THE PRECONDITIONS FOR MARKET INTEGRATION COMPATIBLE GAS TRANSMISSION TARIFFS IN THE CESEC REGION

A CESEC Discussion Paper

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Disclaimer: We strongly stress that the investigated tariff scenarios analysed in this paper are purely hypothetic and only for analytical purposes and thus the results cannot serve as a basis for tariff setting of TSOs, nor can substitute the regulatory scrutiny of justified costs whatsoever.

EXECUTIVE SUMMARY

Access tariffs to cross-border infrastructure are important features of the natural gas market integration "software". Distorted access tariffs can lead to the underutilization of both existing and newly built infrastructure.

This paper addresses the relationship between cross-border gas transmission tariffs (mostly entry-exit tariffs) and regional cross-border gas trading between CESEC countries.[1] First it identifies the present outlier (above average) tariffs in the region that are most likely to distort efficient cross-border trading. Next the paper offers potential explanations for tariffs being outliers. With market simulation tools[2] it assesses the impact of a number of tariff reform scenarios – each addressing outlier tariffs – on market integration, the utilization of existing and a selected set of priority new CESEC infrastructure and on regional social welfare.

The major results of the analyses presented in the paper are as follows.

1. The comparative analysis of (Entry/Exit) tariffs in the CESEC region has shown that

    - cross-border tariffs are on average lower in the Western part of the region and along former transit routes as compared to the South-East part of the region and to borders with newly built and moderately utilized infrastructure;
    - they include certain upward outliers which may be related to trade-restricting arrangements, preservation of market power, transit arrangements or are due to the cost effect of infrastructure new-build;

2. The modelling of alternative tariff reform scenarios for the CESEC region has shown the following:

    - the overall tariff-related market integration and welfare effects in either scenario are not very large;
    - welfare effects would have been significantly higher modelling with 2015 data but a conscious methodological decision was made to assess the current general low-gas-price context and thus have a conservative assessment;
    - additionally the welfare analysis considered existing routes and sources in the CESEC region thus there is upside with the opening of e.g. the Trans-Balkan corridor or access to LNG landed in Croatia;
    - the scenario to lower tariffs across the board to marginal cost results in lower regional gas procurement costs due to almost doubling spot flows leading to the most significant consumer surplus increase across the scenarios; while resulting TSO and LTC-holder revenue losses are similar, those welfare effects are arguably not comparable 1:1; this scenario highlights the outstanding importance of moderate cross-border tariffs on key interconnectors providing spot gas to this LTC-gas dominated region for gas wholesale competition;
    - the scenario to harmonise regional tariffs to the average will impact trade and sourcing costs for the region very negatively;

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[1] See CESEC Action Plan (point D.1).

[2] REKK's European Gas Market Model (EGMM) is employed for this purpose.

- targeted scenarios to adjust outlier tariffs downward could trigger additional flows resulting in general welfare improvements.

3. The modelling of alternative tariff scenarios for a selected set of priority new CESEC infrastructure has shown that

    - proposed regasification tariffs and existing cross-border tariffs to Hungary prohibits gas from a new LNG regasification terminal in Croatia to flow out of the country; only significantly reduced regas and cross-border tariffs can help Croatian LNG to have a region-wide market impact;

    - the implementation of the GR-BG interconnector (or reverse flow), the BG-RO-HU corridor and the BG-RS interconnector at normal tariffs can double the utilization of Greek LNG, Bulgaria and Serbia being the largest beneficiaries; after the implementation of TAP, pipeline gas will compete with Greek LNG in the region.

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1. BACKGROUND

The market integration that the EU aspires to achieve requires compatible regulation between neighbouring countries with regard to interconnector access. Specifically, capacity allocation, congestion management and access tariffs to cross-border infrastructure are important features of the natural gas market integration “software”. Even if a critical infrastructure project is built and commissioned, its contribution to market integration can be obstructed by misguided regulatory policy. In some instances, regulatory distortions lead directly to the underutilization of particular new infrastructures.

This paper addresses the relationship between cross-border gas transmission tariffs (mostly entry-exit tariffs) and regional cross-border gas trading between CESEC[3] countries. It will identify the present outlier (above average) tariffs in the region (see Figure 4 below) and distinguish them based on past analyses and anecdotic evidence. Then it will assess the impact of a number of tariff reform scenarios by removing identified distortions caused by the outlier tariffs with market simulation tools.

The primary function of national gas transmission tariff systems is to provide sufficient revenue for the national TSOs to cover their justified costs. In the region it is the sole responsibility of national institutions (primarily National Regulatory Authorities) to determine gas transmission tariffs, including tariffs for interconnection access. The third package obliged EU member states to apply entry/exit (E/E) transmission tariffs according to principles laid out in Article 13 of the Gas Regulation[4], but this did not specify the exact methodology of allocating justified costs between intra-country and cross-border exit/entry points. Thus Member State NRAs have nearly a free hand in determining the actual tariff levels and structures according to their preferred methodology.

However, beyond TSO cost recovery, the significance of gas transmission tariffs for regional market integration and cross border trade is obvious.

Let’s consider the case of two neighbouring gas markets, A and B, where A is cheaper than B and both have an E/E tariff regime. While the wholesale gas price difference serves as the fundamental driver for cross border trade, this trade incentive is reduced by the sum of the exit tariff from market A plus the entry tariff to market B that the gas traders will have to pay at the border. Trade incentives might be further reduced by congestion on interconnectors (a rare phenomenon in the CESEC region).

The structure of the discussion paper is as follows. Section 2 provides for a detailed review of cross-border gas transmission tariff characteristics for the CESEC region based on the most recent available data. Tariff levels, structures and outliers are elaborated. Section 3 concerns the typology of outlier tariffs and includes a discussion of the circumstances that might explain them. Section 4 first outlines four major hypothetical cross-border tariff reform scenarios, each of them addressing the issue of outlier tariffs. In section 5, REKK’s European Gas Market Model (EGMM) is employed to simulate the likely impacts of those hypothetic

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[3] The CESEC region includes altogether 14 countries, hereafter referred to with the following country codes: Austria (AT), Bosnia and Herzegovina (BA), Bulgaria (BG), Greece (GR), Croatia (HR), Hungary (HU), Italy (IT), FYROM Macedonia (MK), Moldova (MD), Romania (RO), Serbia (RS), Slovenia (SI), Slovakia (SK), Ukraine (UA)

[4] 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

tariff reform scenarios, compared to a reference case of wholesale gas prices, social welfare, the level of gas trading activity (gas flows), the utilization level of infrastructures and TSO revenues from entry-exit tariffs around the region. In particular, we are interested in potential Pareto-improvements, when e.g. a decrease of a particular cross-border tariff might increase trading activity and welfare so that potential losers from the change can be compensated to the level before the change and overall gains still remain positive. Results are presented by:

- The use of the Regional Cost Convergence Index (RCCI), which shows the relative additional cost of the gas bill of the region compared to Western-European markets.[5]
- The change in utilisation in the region's interconnectors.
- Welfare change in the Region's countries presented by countries and stakeholders.

[5] For a detailed description of RCCI, see Section 5.1.

2. REVIEW OF CURRENT GAS TRANSMISSION TARIFF CHARACTERISTICS IN THE CESEC REGION

Gas transmission tariff systems vary from country to country regarding the tariff structure (see Table 1), types of capacity products, measurement units as well as the reference gas conditions in the CESEC region.[6]

Table 1. Gas transmission tariff systems in CESEC countries and the average share of the commodity component in total tariff payments (considering all entry and exit points)

	Tariff system		Average share of commodity component in total tariff (at 56.2% Load Factor)***
	Type of tariff system	Application of capacity and commodity elements****	
Austria	entry-exit	only capacity	0%
Bosnia and Herzegovina	postage stamp	only commodity	100%
Bulgaria	postage stamp	only commodity	100%
Croatia	entry-exit	commodity part at exit points	4%
Greece	entry-exit	commodity part at entry points**	14%
Hungary	entry-exit	commodity part at exit points	12%
Italy	entry-exit	commodity part at entry points	20%
Macedonia	postage stamp	only commodity	100%
Moldova	postage stamp	only commodity	100%
Romania	entry-exit	commodity part at exit points	22%
Serbia*	entry-exit	commodity part at exit points	22%
Slovakia	entry-exit	only capacity	0%
Slovenia	entry-exit	metering cost at entry and exit, other commodity component at exit	17%
Ukraine*	entry-exit	only commodity	100%

Notes:

In those countries, where the payable fee includes a commodity component, it is charged at the exit points (except for Italy and Greece).

The percentage share of the commodity element shown in the table was determined by summing up the fees (entry, exit and commodity) payable for transporting 1 MWh of gas at all entry and exit points in the given country, and dividing the commodity portion by this amount.

** introduced in 2015*

*** only entry points, not including exit point*

**** based on Acer Market Monitoring Report 2015, pp. 251-252.*

***** capacity component refers to tariff elements with a capacity type measurment unit (e.g. EUR/MWh/h), commodity component refers to tariff elements with a commodity type measurement unit (e.g. EUR/MWh)*

[6] Primary gas transmission tariff information for this analysis was collected from the web pages of the national TSOs and NRAs. When entry/exit point prices are the outcome of an auction, reserve prices were applied as a proxy. Technical data on gas characteristics were collected from the web pages of TSOs and the ENTSOG. The source of exchange rate information is the European Central Bank for EU Member States and National Bank homepages for the countries outside the EU.

In order to make baseline comparisons, transmission fees were estimated as a standardized transportation service for each relevant cross-border point and expressed in a common measurement unit (€/MWh) (see Reference scenario in Table 11 in Annex 2 for the estimated transmission fees). The assumed standard transportation service has the following characteristics:

- The duration of transmission contracts is one year
- Contracts refer to firm transportation services
- The booked maximum hourly capacity is 10 000 kWh (/h/y)[7]
- Applied load factor is 56.2%[8]
- Tariff are expressed in €/MWh

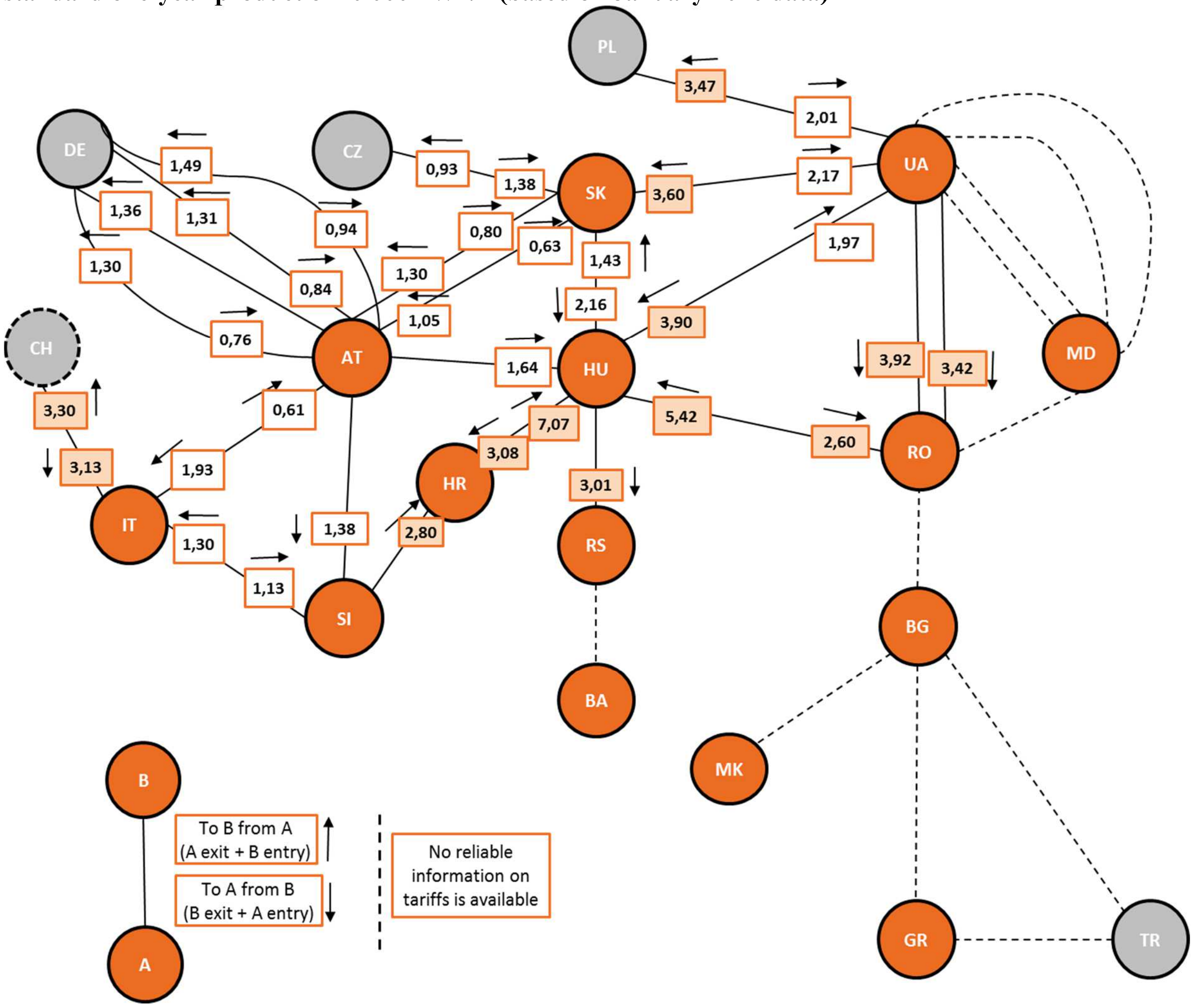
Using our assumed capacity reservation level of 10 000 kWh/h and load factor (56.2%) for the yearly firm transmission service contract, we calculated the overall transportation fee (in €) that would be incurred by a shipper at each interconnection point (IP), making all the necessary conversions regarding gas reference conditions and currency units. Once we have arrived at the total fee corresponding to the standardized service, tariffs can be determined on a per MWh basis, dividing total payments by the yearly transported volume (€/MWh). Where entry and exit tariffs apply, the fee consists of the relevant exit plus entry fees due at the two sides of the border (including the commodity fee at the relevant point).

Figure 1 illustrates the interconnections between the analysed countries and presents the value of estimated total (exit + entry) transmission fees referring to gas flows in both directions. The coloured value boxes mark higher than average tariffs, while the arrows indicate the related flow directions. It is apparent from the figure that tariffs are generally lower in the Western part of the CESEC region and along major former transit routes (e.g. SK-AT-IT; SK-CZ). Countries with a single supply route tend to have higher tariff rates (e.g. RS). Some well-connected countries can also be characterized with high tariff rates (e.g. UA, HU or RO) due to the pricing of new infrastructure, protectionist measures or other reasons (see Section 3 for a discussion on the possible reasons for outlier tariffs).

[7] Capacity size was chosen based on interviews with gas industry market participants.

[8] Load factor is calculated as: (Average flow)/(Average booked capacity). Average booked capacity utilization in Europe is reported in the Acer Market Monitoring Report 2015, pp. 251-252.

Figure 1. Tariffs at interconnection points between CESEC and neighbouring countries, €/MWh for a standard one-year product of 10 000 kWh/h (based on January 2016 data)[9]



Source: REKK

It is also worth looking at total tariffs decomposed to exit and entry tariffs by borders. Figure 2 presents the exit and entry tariffs for all the interconnectors of the CESEC countries.[10] The horizontal lines indicate the mean and median values of exit and entry tariffs in the charts (mean values are 1.33 and 0.92 EUR/MWh, medians are 0.90 and 0.80 EUR/MWh respectively)[11]. Countries with exit tariff levels above the mean are Croatia, Hungary, Romania and Ukraine. Austria and Slovakia are above the median, but under the mean values. Higher than average entry tariffs apply for some of the IPs of Croatia, Hungary, Romania,

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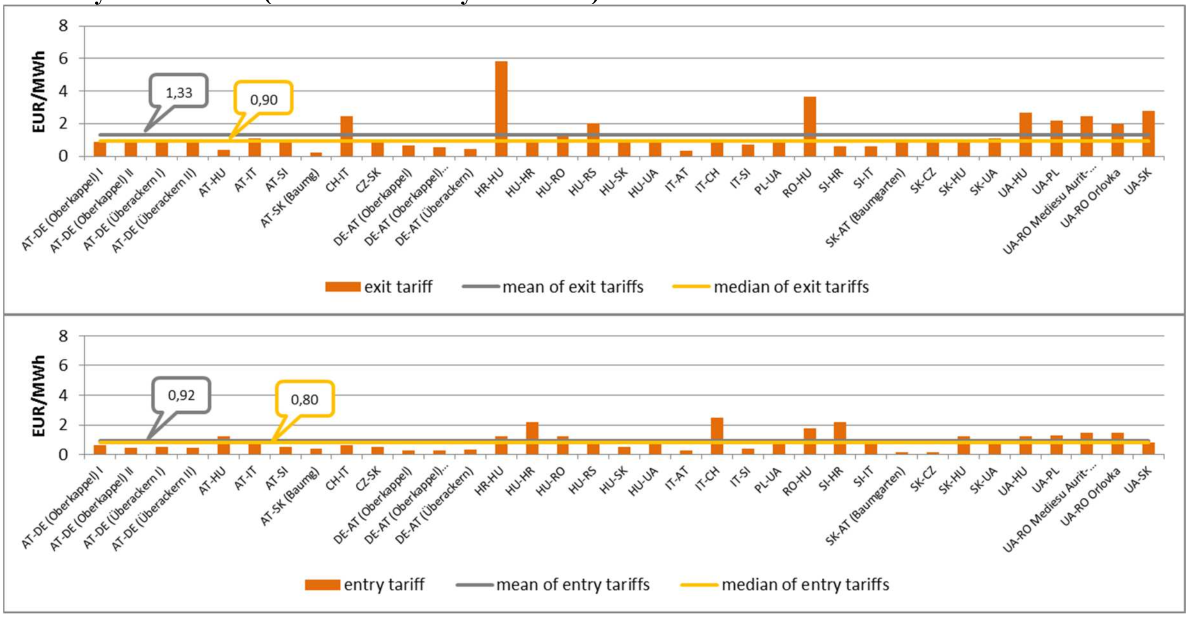
[9] More recently Ukrainian exit and entry tariffs have been increased significantly (see Annex 1. Tariffs at interconnection points with updated ukrainian entry-exit fees). Exit fee modifications have relevance for Ukraine and Russia but not much for the present analysis. However, increased entry fees to Ukraine could likely decrease natural gas flows to Ukraine compared to figures indicated in Tables 20 and 21.

[10] In case of some borders (BG-GR; BG-MK; BG-TR, RO-BG; RS-BA; TR-GR, UA-MD) no reliable information was available on tariffs, and third party access is not always possible, thus we did not include these borders in the later analysis. Some other borders are not included, because according to ENTSOG and TSO websites no capacity is available in the given directions (HU-AT, RS-HU, HR-SI, SI-AT).

[11] Mean exit and entry tariffs would be at 1.52 and 1.1 while the median exit and entry tariffs at 0.92 and 1.06 EUR/MWh without the cross border tariffs between the CESEC region vis-à-vis the Czech Republic and Germany.

Serbia and Ukraine. The entry tariff in Italy is higher than the median value but under the mean. As can be seen from the two graphs, exit tariffs are generally higher than entry tariffs. This can be partly explained by the fact that commodity charges are in most cases applied at the exit points (except in Italy and Greece, where it is applied at the entry points). The combinations of outlier exit and entry tariffs will serve as the basis for a potential typology of outlier cross-border transmission fees in the next section of the paper.

Figure 2. Level of exit and entry tariffs in the CESEC region, compared to the mean and median across the analysed countries (based on January 2016 data)*



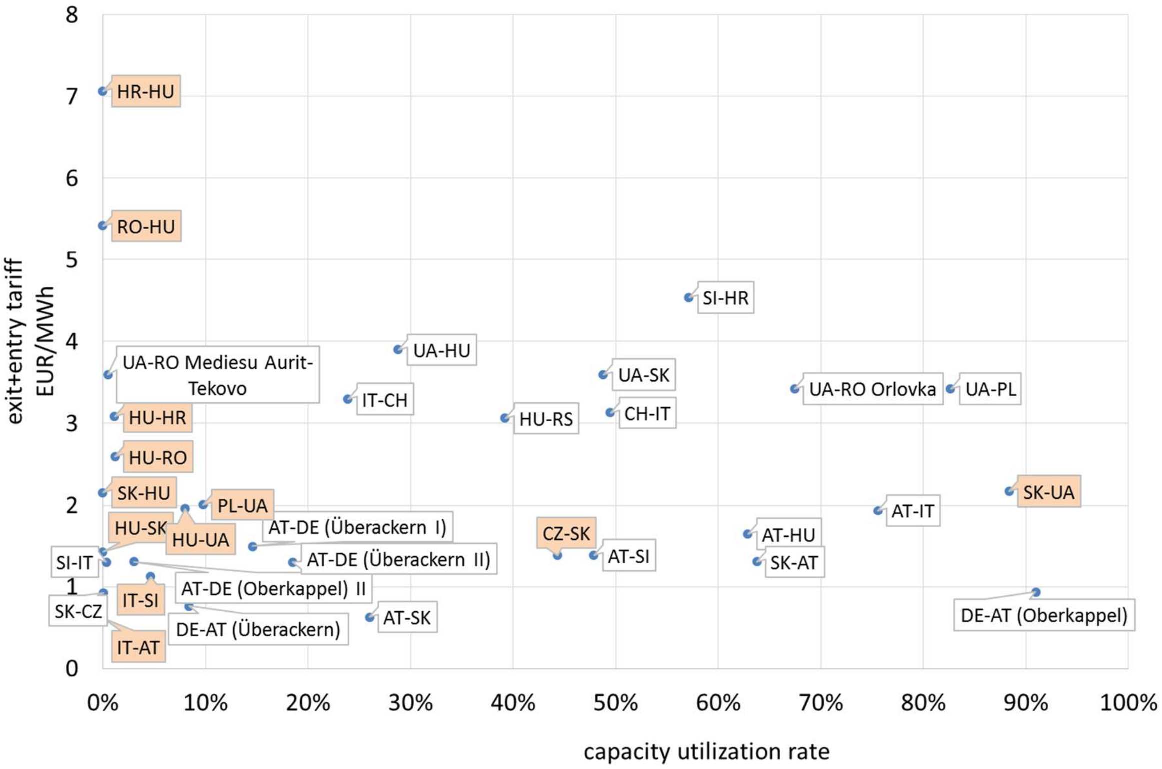
** Note: Since, according to ACER, the average load factor of booked gas transmission capacities decreased from 79% in 2013 to 56.2% in 2015 in Europe, we tested the sensitivity of estimated transmission tariffs to this remarkable change in the load factor. We can only report on a notable 45% increase of Croatian exit tariffs from 2014 to 2015 by assuming a uniform 79% load factor for the period 2013-2015.*

Source: REKK

Figure 3 explores the possible relationship between infrastructure utilisation rates and level of tariffs payable at the IPs in the region. According to the plotted values, lower utilization rates cannot generally be associated with higher tariff rates. One striking result is the underutilization of a large share of the interconnectors: almost half of the observed infrastructure – 15 out of the analysed 33 pipelines – had a utilization rate below 10% in 2015, especially cross-border capacities (and reverse flow possibilities) built and implemented after 2009 (coloured IPs). Only one of the newly realized cross-border capacities has a high utilisation rate (SK-UA). Although most of the highly utilised infrastructures are priced below the average (2.24 €/MWh), there are many exceptions, such as the HU-RS, SI-HR, UA-SK, UA-RO (Orlovka) and UA-PL interconnectors, for which transit fees are determined.

Although there is no significant correlation between tariff levels and utilisation rates, there are many pipelines with high tariffs and rather low utilisation rates (HR-HU, RO-HU, UA-RO, HU-HR, HU-RO) and most of them are newly built infrastructure. However, many of these lines were built to improve supply security which does not ensure high utilization rates under normal market conditions and thus also poses a challenge for tariff setting.

Figure 3. Relationship between tariff levels and capacity utilization, 2015



Source: REKK, ENTSOG and IEA. Only those interconnectors are included for which reliable information was accessible.

Utilization data retrieved from the IEA[12] and ENTSOG[13] showed somewhat higher utilization rates of for the newly implemented infrastructure in 2014, but at only by 1-2% relatively insignificant.

[12] www.iea.org/gtf/
[13] https://transparency.entsog.eu/

3. THE PROBLEM: POTENTIALLY DISTORTIVE ENTRY EXIT-TARIFFS IN THE CESEC REGION

This section identifies those cross-border gas transmission tariffs that may hinder gas market integration in the CESEC region and offers possible explanations for such outlier tariffs. Typology is based on results from past analyses and anecdotic evidence. A basic assumption of the present analysis is that while NRAs assess the overall justified costs of national transmission systems fairly (to be collected through entry-exit tariffs), the allocation of costs among internal and cross-border entry-exit points might sometimes be distortive for various reasons.

Table 11 in Appendix 1 shows 2016 entry, exit and total tariffs for all relevant CESEC cross-border gas shipping directions. There are 8 cases, in addition to all connection points when gas enters neighbouring markets from Ukraine, where the total tariff crossing national borders is above the regional mean value of 2.24 €/MWh. In addition, there are 5 cases when entry tariffs are above the mean value of 0.92 €/MWh but total tariffs remain below average. The remainder of the paper focuses on the analysis of these outliers.

The first of the following pair of cross tables includes those cases with above-average total (exit + entry) cross border transmission tariffs (bold letters) as well as above average entry tariff cases with below average total tariffs (italic letters). The accompanying cross-table provides the possible explanation behind the outlier E/E tariff combinations.

Table 2. Above-average cross border total transmission tariff cases (bold letters) and outlier entry tariffs (*italic letters*) in the CESEC region (left, January 2016 data) and potential underlying explanations (right)

		EXIT	
		Low	High
ENTRY	Low	No problem	**CH-IT; UA-SK**
	High	*AT-HU; HU-UA; PL-UA;SK-HU; SK-UA;* **HU-HR; IT-CH; SI-HR;**	**HR-HU; HU-RO; HU-RS; RO-HU; UA-HU; UA-PL; UA-RO**

		EXIT	
		Low	High
ENTRY	Low	No problem	(a) Low cost country export limitation; (b) former transit fee translated into high exit fee; (c) single route dependence
	High	(d) Market protection of incumbent supplier	(e) New built regulatory trap; and/or combination of cases (a)-(d)

3.1. HIGH EXIT TARIFFS

Higher than *average* exit tariffs might reflect different underlying regulatory "stories".

a. **Low-cost production country export limitation.** Cross-border E/E tariffs can be used in a strategic manner to discourage the export of low-cost gas. Low-cost gas comes mainly from domestic production in the CESEC region (mostly Romania, Croatia and Hungary). Despite the commercial interest of gas extracting companies, government policies might prefer to channel low-cost gas to supply household retail customers or local industry, mostly at regulated (cost-based) prices and limit export opportunities. This might be a particularly attractive policy option if the company involved in gas production is foreign owned. The simplest option to limit the export of domestically produced gas is strategic underinvestment into interconnection infrastructure. This might take the form of postponing the investment decision of an interconnector or resisting reverse flow implementation for an existing one. Once the physical infrastructure is in place, the remaining option to limit natural gas exports in a "market-conforming" manner is to set a prohibitive exit tariff from the country in question. This could make gas export unprofitable and thus unlikely on a purely commercial basis. The sign of this phenomenon is reflected in an outstanding high exit tariff.

- Exit tariffs from Croatia to Hungary and Slovenia and from Romania to Hungary are well above average. After the completion of the Hungary-Romania interconnector in 2010, the Romanian TSO had been reluctant to invest in reverse flow from Romania to Hungary for years. Hungary was against the reverse flow exemption, claiming that in a supply disruption situation Hungary could use Romanian sources (storage or own production). The Commission was involved in the negotiations and a minor reverse flow capacity (5% of the total capacity) was inaugurated in 2013. Since then, exit tariffs from Romania were set at a prohibitive level (2013: 2.25 €/MWh; 2014: 4.42 €/MWh; since then 3.67 €/MWh). Croatia has also been reluctant to implement reverse flow at the Croatian-Hungarian border. The exit tariff from Croatia to both Hungary and Slovenia is 5.8 €/MWh, the highest among CESEC countries.

b. **Transit contract (non-EU) and legacy transit contract (EU) costs translated into high exit fees.** The Third Package obliged EU member states to replace their former gas transmission tariff schemes (mostly distance-related or post stamp) with the Entry/Exit tariff scheme. Part of the rationale for this change was to eliminate gas transit within the EU internal gas market. Nevertheless, the duration of legacy gas transit contracts do not necessarily respect this regulatory change. Ukraine, Turkey and Switzerland still transit natural gas to EU Member States while other EU Member States (e.g. Bulgaria, Hungary or Romania) still "transit" Russian gas through their territories to non-EU countries. In certain cases and directions, we might suspect legacy transit costs to be translated into the E/E tariffs in the form of higher exit fees in order to collect certain pre-determined revenues from given trading partners by affected national TSOs.
   - All above average exit tariffs from Ukraine are suspect cases in this regard.
   - The highest exit fee from Hungary is towards Serbia (2 €/MWh). The case is very sensitive given that total gas quantities for Serbia and Bosnia and Herzegovina are imported through this point. Note that the entry fee from Hungary to Serbia is also slightly above average.

c. **Single route dependence.** There are four countries in the CESEC group with a single gas transmission entry point to their internal systems: Bosnia and Herzegovina, FYR of Macedonia, Moldova and Serbia. The lack of route diversification makes these markets vulnerable not just to the market power by their gas supplier(s) but also to the market power of their transmission provider. This market power might be reflected in high exit tariffs to these markets.
   - The transmission tariff from Hungary to Serbia is clearly an outlier. Although we regarded our information on transmission tariffs for the remaining three countries as uncertain, we have to note that all three cross-border tariffs to

these countries (from Serbia to Bosnia and Herzegovina, from Bulgaria to FYR of Macedonia and from Romania to Moldova) seem to be well above average. However, this is due to higher than average *entry* tariffs in case of Moldova and FYR of Macedonia and high exit *and* entry tariffs to Bosnia and Herzegovina.

3.2. HIGH ENTRY TARIFFS

We discuss two possible underlying "stories" for higher-than-average entry tariffs. One of them is the *new-built regulatory trap* discussed below. According to this hypothesis, a high general cost level of a significantly expanded national transmission system might call for both high exit and entry fees to recover high CAPEX costs. The second story is the following:

d. **Market protection for the incumbent wholesaler.** High entry fees to a gas market favour, ceteris paribus, the incumbent gas wholesaler / supplier of that market by reducing the competitiveness of alternative gas suppliers to that particular market. This case can only be relevant for markets where the incumbent gas wholesaler is in a potentially contestable situation.
    - Cross-border entry tariffs to Croatia and Hungary as well as from Hungary to Serbia are higher than average. Market protection of local incumbent wholesalers might be an issue for all dominant local wholesalers. For Hungary, the new built trap is a potential alternative hypothesis to explain over-average entry tariffs from several directions.

3.3. HIGH ENTRY AND EXIT TARIFFS

The combination of high entry and exit tariffs can reflect the combination of the explanations under points (a)-(d) or be explained by an alternative hypothesis.

e. **The "new-built regulatory trap" (NBRT)**. The 2009 January gas crisis made it clear that a major gas infrastructure upgrade was needed to improve gas supply security and market integration in Central and South East Europe. However, there has been a stark difference in the intensity of cross border gas infrastructure investments among CESEC countries as well as in the level of EU support provided for these efforts since the crisis. Due to the standard transmission tariff regulatory practice for new gas infrastructure with free third party access, the capital cost of new infrastructure enters the cost base of national E/E transmission tariffs mainly through increased depreciation and regulatory asset base. This implies a significant increase in national E/E tariffs as a result of a prudent regulatory practice. Since new interconnectors often create alternative shipment routes for diversification purposes, they immediately become competitive with existing infrastructure for hosting gas flows. However, relatively high tariffs would discourage gas flows away from routes, including new infrastructure components, and lower the probability of recovering the relatively high CAPEX of new infrastructure. Reduced flows due to high relative E/E tariffs put further upward pressure on tariffs that further reduces the competitiveness of new infrastructures. We call this process the "new-built regulatory trap". This will be marked by the generally high relative tariff level of a particular national system. Based on the data in Table 2, Hungary fits into this definition of a new-built regulatory trap. Indeed, all entry tariffs to Hungary are outliers and the Romanian and Serbian exit tariffs are above average. There will be a brief discussion of alternatives responses to the NBRT.

4. DEVELOPMENT OF GAS TRANSMISSION TARIFF REFORM SCENARIOS

In this and forthcoming sections we use the European Gas Market Model (EGMM), developed by REKK, to investigate the likely impact of tariff reform scenarios for the CESEC that eliminate distortive effects of the most egregious outliers. Market and welfare impacts of these scenarios are then compared to the CESEC reference. It is important to note that the Ukrainian transit system charges, the Trans Balkan pipeline and the entry charges for neighbouring countries from the Ukrainian system remained unchanged in the course of the analysis. The reason for that is the existing legal constraint that prohibits any use of the Trans Balkan pipeline by third parties, where only long term contracted gas is shipped.

We strongly stress that the investigated tariff scenarios are purely hypothetic and only for analytical purposes and thus the results cannot serve as a basis for tariff setting or substitute for the regulatory scrutiny of justified costs whatsoever.

The EGMM covers the gas markets of 35 European countries. A detailed description of the model is provided in Annex 4. For this exercise, the model was calibrated to reflect recent (Q1 2016) price and flow patterns.[14] The input data sources used for modelling is summarized in Table 17, Annex 4. Modelled yearly wholesale gas prices of the 2016 reference (in €/MWh) are listed in Table 18, Annex 5. The model assigns transportation tariffs to cross-border interconnection points, where shippers have to pay the sum of the exit rate of the departure country and the entry rate of the country which the gas enters, plus any commodity component due either at the exit or entry points (or, in some cases, both).

To assess the effect of transmission tariff adjustments in the region, we carried out scenario analyses by keeping all model input parameters at the reference level except for the tariffs on gas interconnectors. While we expect only moderate changes in total annual social welfare of the modelled 14 CESEC countries from transmission tariff changes, modelling results reveal the direction, the beneficiaries and those negatively impacted by the change from moving away from distortive tariffs.

Based on the tariff benchmark carried out in Section 3 of this paper the idea was to create a limited number of scenarios to analyse the effect of tariff change on the wholesale gas prices of the CESEC region and on the utilization of existing pipelines.

The following tariff reform scenarios are assessed:

UNIFORM TARIFFS ADJUSTMENTS

a. Reduction of each pair of E/E tariffs to the assumed marginal cost of operating the interconnectors (0.13 €/MWh) at CESEC borders without compensating the tariff decrease in any other way for TSOs. This way total transmission tariff on each border is **0.26 €/MWh**. CESEC and non-CESEC interconnector tariff is changed only on the CESEC side of the pipeline.[15]

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[14] The modelling was carried out in March 2016. Modelled flows were verified with the 2015 actual flows reported by Eurostat, IEA and ENTSOG transparency platform. About 90% of total modelled European flows are close to 2015 data reported by Eurostat, ENTSOG and IEA on 70% of interconnectors. Price levels were calibrated to reflect 2016 Q1 TTF and oil indexed gas prices.

[15] Eg.a Germany-Austria interconnector tariff is adjusted at the Austrian entry side but not on the German exit side, since Germany is not a CESEC country.

b. We set a uniform cross border tariff based on the weighted average of entry tariffs and weighted average of exit tariffs by 2015 observed cross-border flows. Note that weighted average tariffs this way are not identical with average tariffs. Uniform entry tariffs are set to 0.77 €/MWh, exit tariffs to 1.67 €/MWh. Total transmission tariff on each border (except for the Ukrainian borders and the Trans-Balkan corridor) is set to **2.44 €/MWh**.

SELECTIVE TARIFF ADJUSTMENTS

c. Investigation of the effects of gradually decreasing tariffs on outliers and their impact on welfare and market outcomes. The tariff level of outliers was decreased one-by one by 25-50% ceteris paribus.
d. Smoothing of outliers: reduction of outlier tariffs to the average level (without compensation). All entry tariffs above the average entry level were reduced to 0.92 €/MWh and all exit tariffs above the average exit level were set to the average 1.33 €/MWh at the same time. Tariffs under the average remained on their current level.

Despite significant efforts by BULGARTRANSGAZ and DESFA, under the auspices of the European Commission, to conclude an Interconnection Agreement and additional efforts to make reverse flow from Greece to Bulgaria possible, the lack of third party access and limited transparency are still major features of the Trans-Balkan corridor. Consequently, tariff adjustment was not analysed for related interconnectors as well as for the pipelines exiting Ukraine for similar reasons. On these interconnectors, tariffs were not modified in any of the scenarios.

Since we choose not to compensate the TSO for the possible revenue reduction due to tariff decrease, we expect other stakeholders in the gas market to realise some gains in welfare compared to the reference. Our underlying idea is that within the modelled country boundaries, welfare redistribution is possible among stakeholders. For instance, a reduction in tariffs may hurt the TSO on total revenue basis, but may result in a general price reduction and increased consumer welfare. Theoretically, this welfare increase may finance the lost TSO revenues by a simple change of tariffs on the exit to distribution system. We are interested in how the change in regional social welfare, due to increased trade and price changes, compares to the change in aggregate TSO revenues.

5. MODELLING RESULTS

5.1. NON-WELFARE RELATED FINDINGS

5.1.1. *Change in RCC Index (RCCI)*

In this section we give a quick overview of the changes compared to the reference case in market integration indicators other than social welfare. We use the RCCI (Regional Cost Convergence Index) as an indicator of the region's cost (and thus indirectly price-) convergence to Western-European markets.[16] The RCCI is formally calculated as:

$$RCCI = \frac{\sum p_i \cdot q_i}{p_{spot} \cdot Q} - 1$$

Where

i is an index of CESEC countries

p_i is the average annual wholesale gas price in country i in €/MWh

q_i is the annual average gas consumption in TWh

p_{spot} is the average annual wholesale gas price in the TTF in €/MWh

Q is the total gas consumption of the CESEC region in TWh

Table 3. Value of RCCI and consumer surplus in the modelling scenarios

Scenario name	Code	RCCI	Change in RCCI (percentage points)	Absolute change in consumer surplus (M€)
	ref	22.16%		
Cut to 0.13	a	15.09%	-7.07%	550.0
Change to weighted average	b	25.59%	3.43%	-255.3
RO-HU 25% reduction	c1	22.29%	0.14%	-21.4
RO-HU 50% reduction	c2	22.32%	0.16%	-23.9
HR-HU 25% reduction	c5	22.16%	0.00%	0.0
HR-HU 50% reduction	c6	22.16%	0.00%	0.0
HU-RS 25% reduction	c9	22.13%	-0.03%	6.9
HU-RS 50% reduction	c10	22.09%	-0.07%	15.0
SK-HU 25% reduction	c13	22.07%	-0.09%	14.2
SK-HU 50% reduction	c14	21.96%	-0.20%	35.7
HU-HR 25% reduction	c17	22.20%	0.04%	-7.8
HU-HR 50% reduction	c18	22.11%	-0.05%	9.4
Cut outliers to average	d	21.87%	-0.28%	45.2

Source: REKK modelling

[16] The RCC Index was introduced by Kaderják et al (2015), *Natural Gas Market Integration int he Danube Region: the role of infrastructure development*, in: Competition and Regulation 2015, Institute of Economics, MTA, Budapest, pp. 239-65.

The indicator shows the additional cost of the total gas bill which the CESEC region pays compared with procuring all gas demand at the spot price (in our case the TTF). Consumer welfare change results from the modelling underpin these findings. In the reference case, the CESEC region pays an extra of 22.16% due to existing long term contract constraints and infrastructure bottlenecks. In scenario “a”, the region’s tariffs are set at the minimum level allowing for more spot gas flows. This includes a reduction in the DE-AT tariff (considering the AT entry), which allows for more flows on the interconnector (utilisation spiked from 71% to 92%). Consequently, increased trade from Western-Europe to Eastern Europe drives a price convergence – a reduction in CESEC regional prices and an increase in TTF price compared to the reference. In this scenario the RCCI index declined by 7%. We must stress that in all cases we assumed that the price of long-term contracted gas at the border of the importer country is unchanged, so all effects on the RCCI index are stemming from changes in spot gas flows.[17]

In scenario “b”, a price increase happened on some pipelines connecting the region to the Western-European markets. Consequently, availability of cheaper spot gas was limited by the tariffs and the RCCI index increased to 25.59%.

The set of “c” scenarios considers price changes on targeted individual interconnectors within the region, hence the aggregate effect of these scenarios is expected to be negligible.

When tariffs at the RO-HU interconnector are reduced, the overall gas bill of the region becomes somewhat higher than in the reference case. The reason for this is the fact that Romanian domestic production is priced below TTF. Allowing this gas to reach neighbouring markets decreases the price in Hungary and Serbia but does not compensate for the increase in gas price in Romania. This explains the slightly higher RCCI relative to the reference.

Tariff adjustment at the HU-RS interconnector gives negligible but positive results. Increased spot gas flows on the interconnector allow for lower prices in Serbia and Bosnia. Unfortunately, the relatively low consumption of these two countries compared to the whole region’s gas usage makes the effects inconsequential.

Tariff adjustment on the HU-HR interconnector provides differing results. At 25% reduction, the gas price in Croatia is lower than in the reference, but this means that some spot flows originally delivered to the other Balkans countries are “re-routed” to Croatia, so for instance Bosnia and Serbia experience somewhat higher prices than in the reference. The price drop in Croatia does not balance out the price hike in the other countries, leading to a higher RCCI. In the 50% price reduction case, Croatian price decrease is stronger and can compensate for the other countries’ price increase, hence the lower RCCI. Still, the outcomes are to be considered close to zero.

In scenario “d” outlier tariffs are cut back to the average level. This outcome is still rather insignificant since no interconnectors to the Western markets are affected.

Although on regional level most results are negligible, on country level these changes can be considerable. In this case, we provide a simple country average annual price over TTF gas price figure. Formal representation of the index is as:

$$CCCI = \frac{p_i \cdot q_i}{p_{spot} \cdot q_i} - 1$$

[17] This assumption is based on the paper of Simon Pirani and Katja Yafimava (2016): Russian Gas Transit Across Ukraine Post-2019: pipeline scenarios, gas flow consequences, and regulatory constraints. OIES PAPER: NG 105

Where

i is an index of CESEC countries

p_i is the average annual wholesale gas price in country i in €/MWh

q_i is the annual average gas consumption in TWh

p_{spot} is the average annual wholesale gas price in the TTF in €/MWh

Calculation of the RCCI on the country level reveals the large difference in the position of certain CESEC countries. Consumers in more isolated countries (BA, BG, MK, MD, RS) pay high above the TTF and the most radical tariff cut scenario “a” would change the overall picture. However, tariff cuts on individual interconnectors can have a greater impact. For instance, HU-RS tariff reduction makes a significant positive change in the CCCI in Bosnia and Herzegovina and Serbia, and HU-HR tariff adjustment improves the Croatian CCCI.

Table 4. Country level cost convergence index (CCCI)

		AT	BA	BG	GR	HR	HU	IT	MK	MV	RO	SB	SI	SK	UA
	ref	14%	63%	53%	31%	32%	24%	26%	56%	55%	-13%	42%	23%	14%	26%
Cut to 0.13	**a**	17%	44%	47%	26%	17%	19%	18%	50%	41%	-13%	18%	18%	18%	13%
Change to weighted average	**b**	16%	62%	55%	33%	32%	26%	29%	58%	60%	-9%	40%	33%	16%	31%
RO-HU 25% reduction	**c1**	14%	63%	53%	31%	32%	24%	26%	56%	55%	-11%	42%	23%	14%	26%
RO-HU 50% reduction	**c2**	14%	63%	53%	31%	32%	24%	26%	56%	55%	-11%	42%	23%	14%	25%
HR-HU 25% reduction	**c5**	14%	63%	53%	31%	32%	24%	26%	56%	55%	-13%	42%	23%	14%	26%
HR-HU 50% reduction	**c6**	14%	63%	53%	31%	32%	24%	26%	56%	55%	-13%	42%	23%	14%	26%
HU-RS 25% reduction	**c9**	14%	59%	53%	31%	32%	24%	26%	56%	55%	-13%	37%	23%	14%	26%
HU-RS 50% reduction	**c10**	14%	54%	53%	31%	32%	25%	26%	56%	55%	-13%	31%	23%	14%	26%
SK-HU 25% reduction	**c13**	14%	64%	53%	31%	32%	22%	26%	55%	55%	-13%	41%	23%	14%	26%
SK-HU 50% reduction	**c14**	14%	64%	53%	31%	32%	20%	26%	55%	55%	-13%	39%	23%	14%	26%
HU-HR 25% reduction	**c17**	14%	64%	53%	31%	29%	24%	26%	56%	55%	-13%	42%	23%	14%	26%
HU-HR 50% reduction	**c18**	14%	64%	53%	31%	24%	24%	26%	56%	55%	-13%	42%	23%	14%	26%
Cut outliers to average	**davg**	14%	58%	52%	31%	24%	23%	26%	55%	53%	-10%	35%	23%	14%	24%

Source: REKK modelling

5.1.2. Change in pipeline flows and utilisation

Changes in total pipeline flows in the region show the effect of tariff on trade. We differentiated between LTC and spot flows. Scenario “a” had the strongest positive effect by crowding out LTC flows with spot flows. Scenario “b” hindered the spot trade, thus the region’s countries had to procure more LTC gas. The set of individual tariff reduction scenarios “c” and outlier reduction scenario “d” had negligible effects on pipeline utilisation.

LTC flows remain mainly untouched by any sort of tariff adjustment. At the same time, spot flows react to the tariff scenarios even up to an 80% change in the most radical tariff cut scenario (“a”).

Table 5. Relative change of LTC and spot traded gas flows compared to reference on the CESEC region's interconnectors

		LTC	Spot
Cut to 0.13	**a**	-1.0%	+85.9%
Change to weighted average	**b**	+0.8%	-24.1%
RO-HU 25% reduction	**c1**	0.0%	+0.2%
RO-HU 50% reduction	**c2**	0.0%	+0.4%
HR-HU 25% reduction	**c5**	0.0%	0.0%
HR-HU 50% reduction	**c6**	0.0%	0.0%
HU-RS 25% reduction	**c9**	0.0%	+0.3%
HU-RS 50% reduction	**c10**	0.0%	+0.6%
SK-HU 25% reduction	**c13**	0.0%	+0.7%
SK-HU 50% reduction	**c14**	0.0%	+1.1%
HU-HR 25% reduction	**c17**	0.0%	+1.8%
HU-HR 50% reduction	**c18**	0.0%	+2.5%
Cut outliers to average	**d**	0.0%	+3.8%

Source: REKK modelling. For individual pipeline utilisation figures of the different scenarios see Annex 6

5.2. Welfare related results

RCCI in the previous chapter captured the consumer's position change as result of modifying changing wholesale gas prices in the analysed scenarios. Utilisation of the pipelines is also an important indicator of market-based trade. However, there are other players in the market outside of consumers and TSOs whose positions are affected. Total welfare change integrates the position change of all market participants:

- Consumers, by evaluating the consumer surplus
- Producers, by presenting the profit of the natural gas producer companies
- TSOs, by calculating profits on the entry-exit regime and congestion rents
- SSOs, by calculating profits on storage activity
- LNG facility operators
- Long term contract holders, by calculating a profit of selling long-term contracted gas to national markets

Welfare effects are considered for only the CESEC region countries and results are presented as an absolute change compared to reference.

In the simulations *ceteris paribus* cross-border tariff adjustments for TSOs remain uncompensated by tariff increases on internal exit or entry points.

Note that welfare analysis results presented in this paper apply equal weights for the welfare components (surplus or profit) of each stakeholder. Given the short term, static nature of the EGMM model, this approach is justified. However, in a dynamic setting some stakeholders, in particular long term contract holders could adjust to the new tariff conditions so that their short term losses are partly mitigated by initiating contract renegotiation with their suppliers (or in case of the TSO, with the relevant NRA).

5.2.1. A note on TSO profits

Simple modification of TSO E/E tariffs may affect revenues of the TSO that are realised from long-term contracted flows. Since LTC flows were contracted at their minimum on the reference scenario as well, no changes are expected in LTC flow levels. However, if LTC volumes are inflexible, a change in tariffs may introduce additional revenues or losses to the

TSO, which are not balanced by other welfare effects. This is because in the modelling framework we do not consider the welfare of the exporter party. This way any change in the reference tariffs introduces a welfare effect from "outside the system".

Therefore we indicate the TSO welfare effect related to long-term contracted flows to be able to adjust modelling results.

Table 6. LTC and spot flow related welfare change effects, M€

	a	b	c1	c2	c5	c6	c9	c10	c13	c14	c17	c18	dav
TSO profit change from LTC	-614	522	0	0	0	0	-11	-21	0	0	0	0	-21
TSO profit change from spot	-264	16.5	1.2	1.93	-0	-0	-4.7	-10	-1.2	-3.5	2.39	1.61	-11
Total TSO profit change	-878	538	1.2	1.93	-0	-0	-15	-32	-1.2	-3.5	2.39	1.61	-33

Source: REKK modelling

It is apparent that in most scenarios, the LTC related TSO effects are accounting for most of the change. We corrected for this effect in all our results.

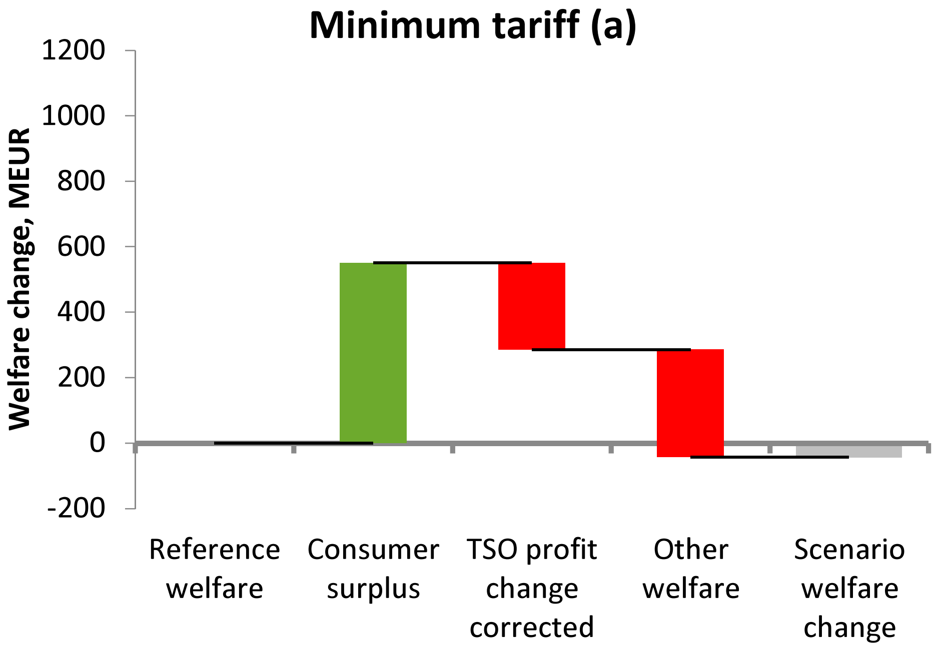
5.2.2. Scenario "a"

Scenario "a" tests a radical decrease (down to 0.13 €/MWh for entry and exit) in the pipeline tariffs across the modelled CESEC countries with the exception of the Trans Balkan pipeline and all pipelines exiting Ukraine as explained earlier. The tariff reduction is more radical in South East Europe than in the Central European countries.[18] Our expectation is that lower tariffs lead to lower wholesale gas prices and increased flow. The consumer welfare will grow by the drop in prices, but at the same time domestic producers will sell their gas cheaper, so their position will also worsen compared to the reference case. The same negative effect is true for long term contract holders. There is a possibility that the positive consumer welfare component will compensate for TSO and producer losses.

Figure 4 shows the modelled welfare change in scenario "a" for the consumers, TSOs and for the other market participants (including storage system operators, LTC contract holders, and domestic producers of natural gas). It is apparent that the price decrease does have positive welfare effects for the consumers, but at the same time the tariff reduction cuts deeply into the revenues of the TSOs and other market participants (in this case, producers are the most affected). On the whole, the welfare change is slightly negative compared to the reference, since consumer welfare change does not fully compensate the reduction of welfare of other market participants.

[18] In this analysis, by Central European countries we mean Austria, Slovakia, Hungary, Slovenia. South-East Europe covers Romania, Bulgaria, Croatia, Bosnia and Herzegovina, FYROM and Serbia.

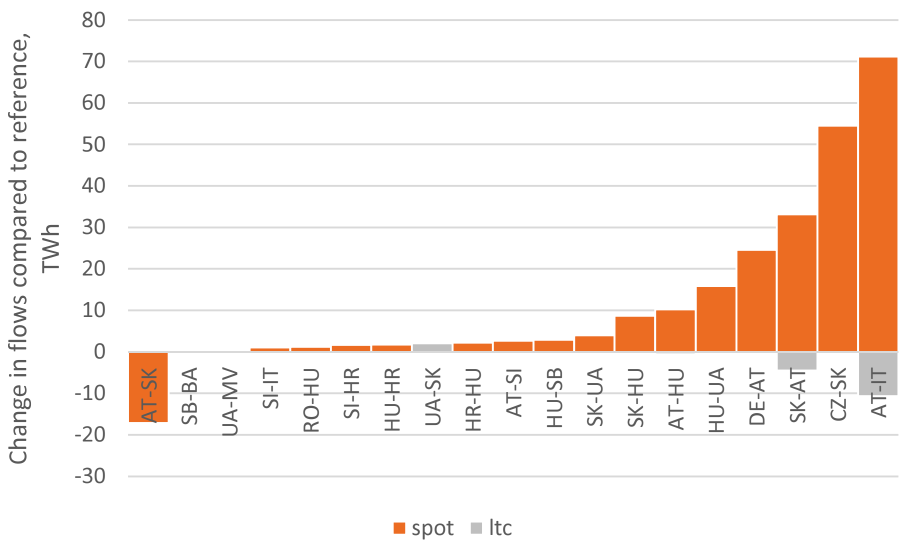
Figure 4. Total welfare change by stakeholders in the CESEC region caused by entry and exit tariffs set to 0.13 €/MWh (M€/year)



Source: REKK modelling

The scenario "a" also tests the possibility for new flow patterns and how far they can be redirected by tariff reduction to new routes. Figure 5 shows change in pipeline flows compared to the reference. It is apparent that spot flows and not LTC flows are affected by the tariff adjustment, with intensifying trade from the West to the East appearing. There were no considerable changes in flows on pipelines not listed in the figure. Flows from Austria to Slovakia are substituted by flows from Germany through Czech Republic to Slovakia and from Austria to Hungary. The Austrian sources seem to flow to Italy. For country level presentation of the results consult Annex 6.

Figure 5. Change in pipeline flows in Scenario "a" compared to reference case, TWh



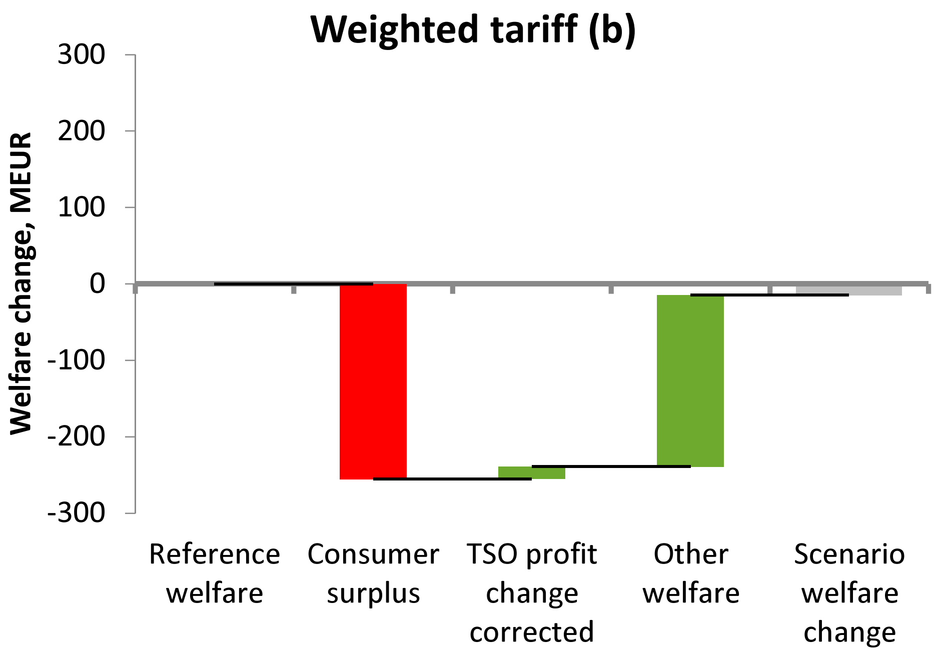
Source: REKK modelling

5.2.3. Scenario "b"

Scenario "b" tests a less dramatic tariff adjustment from the TSOs point of view. Tariffs are set to a weighted average entry and a weighted average exit tariff, calculated based on actual tariff and pipeline utilization data in the first chapter.

All entry tariffs in the CESEC region were set to 0.77 €/MWh and all exit tariffs were set to 1.67 €/MWh. In this scenario the uniform algorithm would lead to a tariff increase in Central Europe and a tariff decrease in South East Europe. In this scenario, 15 borders experience a tariff increase and only 4 borders (SI-HR; HU-RO; HR-HU; HU-RS) a tariff decrease. (for detailed input data consult Table 11 in Annex 2.)

Figure 6. Total welfare change by stakeholders in the CESEC region caused by entry and exit tariffs set to weighted average (M€/year)



Source: REKK modelling

At the CESEC regional level, the tariff increase has a clear negative welfare effect on consumers.

Overall, consumer losses are not compensated by TSO profit change or other market participants.

5.2.4. Set of scenarios "c"

Four borders and five interconnectors were found to be outliers in the tariff benchmarking analysis of the first chapter. In the set of scenarios labelled c1-c20, tariffs were gradually decreased on these selected pieces of infrastructure. The RO-HU, HR-HU, HU-RS, SK-HU and HU-HR tariffs were decreased by 25-50-75% and to 0.13 €/MWh both on the exit and the entry component for the interconnection point. For "c" scenarios, all other pipeline tariffs remained unchanged. We found scenarios with a 75% reduction and 0.13 tariff highly unrealistic and therefore results are not presented here.

Tariff input data used for these scenarios is listed in the Table 12-Table 16. For country level presentation of the welfare effects please see the Annex 3.

5.2.5. Tariff reduction on the Romanian-Hungarian interconnector

To help understand the scenarios, we present a detailed account of a scenario "c" with the example of the RO-HU interconnector and show all effects related to the change in pipeline entry and exit tariffs. For other scenarios, a more concise result containing the welfare change figures will be presented in Annex 3.

The tariff applicable on the Romanian-Hungarian interconnector is exceptionally high, both on the exit part in Romania (3.7 €/MWh) and on the entry side in Hungary (1.7 €/MWh). In the reference case, the pipeline utilised 25% of its total capacity. It is important to note that for this scenario we assume the possibility of marketing Romanian domestic production throughout the region. The analysis takes into account the current domestic production with no additional offshore production.

Four scenarios were dedicated to the analysis of this interconnector. First, both entry and exit tariffs were set 25% and 50% lower than the 2016 applicable tariffs, and finally at 0.13 €/MWh (being the lowest tariff in the CESEC region). We find the 75% and the 0.13 tariff reduction highly unrealistic, and offered results only as an illustration.

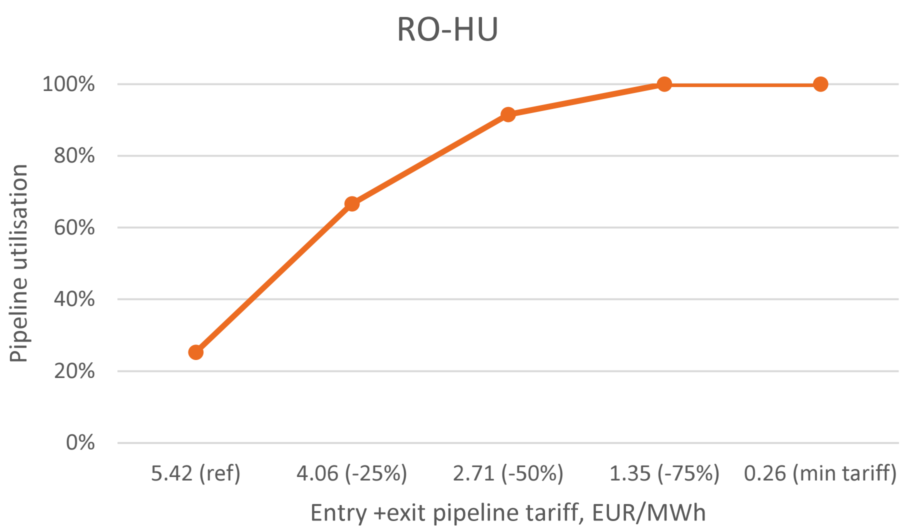
Table 7. Entry, exit and total tariffs applicable on the RO-HU interconnector (€/MWh)

Scenario	HU Entry	RO exit	Total
Reference	1.74	3.67	5.42
25% reduction	1.31	2.76	4.06
50% reduction	0.87	1.84	2.71
75% reduction	0.44	0.92	1.35
Tariff set to 0.13	0.13	0.13	0.26

Source: REKK modelling

As expected, pipeline utilisation surged as a reaction to the lower tariffs. The 25% reduction resulted in a utilisation of 67%, while at 50% tariff reduction utilisation raised over 90%.

Figure 7. Pipeline utilisation of the RO-HU interconnector at various tariff scenarios, %



Source: REKK modelling

The source of the increased flow is the Romanian domestic production. In the 25% tariff reduction case, an additional flow of 0.7 TWh is observed; in the 50% tariff reduction case total additional annual flows reach 1.1 TWh. Most of the gas is consumed in Hungary, some of it is transmitted further to Ukraine. The new gas sources crowd out some flows on Hungary's otherwise utilised interconnectors (SK-HU, UA-HU, AT-HU). However, due to the smaller capacity of the RO-HU interconnector (5 GWh/day) compared to the other pipelines, the utilization effects are negligible.

Table 8. Pipeline utilization effect (% left, TWh right) of the tariff reduction scenarios on the RO-HU interconnector

%	5.42 (ref)	4.06 (-25%)	2.71 (-50%)	1.35 (-75%)	0.26 (min tariff)
RO-HU	25%	67%	92%	100%	100%
SK-HU	12.0%	11.4%	11.4%	11.4%	11.4%
UA-HU	26.5%	26.4%	26.4%	26.4%	26.4%
AT-HU	63.9%	63.5%	63.5%	63.5%	63.5%

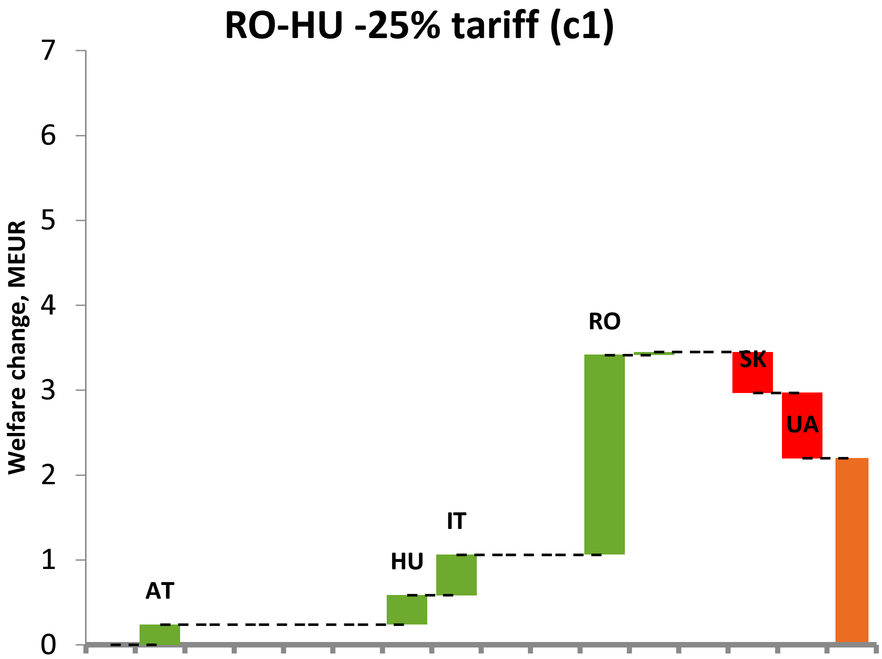
TWh	5.42 (ref)	4.06 (-25%)	2.71 (-50%)	1.35 (-75%)	0.26 (min tariff)
RO-HU	0.4	1.1	1.5	1.6	1.6
SK-HU	5.5	5.3	5.3	5.3	5.3
UA-HU	58.0	57.9	57.9	57.9	57.9
AT-HU	30.2	30.0	30.0	30.0	30.0

Source: REKK modelling

From the welfare point of view:

- Romanian consumers lose due to the fact that cheap domestic gas is sold abroad and they need to procure alternative sources at a higher price.
- Romanian producers realise huge profit gains since they can now sell gas at a higher price in neighbouring markets.
- Romanian TSO also gains because new flows appear on a previously under-utilised infrastructure, generating more revenues. Moreover, the tariff decrease is more than compensated by the surge in flows. At a country level, Romania gains the most in the CESEC region by opening its market.
- Other stakeholder welfare changes are negligible. (The Slovakian LTC holder loses some profits in the lower price environment, but on the whole this effect is small. The Ukrainian TSO sees lower flows due to the fact that Romanian domestic production is supplying the neighbouring countries. In Hungary, lower price levels favour the consumers and TSO profits increase at the same time. Domestic producers and LTC holders do lose compared to reference case, but on a country level the overall effects in Hungary are positive.)

Figure 8. Total welfare effect of the 25% tariff reduction at the RO-HU interconnector by CESEC countries

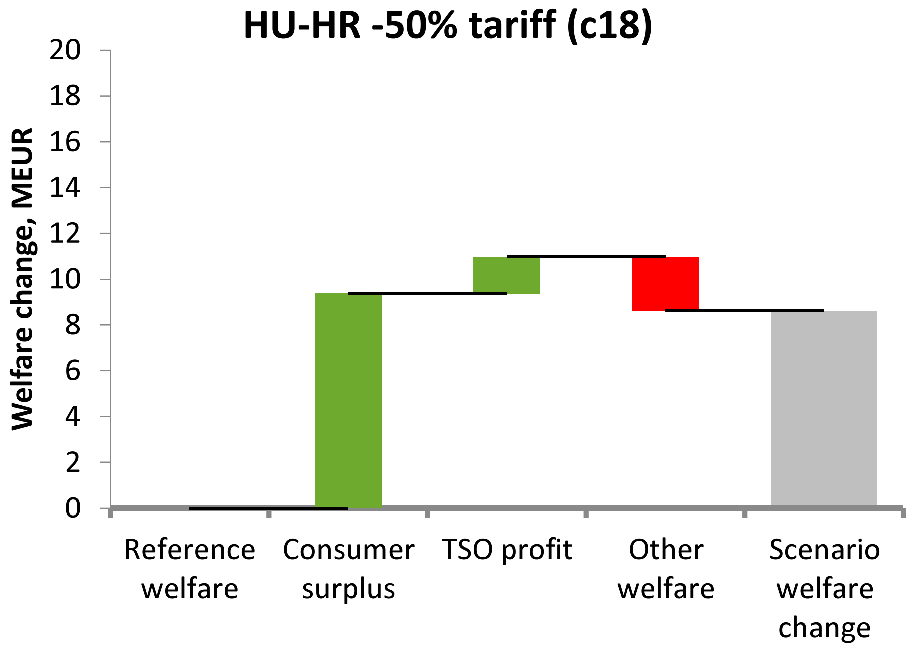


Source: REKK modelling

5.2.6. Tariff reduction on the Croatia-Hungary bidirectional interconnector

Modelling results show that the reduction of the HR-HU tariff is inconsequential, not causing any change in flows or wholesale gas prices as long as there is no LNG in Croatia. In fact, the HU-HR tariff could be reduced up to 50% because the total welfare change at the regional level is positive. The TSOs profit also remains positive due to the larger amount of gas transmitted on the pipeline. For country level presentation of the results please see the Annex 3.

Figure 9. Total welfare change by stakeholders in the CESEC region caused by 50% reduction of entry and exit tariffs on HU-HR interconnector (M€/year)

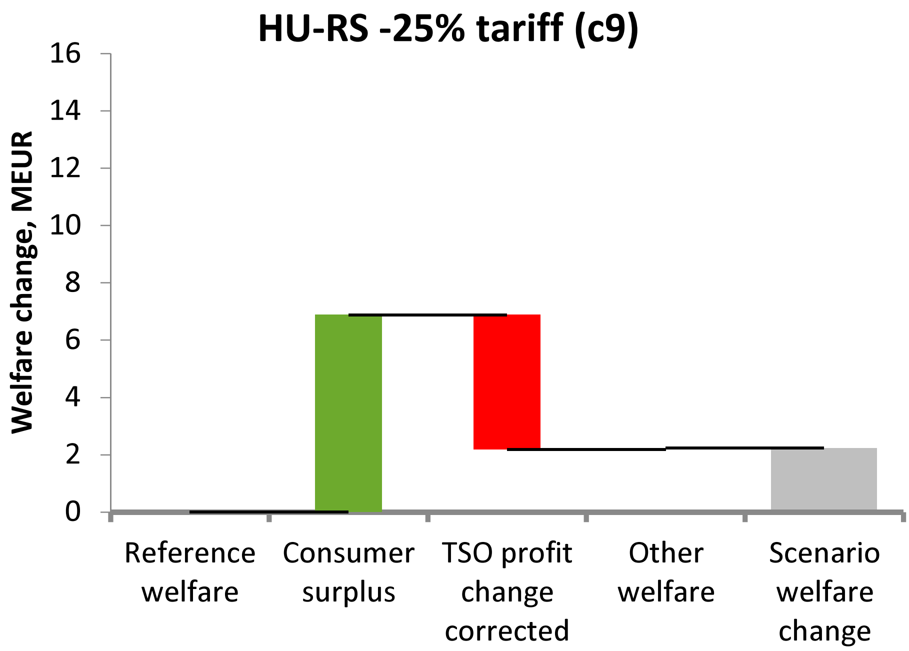


Source: REKK modelling

5.2.7. Tariff reduction on the Hungary-Serbia interconnector

Reduction of the HU-RS tariff creates moderate welfare gains for CESEC as a whole. Serbian consumers benefit the most from the tariff reduction, which is offset to a some extent with the profit reduction of the TSOs. For country level presentation of the results please see the Annex 3.

Figure 10. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on HU-RS interconnector (M€/year)

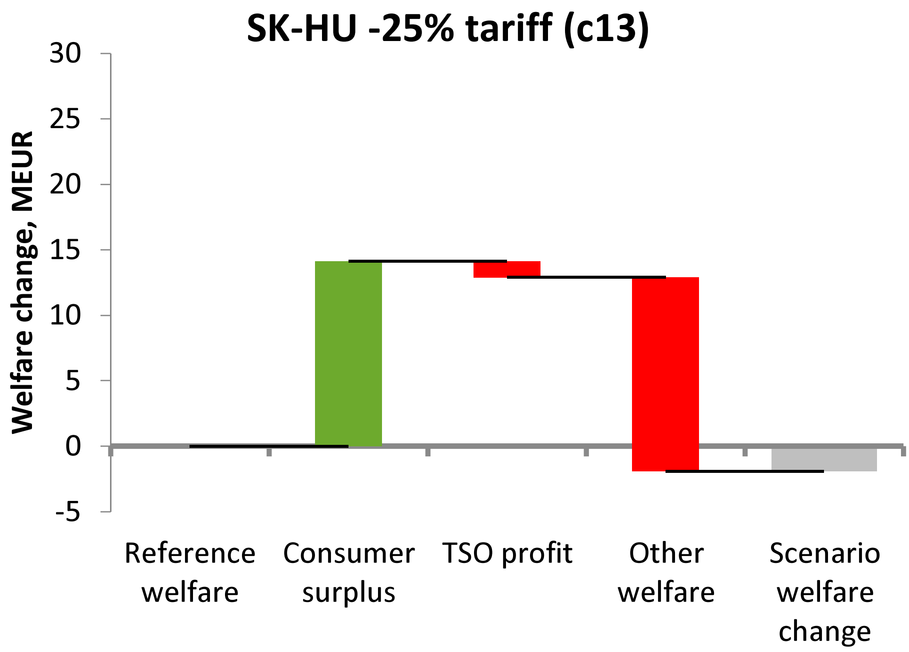


Source: REKK modelling

5.2.8. Tariff reduction on the Slovakia - Hungary interconnector

Reduction of the SK-HU tariff creates the largest change in flows and prices from these individual scenarios. Hungarian consumers benefit from a price reduction, and at the same time the TSOs position hardly changes, meaning the increase in flows compensate the TSO for the tariff price reduction. Yet the total welfare change at a regional level is negative because LTC holders lose profit due to the general regional price decrease. The profit of LTC holders is however very much dependent on the LTC price that they can negotiate with the outside market supplier. For country level presentation of the results please see the Annex 3.

Figure 11. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on SK-HU interconnector (M€/year)



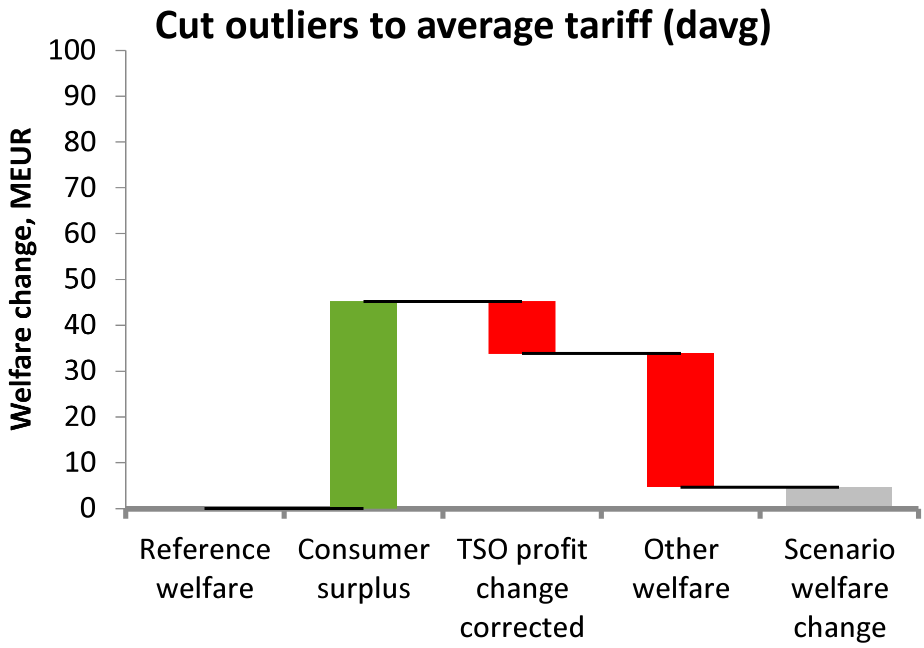
Source: REKK modelling

5.2.9. Scenario "d"

In Scenario "d", all above-average (outlier) tariffs are reduced to the average tariff level in the CESEC region, an entry tariffs of 0.92 €/MWh and exit tariff of 1.33 €/MWh.

There are 6 borders that are affected by the "benchmark cap": these are the HU-RO, HU-HR, SI-HR, AT-HU, SK-HU and HU-RS borders. (For the actual input tariff setting see Table 11 in Annex 2) There is no increase in any transmission tariff, so TSO profit is decreasing in AT, HR, HU and SK. But in Romania and Slovenia increased flow on the TSOs system compensates for the tariff reduction. On a regional level there is a substantial increase in the consumers' welfare especially in UA, HR, HU, IT and RS. The consumer welfare change is decreasing in Romania due to a Romanian wholesale price increase, but this can be compensated; total welfare change in Romania is still positive. On a CESEC regional level total welfare change is slightly positive. (For country level presentation of the results please see the Annex 3.)

Figure 12. Total welfare change by stakeholders in the CESEC region caused by reduction of outlier entry and exit tariffs to average (M€/year)

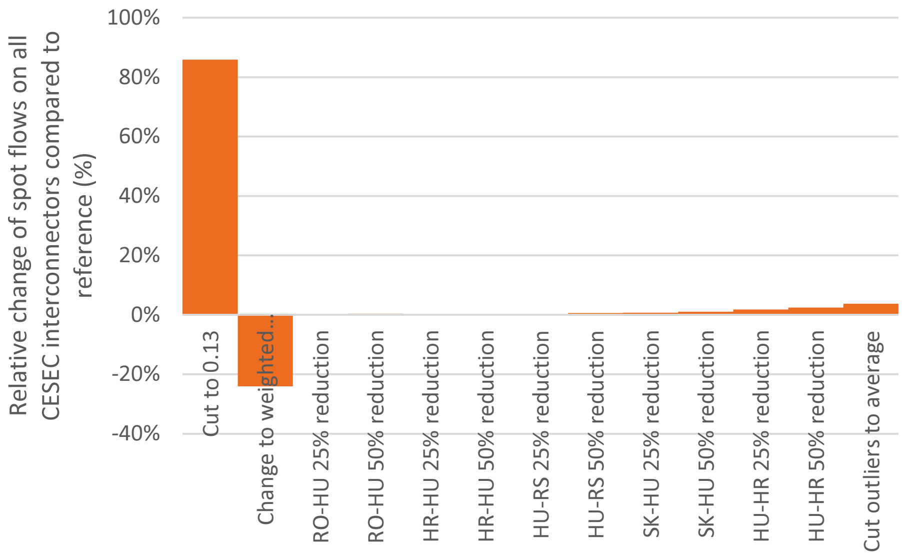


Source: REKK modelling

5.3. General findings

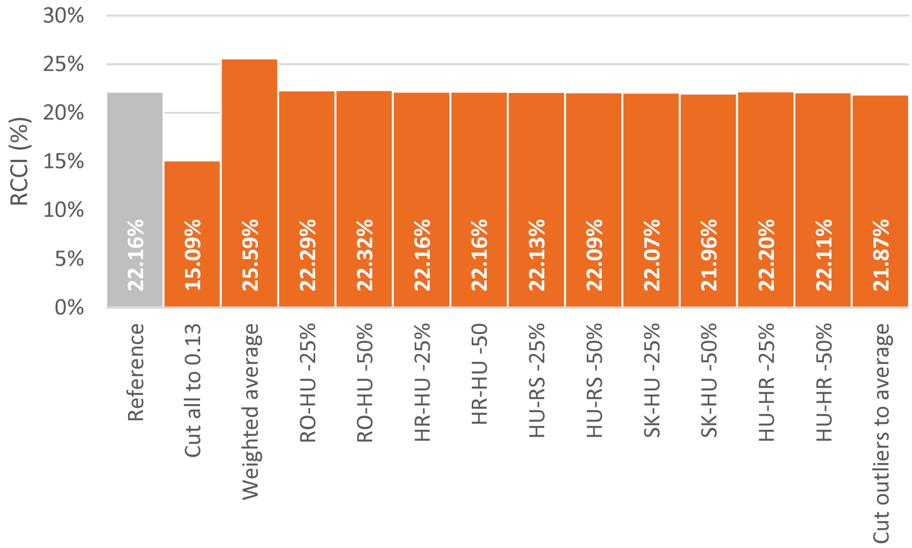
The three main indicators we use to evaluate the scenarios are the RCCI, pipeline utilisation and welfare. The results are summarized in the figures below.

Figure 13. Relative change of spot traded gas flows compared to the reference for CESEC region interconnectors



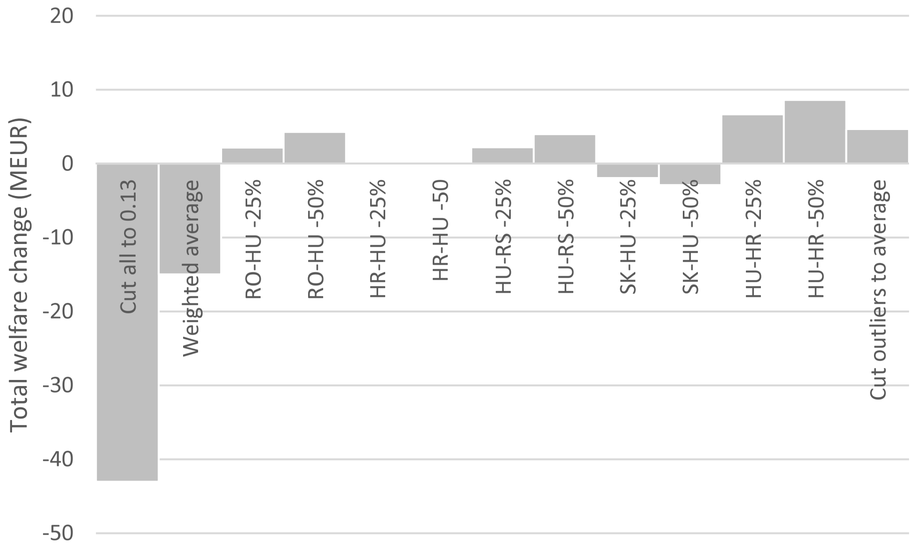
Source: REKK modelling

Figure 14. Value of RCCI in modelled scenarios



Source: REKK modelling

Figure 15. Comparing the total welfare effects of scenarios



Source: REKK modelling

6. THE IMPACT OF TRANSMISSION TARIFFS ON CESEC PRIORITY INFRASTRUCTURE UTILIZATION

A very important lesson from the previous tariff scenario analyses was that moderate cross-border tariffs on key interconnectors providing spot gas to the LTC-gas dominated CESEC region had outstanding importance for increased gas wholesale competition. However, results only related to existing infrastructure.

This brief section reports on selected market simulation results assessing the likely impacts of tariffs on the utilisation of key new CESEC priority infrastructure.

The CESEC region has determined that an LNG terminal in Croatia has the potential to bring about regional benefits. We modelled an LNG terminal of 4 bcm/yr (108 GWh/day) capacity with different regasification fees (starting from 3.2 €/MWh) and with different tariffs on the Croatian Hungarian interconnector that is assumed to be the evacuation route of the terminal (starting from current 7.07 €/MWh).

From the table below it is evident that trade on the Croatian LNG corridor is highly sensitive to tariffs. With a regasification fee at 3.2 EUR/MWh, the Croatian LNG terminal is underutilized. The addition of a high tariff HR-HU interconnector does not change the situation, as all 13 TWh delivered by the LNG terminal is consumed in Croatia. If the HR-HU interconnector exit and entry tariffs are reduced to 1 €/MWh each way, a very small amount (0.5 TWh) flows to Hungary. Only when both the regasification and interconnector tariffs are reduced to 1 EUR/MWh is there a significant flow of Croatian LNG to Hungary, reaching ~2 bcm/yr, and in turn maximizes Croatian LNG utilization. Some of this new source will spread throughout the region on a spot basis, mostly to Ukraine, but small quantities would also reach Serbia in spite of the high tariffs attached to the HU-RS interconnector.

Table 9: **Modelled spot flows on HR_LNG and HR-HU cluster (TWh/yr)**

	ref	HR_LNG	8b	8c	8c-ref
	no HR_LNG	regas: 3.2 €/MWh	regas: 3.2 €/MWh	regas: 1 €/MWh	
	HR-HU: 7.07 €/MWh	HR-HU: 7.07 €/MWh	HR-HU: 2 €/MWh	HR-HU: 2 €/MWh	
HR_LNG	0	16	16	36	36
HR-HU	0	0	0.5	19	19
HU-RS	18	18	18	19	1
HU-UA	8	8	8	13	5
HU-RO	0.25	0.24	0.24	1.3	1.05
SK-HU	13	13	12	5	-8
AT-HU	19	19	19	16	-3

Considering Greek LNG and affiliated infrastructure, namely GR-BG (via IGB or a reverse flow on the Trans Balkan), the BG-RO-HU corridor increases utilization of the terminal with offtake spot-traded and greater flows consumed in the Bulgarian market. Furthermore, the

BG-RS (IBS) interconnector greatly benefited Greek LNG and IGB utilization[19]. Under these conditions, the RO-HU interconnector would not be used and LNG would not reach Hungary.

The inclusion of TAP[20] has a negative effect on Greek LNG utilization, demonstrating competition between long-term contracted pipeline and spot LNG sources in the region. In the following chart it can be observed that the boost in Greek LNG utilization resulting from IGB is almost completely crowded out by contracted flows via TAP.

Table 10: Modelled spot flow on Greek LNG cluster (TWh/yr)

	ref	IGB	IGB+BG-RO	IGB+BG-RO+RO-HU	IGB+IBS	IGB (with TAP)
	GR_LNG: 1.33 €/MWh	GR_LNG: 1.33 €/MWh	GR_LNG: 1.33 €/MWh	GR_LNG: 1.33 €/MWh	GR_LNG: 1.33 €/MWh	GR_LNG: 1.33 €/MWh
		GR-BG: 2 €/MWh	GR-BG: 2 €/MWh	GR-BG: 2 €/MWh		GR-BG: 2 €/MWh
		BG-RO: 2 €/MWh	BG-RO: 2 €/MWh	BG-RO: 2 €/MWh		BG-RO: 2 €/MWh
	RO-HU: 5.04 €/MWh	RO-HU: 5.04 €/MWh	RO-HU: 5.04 €/MWh	RO-HU: 2 €/MWh	RO-HU: 5.04 €/MWh	
					BG-RS: 2 €/MWh	
						TAP: each border 2€/MWh
GR_LNG	22	33	35	35	49	24
GR-BG	n.a	11	12	12	27	2
BG-SB	n.a	n.a	n.a	n.a	20	n.a
BG-RO	n.a	3	5	5	2	3
RO-HU	0	0	0	0	0	0

[19] Please note that Russia's strategic response is not modelled in this paper.

[20] The Azeri gas reaches Italy, Greece and Bulgaria via long-term contract at 8, 1 and 1 bcm/yr respectively

7. CONCLUDING REMARKS

Partial lack of data availability and transparency puts a limit on the potential completeness and correctness of gas transmission tariff analyses for the CESEC region. The situation in this regard is to be improved.

This paper estimates average cross-border gas transmission tariffs for the CESEC region at 2.24 EUR/MWh. Average exit tariffs are 45% higher than average entry tariffs, while the median for the two categories are almost equal. The difference can be partly explained by the fact that commodity charges are in most cases applied at the exit points A few outstanding high exit tariffs (all exits from Ukraine, the RO-HU, HR-HU and HU-RS exits) complete the picture in this regard.

Cross-border tariffs are on average lower in the Western part of the region and along former transit routes as compared to the South-East part of the region and to borders with newly built and moderately utilized infrastructure.

With the exception of the CZ-SK and SK-UA reverse flow projects, capacity utilization of newly built (after 2009) infrastructure is still low in the region. The range of cross border tariffs for these new infrastructure components is from below 1 EUR/MWh (IT-AT reverse flow) to over 7 EUR/MWh (HR-HU reverse flow), although tariffs over 4 EUR/MWh would require a very serious justification.

Market protection (both export and import), legitimacy transit arrangements and the market power of single supply route providers are identified as potential explanations for outlier cross-border tariffs in the region.

Another case is when newly built infrastructure to improve supply security and strengthen the bargaining power of countries against a dominant supplier by improved diversification call for both high exit and entry fees to recover high CAPEX costs. While gas product price discounts can make such infrastructure investments to pay-off fast at the societal level (see the example of the Klaipeda LNG terminal in Lithuania), their daily utilisation might remain moderate due to high tariffs – although otherwise they could better contribute to improved regional gas market integration and competition.

It is suggested that this "new-built regulatory trap" as well as the case of other distorted tariffs are addressed in regional policy and regulatory discussions. The outcome of one of the tariff reform modelling scenarios (scenario "b") illustrates that an ad-hoc "regional socialization" of costs to improve regional supply security by infrastructure build-up might lead to undesirable results.

Four cross-border gas transmission tariff reform scenarios were defined and analysed by the European Gas Market Model. Each of the reform scenarios addressed how gas market integration in terms of gas wholesale price convergence and increased cross-border trading could be improved by tariff reforms only. Three of the scenarios addressed outlier tariffs while the fourth assessed the implications of a "tariff shock" by reducing cross-border tariffs to the marginal cost of operating interconnectors and thus creating a cross-border E/E tariff-free zone within the CESEC region.

To give a full account of the tariff scenario impacts on all relevant stakeholders, the social welfare implications of the scenarios are also presented. Weights for the social welfare components of the stakeholders are equal. Note that our methodology (static modelling and welfare weighting) provides a conservative lower welfare estimate for the scenarios.

Especially, the welfare loss of LTC holders in the present static analysis would – in a dynamic analysis – be better understood as a "competitive pressure" put on LTC gas suppliers to renegotiate gas supply costs to certain CESEC markets.

While being kind-of extreme, the cross-border E/E tariff-free zone scenario (scenario "a") highlights the outstanding importance of moderate cross-border tariffs on key interconnectors providing spot gas to this LTC-gas dominated region for gas wholesale competition. This scenario brings an 80% spot gas supplies increase and decent wholesale price decrease to the region, largely due to increased utilisation of the interconnectors linking Germany and the region. While the overall social welfare impact of the scenario is slightly negative, it is obvious that TSO and producer losses could be easily compensated from consumers' benefits. This is a strong message for regulators when designing tariffs for future spot gas entry points for the region.

The major lesson from the ad-hoc scenario to socialize the cost of recent infrastructure upgrade at the regional level (scenario "b") is the opposite. If cost socialization is done so that the tariffs for key interconnectors, providing spot gas to the region, are increased at the cost of decreasing tariffs for less utilized interconnectors, regional social welfare is deteriorated by reduced spot gas flows and consequent wholesale price increase.

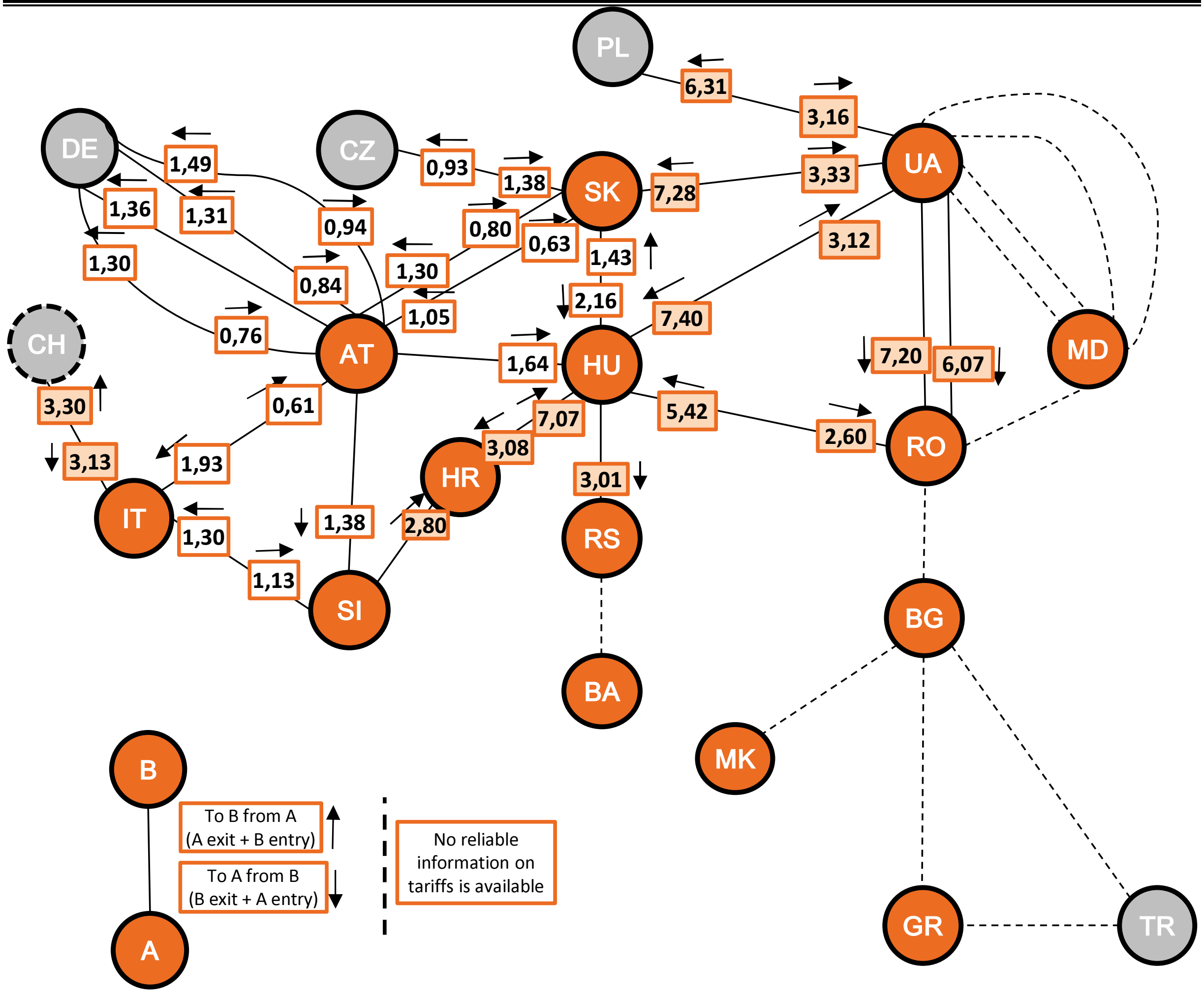
The small and targeted "no regret" scenarios ("c" scenarios), addressing outlier cross-border tariffs one-by-one, teach us that there are a number of opportunities for welfare improvements in the region by regulatory adjustments. While the overall social gains are moderate, tariff reductions at the Romania-Hungary and Hungary-Croatia borders could increase consumer *and* TSO benefits far enough to compensate for the losses of other stakeholders. In addition, tariff reduction at the Hungary-Serbia and Slovakia-Hungary borders also seem reasonable to explore further.

Finally, the not very much over-sophisticated "lawn mower" scenario (scenario "d") by cutting all outliers to the average can bring reasonable benefits for the region. This is done by inviting increased spot trade and Romanian gas to the region so that welfare change in Romania remains positive and TSO losses are compensated for.

The modelling of alternative tariff scenarios for a selected set of priority new CESEC infrastructure has confirmed that moderate access tariffs are key to promote increased spot gas into the CESEC region. Most notably, proposed regasification tariffs and existing cross-border tariffs to Hungary prohibits gas from a new LNG regasification terminal in Croatia to flow out of the country; only significantly reduced regas and cross-border tariffs can help Croatian LNG to have a region-wide market impact.

The implementation of the GR-BG interconnector (or reverse flow), the BG-RO-HU corridor and the BG-RS interconnector at normal tariffs can double the utilization of Greek LNG, Bulgaria and Serbia being the largest beneficiaries; after the implementation of TAP, pipeline gas will compete with Greek LNG in the region.

8. ANNEX 1. TARIFFS AT INTERCONNECTION POINTS WITH UPDATED UKRAINIAN ENTRY-EXIT FEES



9. ANNEX 2. TARIFFS USED FOR MODELLING SCENARIOS

Table 11. Tariffs used on the CESEC interconnectors in reference case and scenarios "a", "b" and "d" (€/MWh)

€/MWh	Reference			Minimum tariff (a)			Weighted tariff (b)			Cut outliers to average tariff (d)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.13	0.56	0.69	0.77	0.56	1.32	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.13	0.64	0.51	1.67	2.18	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.13	0.13	0.26	0.77	1.67	2.44	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.13	0.13	0.26	0.77	1.67	2.44	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.13	0.13	0.26	0.77	1.67	2.44	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.13	2.48	2.61	0.77	2.48	3.25	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.13	0.13	0.26	0.77	1.67	2.44	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	0.13	0.13	0.26	0.77	1.67	2.44	0.92	0.62	1.54
SK-CZ	0.13	0.79	0.93	0.13	0.13	0.26	0.13	1.67	1.80	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.13	0.87	1.00	0.77	0.87	1.63	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.13	0.13	0.26	0.77	1.67	2.44	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.13	0.13	0.26	0.77	1.67	2.44	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	0.13	0.13	0.26	0.77	1.67	2.44	0.92	0.39	1.31
HU-RS	1.01	2.00	3.01	0.13	0.13	0.26	0.77	1.67	2.44	0.92	1.33	2.24
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	0.13	0.13	0.26	0.77	1.67	2.44	0.92	1.33	2.24
HU-HR	2.18	0.90	3.08	0.13	0.13	0.26	0.77	1.67	2.44	0.92	0.90	1.82
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	0.13	0.13	0.26	0.77	1.67	2.44	0.92	0.90	1.82
PL-UA	1.06	0.94	2.01	0.13	0.94	1.07	0.77	0.94	1.71	0.92	0.94	1.86
SK-UA	1.06	1.11	2.17	0.13	0.13	0.26	0.77	1.67	2.44	0.92	1.11	2.03
RO-HU	1.74	3.67	5.42	0.13	0.13	0.26	0.77	1.67	2.44	0.92	1.33	2.24
HU-SK	0.53	0.90	1.43	0.13	0.13	0.26	0.77	1.67	2.44	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	0.13	0.13	0.26	0.77	1.67	2.44	0.92	0.90	1.82
HR-HU	1.25	5.81	7.07	0.13	0.13	0.26	0.77	1.67	2.44	0.92	1.33	2.24
SI-IT	0.70	0.60	1.3	0.13	0.13	0.26	0.77	1.67	2.44	0.70	0.60	1.3

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference. Source: REKK data collection based on TSO websites

Table 12. Tariffs used on the CESEC interconnectors in scenarios "c1-c2" (€/MWh)

€/MWh	Reference			RO-HU					
				25% reduction (c1)			50% reduction (c2)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.29	0.56	0.85	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.86	1.37	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.54	0.84	1.38	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.87	1.07	1.93	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.28	0.33	0.61	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.65	2.48	3.13	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.39	0.73	1.13	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	2.18	0.62	2.80	2.18	0.62	2.80
SK-CZ	0.13	0.79	0.93	0.13	0.79	0.93	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.51	0.87	1.38	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.40	0.23	0.63	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.14	0.90	1.05	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	1.25	0.39	1.64	1.25	0.39	1.64
HU-RS	1.01	2.00	3.01	1.01	2.00	3.01	1.01	2.00	3.01
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	1.20	1.39	2.60	1.20	1.39	2.60
HU-HR	2.18	0.90	3.08	2.18	0.90	3.08	2.18	0.90	3.08
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	1.06	0.90	1.97	1.06	0.90	1.97
PL-UA	1.06	0.94	2.01	1.06	0.94	2.01	1.06	0.94	2.01
SK-UA	1.06	1.11	2.17	1.06	1.11	2.17	1.06	1.11	2.17
RO-HU	1.74	3.67	5.42	1.31	2.76	4.06	0.87	1.84	2.71
HU-SK	0.53	0.90	1.43	0.53	0.90	1.43	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	1.25	0.90	2.16	1.25	0.90	2.16
HR-HU	1.25	5.81	7.07	1.25	5.81	7.07	1.25	5.81	7.07
SI-IT	0.70	0.60	1.30	0.70	0.60	1.30	0.70	0.60	1.30

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference.

Table 13. Tariffs used on the CESEC interconnectors in scenarios "c5-c6" (€/MWh)

€/MWh	Reference			HR-HU					
				25% reduction (c5)			50% reduction (c6)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.29	0.56	0.85	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.86	1.37	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.54	0.84	1.38	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.87	1.07	1.93	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.28	0.33	0.61	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.65	2.48	3.13	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.39	0.73	1.13	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	2.18	0.62	2.80	2.18	0.62	2.80
SK-CZ	0.13	0.79	0.93	0.13	0.79	0.93	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.51	0.87	1.38	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.40	0.23	0.63	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.14	0.90	1.05	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	1.25	0.39	1.64	1.25	0.39	1.64
HU-RS	1.01	2.00	3.01	1.01	2.00	3.01	1.01	2.00	3.01
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	1.20	1.39	2.60	1.20	1.39	2.60
HU-HR	2.18	0.90	3.08	2.18	0.90	3.08	2.18	0.90	3.08
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	1.06	0.90	1.97	1.06	0.90	1.97
PL-UA	1.06	0.94	2.01	1.06	0.94	2.01	1.06	0.94	2.01
SK-UA	1.06	1.11	2.17	1.06	1.11	2.17	1.06	1.11	2.17
RO-HU	1.74	3.67	5.42	1.74	3.67	5.42	1.74	3.67	5.42
HU-SK	0.53	0.90	1.43	0.53	0.90	1.43	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	1.25	0.90	2.16	1.25	0.90	2.16
HR-HU	1.25	5.81	7.07	0.94	4.36	5.30	0.63	2.91	3.53
SI-IT	0.70	0.60	1.30	0.70	0.60	1.30	0.70	0.60	1.30

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference.

Table 14. Tariffs used on the CESEC interconnectors in scenarios "c9-c10" (€/MWh)

€/MWh	Reference			HU-RS					
				25% reduction (c9)			50% reduction (c10)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.29	0.56	0.85	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.86	1.37	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.54	0.84	1.38	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.87	1.07	1.93	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.28	0.33	0.61	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.65	2.48	3.13	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.39	0.73	1.13	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	2.18	0.62	2.80	2.18	0.62	2.80
SK-CZ	0.13	0.79	0.93	0.13	0.79	0.93	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.51	0.87	1.38	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.40	0.23	0.63	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.14	0.90	1.05	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	1.25	0.39	1.64	1.25	0.39	1.64
HU-RS	1.01	2.00	3.01	0.79	1.50	2.30	0.53	1.00	1.53
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	1.20	1.39	2.60	1.20	1.39	2.60
HU-HR	2.18	0.90	3.08	2.18	0.90	3.08	2.18	0.90	3.08
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	1.06	0.90	1.97	1.06	0.90	1.97
PL-UA	1.06	0.94	2.01	1.06	0.94	2.01	1.06	0.94	2.01
SK-UA	1.06	1.11	2.17	1.06	1.11	2.17	1.06	1.11	2.17
RO-HU	1.74	3.67	5.42	1.74	3.67	5.42	1.74	3.67	5.42
HU-SK	0.53	0.90	1.43	0.53	0.90	1.43	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	1.25	0.90	2.16	1.25	0.90	2.16
HR-HU	1.25	5.81	7.07	1.25	5.81	7.07	1.25	5.81	7.07
SI-IT	0.70	0.60	1.30	0.70	0.60	1.30	0.70	0.60	1.30

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference.

Table 15. Tariffs used on the CESEC interconnectors in scenarios "c13-c14" (€/MWh)

€/MWh	Reference			SK-HU					
				25% reduction (c13)			50% reduction (c14)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.29	0.56	0.85	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.86	1.37	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.54	0.84	1.38	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.87	1.07	1.93	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.28	0.33	0.61	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.65	2.48	3.13	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.39	0.73	1.13	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	2.18	0.62	2.80	2.18	0.62	2.80
SK-CZ	0.13	0.79	0.93	0.13	0.79	0.93	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.51	0.87	1.38	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.40	0.23	0.63	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.14	0.90	1.05	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	1.25	0.39	1.64	1.25	0.39	1.64
HU-RS	1.01	2.00	3.01	1.01	2.00	3.01	1.01	2.00	3.01
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	1.20	1.39	2.60	1.20	1.39	2.60
HU-HR	2.18	0.90	3.08	2.18	0.90	3.08	2.18	0.90	3.08
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	1.06	0.90	1.97	1.06	0.90	1.97
PL-UA	1.06	0.94	2.01	1.06	0.94	2.01	1.06	0.94	2.01
SK-UA	1.06	1.11	2.17	1.06	1.11	2.17	1.06	1.11	2.17
RO-HU	1.74	3.67	5.42	1.74	3.67	5.42	1.74	3.67	5.42
HU-SK	0.53	0.90	1.43	0.53	0.90	1.43	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	0.94	0.68	1.62	0.63	0.45	1.08
HR-HU	1.25	5.81	7.07	1.25	5.81	7.07	1.25	5.81	7.07
SI-IT	0.70	0.60	1.30	0.70	0.60	1.30	0.70	0.60	1.30

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference.

Table 16. Tariffs used on the CESEC interconnectors in scenarios "c17-c18" (€/MWh)

€/MWh	Reference			HU-HR (c)					
				25% reduction (c17)			50% reduction (c18)		
	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit	Total
DE-AT	0.29	0.56	0.85	0.29	0.56	0.85	0.29	0.56	0.85
AT-DE	0.51	0.86	1.37	0.51	0.86	1.37	0.51	0.86	1.37
AT-SI	0.54	0.84	1.38	0.54	0.84	1.38	0.54	0.84	1.38
AT-IT	0.87	1.07	1.93	0.87	1.07	1.93	0.87	1.07	1.93
IT-AT	0.28	0.33	0.61	0.28	0.33	0.61	0.28	0.33	0.61
CH-IT	0.65	2.48	3.13	0.65	2.48	3.13	0.65	2.48	3.13
IT-SI	0.39	0.73	1.13	0.39	0.73	1.13	0.39	0.73	1.13
SI-HR	2.18	0.62	2.80	2.18	0.62	2.80	2.18	0.62	2.80
SK-CZ	0.13	0.79	0.93	0.13	0.79	0.93	0.13	0.79	0.93
CZ-SK	0.51	0.87	1.38	0.51	0.87	1.38	0.51	0.87	1.38
AT-SK	0.40	0.23	0.63	0.40	0.23	0.63	0.40	0.23	0.63
SK-AT	0.14	0.90	1.05	0.14	0.90	1.05	0.14	0.90	1.05
AT-HU	1.25	0.39	1.64	1.25	0.39	1.64	1.25	0.39	1.64
HU-RS	1.01	2.00	3.01	1.01	2.00	3.01	1.01	2.00	3.01
RS-BA	1.56	2.71	4.27	1.56	2.71	4.27	1.56	2.71	4.27
BG-MK	1.96	0.45	2.41	1.96	0.45	2.41	1.96	0.45	2.41
BG-GR	0.76	0.45	1.21	0.76	0.45	1.21	0.76	0.45	1.21
BG-TR	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
RO-BG	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*
HU-RO	1.20	1.39	2.60	1.20	1.39	2.60	1.20	1.39	2.60
HU-HR	2.18	0.90	3.08	1.64	0.68	2.31	1.09	0.45	1.54
UA-PL	1.28	2.19	3.47	1.28	2.19	3.47	1.28	2.19	3.47
UA-SK	0.80	2.80	3.60	0.80	2.80	3.60	0.80	2.80	3.60
UA-HU	1.25	2.65	3.90	1.25	2.65	3.90	1.25	2.65	3.90
UA-RO	1.45	2.22	3.67	1.45	2.22	3.67	1.45	2.22	3.67
TR-GR	0.68	8.42	9.10	0.68	8.42	9.10	0.68	8.42	9.10
UA-MD	2.22	1.85	4.07	2.22	1.85	4.07	2.22	1.85	4.07
HU-UA	1.06	0.90	1.97	1.06	0.90	1.97	1.06	0.90	1.97
PL-UA	1.06	0.94	2.01	1.06	0.94	2.01	1.06	0.94	2.01
SK-UA	1.06	1.11	2.17	1.06	1.11	2.17	1.06	1.11	2.17
RO-HU	1.74	3.67	5.42	1.74	3.67	5.42	1.74	3.67	5.42
HU-SK	0.53	0.90	1.43	0.53	0.90	1.43	0.53	0.90	1.43
SK-HU	1.25	0.90	2.16	1.25	0.90	2.16	1.25	0.90	2.16
HR-HU	1.25	5.81	7.07	1.25	5.81	7.07	1.25	5.81	7.07
SI-IT	0.70	0.60	1.30	0.70	0.60	1.30	0.70	0.60	1.30

Note: green cells indicates tariff lower than reference tariff, red cell indicates tariff higher than reference. Non-colored cells indicate unchanged tariff compared to reference.

10.ANNEX 3. DETAILED WELFARE EFFECTS

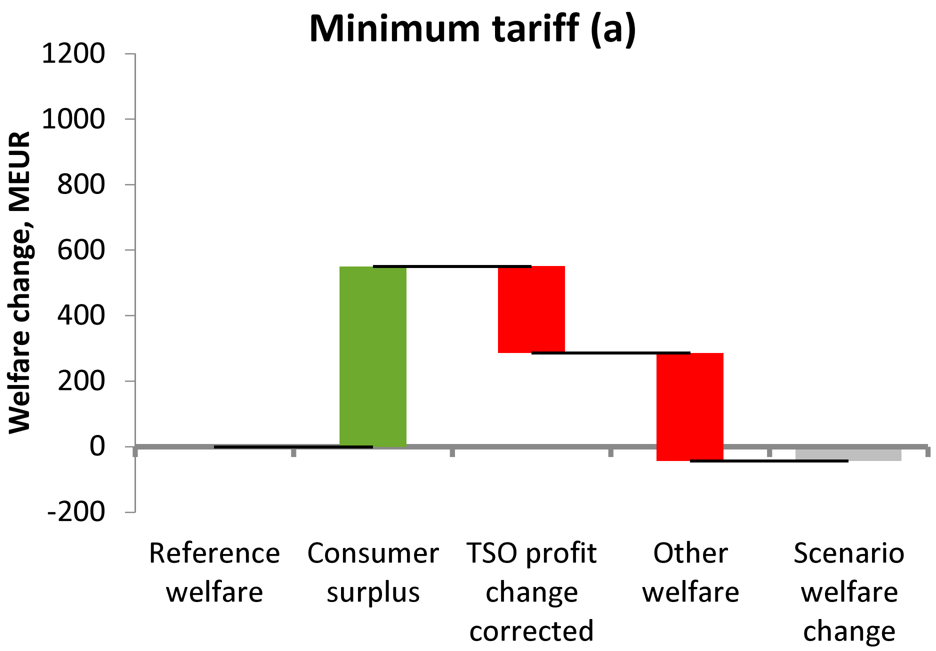
The figures below give an indication of the welfare change effects for all scenarios. Total welfare effects refer to the welfare of the CESEC region, including all stakeholders in the natural gas market.

For each scenario, three welfare change charts are displayed.

- The first chart shows the total welfare of the scenario relative to the welfare in the reference. This chart is useful for indicating the level of welfare change tariff adjustments can achieve. In general, it can be concluded that even the scenarios with the highest impact affect the regional welfare, 3% at most.
- The second chart displays the welfare change itself. The total welfare change in the region is divided into three distinctive stakeholder categories:
    - consumer surplus
    - TSO profits
    - Other stakeholder welfare effects (including profit change of the long term contract holder, profit change of the local natural gas producer and profit change of the storage system operator)
- The third chart divides the welfare effect up among the countries in the region. Countries affected with over 0.1 M€ welfare change is shown in the figure.

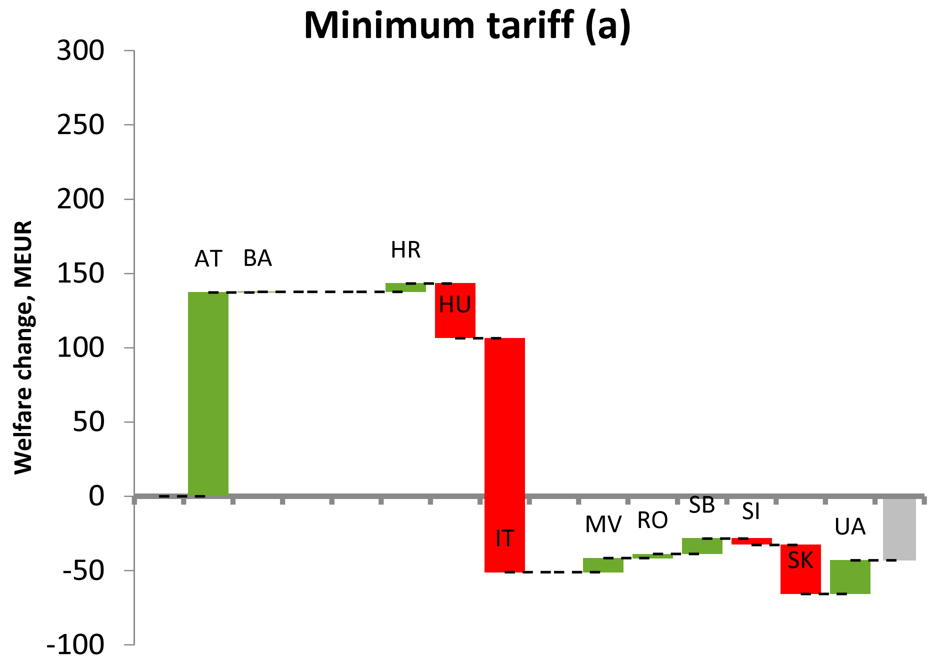
Green bars indicate an increase in welfare while red bars show a decrease in welfare. The last column shows the total welfare change compared to the reference case.

Figure 16. Total welfare change by stakeholders in the CESEC region caused by reduction of entry and exit tariffs to 0.13 €/MWh (M€/year)



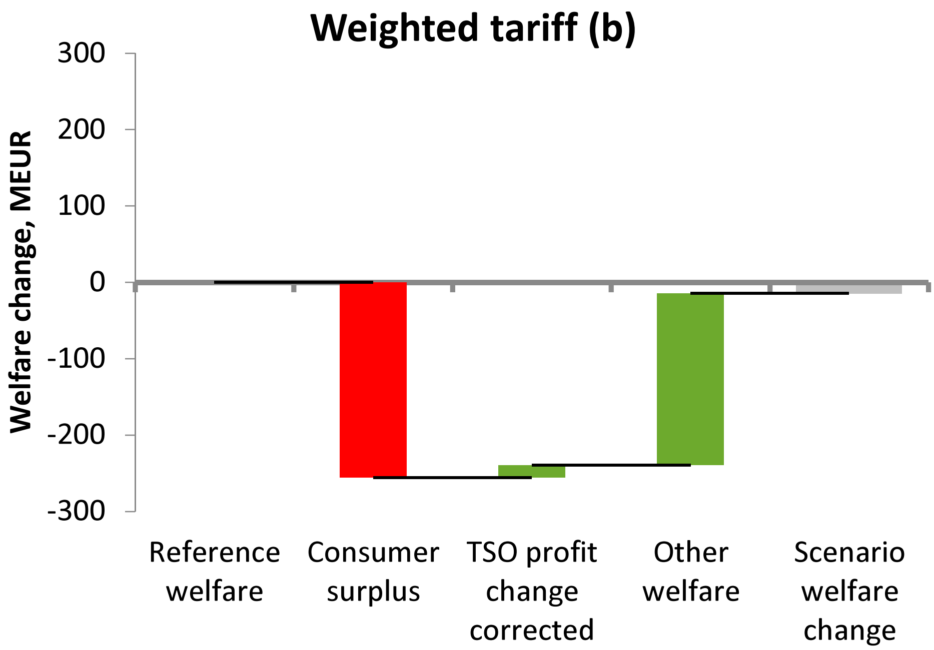
Source: REKK modelling

Figure 17. Total welfare change by countries in the CESEC region caused by reduction of entry and exit tariffs to 0.13 €/MWh (M€/year)



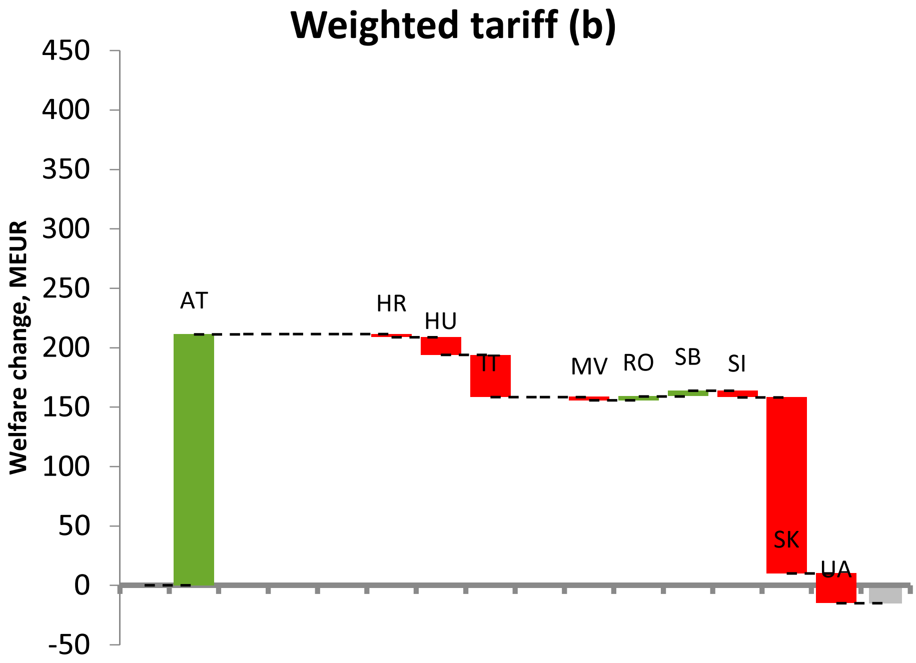
Source: REKK modelling

Figure 18. Total welfare change by stakeholders in the CESEC region caused by reduction of entry and exit tariffs to weighted average tariff (M€/year)



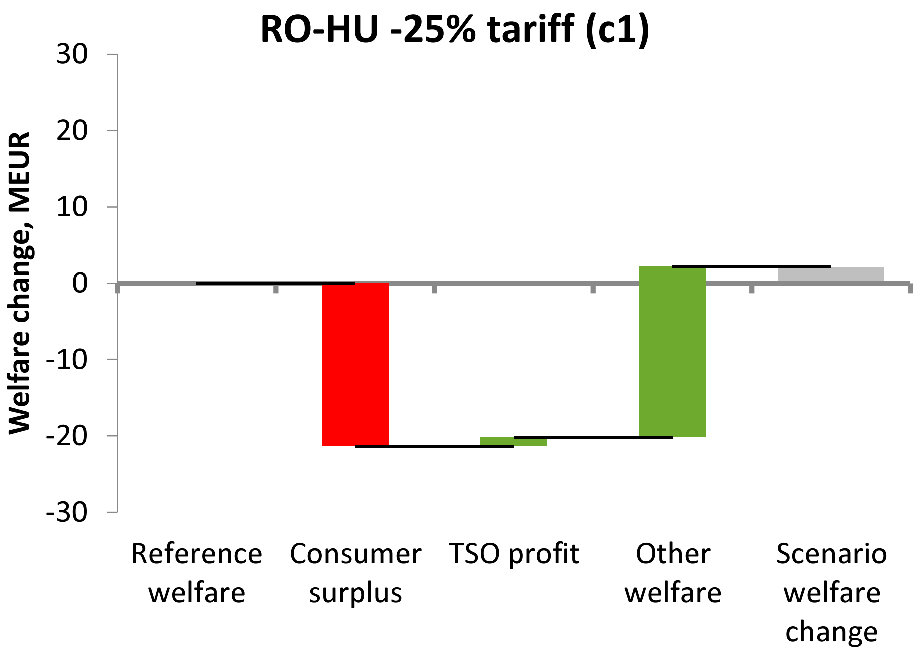
Source: REKK modelling

Figure 19. Total welfare change by countries in the CESEC region caused by reduction of entry and exit tariffs to weighted average tariff (M€/year)



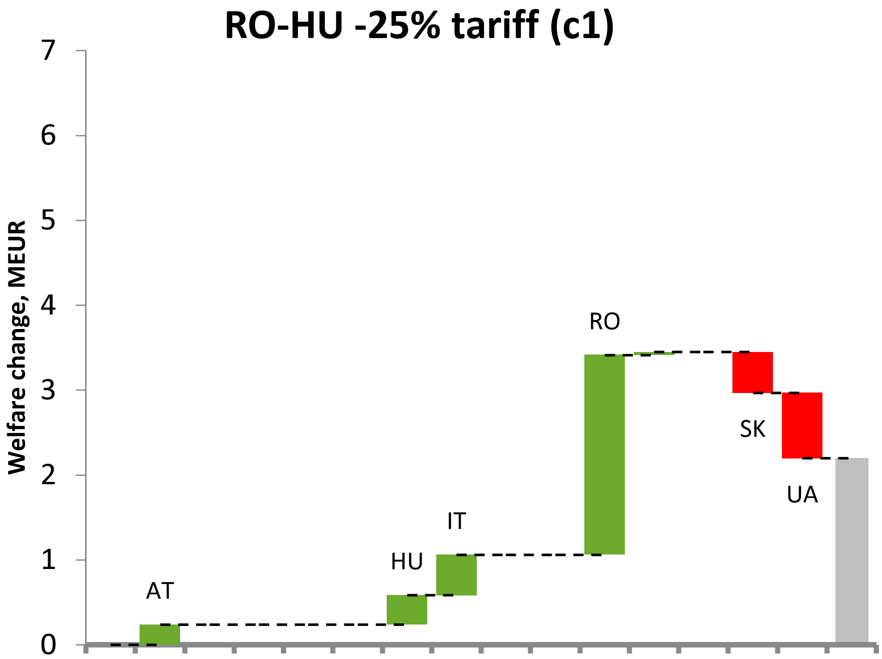
Source: REKK modelling

Figure 20. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on RO-HU interconnector (M€/year)



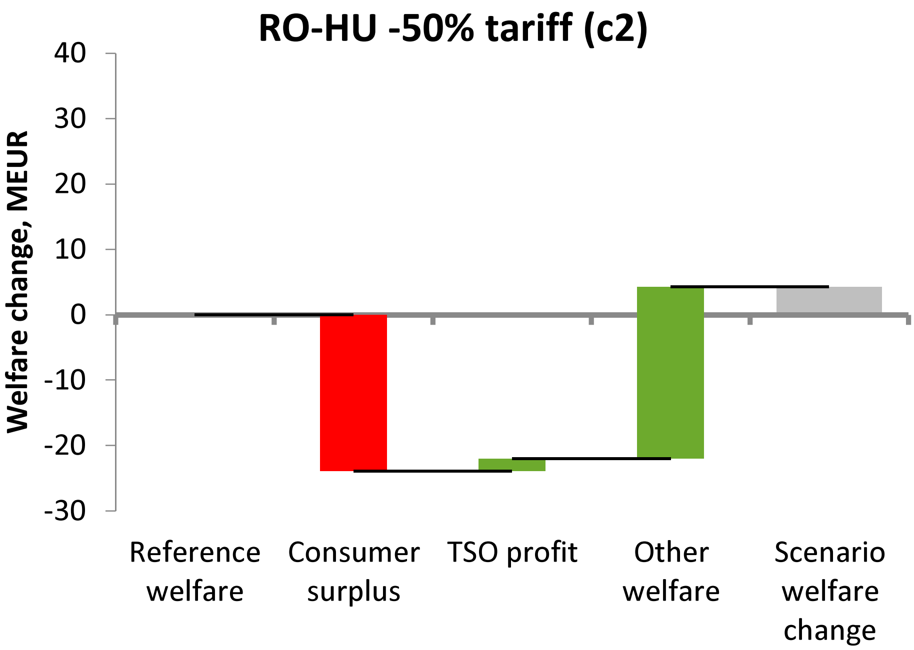
Source: REKK modelling

Figure 21. Total welfare change by countries in the CESEC region caused by 25% reduction of entry and exit tariffs on RO-HU interconnector (M€/year)



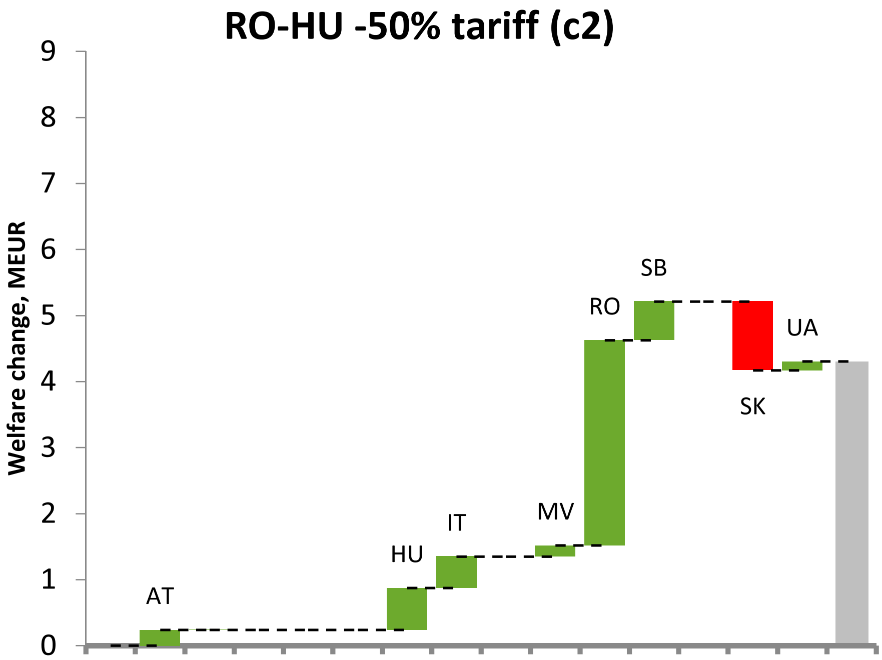
Source: REKK modelling

Figure 22. Total welfare change by stakeholders in the CESEC region caused by 50% reduction of entry and exit tariffs on RO-HU interconnector (M€/year)



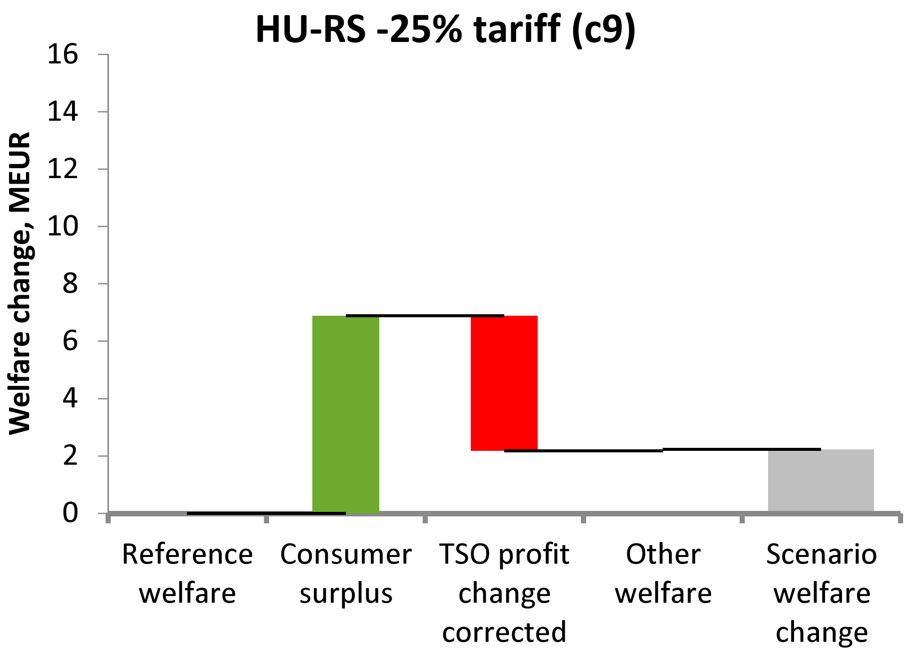
Source: REKK modelling

Figure 23. Total welfare change by countries in the CESEC region caused by 50% reduction of entry and exit tariffs on RO-HU interconnector (M€/year)



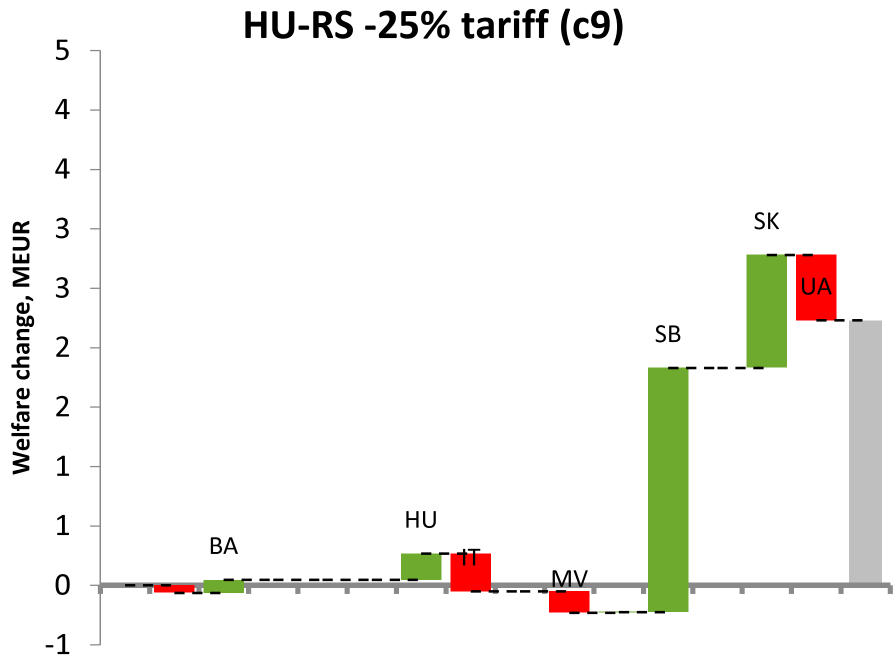
Source: REKK modelling

Figure 24. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on HU-RS interconnector (M€/year)



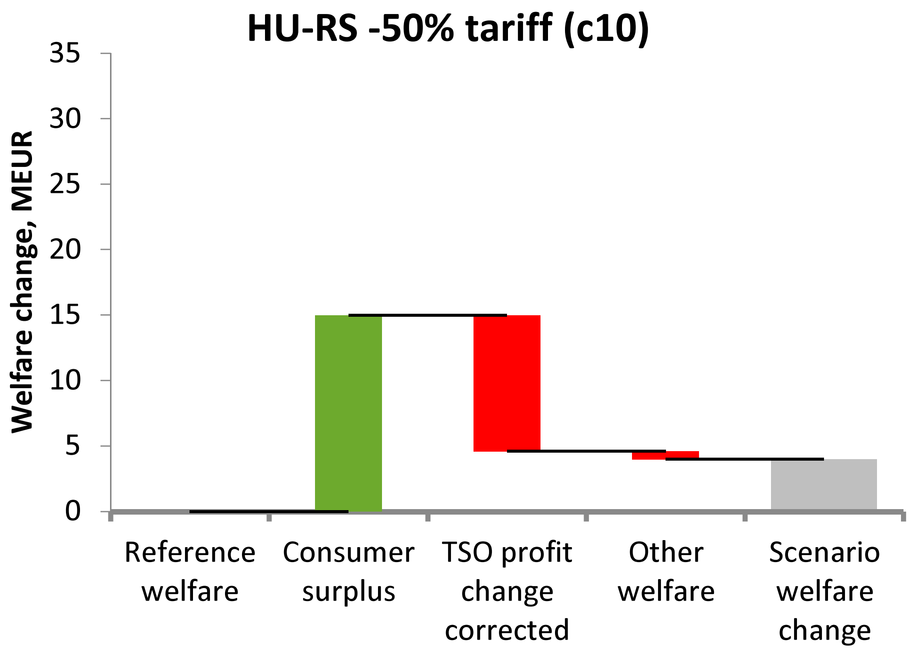
Source: REKK modelling

Figure 25. Total welfare change by countries in the CESEC region caused by 25% reduction of entry and exit tariffs on HU-RS interconnector (M€/year)



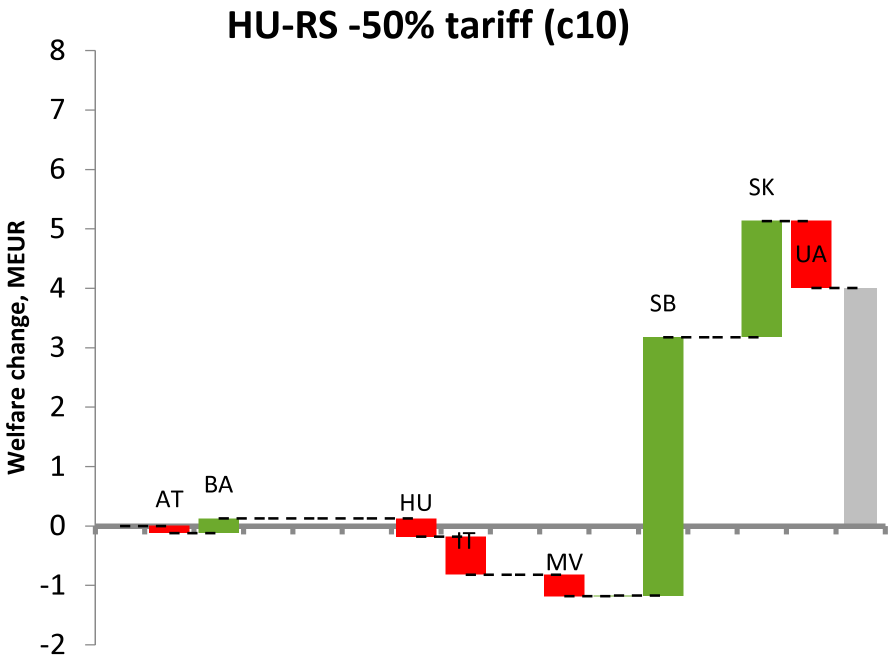
Source: REKK modelling

Figure 26. Total welfare change by stakeholders in the CESEC region caused by 50% reduction of entry and exit tariffs on HU-RS interconnector (M€/year)



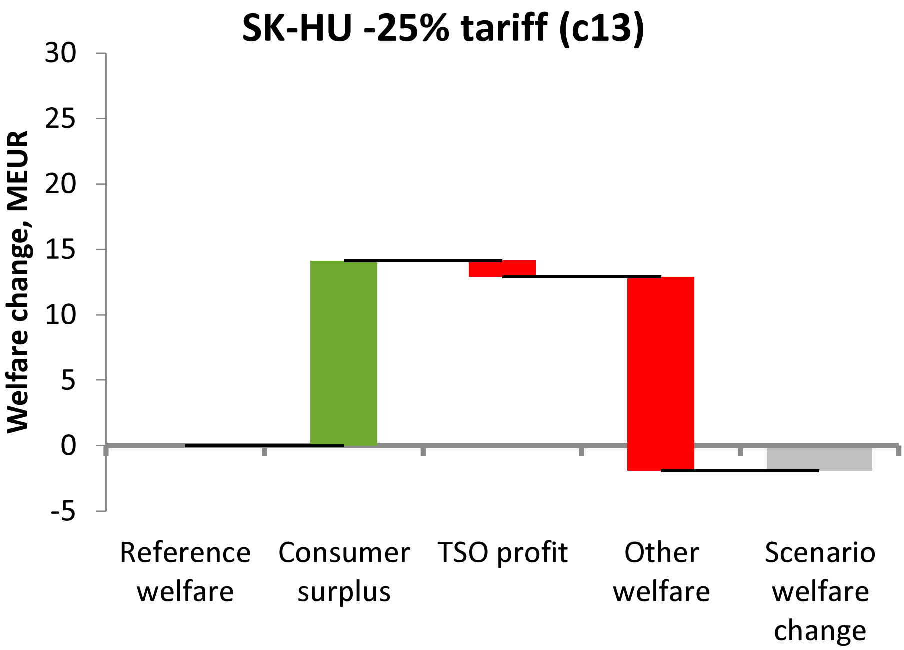
Source: REKK modelling

Figure 27. Total welfare change by countries in the CESEC region caused by 50% reduction of entry and exit tariffs on HU-RS interconnector (M€/year)



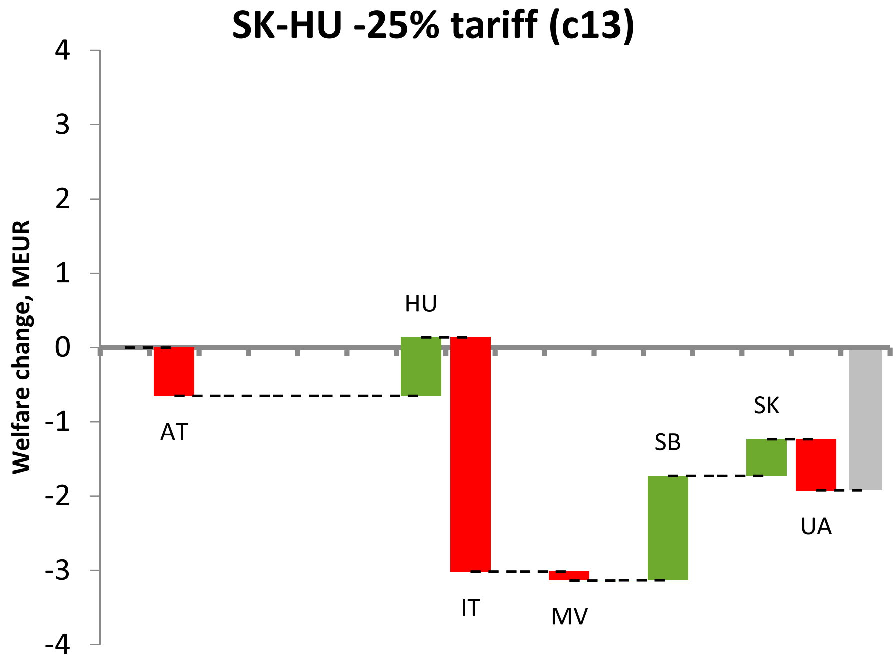
Source: REKK modelling

Figure 28. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on SK-HU interconnector (M€/year)



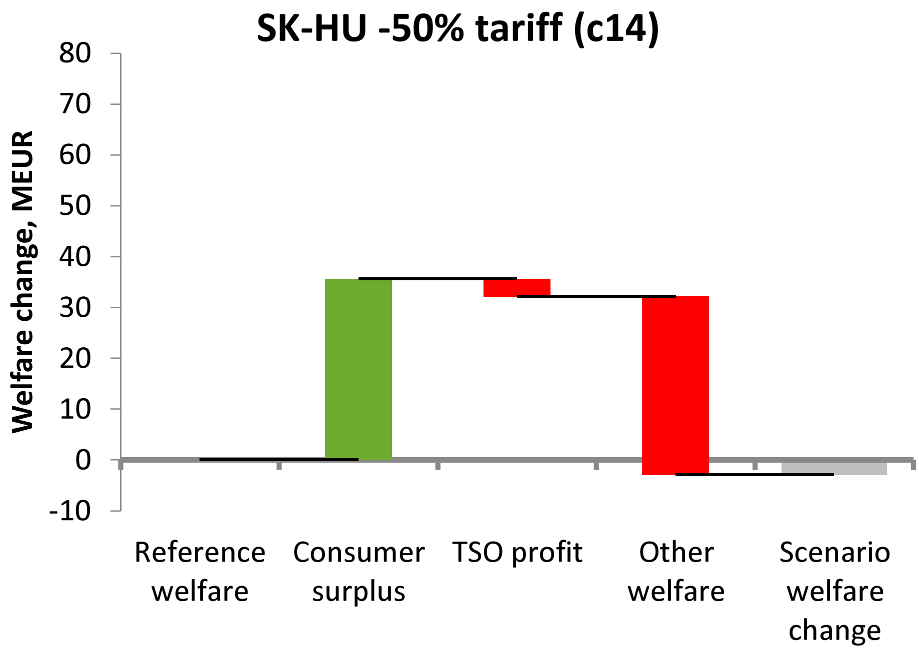
Source: REKK modelling

Figure 29. Total welfare change by countries in the CESEC region caused by 25% reduction of entry and exit tariffs on SK-HU interconnector (M€/year)



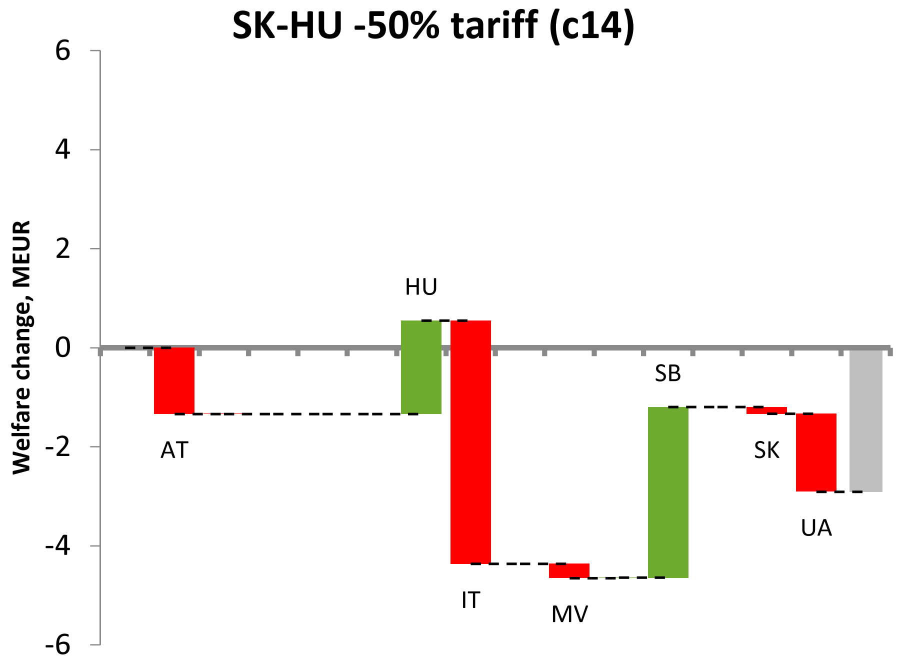
Source: REKK modelling

Figure 30. Total welfare change by stakeholders in the CESEC region caused by 50% reduction of entry and exit tariffs on SK-HU interconnector (M€/year)



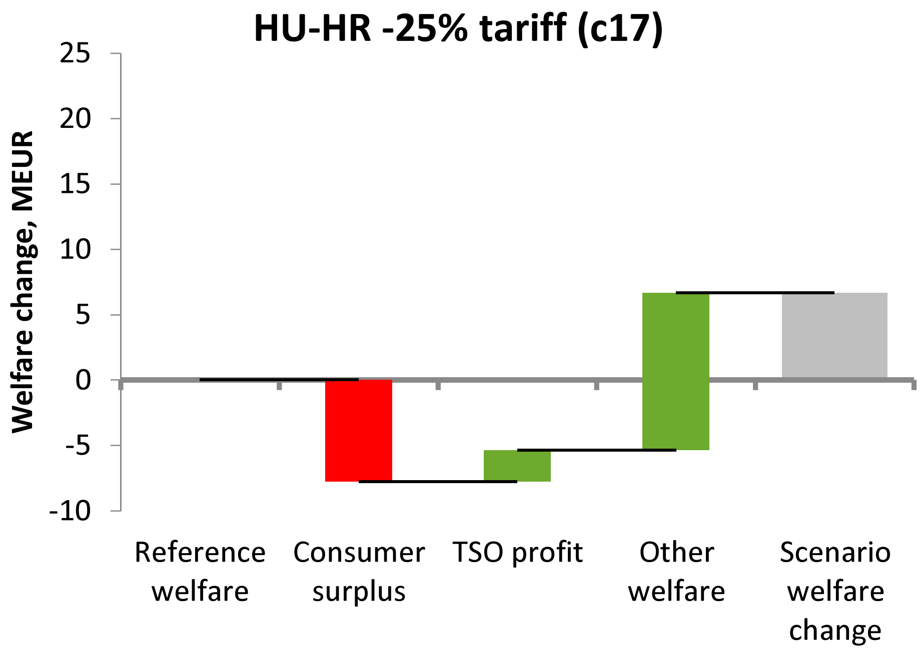
Source: REKK modelling

Figure 31. Total welfare change by countries in the CESEC region caused by 50% reduction of entry and exit tariffs on SK-HU interconnector (M€/year)



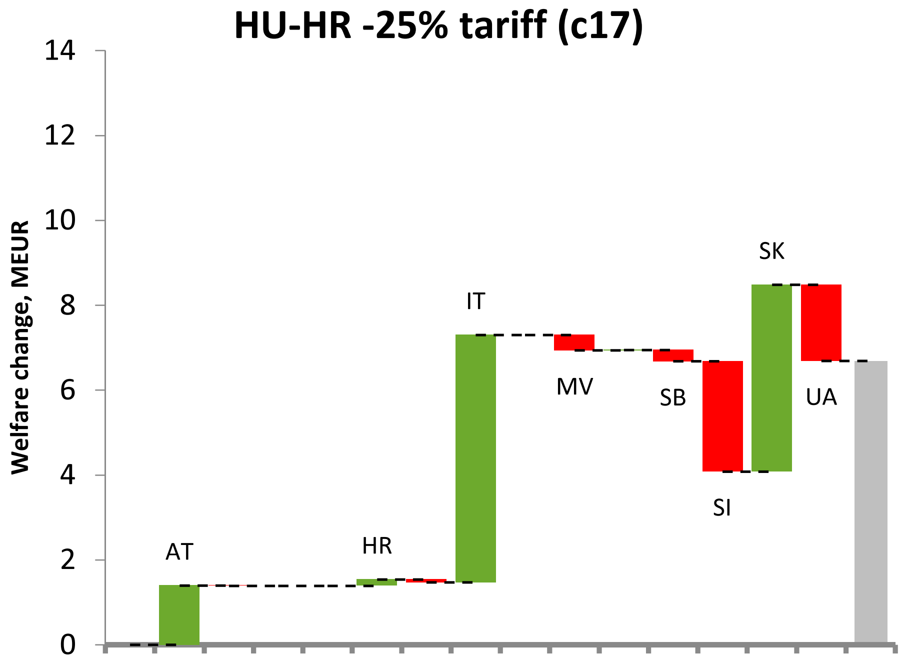
Source: REKK modelling

Figure 32. Total welfare change by stakeholders in the CESEC region caused by 25% reduction of entry and exit tariffs on HU-HR interconnector (M€/year)



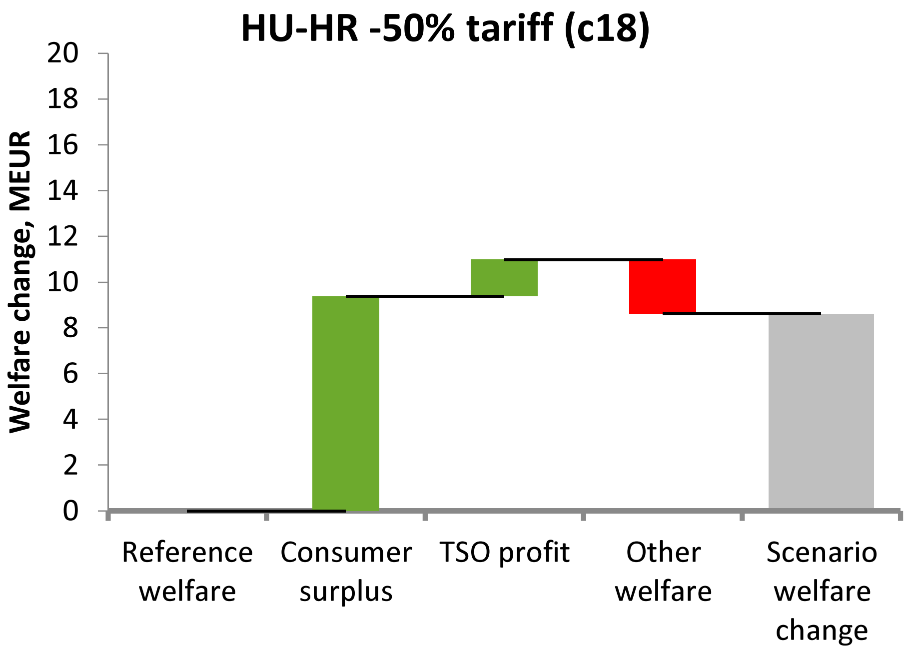
Source: REKK modelling

Figure 33. Total welfare change by countries in the CESEC region caused by 25% reduction of entry and exit tariffs on HU-HR interconnector (M€/year)



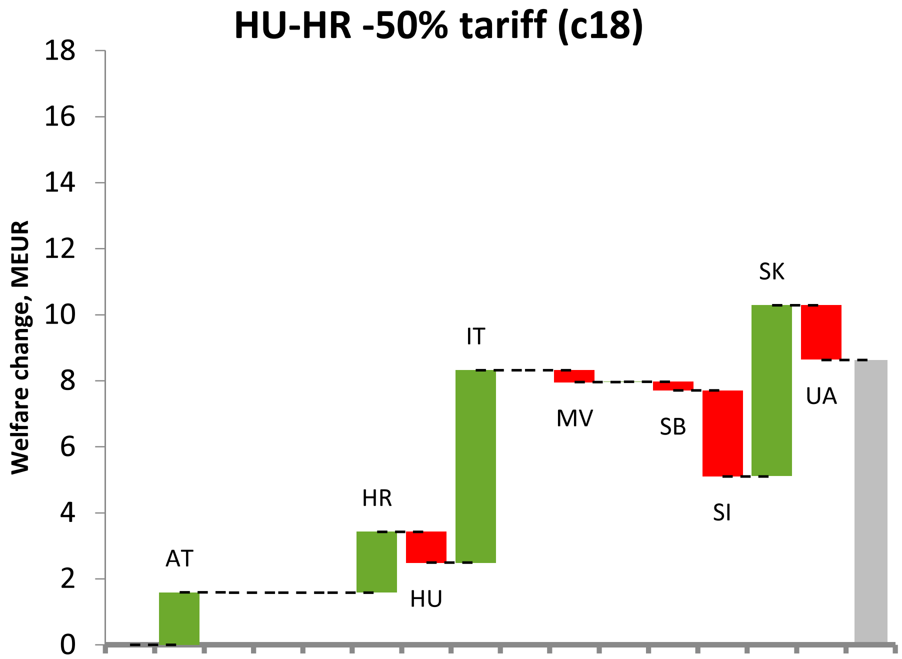
Source: REKK modelling

Figure 34. Total welfare change by stakeholders in the CESEC region caused by 50% reduction of entry and exit tariffs on HU-HR interconnector (M€/year)



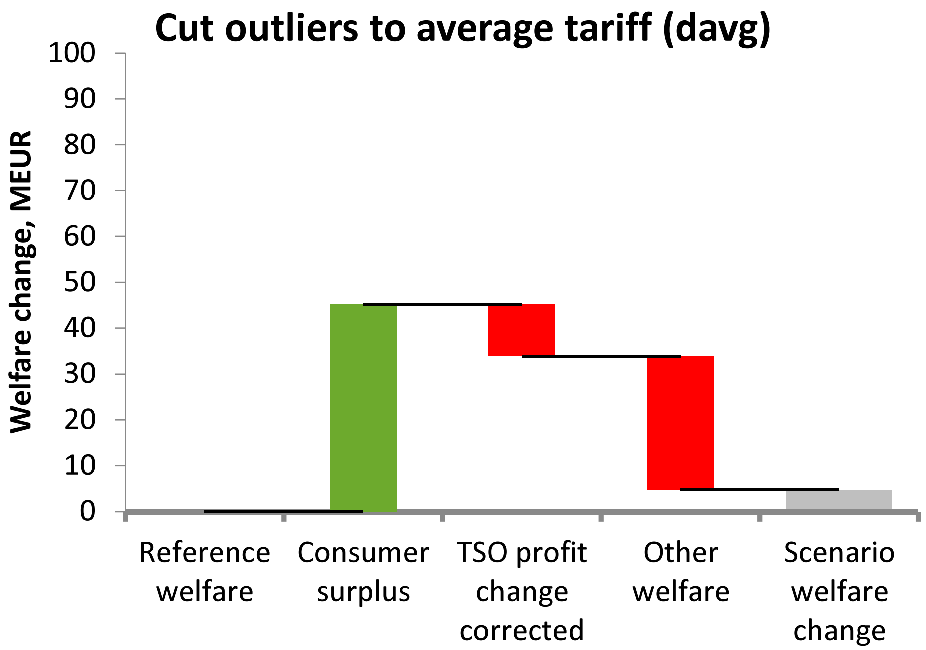
Source: REKK modelling

Figure 35. Total welfare change by countries in the CESEC region caused by 50% reduction of entry and exit tariffs on HU-HR interconnector (M€/year)



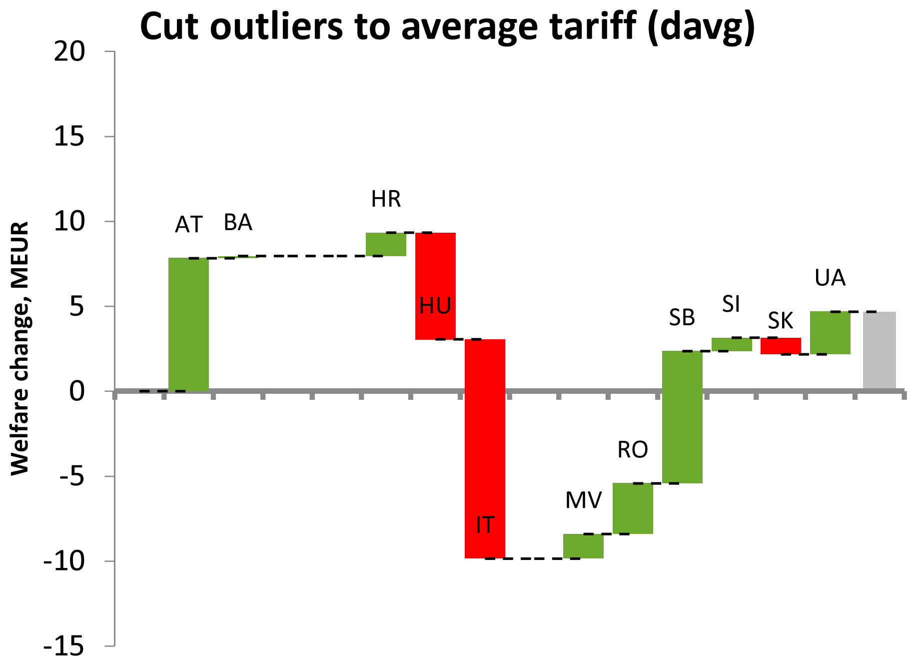
Source: REKK modelling

Figure 36. Total welfare change by stakeholders in the CESEC region caused setting outliers to average tariffs (M€/year)



Source: REKK modelling

Figure 37. Total welfare change by countries in the CESEC region caused setting outliers to average tariffs (M€/year)



Source: REKK modelling

11.ANNEX 4. EGMM MODEL DESCRIPTION

REKK's European Gas Market Model (EGMM) has been developed to simulate the operation of an international wholesale natural gas market in whole Europe (35 countries). Large external markets, such as Russia, Norway, Turkey, Libya, Algeria and LNG exporters are represented by exogenously assumed market prices, long-term supply contracts and physical connections to Europe.

Given the input data, the model calculates a dynamic competitive market equilibrium for the modelled countries, and returns the market clearing prices, along with the production, consumption and trading quantities, storage utilization decisions and long-term contract deliveries. Based on these outputs the model also calculates the components of social welfare.

Model calculations refer to 12 consecutive months, with a default setting of April-to-March.[21] Dynamic connections between months are introduced by the operation of gas storages ("you can only withdraw what you have injected previously") and TOP constraints (minimum and maximum deliveries are calculated over the entire 12-month period, enabling contractual "make-up").

The European Gas Market Model consists of the following building blocks: (1) local demand; (2) local supply; (3) gas storages; (4) external markets and supply sources; (5) cross-border pipeline connections; (6) long-term take-or-pay (TOP) contracts; and (7) spot trading. We will describe each of them in detail below.

The European Gas Market Model algorithm reads the input data and searches for the simultaneous supply-demand equilibrium (including storage stock changes and net imports) of all local markets in all months, respecting all the constraints detailed above. In short, the equilibrium state (the "result") of the model can be described by a simple no-arbitrage condition across space and time. However, it is instructive to spell out this condition in terms of the behaviour of market participants: consumers, producers and traders.[22]

Local consumers decide about gas utilization based on the market price. This decision is governed entirely by the local demand functions.

Local producers decide about their gas production level in the following way: if market prices in their country of operation are higher than unit production costs, then they produce gas at full capacity. If prices fall below costs, then production is cut back to the minimum level (possibly zero). Finally, if prices and costs are exactly equal, then producers choose some amount between the minimum and maximum levels, which is actually determined in a way to match the local demand for gas in that month.

Traders in the model are the ones performing the most complex optimization procedures. First, they decide about long-term contract deliveries in each month, based on contractual constraints (prices, TOP quantities, penalties) and local supply-demand conditions. Second, traders also utilize storages to arbitrage price differences across months. For example, if market prices in January are relatively high, then they withdraw gas from storage in January and inject it back in a later month in such a way as to maximize the difference between the selling and the buying price. As long as there is available withdrawal, injection and working

[21] The start of the modeling year can be set to any other month.

[22] We leave out storage operators, since injection and withdrawal fees are set exogenously, and stock changes are determined by traders.

gas capacity, as well as price differences between months exceeding the sum of injection costs, withdrawal costs, and the foregone interest, the arbitrage opportunity will be present and traders will exploit it.[23,24] Finally, traders also perform spot transactions, based on prices in each local and outside market and the available cross-border transmission capacities to and from those markets, including countries such as Russia, Norway, Turkey, Libya, Algeria or LNG markets, which are not explicitly included in the supply-demand equalization.

Table 17. Sources of input data used in the EGMM

Input data	Unit	Source of data
Demand	TWh/year	Eurostat 2015
Production	TWh/year, max GWh/day	Eurostat 2015 fact
Pipeline capacity	GWh/day	ENTSOG capacity map 2015
LNG capacity (regasification)	GWh/day	GLE capacity data + PL LNG terminal
Storage capacity (injection, withdrawal, working gas)	GWh/day , TWh/year	GSE 2015
Tariffs (LNG, storage, pipeline entry and exit)	€/MWh	REKK calculation based on TSO published tariffs as of January 2016
LTC (ACQ, price, route)	TWh/year, flexibility, €/MWh	Cedigas, REKK collection and calculation of price based on statistical reports for 2015
Outside market prices (NO, RU, DZ, LNG)	€/MWh	REKK calculation based on statistical data

[23] Traders also have to make sure that storages are filled up to their pre-specified closing level at the end of the year, since we do not allow for year-to-year stock changes in the model.

[24] A similar intertemporal arbitrage can also be performed in markets without available storage capacity, as long as there are direct or indirect cross-border links to countries with gas storage capability. In this sense, flexibility services are truly international in the simulation.

12.ANNEX 5. DETAILED PRICE EFFECTS

Figure 38. 2016 reference case yearly average prices, €/MWh

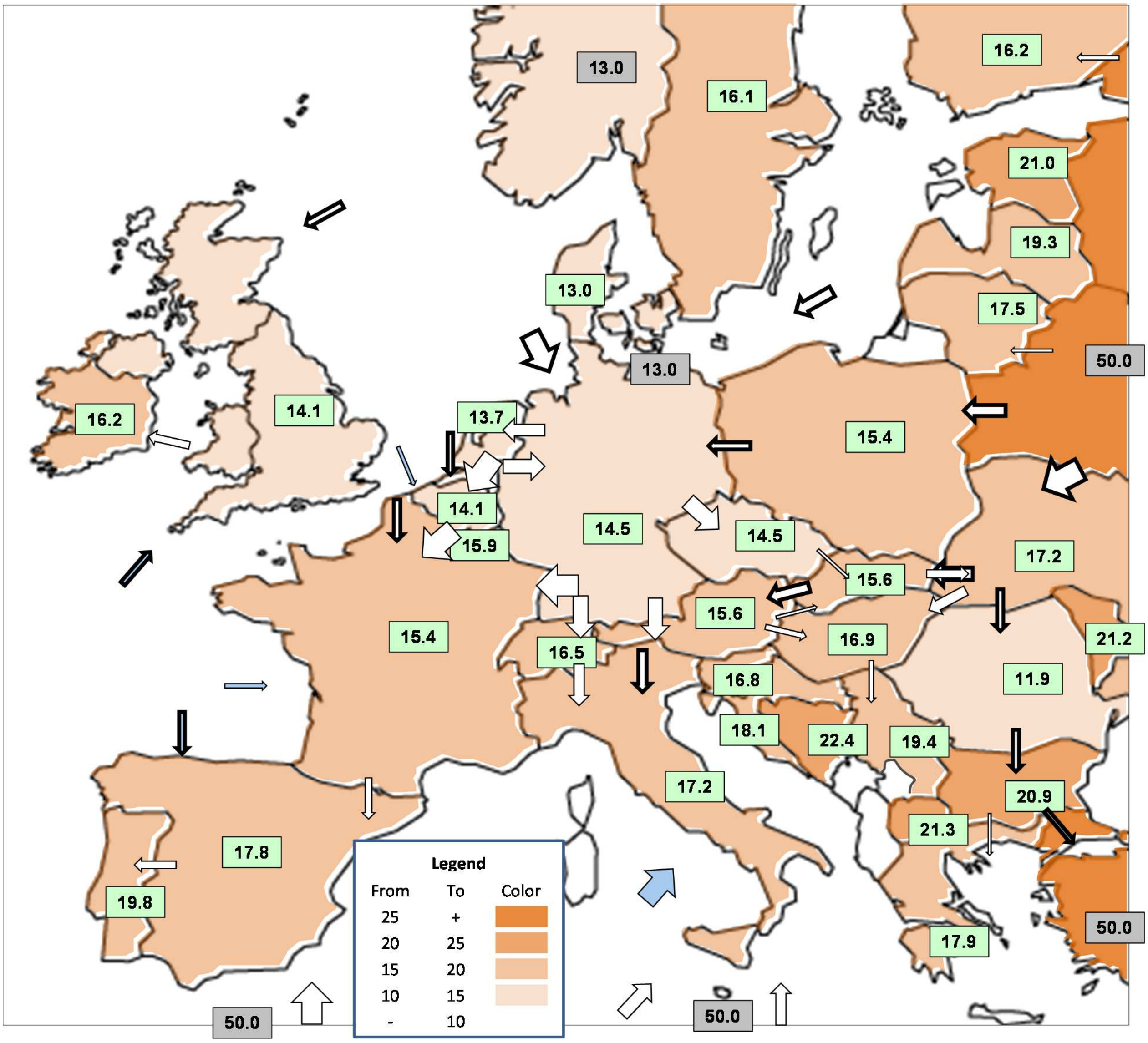


Table 18. Modelled reference wholesale gas price for the CESEC region in 2016 Q1 (€/MWh)

	Modelled wholesale gas price €/MWh
AT	15.6
BA	22.4
BG	20.9
GR	17.9
HR	18.1
HU	16.9
IT	17.2
MK	21.3
MD	21.2
RO	11.9
RS	19.4
SI	16.8
SK	15.6
UA	17.2

Table 19. Absolute price change of the modelled scenarios compared to the reference (€/MWh)

	ref	a	b	RO-HU		HU-RS		SK-HU		HU-HR		davg
				25%	50%	25%	50%	25%	50%	25%	50%	
AT	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	-2.0	-0.5	0.0	0.0	-0.6	-1.3	0.0	0.0	0.0	0.0	-0.7
BG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HR	0.0	-1.6	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.2	-1.2
HU	0.0	-0.1	0.1	0.0	0.0	0.1	0.1	-0.2	-0.5	0.0	0.0	-0.2
IT	0.0	-0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MD	0.0	-1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
RO	0.0	0.3	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
RS	0.0	-2.8	-0.6	0.0	0.0	-0.7	-1.4	-0.1	-0.3	0.0	0.0	-0.9
SI	0.0	-0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SK	0.0	1.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
UA	0.0	-1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Region	0.0	-0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

13. ANNEX 6. MODELLED UTILISATION OF PIPELINES

Table 20. Change in relative utilisation of pipelines, %. Green background indicated 2% higher utilisation while red background shows 2% lower utilisation.

	ref	a	b	c1	c2	c5	c6	c9	c10	c13	c14	c17	c18	davg
DE-AT	71%	92%	40%	71%	71%	71%	71%	71%	71%	71%	71%	73%	73%	71%
AT-DE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
AT-SI	24%	31%	17%	24%	24%	24%	24%	24%	24%	24%	24%	17%	17%	26%
AT-IT	58%	73%	56%	58%	58%	58%	58%	58%	58%	58%	58%	59%	59%	57%
IT-AT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CH-IT	26%	20%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
IT-SI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SI-HR	14%	23%	0%	14%	14%	14%	14%	14%	14%	14%	14%	0%	0%	19%
SK-CZ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CZ-SK	7%	28%	12%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
AT-SK	19%	0%	0%	19%	19%	19%	19%	19%	19%	20%	21%	22%	22%	19%
SK-AT	51%	56%	52%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%	51%
AT-HU	64%	84%	63%	63%	63%	64%	64%	64%	64%	62%	62%	64%	64%	73%
HU-SB	48%	54%	50%	48%	49%	48%	48%	50%	51%	49%	49%	48%	48%	50%
SB-BA	23%	25%	23%	23%	23%	23%	23%	23%	24%	23%	23%	23%	23%	23%
BG-MK	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
BG-GR	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
BG-TR	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
RO-BG	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
HU-RO	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HU-HR	0%	6%	11%	0%	0%	0%	0%	0%	0%	0%	0%	11%	13%	0%
UA-PL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
UA-SK	42%	43%	43%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
UA-HU	26%	26%	26%	26%	26%	26%	26%	27%	27%	26%	26%	27%	27%	26%
UA-RO	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
TR-GR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
UA-MV	29%	30%	28%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
HU-UA	7%	31%	1%	7%	7%	7%	7%	7%	6%	7%	7%	3%	2%	14%
PL-UA	42%	42%	51%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%
SK-UA	48%	52%	46%	48%	48%	48%	48%	48%	48%	48%	48%	51%	51%	48%
RO-HU	25%	100%	97%	67%	92%	25%	25%	25%	25%	25%	25%	25%	25%	100%
HU-SK	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SK-HU	12%	31%	8%	11%	11%	12%	12%	12%	13%	15%	18%	12%	12%	13%
HR-HU	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SI-IT	0%	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: REKK modelling

Table 21. Change in absolute pipeline flows, TWh/year. Green background indicated 2% higher utilisation while red background shows 2% lower utilisation.

	ref	a	b	c1	c2	c5	c6	c9	c10	c13	c14	c17	c18	davg
DE-AT	80.7	105.3	45.3	80.7	80.7	80.7	80.7	80.7	80.8	80.7	80.7	83.2	83.7	81.1
AT-DE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AT-SI	9.9	12.6	6.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	7.1	7.1	10.8
AT-IT	242.6	303.0	231.6	242.9	242.9	242.6	242.6	242.4	242.3	242.1	241.3	245.3	245.3	237.9
IT-AT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH-IT	58.6	45.3	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6
IT-SI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SI-HR	2.8	4.4	0.0	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0	3.7
SK-CZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CZ-SK	17.4	71.9	31.1	17.4	17.4	17.4	17.4	17.4	17.4	17.5	17.5	17.4	17.4	18.0
AT-SK	17.2	0.0	0.0	16.9	16.9	17.2	17.2	17.3	17.5	18.4	19.2	19.6	20.2	17.0
SK-AT	286.5	315.1	290.5	286.4	286.4	286.5	286.5	286.6	286.6	286.5	286.5	286.6	286.6	286.6
AT-HU	30.2	39.8	29.9	30.0	30.0	30.2	30.2	30.3	30.3	29.5	29.5	30.2	30.3	34.6
HU-SB	24.8	27.7	25.5	24.8	24.9	24.8	24.8	25.6	26.3	25.0	25.2	24.8	24.8	25.8
SB-BA	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BG-MK	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BG-GR	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
BG-TR	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9	131.9
RO-BG	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4	173.4
HU-RO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HU-HR	0.0	1.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	3.7	0.0
UA-PL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UA-SK	353.0	355.0	356.8	352.9	352.9	353.0	353.0	353.1	353.1	353.0	353.0	353.0	353.0	353.1
UA-HU	58.0	57.2	58.0	57.9	57.9	58.0	58.0	58.1	58.2	58.0	58.0	58.1	58.1	58.0
UA-RO	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9	177.9
TR-GR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UA-MV	7.7	8.1	7.5	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
HU-UA	4.7	20.6	0.5	4.7	5.0	4.7	4.7	4.5	4.2	4.7	4.8	1.8	1.2	9.0
PL-UA	6.9	6.9	8.5	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
SK-UA	46.5	50.5	44.6	46.5	46.5	46.5	46.5	46.5	46.5	46.3	46.1	49.0	49.5	46.8
RO-HU	0.4	1.6	1.6	1.1	1.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.6
HU-SK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SK-HU	5.5	14.2	3.9	5.3	5.3	5.5	5.5	5.7	6.0	7.2	8.3	5.5	5.5	5.8
HR-HU	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SI-IT	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: REKK modelling

14. ANNEX 7. TECHNICAL ANNEX

Table 22. Exchange rates used for tariff calculation

	National currency/€
HU	309.14
RO	4.44
CZ	27.39
BG	1.96
HR	7.62
RS	120.56
PL	4.18
UA	22.71
LT	3.43
MV	20.45
BA	1.96
MK	61.59
TR	2.97
CH	1.08
UK	0.73
DK	7.46
SE	9.34
US	1.13

Source: ECB 2015

Table 23. ISO 3166-1 alpha-2 Country codes

ISO country code	Country name
AT	Austria
BA	Bosnia and Herzegovina
BG	Bulgaria
CH	Switzerland
CZ	Czech Republic
DE	Germany
GR	Greece
HR	Croatia
HU	Hungary
IT	Italy
MD	Moldova
MK	Former Yugoslavian Republic of Macedonia
PL	Poland
RO	Romania
RS	Serbia
SI	Slovenia
SK	Slovakia
TR	Turkey
UA	Ukraine