60000.00	50000.00	100000.00	
AD En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total	
	(\$22;\$22)	141.7455	201.7273	338.9091	420.7273	255.5273	584.3636	
AD Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)	
	326.0889	326.6222	322.7778	434.1111	435.1111	315.5111	50.0000	

RU-UA total	BY-UA total	Storage entry total
80 000.00	0.01	90 000.00
UA-RO	UA-MD	Storage exit total
70000.00	60000.00	50000.00

- If there is 0 booking forecasted for a given point, there are two options:
 - We can either leave out the point entirely from the calculation
 - We can include the point, with a marginal booking value (e.g. 0.01 MWh/h/year)

Calculation for Ukraine

$$W_{c,En} = \frac{CAP_{En} \times AD_{En}}{\sum_{all\ En} CAP_{En} \times AD_{En}}$$

$$W_{c,Ex} = \frac{CAP_{Ex} \times AD_{Ex}}{\sum_{all\ Ex} CAP_{Ex} \times AD_{Ex}}$$

MWh/h/y							
CAP En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	50 000.00	60 000.00	70 000.00	80 000.00	0.01	90 000.00	100 000.00
CAP Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	100000.00	90000.00	80000.00	70000.00	60000.00	50000.00	100000.00
AD En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	78.1455	141.7455	201.7273	338.9091	420.7273	255.5273	584.3636
AD Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	326.0889	326.6222	322.7778	434.1111	435.1111	315.5111	50.0000
Wc En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	\$(20;\$25;\$25)	0.0630	0.1045	0.2007	0.0000	0.1703	0.4326
Wc Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	0.1975	0.1781	0.1564	0.1841	0.1581	0.0956	0.0303

Calculation for Ukraine

$$R_{En} = W_{c,En} \times R_{\Sigma En}$$

$$R_{Ex} = W_{c,Ex} \times R_{\Sigma Ex}$$

Total Allowed Revenue	5 000 000 000
Entry Split	50
Exit Split	50
Entry	2 500 000 000
Exit	2 500 000 000
Distance matrices	
Entry	PL-UA
	HU-UA
	SK-UA
	RU-UA total
	BY-UA total
	Storage entry total
	Production entry total
MWh/h/y	
CAP En	PL-UA
	50 000.00
CAP Ex	UA-SK
	100000.00
AD En	PL-UA
	78.1455
AD Ex	UA-SK
	326.0889
Wc En	PL-UA
	0.0289
Wc Ex	UA-SK
	0.1975
R En	PL-UA
	=SC\$5*C30
R Ex	UA-SK
	493 783 458

Calculation for Ukraine

$$T_{En} = \frac{R_{En}}{CAP_{En}} \qquad T_{Ex} = \frac{R_{Ex}}{CAP_{Ex}}$$

MWh/h/y							
CAP En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	50 000.00	60 000.00	70 000.00	80 000.00	0.01	90 000.00	100 000.00
CAP Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	100000.00	90000.00	80000.00	70000.00	60000.00	50000.00	100000.00
AD En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	78.1455	141.7455	201.7273	338.9091	420.7273	255.5273	584.3636
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	0.0289	0.0630	0.1045	0.2007	0.0000	0.1703	0.4326
Wc Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	0.1975	0.1781	0.1564	0.1841	0.1581	0.0956	0.0303
R En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	72 314 339	157 402 305	261 344 493	501 792 196	78	425 628 270	1 081 518 318
R Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	493 783 458	445 131 957	391 015 659	460 150 051	395 322 885	238 882 975	75 713 014
EUR/kWh/h/y							
T En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total
	1.45	2.62	3.73	6.27	7.79	4.73	10.82
T Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)
	4.94	4.95	4.89	6.57	=(G37/G22)/1000	4.78	0.76

Thank you for your kind attention!

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- If the total expected income is not equal to the total allowed revenue, rescaling can be applied
- Tariffs can either be multiplied with a given number, or a certain value can be added to all tariffs
- Typical example: adjustment of storage tariffs
- At least 50% discount should be applied in storage entry and exit points
- After calculating the discounted values all tariffs should be rescaled
- Entry and exit rescaling factor should be calculated separately
- Tariff levels compared to each other are not distorted that way

Rescaling for Ukraine

After the adjustments of Storage tariff (-50%)									
EUR/kWh/h/y									
Original tariffs								Total revenue:	
T En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total	5 000 000 000	
	1.45	2.62	3.73	6.27	7.79	4.73	10.82	2 500 000 000	Entry
T Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)	2 500 000 000	Exit
	4.94	4.95	4.89	6.57	6.59	4.78	0.76		
Modified Tariffs								Total revenue:	
Storage discount	50%							4 667 744 377	
								2 287 185 865	Entry
T En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total	2 380 558 513	Exit
	1.45	2.62	3.73	6.27	7.79	2.36	10.82		
T Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)		
	4.94	4.95	4.89	6.57	6.59	2.39	0.76		
								Rescaling factor	
								1.0930	Entry
								1.0502	Exit
Rescaled Tariffs								Total revenue:	
T En	PL-UA	HU-UA	SK-UA	RU-UA total	BY-UA total	Storage entry total	Production entry total	5 000 000 000	
	1.58	2.87	4.08	6.86	8.51	2.58	11.82	2 500 000 000	Entry
T Ex	UA-SK	UA-HU	UA-PL	UA-RO	UA-MD	Storage exit total	Domestic exit (TSO+DSO)	2 500 000 000	Exit
	5.19	5.19	5.13	6.90	6.92	2.51	0.80		