

A top-down approach to identify the most important natural gas cross-border infrastructure projects

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Introduction

Well-conceived infrastructure development is the key to a fully integrated gas market as depicted in the Energy Union Package. Physical interconnection is the hardware that enables security of supply, which has become a particularly high priority issue, especially in the new Member States. The Energy Union package provides financial tools to accelerate the implementation of key PCI projects. Yet, at the same time, gas demand is declining in most European countries, and energy efficiency policies might even accelerate this process. The aim of this paper is to identify the most important missing natural gas interconnections under varying market circumstances.

The framework goes beyond assumptions underpinning the current market structure, first reflecting a change to the contracted delivery point of Russian gas as outlined by Gazprom CEO Alexei Miller¹. The concept that contract delivery would be changed from contracting party's entry border point to the EU border questions the pre-defined transmission route and the ultimate delivery point, the last tenet of long-term contracts that remains untouched to date. Using model simulation, the effect of this contractual revision can be quantified and measured according to the natural gas market prices and the welfare position of the gas market players in the modelled countries (consumers, producers, long term contract holders, SSO, TSO).

The intensified climate efforts addressed in the Energy Union Package and the 2030 Climate and Energy Policy Framework will also have an impact on the ultimate design of gas infrastructure. One scenario is dedicated to the implications of a redistribution of gas consumption resulting from climate regulation.

The first section of the paper provides a literature overview, the second chapter describes the applied methodology while the third chapter summarizes the modelling results. Chapter four offers conclusions from the analysis.

¹ <http://rt.com/business/249273-gazprom-ukraine-gas-transit/>

Background

The Energy Union Package released by the European Commission in February 2015² established five dimensions toward a more cohesive energy union, three of which will be addressed in this paper: 1) energy security; 2) full market integration (gas); and 3) energy efficiency contributing to moderation of (gas) demand.

The energy security vision of Europe was set out in the May 2014 Communication of the Commission on its Energy Security Strategy, which assessed the vulnerability of EU member states to a supply shock premised on an interruption of Russian gas deliveries through Ukraine. The main message was that solidarity and cooperation among member states would substantially reduce the damages of a supply disruption. In the following analysis this solidarity and cooperation translates to an assumption that trade across gas infrastructure will not be constrained by any intervention from Member States.

The need for more interconnected markets via source and route diversification has been addressed by the 347/2013 infrastructure regulation, the PCI (Project of Common Interest) selection process and by the Energy Strategy as well, already reducing the 248 PCI list to 33 short and mid-term key infrastructure projects³. The Energy Union Package has proposed a European Fund for Strategic Investments (EFSI) to support financing of this infrastructure. One of the key outcomes of this paper is to contribute to the debate on which pieces of infrastructure are best suited from a European social welfare point of view.

The second issue that this paper addresses is the goal of market integration as outlined in the Energy Union proposal. The European energy market has gone through a liberalization process that has changed the playing field substantially; the shift from system dominated by state owned, vertically integrated monopolies to retail market competition took more than 20 years now.

The key component of the European regulation is the regulated third party access to pipeline infrastructure. The access rules and allocation of capacities are regulated in detail, and specific language addresses the problem of contractual congestion and capacity hoarding, whereby long term capacity booking prevents the efficient use of the existing infrastructure.

² http://ec.europa.eu/priorities/energy-union/docs/energyunion_en.pdf

³ <https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest>

The use-it or lose it principle is applied to free up immediate unused capacities that are typically tied to long term gas supply contracts (LTCs). Long term take-or pay gas purchase contracts were thought to be one of the cornerstones of security of supply in the EU, but now related capacity bookings are identified as the main obstacles to European gas market integration (Commission Inquiry 2007).

Neuhoff and Hirschhausen (2005) analysed the economics of long-term gas contracts under changing institutional conditions, mainly in the process of gas sector liberalization. The original role of long term gas purchase contracts and the underlying fundamentals were described in the literature very precisely (Neuhoff and Hirschhausen (2005), Asche et.al. (2002), Stern and Rogers (2012, 2014), Henderson and Pirani eds. (2014)).

Traditionally, capital intensive investment into major pipelines was supported by long term ship or pay contracts. This secured the bankability of the projects. KEMA (2013) argues that in a mature market, with market-based pricing and secure and predictable demand, this added value is diminishing. There is less need for long term transportation capacity contracts to serve as physical back up for the commodity business in the presence of liquid markets. Long term transportation capacity booking, rather, serves as a hedge against the transportation congestion cost risk. But in a well-developed market there are other means, outside long term transport contracts, to cover this risk. The development of the new network codes and transmission capacity booking rules work to this end.

Although European regulation and network codes have addressed the long term booking of gas infrastructure, a significant obstacle to new players entering the market, the fundamental change in the long term transportation contracts was never seriously considered. Surprisingly, the notion of fixed routes with a delivery point at the buyers' border entry point has been challenged by Russia and not by European counterparts, in light of recent events in Ukraine. One of the reasons is that defined routes are cumbersome in a market-based transmission capacity allocation environment with increasing spot based trading between a growing number of buyers. This constrains the seller's ability to adjust its trading strategy to the changing market conditions.

At the end of 2014 Russian President Vladimir Putin finally announced the cancellation of the South Stream project, largely because a mutual agreement on the exemption terms from the European TPA rules could not be reached. Without the construction of a huge Southern gas transmission pipeline the responsibility has been shifted to the EU⁴, implying that the EU rules are making any ‘business as usual’ activities related to financing of LTC supply and transmission contracts impossible. This manifested in Mr. Putin’s state-level visits to the capitals of European buyers in the beginning of 2015 when, along with the cancellation of South Stream, he also threatened to stop deliveries through Ukraine to Europe entirely after 2019. This would fundamentally change the delivery point at the EU border where buyers are responsible for intra-EU transport. The Energy Union package is, to a degree, emblematic of the EU’s frosty relations with Russia, and suggests that the EU consider reframing its energy relationship with Russia based on a level playing field in terms of market opening and fair competition for the mutual benefit of both sides.

This paper also contributes to the debate that emerged after the cancellation of South Stream concerning the feasibility and seriousness of Turkish Stream (Stern 2015). It tests how far the current European natural gas transmission infrastructure could stretch to deliver gas on a market basis if Russia treats the EU as a single entity and excludes Ukraine transit. This infers that all Russian gas would be delivered through North Stream (to Germany), Yamal (to Poland), and Turkey to Bulgaria and Greece. Of course countries supplied directly from Russia (Finland, and the Baltic States) would be served as before.

Finally, the paper reflects on the consequence of more efficient energy (gas) consumption. Energy efficiency investments reduce overall gas demand, but decarbonisation plans, especially in countries with a substantial share of fossil fuels in their energy mix, might incentivize an increase in gas consumption to meet climate targets. The energy efficiency measures will affect the wholesale gas market price and the shift in gas demand will have an effect on the utilization of existing and planned gas infrastructure. When deciding on which infrastructure to build, the energy efficiency driven demand change must be taken into account, and this issue will be addressed in the analysis.

⁴ <http://www.euractiv.com/sections/global-europe/russia-sheds-light-turkish-stream-project-311900>

Methodology

Theory suggests that in an integrated market of homogenous products the price differences between countries should equal the transportation costs, and when the spread intensifies transportation systems become congested. Based on the literature described above, this paper assumes that the European natural gas market is fully integrated as intended. Although it is understood that this is not necessarily true in all parts of the EU, we base the assumption on the fact that the European regulation is on a path towards an integrated gas market. (Gas Target model (ACER, 2015)⁵, Energy Union Package (COM 2015))

The paper aims to define the most important missing natural gas interconnections under different market circumstances. Two important possible changes in the European market will be simulated: 1) the change of delivery points of Russian gas supply contracts to the borders of the EU, excluding Ukraine, and 2) a more intense European climate policy. Four scenarios will be compared:

- First, the 2015 reference year will be modelled with the existing European infrastructure and supply sources, using existing long term contract ACQ, flexibility and price terms and delivery points as they are at the beginning of 2015.
- Second, a 2020 reference year will be modelled using forecasted 2020 demand, indigenous production⁶ and 30 bcm less long term contracted gas in place. At the same time we allow for infrastructure development with the FID projects that are planned to be commissioned until 2020.
- Third, the previous 2020 scenario is modelled with only a change to the delivery point of Russian long term contracts: gas is dropped at the EU borders, absent Ukraine, at a uniform price.
- Fourth, a strong European energy efficiency and renewable policy will be assumed to test the effect of changed demand setting.

⁵ Our European Gas Market Model is simulating the vision of the Gas Target Modell by representing a competitive European gas market, comprising entry-exit zones (in our model each country is one zone), where market integration is served by appropriate level of infrastructure, which is utilised efficiently and enables gas to move freely between market areas to the locations where it is most highly valued by gas market participants.

⁶ Demand and production forecasts of TYNDP 2015 is used

In all scenarios, the necessary infrastructure required to arrive at an integrated European market will be identified, where price differences reflect the cost of transmission at the border point.

The first premise is that, with North Stream in place and diverse suppliers already participating in the market (e.g. NL, NO and LNG), North West Europe is largely unaffected by the change in Russian contract delivery points. However in Central and Southern-Eastern European (CSEE) countries which are for historical and geographical reasons more dependent on Russian gas supplied through Ukraine, such a change will trigger the need to build more pipeline infrastructure.

Secondly, it is assumed that a more intense European climate policy will cause significant changes in the gas demand of EU countries—mostly reducing demand but in some countries increasing it—which will impact the utilization of identified infrastructure.

All of Europe will be modelled, however this paper concentrates on the most vulnerable CSEE countries with a high dependence on Russian gas. Differences in the modelled wholesale gas market prices between the reference case and other scenarios are quantified and monetized to represent the aggregate shift in social welfare. This takes into account changes in all market players: consumers, producers, transmission and storage system operators, traders and long term contract holders. The authors believe that no policy or infrastructure investment causing negative welfare change should be implemented. They, however, stress that the monetized benefits must be evaluated against the cost. This last step of cost estimation is however beyond the scope of this paper.

For the simulations we use the European Gas Market Model developed by REKK. The more detailed model description can be read in REKK & KEMA (2013) for the predecessor DRGMM model. In the extended EGMM model the fundamentals are the same, but LNG markets are more accurately represented. The coverage was extended to 35 European countries, covering the EU (except for Malta and Cyprus) and the Energy Community endogenously. Previous use of EGMM for modelling can be found in (REKK (2012), REKK&KEMA (2013), Sartor et al. (2014), Selei and Tóth (2013)).

The identification of key infrastructure is as follows: first when the model finds congestion on an existing infrastructure, the capacity of the pipeline will be enlarged to lift the congestion; second when two neighbouring countries without physical connection have a modelled gas wholesale price difference of more than 2 €/MWh (the assumed transportation cost in the case of new infrastructures), they will be connected with the pipeline capacity proposed in the 2015 TYNDP.

Modelling results

As a starting point, a reference scenario is established based on 2015 demand, supply, infrastructure and contractual conditions. TYNDP 2015 is used for demand⁷ and domestic production forecasts for 2015. Existing infrastructure is expanded to those which already reached final investment decision⁸. The assumed storage and transmission tariffs also reflect current market conditions, based on published tariffs.

In a 2015 modelled reference the average price of the analyzed region (23.3 €/MWh) is 1.6 €/MWh more expensive than the EU28 average (21.7 €/MWh). There is only one congested pipeline in Europe (AT-HU) in the reference scenario, which is consistent with data from the past few years. Accordingly, as a first step AT-HU was extended in the model, to allow flows from Western Europe into the CSEE region. The most important projects identified are:

- RO-HU reverse flow, which is currently operated at only 5% of the main flow capacity direction and strongly supported and partly financed by the EU;
- the RO-MV interconnector, which has been agreed upon numerous times but postponed to preserve short-term gains in negotiations over the contract price with Russia⁹;
- the IGB (GR-BG), which project has for a few years now the commissioning date set always for the end of next year, despite strong support from the EU side; and

⁷ TYNDP Grey scenario, annual data

⁸ SK-HU, FR-ES bidirectional interconnectors, Polish LNG terminal. For all infrastructure capacity (pipeline, storage, LNG) data we used ENTSO-G capacity map data

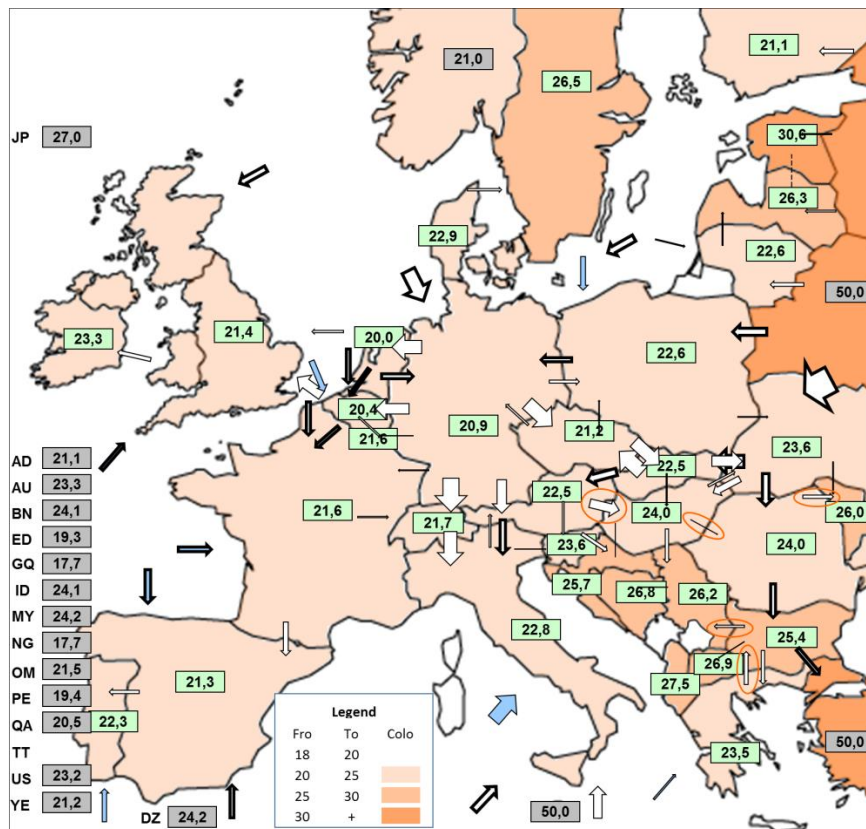
⁹ We include this interconnector into all of the following scenarios to prevent the isolation of Moldovan gas market.

- BG-SB, also on PCI (Project of Common Interest of the EU) and on the PEI (Project of Energy Community Interest) lists and to be commissioned by the end of 2015.

The results are very intuitive as these projects have been identified previously by other relevant bodies as key projects to the region (ENTSO-G TYNDP, COM 2014).

The modelled equilibrium annual average gas wholesale prices and trade flows in the presence of key infrastructures¹⁰ are depicted below in Figure 1.

Figure 1 2015 setup with key infrastructure



Blue arrows: LNG flows, white arrows: modelled gas flow on interconnectors, congested¹¹ when colored; Green boxes: modelled yearly average wholesale gas prices; Grey boxes: outside market spot prices

¹⁰ indicated by orange circles

¹¹ Congestion on the map occurs when the pipeline is not 100 % utilized during no more than 3 of the 12 modelled months

The welfare changes observed in the table below (Table 1) explains why the implementation of these well-known projects might have been consistently delayed¹². Although individual TSOs might not have incentive to complete these projects and the investment cost have not yet been taken into account, total social welfare gains due to the realization of these projects are on the magnitude of 10 million €/year for CSEE. The two most significant factors reducing total welfare are the large decrease in Romania's consumer surplus and the losses for the long term contract holders in the countries where prices fall. The total welfare change for the EU 28 is actually negative, meaning that with the current set of long term contracts in place the interconnection of markets will actually create social welfare losses.

Table 1 Welfare change due to key infrastructure in 2015

	Price (€/MWh)		Welfare change (million €)							
	Reference	With new infra	Consumer Surplus	Producer surplus	SSO operating profit	SSO arbitrage profit	Net profit from long-term contracts	TSO operating profit	TSO auction revenue	Total welfare
AT	22.1	22.5	-36.2	6.6	0.0	0.0	34.6	1.6	-0.6	6.0
BA	27.0	26.8	0.2	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
BG	26.2	25.4	27.0	-3.5	0.7	0.0	-21.5	6.2	0.0	9.1
GR	23.3	23.5	-8.5	0.0	0.0	0.0	-1.8	3.3	0.0	-7.0
HR	25.6	25.7	-4.7	2.0	0.0	3.4	0.0	-0.1	-2.8	-2.2
HU	24.7	24.0	67.4	-9.5	-4.4	0.0	-35.3	5.5	-16.0	7.7
MK	27.9	26.9	1.6	0.0	0.0	0.0	-1.5	0.0	0.0	0.1
MV	27.7	26.0	16.1	0.0	0.0	0.0	-1.0	0.8	0.0	16.0
RO	20.5	24.0	-381.5	377.2	-5.0	0.0	14.6	3.1	0.0	8.5
SB	26.7	26.2	17.9	-1.0	-10.4	-1.6	-7.6	1.8	0.0	-0.9
SI	23.2	23.6	-3.4	0.0	0.0	0.0	3.8	-0.3	-3.7	-3.6
SK	22.7	22.5	9.7	0.0	0.0	0.0	-7.6	-14.4	-11.3	-23.6
Total in the Region	23.3	23.9	-294.3	372.0	-19.1	1.7	-23.6	7.6	-34.4	9.9
Total in EU28	21.7	21.8	-182.6	329.3	-52.6	-5.9	-105.4	3.0	-32.7	-46.9

Next, the 2020 reference scenario will be set to serve as a starting point for the consequential analysis. Beyond using 2020 TYNDP forecasts of demand and domestic

¹² HAG: Hungarian TSO operation profit is by far outweighed by the auction revenues that can be earned on a congested pipeline. The producer surplus loss is affecting the mother company of the TSO. The state owned long term contract holder and the state owned storage operator are also losing, so there is little incentive to have more access to the West through this pipeline.

RO-HU and RO-MV: Romania, as the only country in the region with substantial domestic gas production, is keen on protecting its domestic market. Having interconnection in this case would certainly bring convergence in prices regionally, but in this case it means that Romanian prices would increase.

IGB: The incumbent company owning the TSO holds the long term contract with Russia and the new pipeline would create competition to the long term contracted gas that has to be taken on a take-or pay basis.

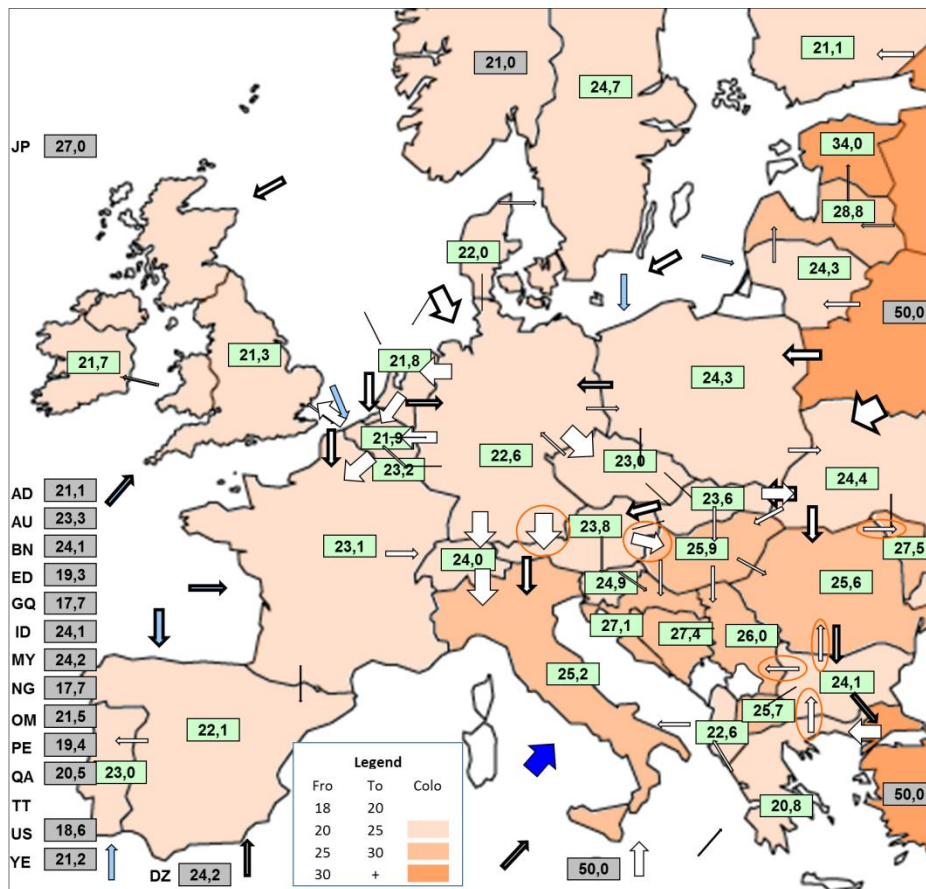
production data, it is also assumed that the Trans-Adriatic Pipeline comes into operation¹³ and the long-term contracts expiring by 2020 are not extended¹⁴.

Due to the lower volume of long-term contracted gas, average wholesale prices increase throughout Europe. This price increase is higher in the CSEE Region than in Western Europe, which signals that beyond the extension of HAG the enlargement of the DE-AT interconnector is also imperative for adequate delivery from Western to Southern and Eastern Europe. In 2020 the key infrastructure is representative of 2015, with the only difference being that the BG-RO interconnector is also needed.

¹³ In parallel, we also include 1 bcm contracted Azeri gas to Greece and 8 bcm Azeri gas to Italy at a price of 25.2 (reference price in Italy)

¹⁴ The expiring long term contracts are: RU-HU, RU-SI, RU-GR, RU-AT, NO-AT, DZ-IT, all together -30 bcm. Out of that 10 bcm is the Russian gas, 17 bcm Algerian gas to Italy, and 2,7 bcm Norwegian gas to Austria. This is a quite rigid assumption, since we do not think that Russian gas will not arrive to the region after the contracts expire, and spot trading with Russia in the model is not possible (reflected in very high – 50 €/MWh- outside spot Russian gas). For modelling purposes we use this assumption to allow the new sources and new infrastructure to find its way to the market. The strategic behaviour of Russia is not analysed in this paper.

Figure 2 2020 setup with key infrastructure



Partly due to the phasing out of long term contracts, the social welfare gains become significantly higher in 2020: gains are positive for the EU28, and the region adds 343 million €/year. The long term contract holders position is still negative on a regional and EU28 level, but TSO revenues become more balanced: in CSEE the loss of auction revenues are outweighed by the increase of gas flows on new pipelines and hence by the increase of TSO operating profit. Total welfare loss in the region is negligible for Slovenia but is substantial for Slovakia. For the rest of the CSEE countries the total welfare change is positive.

Table 2 Welfare change due to key infrastructure in 2020

	Price (€/MWh)		Welfare change (million €)							
	Reference	With new infra	Consumer Surplus	Producer surplus	SSO operating profit	SSO arbitrage profit	Net profit from long-term contracts	TSO operating profit	TSO auction revenue	Total welfare
AT	24.3	23.8	37.8	-5.5	0.0	0.0	-26.5	106.7	-30.2	82.2

BA	30.3	27.4	4.8	0.0	0.0	0.0	-4.4	0.0	0.0	0.4
BG	30.5	24.1	272.3	-76.5	7.5	0.0	-176.8	39.3	29.1	95.0
GR	20.8	20.8	-0.2	0.0	0.0	0.0	0.1	0.0	29.0	28.9
HR	28.0	27.1	20.6	-8.2	0.2	3.6	0.0	0.0	-4.4	11.8
HU	27.8	25.9	222.1	-22.0	0.0	0.0	0.0	-16.2	-51.6	132.2
MK	27.7	25.7	3.1	0.0	0.0	0.0	-3.0	0.0	0.0	0.1
MV	29.4	27.5	19.4	0.0	0.0	0.0	-1.2	0.7	0.0	18.9
RO	26.9	25.6	140.3	-120.5	-8.4	0.0	-6.1	6.2	0.5	12.0
SB	30.0	26.0	140.5	-4.0	-16.1	-3.1	-50.1	8.1	0.2	75.5
SI	25.4	24.9	4.1	0.0	0.0	0.0	-1.8	-0.3	-3.6	-1.5
SK	24.1	23.6	32.9	0.0	0.0	0.0	-38.0	-20.7	-86.2	-111.9
Total in the Region	26.5	24.8	897.8	-236.8	-16.8	0.6	-307.8	123.8	-117.3	343.6
Total in EU28	23.2	23.1	647.7	-155.2	-29.3	-8.0	-150.6	148.0	-169.0	283.7

In the second 2020 scenario, key natural gas infrastructure will be identified in an innovative way: Russian gas is assumed to be delivered exclusively to EU borders absent Ukraine (Nord Stream - DE, Yamal PL, Turkish stream and borders with the Baltic countries) at the same price (23 €/MWh) for all buyers, with market forces dictating the internal distribution of the gas between countries. In this scenario the Russian deliveries to Europe are not sufficient without the Ukrainian transmission system, so if Russia decides to neglect the use of existing pipeline through the Ukraine, at least two stings from the proposed Turkish pipeline (delivering 30 bcm/ year natural gas to Turkey) has to be built. Additionally in order to be able to deliver Russian gas from Turkey to Europe the TR-GR interconnector had to be expanded and the Trans-Balkan pipeline was reversed from Turkey to Bulgaria¹⁵.

Results of Table 3 indicate that only the structural change shifting the delivery point of Russian gas to EU borders would bring nearly comparable benefits to the region as the construction of infrastructures alluded to above in the 2020 reference scenario (340 million €/yr). It is important to note that the regional average price (26.5 €/MWh for the region and 23.2 €/MWh for the EU28) does not change at all when the contractual structure is altered, but at the same time total welfare significantly increases. Modelling proves that the pre-defined long term contract routes are a barrier to efficient use of infrastructure, where gas would otherwise flow from low to high priced markets. Thus, allowing market forces to distribute gas would certainly bring substantial social welfare benefits.

¹⁵ These are assigned by the green circles

Table 3 Welfare change due to change in RU contract delivery point (structural change)

	Price (€/MWh)		Welfare change (million €)							
	Reference 2020	Without LTC routes	Consumer Surplus	Producer surplus	SSO operating profit	SSO arbitrage profit	Net profit from long-term contracts	TSO operating profit	TSO auction revenue	Total welfare
AT	24.3	25.7	-107.6	18.3	0.0	0.0	38.3	-227.4	51.6	-226.8
BA	30.3	33.0	-4.1	0.0	0.0	0.0	18.4	0.0	0.0	14.3
BG	30.5	19.3	499.8	-147.6	0.0	0.0	460.0	-24.1	15.4	803.6
GR	20.8	21.2	-15.2	0.0	0.0	0.0	-147.0	48.7	15.4	-98.1
HR	28.0	29.3	-31.6	11.8	-0.3	0.6	0.0	0.0	-0.6	-20.0
HU	27.8	29.0	-123.0	13.1	0.0	0.0	0.0	-1.9	7.7	-104.1
MK	27.7	22.2	8.6	0.0	0.0	0.0	64.9	0.0	0.0	73.5
MV	29.4	30.5	-10.0	0.0	0.0	0.0	5.6	-0.1	0.0	-4.5
RO	26.9	28.1	-119.2	108.8	-2.7	0.0	18.5	-108.1	0.0	-102.8
SB	30.0	31.1	-39.5	1.3	-5.4	-1.5	119.9	-0.2	0.0	74.6
SI	25.4	26.8	-11.9	0.0	0.0	0.0	5.5	0.3	-1.6	-7.7
SK	24.1	25.1	-57.9	0.0	51.2	0.0	151.2	-184.1	-22.9	-62.5
Total in the Region	26.5	26.5	-11.7	5.8	42.8	-0.9	735.3	-496.8	65.0	339.5
Total in EU28	23.2	23.2	-257.7	257.9	-33.4	44.6	1255.6	-456.3	-49.1	761.6

It is however important to highlight that total social welfare change is negative for many of the CSEE countries: Austria, Greece, Hungary, Romania, Slovakia, Croatia, Slovenia and Moldova lose while Bulgaria, Macedonia, Serbia and Bosnia would benefit from the structural change. This result explains why European reaction to the Russian idea of changing the delivery point was immediately referring to the need that change of the long term contract should be mutually agreed by the parties. The results also support that neglecting the existing Ukrainian transmission route is a costly solution.

Beyond the previously identified key infrastructure, the Polish-Slovakian interconnector becomes crucial to deliver Russian gas from Yamal to Central- and Southern Europe in this scenario.

Figure 3 Key infrastructure in 2020 setup without long-term contract routes

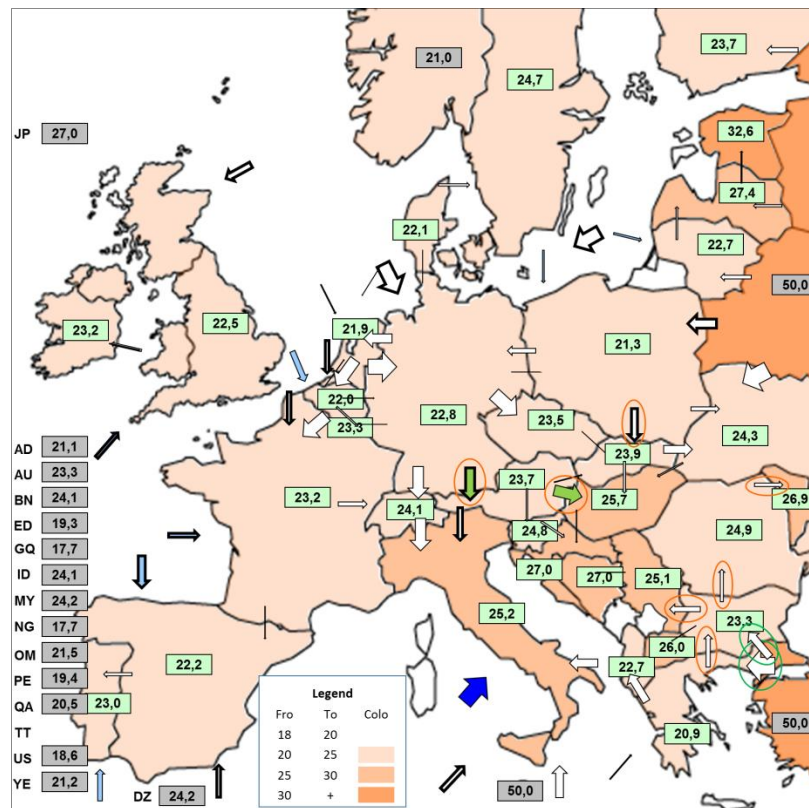


Table 4 shows that in case of structural change of LTCs the investment into necessary infrastructure would triple the yearly social welfare change for the region (1050 €/yr) and also benefit the EU28. More importantly, the distribution between the market participants changes substantially. Under the current LTC conditions (Table 2), consumers would benefit from the infrastructure at the expense of TSOs and long term contract holders (the gas industry), but when contract delivery points are altered (Table 3) the consumers still benefit and at the same time the position of long term contract holders also improves. The TSOs would certainly loose on auction revenues because congestion is eased, but the operating profit growth would out weight these losses. It can be concluded that the initiative of the Russian President in fact assists the EU's progress towards a more competitive and efficient European gas market. In this regard a change of delivery points in the contracts should be welcomed.

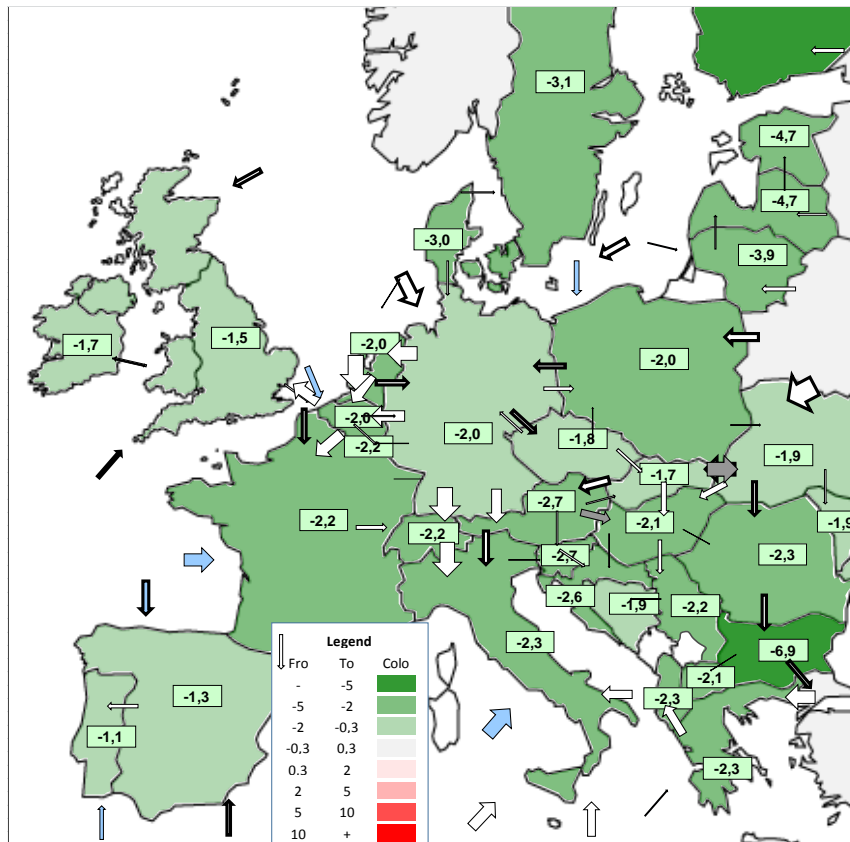
Table 4 Welfare change due to key infrastructure in 2020 without LTC routes

	Price (€/MWh)		Welfare change (million €)							
	Reference	With new infra	Consumer Surplus	Producer surplus	SSO operating profit	SSO arbitrage profit	Net profit from long-term contracts	TSO operating profit	TSO auction revenue	Total welfare
AT	25.7	23.7	153.0	-24.6	0.0	0.0	0.0	428.7	-80.7	476.5
BA	33.0	27.0	9.6	0.0	0.0	0.0	0.0	0.0	0.0	9.6
BG	19.3	23.3	-191.0	63.9	9.9	6.2	252.8	45.6	-5.9	181.5
GR	21.2	20.9	12.4	0.0	0.0	0.0	-16.6	-12.5	-5.9	-22.7
HR	29.3	27.0	54.4	-20.7	0.4	2.3	0.0	0.0	-3.8	32.5
HU	29.0	25.7	358.7	-36.0	0.0	0.0	0.0	-26.5	-65.1	231.2
MK	22.2	26.0	-6.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.0
MV	30.5	26.9	35.5	0.0	0.0	0.0	0.0	1.6	0.0	37.1
RO	28.1	24.9	332.0	-293.5	-9.1	0.0	0.0	15.8	0.0	45.2
SB	31.1	25.1	212.4	-6.3	-10.7	-1.5	0.0	13.2	0.0	207.0
SI	26.8	24.8	16.8	0.0	0.0	0.0	-7.5	-0.5	-1.8	7.0
SK	25.1	23.9	70.1	0.0	-51.2	0.0	0.0	-18.2	-149.2	-148.5
Total in the Region	26.5	24.5	1058.0	-317.2	-60.6	7.0	228.7	447.1	-312.4	1050.5
Total in EU28	23.2	23.2	316.4	8.3	-2.1	-35.4	921.4	400.4	-467.7	1141.4

Table 5 summarizes the utilization rate of the identified key infrastructural projects, as a percentage of their current size (if existing: DE-AT, AT-HU) or of their proposed size (according to 2015 TYNDP). Comparing scenarios with and without LTC routes it can be observed that by neglecting contract routes utilization of key infrastructure significantly increases. Table 5 also highlights the importance of the extension of the DE-AT interconnector to allow gas flow from the West to the East and the PL-SK interconnector to allow gas flow from the North to the South.

As a sensitivity check for results above, we also tested for a climate scenario. For this analysis the full RES policy scenario was applied, which was quantified in a previous Towards2030-dialog issue paper (Tóth et. al., 2014). Under this scenario, the gas consumption savings due to both energy efficiency and the increase of RES is approximately a 12% for EU 28 countries. According to modelling results this leads to a 2.5 €/MWh price decrease in the CSEE region and in 2.2 €/MWh price decrease in EU28, assuming current market structure with long term contract routes. A change in these routes results in a price decrease of 1.8 €/MWh and 2 €/MWh respectively (Figure 4).

Figure 4: Natural gas yearly wholesale price decrease due to energy efficiency and climate change measures in the 2020 scenario with existing LTCs' (€/MWh)



Additionally, the modelling results show that the need for the pipeline infrastructure will not be diminished by decreasing European gas demand due to climate cooperation. Assuming current market structure, the utilization of identified key infrastructure even increases due to the unequal distribution of gas demand reduction between countries. (Table 5)

Table 5 Change in utilization of key infrastructure due to climate-related demand changes

Project	2020 reference						2020 without LTC routes					
	Normal demand			Modified demand			Normal demand			Modified demand		
	Capacity (TWh/yr)	Flow (TWh/yr)	Utilization of pipeline (%)	Capacity (TWh/yr)	Flow (TWh/yr)	Utilization of pipeline (%)	Capacity (TWh/yr)	Flow (TWh/yr)	Utilization of pipeline (%)	Capacity (TWh/yr)	Flow (TWh/yr)	Utilization of pipeline (%)
GR-BG	48.9	38	78%	48.9	39	80%	48.9	32	65%	48.9	26	53%
BG-RO	14.6	9.9	68%	14.6	12.8	88%	14.6	24.7	169%	14.6	21.1	145%
BG-SB	29.2	24	81%	29.2	25	86%	29.2	38.5	132%	29.2	40	137%
RO-MV	24.5	4.5	18%	24.5	9.9	40%	24.5	10.7	44%	24.5	11	45%

PL-SK							44.9	133.6	298%	44.9	129.7	289%
DE-AT	72.6	130	179%	72.6	180.4	248%	72.6	346	476%	72.6	342	471%
AT-HU	47.1	74.7	159%	47.1	80.7	171%	47.1	78.4	167%	47.1	85	181%

Conclusion

1. Beyond the expansion of existing infrastructures (Austria to Hungary in 2015; Germany to Austria in 2020), the identified infrastructures to be implemented (with predefined routes for long term contracts) are the full reverse flow on the Romanian-Hungarian, the Romanian-Moldavian 1,5 bcm/yr pipeline, the 5 bcm/yr interconnector between Greece and Bulgaria, and the Bulgarian – Serbian 3 bcm /yr interconnector and by 2020 also the Bulgaria to Romania interconnector.
2. Modelling runs for 2015 show that with current destination restrictions in long term contracts additional interconnections between markets will create losses on European level. In the 2020 scenario, however, mainly due to the phasing out of long term contracts, the social welfare impact of new infrastructure becomes significantly higher and positive in the EU28. The policy implication is that by 2020 there will be substantially less incentive for market participants to delay the identified projects.
3. Beyond assumptions in the present structure and route of Russian long term contracts in the 2020 setup, key natural gas infrastructure was also identified more innovatively: Russian gas was delivered exclusively to EU borders outside of Ukraine at the same price (23 €/MWh) for all buyers, leaving market forces to handle the internal distribution of the gas between countries. For this scenario the pre-requisite is that two strings of the Turkish Stream are built (30 bcm/yr), the Turkey- Greece interconnector is extended, and reverse flow on Trans-Balkan is allowed between Turkey and Bulgaria. In this scenario on top of the defined key projects of point 1 the Polish-Slovakian interconnector assumes a significant role in delivering Russian gas from Yamal to CSEE.
4. Only the structural change in Russian delivery points at EU borders (without any PCI project built) would bring benefits to the region of a similar magnitude as building all of the infrastructures identified for 2020 integration, however the position of the

market participants shifts substantially. LTC holders would benefit considerably by eliminating contract routes, but the total welfare change for most of the CSEE regions (except for Bulgaria) would be negative.

5. Modelling LTC delivery point changed to EU borders together with the PCI projects of point 1 plus Polish-Slovakian interconnector positive welfare change results triple: besides LTC contract holders, also consumers and TSOs would become beneficiaries of the structural change. Thus the Russian President might inadvertently encourage a more competitive and efficient European gas market by freeing up delivery points in the existing contracts.
6. Finally, the demand scenario analysis that quantifies gas consumption savings due to energy efficiency and RES development shows that average European-wide wholesale gas prices would decrease an average of 2.3 €/MWh. These measures also solidify the utilization of the identified key pipeline infrastructure.

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