NETWORK CODE ON GAS INTEROPERABILITY AND DATA EXCHANGE

Implementation in the Energy Community

December 2016

Content

I. INTRODUCTION

1. About ECRB

The Energy Community Regulatory Board (ECRB) operates based on the Energy Community Treaty. As an institution of the Energy Community[1] the ECRB advises the Energy Community Ministerial Council and Permanent High Level Group on details of statutory, technical and regulatory rules and makes recommendations in the case of cross-border disputes between regulators.

ECRB is the independent regional voice of energy regulators in the Energy Community. ECRB's mission builds on three pillars: providing coordinated regulatory positions to energy policy debates, harmonizing regulatory rules across borders and sharing regulatory knowledge and experience.

2. Background and scope

Interoperability of connected gas transmission networks is a key requirement for undisturbed cross border flows. Regulation (EC) 2015/703 establishing a network code on interoperability and data exchange rules (hereinafter 'IO NC')[2] sets interoperability standards for EU gas networks. It is still not applicable in the Energy Community Contracting Parties (EnC CPs). Its coherent application in the Energy Community is essential for ensuring interoperability and market integration.

In most of the EnC CPs gas markets do not exist or they are still on a low level of development. Also the gas systems of the EnC CPs lay behind European developments as regards network intensity and interconnections. Implementation of the IO NC is important for already connected systems but also in the light of future network constructions. Pipeline projects in countries without gas infrastructure also should be in line with IO NC.

The present paper compares the actual interoperability rules and practice applied on gas transmission interconnection points (IP) in the Energy Community. More specifically compliance with the IO NC is analyzed, looking into the existence of Interconnection Agreements as well as units, gas quality- and data exchange-standards applied. The analysis covers IPs between Contracting Parties and towards neighboring EU Member States.

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[1] www.energy-community.org. The Energy Community comprises the EU and Albania, Bosnia and Herzegovina, Macedonia, Georgia, Kosovo*, Moldova, Montenegro, Serbia and Ukraine. Armenia, Turkey and Norway are Observer Countries. [**Throughout this document the symbol * refers to the following statement: This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Advisory Opinion on the Kosovo declaration of independence*].

[2] Commission Regulation (EU) 2015/703 of 30 April 2015 establishing a network code on interoperability and data exchange rules, OJ of the EU L113 of 1.5.2015., p.13-26 (http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0703&from=EN)

3. Methodology and scope

Data and analyses provided in present report are exclusively based on information provided by the regulatory authorities of the analyzed markets.

The report covers Bosnia and Herzegovina, FYR of Macedonia, Moldova, Serbia and Ukraine as Energy Community Contracting Parties, and Austria, Italy, Poland, Romania, Greece and Hungary[3] as EU countries neighboring the Energy Community Contracting Parties. Data for Poland are related to its IPs with Ukraine only.

Albania, Kosovo* and Montenegro are not part of this analysis due to absence of gas infrastructure in these markets.

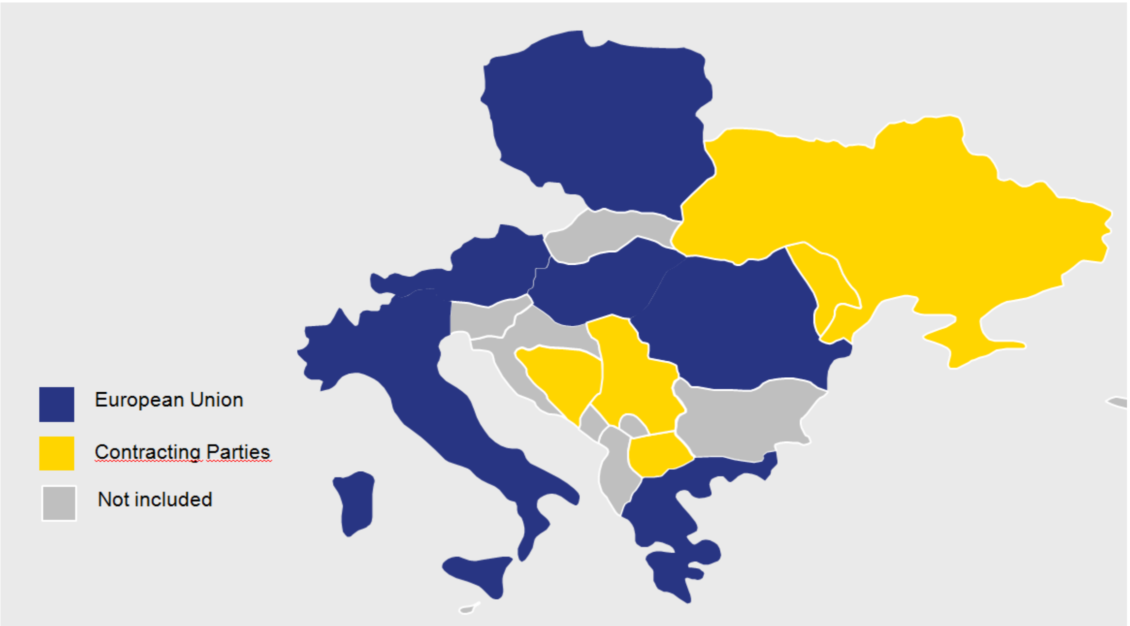

Figure 1: jurisdictions covered

[3] For efficient and output oriented implementation of the IO NC (and other gas Network Codes) also reciprocal application on the IPs of Bulgaria and Slovakia to neighboring CPs is essential. For the purpose of the present report Bulgaria and Slovakia did not participate in the survey.

Figure 2: gas transmission systems

Source: ENTSOG

II. FINDINGS

The present paper compares the actual practice implemented on IPs between natural gas transmission systems EnC CPs and some EU neighboring MS as regards the rules for Interconnection agreements (IA), units, gas quality and data exchange as defined in the IO NC.

1. Interconnection agreements

1.1. General findings: availability and content

The IO NC defines rules for the content of an IA. Namely two adjacent transmission system operators shall define the terms and conditions for natural gas flow control, measurement principles for gas quantities and quality, rules for matching, rules for the allocation of gas quantities, communication procedures in case of exceptional events, settlement of disputes arising from the IA as well as the process its amendment.

In order to see the complexity of activities stemming from these obligations for a TSO, the present analysis, first, looks into the **maximum number of network users active on the investigated IPs during the past five years**. It shows that huge differences exist:

One group of countries has a limited number of network users only, namely:

- Bosnia and Herzegovina, with two network users on the IP to Serbia;
- Moldova, with one network user on the IP with Romania and one on the IP to Ukraine;
- Greece, with two to three network users on the IPs to Bulgaria and Turkey;
- Serbia, with two network users on the IP to Bosnia and Herzegovina and four on the IP to Hungary;
- FYR of Macedonia, with four network users on the IP to Bulgaria.

The second group includes countries with a significant number of network users on their IPs:

- Poland, with one network user on the IP from Ukraine and seven on the IP to Ukraine;
- Ukraine, with all together 16 IPs provided information on the numbers of network user for the three IPs for which IAs exists: there were 15 network users on the IP from Poland, 20 network users on the IP from Slovakia and 23 network users on the IP from Hungary;
- Romania, with a maximal number of 19 network users on to IP with Hungary;
- Austria, with more than 50 network users on its IPs;
- Italy, with more than 100 network users on its IPs.

The table hereinafter provides general IA related information for the investigated IPs.

Table 1. General information about IAs[4]

Country	Does an IA exist?	Does the TSO invite network users to comment the IA?	Is the IA based on the ENTSOG template?
Bosnia and Herzegovina	NO [IP to RS]	NA[5]	NA
FYR of Macedonia	NO [IP to BG[6]]	NA	NA
Moldova	NO [IPs to UA | ROM]	NO	Partially/NO
Serbia	NO [IP to BiH] YES [IP to HU[7]]	NA	NA
Ukraine	YES [IPs to: PL[8]; HU[9]; SK: Budnice; ROM: T1] NO [IPs: SK: Velke Kapusany[10], ROM: MA, T2, T3, MD] NO [IPs to 3rd countries – Belarus, RU]	NO	Partially (2 from 4)[11]
Austria	YES	NO	NO
Italy	YES	YES/NA	YES
Poland	YES [IP to UA[12]]	NO	NO
Romania	YES/NO	YES	YES
Greece	YES [IP to BG] NO [IP to TK]	YES	YES
Hungary	YES [IPs to EU MS | SRB[13]| UA[14]]	NO	YES

[4] This table makes reference to the availability of IAs in the sense of the IO NC only. Other technical arrangements outside the scope of the IO NC are not reflected.
[5] Throughout the document abbreviation “NA” stays for “not applicable”
[6] A technical agreement is place that is however not covering all requirements of an IA foreseen under the IO NC. Under the CESEC Action Plan 2.0 agreed at the CESEC Summit September 2016 (http://ec.europa.eu/energy/sites/ener/files/documents/CESEC%20Action%20Plan%202.0%20-%20FINAL.PDF) Bulgaria undertook the obligation to launch discussions on an IA between Bulgartransgaz and GAMA by September 2016 and finalise by 31.12.2016. Concrete progress has not been reported so far.
[7] The existing IA, an annex to the existing transit contract, is prevailingly but not 100% in line with the IO NC. It will require renewal after successful unbundling of Srbijagas.
[8] The IA for the IP Hermanovice has been concluded in 2014; the IA for the transit IP Drozdovichi-Drozdowicze requires update though.
[9] Full operation depends on matching shipper pairs.
[10] Under the CESEC Action Plan 2.0 agreed at the CESEC Summit September 2016 (http://ec.europa.eu/energy/sites/ener/files/documents/CESEC%20Action%20Plan%202.0%20-%20FINAL.PDF) Slovakia undertook the obligation to continue discussions on a conclusion of an IA.
[11] The IAs for IP Budince and IP Beregdaroc-Beregovo contain all rules specified in the template, but as agreements were signed before publishing of the template, they are not actually based on it. For IP Hermanowice the IA was signed in 2006, so it is not based on ENTSOG template.
[12] The IA for the IP Hermanovice has been concluded in 2014; the IA for the transit IP Drozdovichi-Drozdowicze requires update though.
[13] The existing IA, an annex to the existing transit contract, is prevailingly but not 100% in line with the IO NC. It will require renewal after successful unbundling of Srbijagas.
[14] Full operation depends on matching shipper pairs.

Looking specifically into the situation at CP IPs the following map shows to which extent IAs are in place:

Figure 3: Interconnection Agreements on CP Interconnection Points[15]

Source: ENTSOG map adjusted

15 Legend: ● IA existing ● IA not existing ● IA existing but needs update

From the analysis the following **main general IA results** can be summarized:

- In the majority of the analyzed countries TSOs did not *invite network users* to comment IA drafts before concluding or amending it[16]. For the case of Italy changes to existing IAs have not been made after the entry into force of the IO NC in May 2016; should changes be made to rules affecting network users, network user will be invited to comment proposed text of the IA.
- The *ENTSOG IA template*[17] was used in a limited number of cases (e.g. for some IPs in Ukraine, Moldova, Italy, Greece, Hungary; IP Romania-Hungary).
- All IAs contain *rules on flow control*[18] and these rules include designation of the TSO responsible for steering the gas flow across the IP.
- All IAs contain details on *measurement standards on IPs for gas quantity and quality*[19]. The IO NC defines a very detailed list of measurement principles on which the adjacent transmission system operators have to agree. This list comprises 16 measurements principles. The survey showed that on most of the IPs the IAs include all required measurements principles. On one IP in Poland and Romania and on both IPs in Moldavia the IAs do not include measurement principle and in the case of one IP in Ukraine (Hermanowice) 8 measurement principles are not part of the IA. IAs do not include rules between TSOs for access, additional verification and modification of the measurement facility in Hungary. IAs do not include the method of determining a correction to a measurement in case of failure and rules between TSOs for modification of the measurement facility in Greece.

1.2. Matching

Matching processes[20] are very important on IPs with different network users at two IP sides. The adjacent transmission system operators have rules dealing with the matching process. Unless otherwise agreed between them in their IAs, the so-called 'lesser rule'[21] has to be applied as default rule[22].

Also, transmission system operators perform the matching process, if not agreed in any other way, in the following sequential steps[23]:

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[16] Such consultation is required by Article 4(2) IO NC.
[17] Available at: http://www.entsog.eu/publications/interoperability#INTERCONNECTION-AGREEMENT-TEMPLATE. The ENSTOG template is offered as default solution in Article 5 IO NC, in case TSOs should not agree on an IA alternatively.
[18] Required by Article 6 IO NC.
[19] Required by Article 7 IO NC
[20] 'Matching process' is the process of comparing and aligning processed quantities of gas for network users at both sides of a specific interconnection point, which results in confirmed quantities for the network users (cf Articles 2(d) and 8 IO NC).
[21] The 'lesser rule' means that, in case of different processed quantities at either side of an interconnection point, the confirmed quantity will be equal to the lower of the two processed quantities (cf Article 2(c) IO NC).
[22] Cf Article 8(5) lit (a) IO NC.
[23] Article 8(5) lit (c) IO NC.

1. calculating and sending processed quantities of gas by the initiating TSO within 45 minutes of the start of the nomination or re-nomination cycle;
2. calculating and sending of confirmed quantities of gas by the matching TSO within 90 minutes of the start of the nomination or re-nomination cycle;
3. sending confirmed quantities of gas to network users and scheduling the gas flow across the IP by the adjacent TSOs within two hours of the start of the nomination or re-nomination cycle.

Minor differences from this sequence exist on IPs in Greece[24], FYR of Macedonia, Serbia[25], Bosnia and Herzegovina Moldova and Ukraine on its IPs to Slovakia and Hungary. At the same time, there are difficulties with matching processes in Ukraine (flow direction from Ukraine to EU countries) due to the fact that network users do not provide the Ukrainian TSO with the required information.

The IO NC[26] defines the minimum harmonised information necessary for matching-related data exchange, namely: IP identification; network user identification; identification of the party delivering to or receiving gas from the network user; start and end time of the gas flow for which the matching is made; gas day; processed and confirmed quantities and direction of gas flow. In all analysed countries the IAs specify information for data exchange for matching purposes. On the Ukrainian IP to Hungary, however, network users do not provide the adjacent TSOs with all elements of the harmonized information required by the IO NC, despite the fact that the IA between TSOs of Ukraine and Hungary complies with the related IO NC requirements.

Table 2 provides information on matching process per country.

[24] There is currently no re-nomination cycle on the existing IA. Matching process lasts one hour.
[25] Downstream TSO sends nomination/re-nomination. Upstream TSO confirms nomination/ re-nomination. Timeline for confirmation depends on confirmation which upstream TSO gets from his upstream TSO (on UKR/HUN border), but normally it is first full hour.
[26] Cf Article 8(4) IO NC.

Table 2 Matching process

Country	Rules for the matching process	Is the matching process during nomination cycle in line with the IO NC?	Does the IA specify information for data exchange for matching process?
Bosnia and Herzegovina	NA	NO	NA
FYR of Macedonia	Some other rules	NO	NA
Moldova	Lesser rule	YES: Moldovatransgaz NO: Vestmoldtransgaz	YES
Serbia	Some other rules	NO	YES
Ukraine	Lesser rule	YES[27]: for IPs with PL, HU, SK	YES
Austria	Lesser rule	YES	YES
Italy	Lesser rule	YES	YES
Poland	Lesser rule	YES	YES
Romania	Lesser rule	YES	YES
Greece	Lesser rule	YES	YES
Hungary	Lesser rule	YES	YES

An operational balancing account (OBA)[28] is used for the **allocation of gas quantities** in Austria, Italy, Greece, Hungary, Moldova (on IP with Romania), Poland, Romania and Ukraine. On the IP between Poland and Ukraine an OBA is used but is settled to zero at the end of each month. On one IP in Moldova allocation is based on measurement. On Serbian IPs with Bosnia and Herzegovina and Hungary, the biggest network user allocation is based on measurement and for all other allocation is equal to nomination and some other allocation rule in FYR of Macedonia.

The **communication language** between transmission system operators in case of exceptional events is English[29] on most IPs. Russian and Romanian is used in Moldova and Serbian on the IP between Serbia and Bosnia and Herzegovina.

Dispute settlement mechanisms are defined in the majority of IAs. Different from that and from the requirement of the IO NC[30], the IAs applicable on the IPs between Poland and Ukraine define that disputes shall be settled by negotiations but does not specify the applicable law, the court of jurisdiction or the terms and conditions of the appointment of experts of an institutional forum.

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[27] For the IPs to Hungary and Slovakia: with minor time wise deviations from the sequence provided in Article 8(5) lit (c) IO NC.
[28] An ‘operational balancing account' means an account between adjacent transmission system operators, to be used to manage steering differences at an interconnection point in order to simplify gas accounting for network users involved at the interconnection point (cf Article 2(g) IO NC), such is provided in Article 9(1) IO NC as default rule.
[29] English is defined as default communication language by Article 10 IO NC.
[30] Cf Article 11.

2. Units

Chapter III of the IO NC specifies the reference conditions for volume at 0°C and 1.01325 bar; and 25°C as default combustion reference temperature for gross calorific value (GCV), energy and Wobbe-index[31]. Also, a common set of units for any data exchange and data publication is defined, namely: bar for pressure, °C for temperature, m^3 for volume, kWh/m^3 for GCV, kWh for energy and kWh/m^3 for Wobbe index.

The analysis (cf table 3) shows that:

- the **reference pressure** on IPs in all countries is equal to the value defined in the IO NC;
- 0°C as **reference condition for temperature** is only applied on the IPs of the analyzed EU countries and partially in Ukraine. In Italy units additional to the common sets are used according to Article 14 IO NC. In Bosnia and Herzegovina and Serbia the reference condition for temperature is 15°C; Moldova, FYR of Macedonia and partially Ukraine use 20°C in line with import contracts;
- The **combustion reference temperature** for calorific value, energy and Wobbe index are 25°C in all countries except Bosnia and Herzegovina and Serbia where 15°C is in use as reference temperature.
- The **gross calorific value** is used in all analyzed EU MSs and Ukraine, however not in Bosnia and Herzegovina, Serbia, FYR of Macedonia and Moldova.
- The used **unit for energy** is KWh in all analyzed EU MSs, but not in Bosnia and Herzegovina, FYR of Macedonia and Serbia, where MJ is in use, as well as Moldova where both MJ and kcal are used. In Ukraine KWh is used at IP to EU countries, kcal on all others.

Table 3 provides an overview about the reverence conditions in the analyzed markets.

[31] The Wobbe Index is an indicator of the interchangeability of fuel gases such as natural gas. The Wobbe Index is used to compare the combustion energy output of different composition fuel gases in an appliance (fire, cooker etc.). If two fuels have identical Wobbe Indices then for given pressure and valve settings the energy output will also be identical. Typically variations of up to 5% would not be noticeable to the consumer.

Table 3 Natural gas reference conditions and units for energy on IPs

Country	Temperature and pressure for volume IO NC: 0°C | 1.01325 bar	Combustion temperature and type of calorific value IO NC: 25°C | gross	Unit for energy IO NC: kWh
Bosnia and Herzegovina	15°C | **1.01325 bar**	15°C | lower	MJ
FYR of Macedonia	20°C | **1.01325 bar**	**25°C** | lower	MJ
Moldova	20°C | **1.01325 bar**	**25°C** | lower	MJ | kcal
Serbia	15°C | **1.01325 bar**	15°C | lower	MJ
Ukraine	20°C | **0° C | 1.01325 bar**	**25°C | gross**	**KWh** | kcal
Austria	**0°C | 1.01325 bar**	**25°C | gross**	**kWh**
Italy	15°C | **0° C | 1.01325 bar**	15°C | **25°C | gross**	**kWh |** MJ
Poland	**0°C | 1.01325 bar**	**25°C | gross**	**kWh**
Romania	**0°C |1.01325 bar**	**25°C | gross**	**kWh**
Greece	**0°C | 1.01325 bar**	0°C **| gross**	**kWh**
Hungary	**0°C | 1.01325 bar**	**25°C | gross**	**kWh**

3. Gas quality

Chapter IV of the IO NC defines the transmission system operators' obligation to publish on their websites for each IP and at least on an hourly basis during the gas day: the Wobbe-index and GCV for gas entering their transmission network.

- In Bosnia and Herzegovina, Ukraine, FYR of Macedonia and on the IP between Moldova and Romania, transmission system operators do not publish this information at all;
- required data is published for the IPs between Moldova and Ukraine[32] on weekly basis, in Austria, Greece, Hungary Romania and Serbia on daily basis; only in Poland the transmission system operator publishes the Wobbe-index and GCV on hourly level. In

[32] Related publications are only provided by Moldova.

Italy activities targeting the Wobbe-index and GCV on hourly basis both on the TSO's website and ENTSOG Transparency Platform are currently on under development.

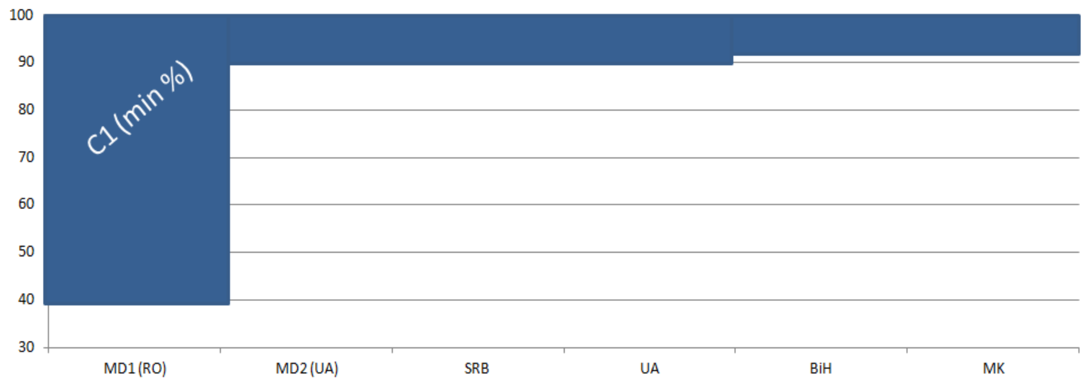
Although it is not part of the IO NC, the survey also looks into compliance with gas quality parameters that are prescribed in applicable natural gas quality standards. The results of this investigation are presented in the table below.

Table 4 Natural gas quality parameters

Country	C1[33]	C2[34]	C3[35]	C4+[36]	N2[37]	Iso butan	n-butan	Iso pentan	n-pentan	CO_2 (mol)
Bosnia and Herzegovina	Min 92%	Max 4%	Max 2%	Max 2%	Max 2%	NA	NA	NA	NA	NA
FYR of Macedonia	Min 92%	Max 4%	Max 2%	NA	Max 2%	NA	NA	NA	NA	NA
Moldova (IP with RO)	Min 40%	Max 15%	Max 6%	NA	Max 15%	Max 4%	Max 4%	Max 2%	Max 2%	Max 2%
Moldova (IP with UKR)	Min 90%	Max 7%	Max 3%	Max 3%	Max 5%	NA	NA	NA	NA	Max 2%
Serbia	Min 90%	Max 4%	Max 2%	Max 2%	Max 3%	NA	NA	NA	NA	Max 2%
Ukraine	Min 90%	Max 7%	Max 3%	Max 3%	Max 5%	NA	NA	NA	NA	Max 2%
Austria[38]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Italy[39]	NA	NA	NA	NA	NA	NA	NA	NA	NA	Max 3%
Poland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Romania	Min 70%	Max 10%	Max 3,5%	Max 1,5%	Max 10%	NA	NA	Max 0,5%	Max 0,5%	Max 8%
Greece	Min 75%	NA	NA	NA	Max 6%	NA	NA	NA	NA	NA
Hungary	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[33] Methane.
[34] Ethane.
[35] Propane.
[36] Butane.
[37] Nitrogen.
[38] The Austrian standard for gas quality gives information about Wobbe index, HHV and relative density and the combination of these three values return the chemical composition of the gas mix. However, the standard does not give any direct indication for the chemical hydrocarbon composition of the natural gas.
[39] In Italy the values for C1, C2,C3, C 4+, N2, iso-butan, n-butan, iso-pentan, n-pentan are intrinsically limited by the acceptability Range of the Wobbe index.

The graphs hereinafter illustrate the gas quality differences listed in table 4 in a more visual format. Figure 4 demonstrates that the biggest deviations relate to the minimum percentage of methane (C1), all other parameters being more aligned.



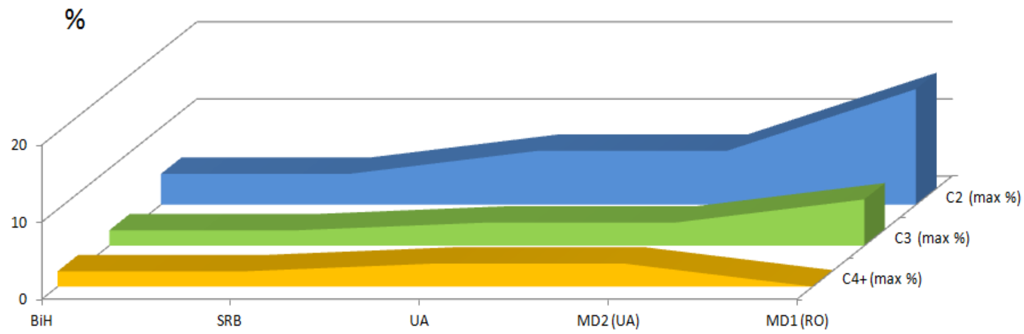


Figure 4: EnC CPs Natural gas quality parameters

According to the information provided for the present report **neither differences in gas quality nor different odourisation practices ever caused restrictions to cross- border trade in any of the analyzed markets**.

Table 5 shows the defined minimum and maximum values for natural gas characteristics using the following reference conditions: 0°C and 1.01325 bar for volume, gross Wobbe index and gross calorific value at 25°C for combustion in line with IO NC - Chapter III Units. Data for combustion or metering available at other referent conditions is converted to the IO NC's reference conditions (25°C/0°C) in accordance with the conversion factors provided in the Annex to the IO NC; further to this the following relations are used:1 kWh = 3,6 MJ; 1 kcal = 4,1868 MJ.

Table 5 GCV, Wobbe index and sulfur, oxygen and water dew parameters range

Country	GCV (KWh/m^3)	Wobbe (KWh/m^3)	Total sulfur (mg/m^3)	Mercaptane sulfur (mg/m^3)	H2S (mg/m^3)	Oxygen (%mol)	Water dew point (°C)
Bosnia and Herzegovina	10,076 – 11,374	13,650 – 16,412	Max. 20	Max. 6	Max. 5	NO	-5/40 bar
FYR of Macedonia	10.471 average	13.821 average	Max. 20	Max. 5	Max. 5	0,2	-8/40 bar
Moldova	Min. 10,343	12,074 – 15,937	NO	Max. 36	Max.20	1	NO
Serbia	10,562 – 11, 212	13,650 – 14,950	Max. 20	Max. 5,6	Max. 5	NO	-5/40 bar
Ukraine	10,102 – 10,659	11,402 - 15,085	NO	Max. 20	Max. 6	0,02	-2,5/70 bar
Austria	10,700 – 12,800	13,330 – 15,700	Max. 10	Max. 6	Max. 5	0,5	-8/40 bar
Italy	10,234 – 13,259	13,852 - 15,322	Max. 158	Max. 16,35	Max. 5	0,6	-5/70 bar
Poland	Min. 10,556	12,500 – 15,806	Max. 20	Max.16	Max. 7	0,2	-5/55 bar
Romania	Min. 9,094	NO	Max. 100	Max.8	Max.6,8	0,02	
Greece	10.200 – 13.710	13.100 – 16.370	Max. 80	NA	Max. 5.4	0,2	5/80 bar
Hungary[40]	8.600 – 12.580	12.680 – 15.210	Max. 100	NA	Max.20	0,2	-8/40 bar

4. Data exchange

Chapter V of the IO NC defines different **types of data exchange**, namely: document based data exchange, integrated data exchange and interactive data exchange.

- In Austria document based data exchange and integrated data exchange is in use, in both cases using the data format Edig@s/HML.
- On IPs between Ukraine and EU MSs IPs matching is done by using excel sheets exchanged via email.

[40] Data for GCV, Wobbe index, Total sulphur and Water dew point in Hungary are from 6th CEER Benchmarking report on the quality of electricity and gas supply - 2016.

- On the IP between Romania and Hungary integrated data exchange and interactive data exchange are used.
- On IPs in Italy for document based and interactive data exchanges the solutions described in Article 21 IO NC are applied, while for integrated data exchange the implementation of the solution envisaged by this Article is currently in progress.
- On the IP between Moldova and Ukraine another type of data exchange is used, namely: Modbus TCP-IP. On the IP between Moldova and Romania encrypted manufacturer is used for data exchange.
- In Greece, on IPs between Hungary and Serbia and IPS between Serbia and Bosnia and Herzegovina the transmission system operators exchange information by sending emails.
- On the FYR of Macedonian IP with Bulgaria another type of data exchange is used[41].

Different security measures can be taken to **protect data exchange**.

- On Austrian IPs and on the IP between Romania and Hungary the data exchange security measures are: protection of the confidentiality by encryption, integrity and authenticity by signature of the sender and security measure to prevent unauthorized access to IT infrastructure.
- A restricted list of email addresses is used in the information exchange on the IPs between Poland and Ukraine. Concretely, only emails sent by authorized persons are accepted and processed. On IPs with other EU MSs security measure to prevent unauthorized access to IT infrastructure is used.
- On IPs in Italy the data exchange system security and availability requirements are in line with the IO NC standards.
- Integrity and authenticity by signature of the sender is used as a security measure on the IP between Moldova and Ukraine. On the Moldovan IP to Romania protection of confidentiality by encryption, integrity and authenticity by signature of the sender are used.
- On the IPs between FYR of Macedonia and Bulgaria, Hungary and Serbia as well as between Serbia and Bosnia and Herzegovina sophisticated measures for data protection are not in place. In case unusual or suspicious information appears during email correspondence for the IPs in Serbia, the relevant transmission system operators verify by phone call.

[41] Further details have not been received.

III. SUMMARY AND CONCLUSIONS

The present survey identifies a certain level of compliance for the arrangements in place at IPs in the Energy Community, namely between CPs and between CPs and MSs with the IO NC. This predominantly relates to rules for flow control and details on measurement standards for gas quantity and quality being part of the existing Interconnection Agreements as required by the IO NC. Also, they define the applicable matching process; however with some deviations from the IO NC as regards the rules for matching process, steps and timeframe. An operational balancing account is used for the allocation of gas quantities on most of the IPs. On some IPs the communication language is not English and for one IP the Interconnection Agreement does not define details on the dispute settlement mechanism.

As regards the CPs, further deviations from the IO NC currently exist on technical level: on all IPs on the side of the Contracting Parties the reference conditions, set of units and calorific values used differ from the IO NC. Most of the Contracting Parties' transmission system operators do not fully comply with the publication requirements of the IO NC on the Wobbe-index and gross calorific value, in particular as regards the publication frequency. Finally, transmission system operators in the Contracting Parties on all IPs exchange data information via email instead of using one of three solutions defined in the IO NC.

A more prominent shortcoming is the lack of Interconnection Agreements on IPs between the Energy Community Contracting Parties but also on some IPs to neighboring EU transmission systems.

The implementation status is significantly higher for the assessed EU member countries.

Based on the above findings, this report **recommends the Contracting Parties to implement the IO NC** with the goal to create preconditions for efficient use of cross border capacities and attracting new shippers, increase gas flows from different gas sources and facilitate gas trade in the region for the benefit of final customers of natural gas. The identified incompliances with the IO NC to a prevailing extent are of pure technical nature that can be adjusted without problems. **A realistic implementation deadline should not be less than two years after the adoption of the NC**. At the same time a framework for the implementation of the IO NC on IPs between the Energy Community Contracting Parties' and neighboring EU countries' transmission system operators has to be ensured.

Provisions of the IO NC should be also the default rules for all new IPs in the Energy Community Contracting Parties.