



## **Quality of Electricity Supply in the Energy Community**

Annex on the 6<sup>th</sup> CEER Benchmarking Report

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## 1. INTRODUCTION

### 1.1 About ECRB

The **Energy Community**<sup>1</sup> comprises Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo\*<sup>2</sup>, Moldova, Montenegro, Serbia and Ukraine. Armenia, Georgia, Turkey and Norway are Observer Countries. The key aim of the organization is to extend the EU internal energy market to South East Europe and beyond on the basis of a legally binding framework.

The Energy Community Regulatory Board (ECRB) operates based on the Energy Community Treaty. As an institution of the Energy Community 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.

### 1.2 Background and scope

Quality of electricity supply as a topic was introduced into the ECRB Work Program already in 2008; the first ECRB "Report on Quality of Electricity Service Standards and Incentives in Quality Regulation" was published in 2009. Also, during 2009 and 2010, the ECRB organized two workshops which were followed by the report "Assistance to regulators in introducing and improving service quality regulation in the Energy Community", published in 2010. In 2011 ECRB members participated in the 5<sup>th</sup> CEER Quality of Supply Benchmarking Report<sup>3</sup> to which the analysis for the ECRB member countries – performed based on the CEER benchmarking indicators – was added as an annex.

Following the well established ECRB-CEER cooperation tradition on the very topic, the present benchmarking report represents an annex to the "6<sup>th</sup> CEER Benchmarking Report on Quality of Electricity Supply", covering the Energy Community Contracting Parties (CPs) **Albania, Bosnia and Herzegovina, FYR Macedonia, Kosovo\*,<sup>4</sup> Montenegro, Serbia and Ukraine.**

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<sup>1</sup> [www.energy-community.org](http://www.energy-community.org).

<sup>2</sup> 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.

<sup>3</sup> The Council of European Energy Regulators (CEER) prepares a Benchmarking Report on the Quality of Electricity Supply every few years. The first report was issued in 2001, followed by the second, third and fourth editions in 2003, 2005, 2008 and 2011. These five benchmarking reports, published up to now, present an overview and analysis of practices in the CEER countries related to quality of electricity supply.

This report covers all **three aspects of quality of electricity supply**, namely:

- Continuity of Supply (CoS),
- Voltage Quality (VQ) and
- Commercial Quality (CQ).

In general, the present report aims to present an overview and analysis of current practices in the CPs. It also provides an assessment of areas where a move towards harmonisation could further improve quality of supply. The findings and recommendations of the report will hopefully lead to further development of national regulation and harmonization among the CPs.

*Chapter 2* of the report deals with continuity of supply related to the availability of electricity. It provides an overview of the existing quality of service regulation frameworks of continuity of supply applied in the CPs. Analyses in this chapter are made on the basis of data from CoS measurements and statistics as well as on the basis of information on: audits on continuity data; regulation and standards on continuity of supply; incentive mechanisms for continuity of supply and effects of continuity of supply incentive regimes.

*Chapter 3* is dedicated to voltage quality. In simple terms, voltage quality deals with deviations from nominal values of voltage frequency and voltage magnitude and by distortions. This chapter provides an overview of existing practice in voltage quality monitoring and regulation in transmission and distribution of electricity in the CPs and covers VQ regulation and legislation, voltage quality monitoring system (VQMS), data collection, aggregation and publication from VQMS, VQ indicators, actual data for voltage dips, other VQ parameters, mitigation measures and studies on estimation of costs due to poor voltage quality.

*Chapter 4* focuses on commercial quality, which relates to the nature and quality of customer services provided to end-consumers of electricity. Commercial quality is directly associated with transactions between electricity companies (either DSOs or suppliers, or both) and customers. Commercial quality covers not only the supply and sale of electricity, but also various forms of contacts between electricity companies and customers. The questionnaires on commercial quality were divided in the following groups: connection related activities, customer care, technical service, metering and billing. Therefore, this chapter also follows that grouping.

### 1.3 Methodology

The analysis for the Energy Community is based on indicators used by CEER for its benchmarking analysis. To this extent the assessment for the CPs bases on the same definitions and theoretical background as defined for the EU Member States, in particular with a view to ensure comparability.

## 1.4 Acknowledgements

ECRB expresses its gratitude for the colleagues from the regulatory authorities (RAs), transmission system operators (TSOs) and distribution system operators (DSOs) from the Energy Community Contracting Parties for participating in the present analysis. In this context special thanks are also addressed to Mr Srdjan Žutobradić, Mrs Milodarka Dautović and Mr Nikola Dubajić for their effort in preparing this survey. At the same time ECRB also expresses its appreciation for the support received from the EU regulators on CEER level.

## 2. CONTINUITY OF SUPPLY

### 2.1 Introduction

This chapter provides an overview of the existing quality service regulation frameworks of continuity of supply (CoS) applied in the Energy Community CPs.

This section will place a special focus on general experiences, experiences with the implementation processes and possible future improvements of the systems in place. Although there is some minor evidence on better developed regulation frameworks (by means of minimal standards on continuity of supply as well as the implementation of incentive schemes in particular CPs), **most of the observed CPs are in a very early stages of the development of service quality regulation.** The main focus within this chapter is therefore put on the characteristics of CoS monitoring schemes in distribution and transmission. The proper application of such schemes is the precondition for the future framework extensions.

For some rare cases with applied minimal standards on continuity of supply, as well as reward/penalty schemes, examples of existing regulatory practice in the area will be presented.

Review and analysis of collected data on continuity of supply show also the differences in timing and scope of CoS monitoring development among CPs. Consequently, countries were not able to provide the complete data set on different aspects of CoS monitoring and regulation expected from the questionnaire.

Continuity of supply is examined from different aspects and categorized into the following chapters:

- Continuity monitoring
- Audits on continuity data
- Regulation and standards on continuity of supply
- Incentive mechanisms for continuity of supply
- Effects of continuity of supply incentive regimes

Information on the provided data on continuity of supply is presented in Table 1.

Table 1: Indication of what kind of information on continuity of supply has been provided by different countries

Country	Continuity measurement	Audits on continuity data	Regulation and standards on continuity of supply	Incentive mechanisms for continuity of supply	Effects of continuity of supply incentive regimes	Data on Network and Continuity indicators
Albania	X (Partially)					
Bosnia and Herzegovina	X	X				X (Partially)
FYR of Macedonia	X		X			X (Partially)
Kosovo*	X		X			X (Partially)
Montenegro	X		X			X (Partially)
Serbia	X	X	X			X (Partially)
Ukraine	X	X				X (Partially)

It can be concluded from Table 1 that **most of the analyzed elements are not applicable due to an early stage of continuity of supply regulation implementation in all CPs**. The lack of data limits the scope of benchmarking of the actual levels and trends of continuity of supply among different CPs.

According to the current status of implementation, the following chapters mainly focus on an overview of the monitoring concepts, on the aspects and on the characteristics of regulation frameworks applied (including standards on continuity of supply). The aim is to benchmark the implementation process of continuity of supply monitoring and regulation, and to look deeper into related prerequisites, namely:

- the establishment of legal framework,
- usage of standards and guidelines of good practice,
- the implementation of the continuity of supply monitoring system,
- continuity standards and incentive schemes.

Such structured information should be useful for NRAs that have plans to introduce quality regulation regime in depth in the future.

In the subsequent sections different terms for the network user are used:

- customer
- consumer
- (network) user

While the “network user” (or simply “user”), comprising both generator and consumer, is certainly the most appropriate term, different terms with the same meaning are used having in mind that there is no harmonized use of terms in place in the analyzed markets.

Also, different terminology is used when referring to the responsible party for continuity of supply. Although the Electricity Directive EC/72/2009 defines the terms transmission system operator and distribution system operator, or simply system operator, the concept of system operation refers to dispatching of generators and it is different from network ownership and operation.

## 2.2 Continuity of Supply Monitoring

Monitoring of quality levels by using indicators and standards represents the basis for regulating quality. In general, the actual monitoring of continuity of supply can be performed on two different levels, namely on the system level and on the consumer-specific level. The implementation of adequate monitoring systems is essential for setting standards as well as penalties and rewards related to both monitoring levels.

In the CPs monitoring of continuity of supply is performed in different ways – including different types of interruptions, different sets of indicators as well as different reporting detail. The following sections pinpoint the differences as well as concepts that are harmonized among the CPs. The harmonization, where existing, is not a result of legal enforcement but it has been implemented following examples of good practice in the EU<sup>5</sup>.

An overview on monitoring techniques and results is presented in this section.

### 2.2.1 *Types of interruptions monitored*

All CPs use some sort of monitoring of interruptions as shown in Table 2. The focus of the CPs is mainly on long interruptions (duration > 3 minutes). The qualitative information on long interruptions is essential for calculation of continuity indicators that are widely used in regulation.

Three regulators declare to have access to the information regarding the number of short-term interruptions: short interruptions are monitored in the Ukraine, FYR Macedonia, and in a part of Bosnia and Herzegovina. In this context it is important to explain the way how short interruptions are currently monitored, especially due to the fact that SCADA is not yet fully implemented in the networks of CPs. The CPs that reported monitoring of short interruptions were additionally asked to provide brief information on the type of measurement method that is used, i.e. manual recording, usage of SCADA DMS, local substation logging, counter readings on reclosing devices or other methods.

In Bosnia and Herzegovina most of the distribution facilities do not have equipment for remote supervision and control installed (except facilities of one out of the five distribution companies which have SCADA system installed). All (short and long) interruptions are recorded manually and stored locally in registers (registry books). Contingency statistics are recorded manually by the staff on duty.

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<sup>5</sup> E.g. by adopting standards as EN 50160 and others.



Registered data are consolidated in the main dispatching centers for the distribution network control. These data are subject to checks by the regulatory commission staff during monitoring activities.

Considering the general lack of SCADA, it can be concluded that **local substation logging and counter readings on reclosing relays are most commonly used practice for recording the interruptions.**

**Unplanned long interruptions are monitored in all countries. However, not all countries monitor this type of interruptions at all voltage levels.**

**Moreover, usually there is also a distinct and separate data collection for planned and unplanned interruptions.** An “on time” announcement of the planned action reduces the effect of the interruption on the consumer.

Bosnia and Herzegovina and FYR Macedonia have also accomplished to set some rules with limited scope (SCADA installed at certain voltage level or proprietary solutions by DSOs), the other CPs either have not set any rules yet or are planning to establish the rules and implement SCADA in the future.

Nearly half of the CPs has established some sort of standardized way for recording and reporting applied by means of dedicated application software or by the use of harmonized forms for data collection. This is usually a result of national regulations imposing obligations for companies to implement reporting without taking into consideration technical preconditions for interruption monitoring and time for such implementation. EU experiences showed that this is not the best approach and such practice should be gradually replaced by the automated logging of interruptions by SCADA and associate software solutions (DMS, GIS etc.).

Table 2: Types of interruptions monitored

Country	Transient	Short	Long	Unplanned	Planned	Rules for automatic logging of interruptions (i.e. SCADA)	Standardized system for recording and reporting of interruptions
Albania			X	X	X	No	No
Bosnia and Herzegovina		X, partly (ERS only)	X	X	X	Partly. Some DSO use proprietary software for processing of interruptions, some use SCADA system at MV.	Yes, there is a uniform form for keeping records on interruptions in electricity supply and reporting forms prescribed by Regulatory Commission.
FYR of Macedonia		X	X	X	X	SCADA comprising 110 kV substations that have possibility for remote records of interruptions.	DSO should keep records and report to ERC
Kosovo*			X	X	X	No (TSO has installed SCADA in 2011 and are able to record interruptions on HV also in some MV feeders)	DSO should keep records for long interruptions(planned/unplanned) and report to ERO
Montenegro			X	X	X	SCADA for transmission	Yes, for long interruptions only
Serbia			X	X	X	No	Standardized form for recording and reporting of long interruptions is prescribed by the Information Rules issued by the NRA
Ukraine		X	X	X	X	No	Yes (approved by the NERC)

Definitions related the duration of long, short, and transient interruptions in different countries are shown in Table 3.

Table 3: Definitions of long, short and transient interruptions

Country	Transient	Short	Long
Albania	< 3 min	< 15 min	> 15 min
Bosnia and Herzegovina	Not defined	1 s < T ≤ 3min	> 3 min
FYR of Macedonia	Not defined	1.5 s < T ≤ 3 min	> 3 min
Kosovo*	Not defined	< 3 min	> 3 min
Montenegro	Not defined	≤ 3 min	> 3 min
Serbia	Not defined	Not defined	> 3 min
Ukraine	Not used	< 3 min	≥ 3 min

Albanian definitions significantly differ from the rest of the countries as well as from definitions that can be found in standards (EN 50160) where the *unplanned interruption* (“accidental supply interruption”) is classified as:

- a *long interruption* (>3 min),
- a *short interruption* (≤ 3 min).

The deviation in Ukraine, where an interruption lasting exactly three minutes is classified as *long interruption*, is minor and therefore not significant; the same can be concluded for Kosovo\*, where the same type of interruptions (duration of exactly three minutes) are excluded from monitoring.

Furthermore, some minor differences in definitions can be found also for the duration of *short interruptions*, especially at setting the lower limits: some definitions do not set lower bounds; some set the limit at 1.0 second or 1.5 seconds.

Albania is also the only CP that defines the type of *transient interruptions*; the *transient interruptions* in Albania would classify as *short interruptions* in other countries.

### 2.2.2 Planned and unplanned interruptions

An overview of the definitions used for *unplanned and planned interruptions*, as well as rule on advance notice regarding the planned interruptions is given in Table 4. **The majority of CPs has set definitions for both planned and unplanned interruptions referring to the availability of advance notices to customers. Both types of interruptions are monitored accordingly.**

A *planned interruption* is defined in EN 50160 (“prearranged supply interruption”) as an interruption for which customers are informed in advance, to allow the execution of scheduled works on the distribution system.

An *unplanned interruption* is defined in EN 50160 (“accidental supply interruption”) as an interruption caused by permanent or transient faults, mostly related to the external events, equipment failures or interference.

**Most CPs use similar definitions for *planned interruptions*.** However, they do not refer to EN 50160 or any other references, such as international guidelines or norms. Advanced notification is necessary for an interruption to be classified as a planned interruption. More detailed descriptions of definitions, comprising also some information on exemptions, were provided by Ukraine and Bosnia and Herzegovina.

**All CPs have issued the rules on notice to customers affected, whereas the requirements for advance notice vary between 24 hours up to 10 days.**

Table 4: Definitions of planned and unplanned interruptions

Country	Planned	Unplanned	Rules issued about notice to customers affected
Albania	customers are noticed in advance	all breakdowns not noticed in advance	Rules and procedures for giving notice defined by DSO are applied (72 hours in advance).
Bosnia and Herzegovina	Planned interruptions are those announced ones for the purposes of doing planned activities of regular and extraordinary maintenance, inspection and overhaul, connections of new customers, testing and control of measuring and protection devices and enlargement of the network.	Non-planned interruptions are those non-announced ones. If the planned interruption lasts longer than it has been announced, the time above the planned is included in the non-planned interruptions which the operator is responsible for.	Distributor is obliged to inform the end users on the term and expected time of duration of the planned interruption, no later than 24h (RS)/48h (FBiH) before the planned interruption as follows: <ul style="list-style-type: none"> <li>• for end users at medium voltage - directly by phone along with the written notice on information details by fax or email and</li> <li>• for end users at low voltage - in the mass media, in a clear and appropriate way;</li> </ul>
FYR of Macedonia	An interruption notified in advance to all affected customers with adequate notice	An interruption non notified in advance to all affected customers or notified with inadequate notice	Timely in written form in case of single customer affected, 24 hour in advance in case of group of customers affected

Country	Planned	Unplanned	Rules issued about notice to customers affected
Kosovo*	An interruption notified in advance to all affected customers with adequate notice.	An interruption non notified in advance to all affected customers.	Where the TSO and DSO carries out planned service interruptions on the distribution system it shall use its best endeavors to ensure that it provides a minimum of 24 hours notice to at least 90% of the affected customers. For the purposes of this standard, the notice given to affected customers shall be in the form of announcements through local TV and radio for interruptions that occurs in local areas (limited) and where the proposed interruption is widespread, through a national TV and suitable high-circulation daily national newspaper.
Montenegro	an interruption notified in advance to all affected customers with adequate notice	An interruption non notified in advance to all affected customers (an interruption not notified on time to all affected customers)	Yes. Minimum time-lag requested is at least 24h, notice by public media or in other adequate way
Serbia	an interruption notified in advance to all affected customers with adequate notice	an interruption non notified in advance to all affected customers	Yes, minimum time-lag requested is at least 24h, noticed by public media or in other adequate way
Ukraine	De-energization of a part of the network and equipment, made by the DSO to undertake routine repair or maintenance of electrical networks. Exemptions are also defined.	temporary suspension of power supply to consumers as a result of de-energization of a part of the network due to the fault of other licensees (UTILITIES), consumers, force majeure event, fault of others, technical failures in the electrical network of the DSO	Yes 10 days for legal entities with repeated notice 1 day and 10 days for households

### 2.2.2 Voltage levels monitored

The incidents at different voltage levels are monitored in different CPs as shown in Table 5.

**Incidents on MV and HV level are monitored in all CPs.** Surprisingly, most of the CPs reported that they monitor interruptions on LV level (except Albania). The reliable recording of interruptions on LV level (interruption register) requires big investments in equipment for protection and remote supervision and control or call center functions, and it is not yet widely implemented in the EU Member States.

Efficient monitoring of interruptions for particular voltage levels covers the recording interruptions caused by incidents on own voltage level and by incidents on all higher voltage levels that affect the

observed interruptions<sup>6</sup>. However, interruptions that are caused on LV remain unrecorded in case there is no manual, semi-automated (i.e. using call centre services) or automated process of monitoring implemented on LV network (i.e. SCADA). The interruptions caused on LV that do not affect the protection system under supervision of SCADA installed on MV (or LV) or that are not reported by affected customers through the call centers, don't attribute to the MV statistics and consequently to the CoS indicators.

Only Ukraine, with monitoring on LV level established already in 2008, is on a good way to achieve comprehensive monitoring on all voltage levels.

Table 5: Voltage levels for which monitoring of continuity takes place

Country	LV	MV	HV	EHV
Albania		X	X	
Bosnia and Herzegovina	See note	X	X	X
FYR of Macedonia	See note	X	X	
Kosovo*	See note	X	X	X
Montenegro	See note	X	X	
Serbia		X	X	X
Ukraine	X <sup>7</sup>	X	X	X

**Note:** The table represents the voltage level at which incidents are recorded. The incident is typically recorded by an opening of a circuit breaker or another interrupting device. The customers at that voltage level and at any lower voltage levels have their interruptions counted in that way. Although monitoring at LV level was reported by CPs, in practice LV recording is partially implemented only in Ukraine. In many CPs, the network operators usually provide the number of affected customers at lower voltage levels (i.e. LV) due to the interruption at certain (higher) voltage level (i.e. MV) and this number is considered when calculating continuity indicators. However, this is not sufficient to be considered as monitoring of interruptions at certain voltage level.

### 2.2.3 Classification of the interruption's cause

An overview of the classification of interruption causes is given in Table 6. **Most CPs collect the information on the cause of interruptions.** Such information is very important for both the system operator and the regulator.

From the CPs' answers it can be concluded that **there is no harmonization related to classification of interruption causes.** It is also obvious that almost all CPs divide causes into separate categories. 5 CPs (all except Montenegro and Kosovo\*) use the categories "third party" or "force majeure" (in a few cases with different designations).

<sup>6</sup> For example, a fault at MV will result in interruption for an LV customer: such interruptions may be recorded (registered) also for LV level.

<sup>7</sup> Established since 2008; use of data from Call Centre IS + manual processing.

It is interesting that Ukraine also uses the category “planned interruption without notice” – such classification indicates quite sophisticated integration of different databases, and implementation of interacting e-business processes supporting such classification.

Table 6: Cause categories used when recording interruptions

County	Categories used when recording interruptions	Recording scope (all/only of specified cause)	Separately recording according to interruption's cause	Classification of causes adopted
Albania	1) planned interruptions 2) Force majeure 3) Third Party 4) DSO Responsibility	All	Yes	The classification, which relates to: transformers, bus bars, isolators, cable, wires, etc.
Bosnia and Herzegovina	Interruptions caused by force majeure, third party responsibility and responsibility of distributor.	All	Yes	Force majeure, third party responsibility and responsibility of distributor.
FYR of Macedonia	HV and MV: unplanned, planned, interruptions due to force majeure, interruptions due to weather conditions, damages caused by third persons, due to interruptions on the transmission grid (MEPSO)	All (HV, MV)	Yes	planned, unplanned, interruptions due to force majeure, interruptions due to force weather conditions, damages caused by third persons, due to interruptions on the transmission grid
Kosovo*	Planned and unplanned interruptions.	All	Yes	Interruptions that result from system faults.
Montenegro	Planned works, damages in the system, damages with customers, meteorological conditions, unknown causes	All	Yes	Planned works, damages in the system, damages with customers, meteorological conditions, unknown causes
Serbia	own network/other energy entity/third party/animals/force majeure/unknown/other	All	Yes	own network/other energy entity/third party/animals/force majeure/unknown/other
Ukraine	Planned interruption with notice; Planned interruption without notice; unplanned (emergency) interruption through the fault of other licensees or consumers; force majeure; unplanned (emergency) interruption through the fault of others; unplanned (emergency) interruption due to the technical failures in the electrical network of the licensee	All	Yes	

#### *2.2.4 Exceptional events*

Exceptional weather conditions and other exceptional circumstances can significantly affect the continuity of supply. Interruptions caused by exceptional events, even if quite rare, are usually very long and/or affect a substantial number of customers. The concept of exceptional events may reflect the unique characteristics of each CP's electricity sector and the impact of severe weather conditions in each CP.

This section contains information on existing concepts on exceptional events among the CPs. According to the terminology used by the CEER, the term "exceptional events" will be used as a collective term in this section.

In

Table 7, exceptional events, their definitions and their influence on interruption statistics are presented.

Albania, Montenegro and Serbia do not consider the concept of exceptional events or other similar concepts related to situations which are subject of the specific treatment in their national quality of supply regulations. In Serbia the information code regarding the classification of interruptions comprises the definition of force majeure.

The concepts of different kinds of exceptional events of other four countries are defined as described in



Table 7 and can be grouped, despite of similar designation, as follows:

- extraordinary situations with significant impact on the continuity of supply (Bosnia and Herzegovina, Serbia and Ukraine);
- force majeure (FYR Macedonia, Serbia and Kosovo\*<sup>8</sup>).

These situations can be classified based on their causes or on their impact on network performance.

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<sup>8</sup> An assumption since information on concept hasn't been provided!

Table 7: Definitions of exceptional events

Country	Designation	Concept	Exceptional events excluded from the interruption statistics
<b>Albania</b>	Not defined	Not applicable	No
<b>Bosnia and Herzegovina</b>	Force majeure	"Force majeure" - all events which cause interruption of supply, and are out of control of a distributor: natural disasters (earthquake, fire, flooding), extreme weather conditions (lightning, storm wind, excessive ice etc), interruptions at the transmission voltage level, load shedding due to shortage of supply, under-frequency relief of load and orders of the respective authorities.	Normally not (but available also excluded)
<b>FYR of Macedonia</b>	Force majeure	Force majeure is defined as all unpredictable natural events, disasters and circumstances determined by the law (defined in Rulebook on conditions for electricity supply)	No (data is available upon request)
<b>Kosovo*</b>	Force majeure	Yes. Events, circumstances or occurrences beyond the control of the system operator. The force majeure will be defined by the government for special cases.	Yes
<b>Montenegro</b>	Force majeure	Force Majeure are natural events that have the character of natural disasters (floods, earthquakes, fires, atmospheric discharges; winds, ice and snow that exceed projected technical standards established for a particular building/facility or equipment of an relevant operators, etc.) that could not be predicted, prevented, avoided or eliminated by taking measures that are applied in order to maintain safe and reliable operation of the power system, and which are determined on the basis of the report of the competent state authorities, as well as emergency and military actions and measures that have been introduced based on the decisions of the competent state authorities	No
<b>Serbia</b>	Force majeure <sup>9</sup>	Events, circumstances or occurrences beyond the control of the system operator, the appearance of which he could not foresee, avoid or eliminate, and in particular natural phenomena such as – floods, earthquakes, landslides and rockfalls, as well as social phenomena – wars, terrorist acts and strikes, as well as measures and decisions of governmental bodies.	No
<b>Ukraine</b>	Force majeure	Yes. Interruption due to force majeure – interruption as a result of an irresistible emergency force which cannot be prevented by the use of highly skilled personnel and practices and can be caused by exceptional weather conditions and natural disasters (hurricanes, storm, flood, snow accumulation, ice, earthquake, fire, subsidence and landslide) and other contingencies. The event of force majeure must be documented.	No, but interruption due to exceptional events are not used for calculation of target indices.

<sup>9</sup> Informational definition only.

**No statistical methods defining "major event days" or "exceptional condition periods" (i.e. IEEE Std 1366-2003, Annex B) exist. Also, there is no evidence of explicit regulations defining "exceptional events".**

The information collected from the CPs shows a **lack of harmonization which is probably caused by different concepts of national legislation on obligations and by inherent climate differences**. Therefore stringent harmonization might most probably not be feasible at all. The lack of harmonization as regards exceptional events affects the comparison of interruption data between the observed CPs significantly.

It is important to mention that Kosovo\* excludes exceptional events from their statistics. In Bosnia and Herzegovina and FYR Macedonia such separate statistics (with/without exceptional events) are only provided upon request.

### 2.3 Continuity of Supply Indicators

An overview on the definitions of different indices used for quantifying the number of interruptions is given in CEER's 5<sup>th</sup> Benchmarking Report on Quality of Electricity Supply (2011). The same definitions are used for the purpose of this report.

Continuity of supply indicators measure grid performance at delivery points. The meaning of these indicators depends on the set of interruptions considered in calculation and related interruption durations.

If all interruptions are considered in the indicators calculation, they will provide information on the continuity of supply as seen by the customers - such a calculation is also important for evaluating the impact of the exceptional/force majeure events in terms of continuity of supply. For such analysis, all interruptions caused by exceptional events must be identified.

Usually, the indicators for long interruptions are split into two categories, namely unplanned and planned interruptions. Short interruptions are mostly caused by unexpected events, therefore a separation in planned and unplanned cases is not used.

**There are no significant CP-specific differences between typically used continuity indicators.** It is obvious that a range of indicators is in use, depending on their purpose and, of course, availability and comprehensiveness of the interruption statistics.

**Regarding the measurement of long interruptions (> 3 minutes), the most common indicators for measuring continuity of supply are System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) for distribution networks and Energy Not Supplied (ENS) and Average Interruption Time (AIT) for transmission networks. Momentary Average Interruption Frequency Index (MAIFI) values are used for short interruptions.**

### *2.3.1 Level of detail of the calculated indicator*

Continuity of supply indicators can be calculated for a country or region as a whole, for each system operator, for a certain city, for each feeder, or even for each individual customer. Calculation of indicators for a different observation scope is an essential tool in the process of benchmarking for regulators and systems operators. Regulators use such data for benchmarking DSOs, for setting the appropriate continuity standards according to regional or network characteristics, etc. DSO can use such data to make investment or maintenance decisions. The practice on calculation of system indicators varies strongly between different CPs, as shown in

Table 8.

**All CPs publish indicators calculated for the entire jurisdiction. In only few of the investigated markets, the indicators are calculated per system operator and/or per region/city.** Further distinctions can be made based on the voltage level on which the incident takes place or on the cause of the incident. **A distinction based on voltage level is made by all CPs. Information on the cause of the incident is also provided by all CPs. However, the classifications used for the voltage levels and causes significantly differ between the investigated markets:** the reason is different level of data availability and non-harmonized types of causes among CPs. Four CPs provided separate indicators for rural and urban areas; one CP distinguishes between underground and overhead (“aerial”) networks. Also here, different CPs use different classifications. Bosnia and Herzegovina reported that indicators are calculated also according to the grounding of MV networks.

For three countries that provided disaggregated data according to the network type, the classification concepts are as follows:

- Bosnia and Herzegovina: in Republika Srpska the classification of distribution areas is done without formal definition by DSO as follows: city areas, outskirts, village areas (the indices are calculated aggregated only in Federation BiH);
- Ukraine: the Supreme Council Presidium Decree № 1654 X "Settlement of administrative-territorial structure" defines separation of urban settlements from rural settlements.

Table 8: Level of detail in interruption recording

Country	National	System Operators	Region	City/District	Sub-station	Feeder	Customer	Voltage level	Causes	Urban/Rural	Cable/Overhead	Other
Albania	X							X	X	X	X	
Bosnia and Herzegovina	X	X	X (Partly)					X	X	X		X (grounding of MV network)
FYR of Macedonia	X	X			X	X		X	X			
Kosovo*	X							X	X (planned/unplanned only)			
Montenegro	X							X	X			
Serbia	X							X	X			
Ukraine	X	x		X				X	X	X		

### 2.3.2 Indices for long and short interruptions

An overview of the different indices used for quantifying long interruptions as well as weighting method used when calculating indices is provided in Table 9.

**SAIDI and SAIFI are the most commonly-used indices for distribution networks.** Serbia calculates also the index Customer Average Interruption Duration Index (CAIDI) which is a derivate of SAIDI in SAIFI. The method of weighting impacts the results by introducing different bias. All CPs that calculate these indices use the same weighting method based on the number of customers: each customer is therefore treated equally, independent of its size and load profile. This is an important finding that has positive impact on benchmarking.

**ENS and AIT are the most commonly-used indices for continuity of supply in transmission networks.**

Table 9: Long interruption – indices for quantifying

Country	Index	Weighting (N/A for ENS)
Albania	raw data on interruption properties and location of interruption only	The number of customers (identified manually)
Bosnia and Herzegovina	SAIDI & SAIFI ENS (Transmission)	The number of customers (manually, using the connectivity models or estimated)
FYR of Macedonia	Distribution -SAIDI, SAIFI, CAIDI (Requested by Grid Code, but no data yet)	Not applicable (no rules, SCADA is used on HV level)
Kosovo*	Distribution-SAIDI, SAIFI, ENS (Transmission)	The number of customers (manually by DSO)
Montenegro	SAIDI and SAIFI for DSO, ENS and AIT for TSO	Not applicable
Serbia	Distribution -SAIDI, SAIFI, CAIDI; AIT, ENS (Transmission);	distribution indicators (SAIDI, SAIFI) - number of customers; transmission indicators (AIT)- average power supplied (weighting is done manually according to the NRA rules)
Ukraine	SAIDI, SAIFI, ENS (only for distribution; for Transmission - data not yet available)	The number of customers

The number of short interruptions per year (MAIFI) is used as indicator in Bosnia and Herzegovina (but only for the distribution network of the power utility “Elektroprivreda Republike Srpske”) and in Ukraine, based on SCADA, where available. None of the CPs gathers data on transient interruptions.

## 2.4 Analysis of data on continuity of supply

This section provides an overview of the CPs’ networks and compares the values of the most important indicators over a number of years. Even though the calculation methods slightly differ between the CPs, the results are shown in the same diagrams. When interpreting the results, the differences in calculation and scope of monitoring (voltage levels) should be considered.

For the purpose of this benchmarking, it is crucial to exclude the influence of CP specific factors from indices, caused by non-harmonized proprietary rules applied for interruption monitoring. The typical example is the influence of exceptional events. As it was not possible to neutralize the consequences of these differences between CPs by excluding the impact of the exceptional events from the reported CoS index values (exceptional events are mostly not excluded from the interruption statistics), it is also **very difficult to assess how exceptional events influence the interruption statistics of each CP. Accordingly, any conclusion concerning the level of continuity of supply that exclusively relates to the responsibility of the performance of system operators is not feasible.**

Due to the lack of availability of the required data and the problems of comparability, the benchmarking analysis is focused on the indices that have been provided by at least four CPs:

- representing the value aggregated on the national level;
- comprising interruptions at all voltage levels monitored;
- including the interruptions caused by exceptional events.

Furthermore, some additional analysis on the impact of planned interruptions is shown in the total statistics.

The reported set of indices per CP and the indices that are used in comparison (bold “X”) are shown in

Table 10.

Table 10: The indices provided

Continuity indicator	Interruptions considered	Scope	BA	RS	UA	KS*
<b>UNPLANNED, SAIDI</b>	<b>w/o exc. events (All networks)</b>	<b>Whole country</b>	<b>X</b>		<b>X</b>	<b>X</b>
<b>UNPLANNED, SAIFI</b>	<b>w/o exc. events (All networks)</b>	<b>Whole country</b>	<b>X</b>		<b>X</b>	<b>X</b>
<b>UNPLANNED, SAIDI</b>	<b>All interruptions (All networks)</b>	<b>Whole country</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>UNPLANNED, SAIFI</b>	<b>All interruptions (All networks)</b>	<b>Whole country</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>PLANNED, SAIDI</b>	<b>All interruptions (All networks)</b>	<b>Whole country</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>PLANNED, SAIFI</b>	<b>All interruptions (All networks)</b>	<b>Whole country</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
UNPLANNED, MAIFI	All interruptions (All networks)	Whole country	X		X	
AIT (Transmission)	w/o exc. events (Only interruptions on T network)	Whole country, transmission system		X		X
<b>ENS (Transmission)</b>	<b>w/o exc. events (Only interruptions on T network)</b>	<b>Whole country, transmission system</b>	<b>X</b>	<b>X</b>		<b>X</b>
UNPLANNED, MAIFI	w/o exc. events (All networks),	Whole country			X	
Unplanned AIT (Transmission)	w/o exc. events (Only interruptions on T network)	Whole country, transmission system		X		
Planned AIT (Transmission)	w/o exc. events (Only interruptions on T network)	Whole country, transmission system		X		



Continuity indicator	Interruptions considered	Scope	BA	RS	UA	KS*
Unplanned ENS (Transmission)	w/o exc. events (Only interruptions on T network)	Whole country, transmission system	X	X		
Planned ENS (Transmission)	w/o exc. events (Only interruptions on T network)	Whole country, transmission system	X	X		
UNPLANNED, SAIDI	w/o exc. events (Only interruptions on EHV networks)	Whole country, EHV	X			
UNPLANNED, SAIDI	w/o exc. events (Only interruptions on HV networks)	Whole country, HV			X	X
<b>UNPLANNED, SAIDI</b>	<b>w/o exc. events (Only interruptions on MV networks)</b>	<b>Whole country, MV</b>	<b>X</b>		<b>X</b>	
UNPLANNED, SAIDI	w/o exc. events (Only interruptions on LV networks)	Whole country, LV	X		X	X
UNPLANNED, SAIFI	w/o exc. events (Only interruptions on HV networks)	Whole country, HV			X	X
<b>UNPLANNED, SAIFI</b>	<b>w/o exc. events (Only interruptions on MV networks)</b>	<b>Whole country, MV</b>	<b>X</b>		<b>X</b>	
UNPLANNED, SAIFI	w/o exc. events (Only interruptions on LV networks)	Whole country, LV	X		X	X
UNPLANNED, MAIFI	w/o exc. events (Only interruptions on HV networks)	Whole country, HV			X	
UNPLANNED, MAIFI	w/o exc. events (Only interruptions on MV networks)	Whole country, MV			X	

Legend: All networks: EHV, HV, MV and LV; w/o exc. Events: Interruptions not attributable to exceptional events

Only two CPs, namely Bosnia and Herzegovina and Ukraine provided indices classified by territorial density. The reported set of indices per CP is shown in the table below.

Table 11: The indices by territorial density

Continuity indicator	Interruptions considered	Territory	BA	UA
UNPLANNED, SAIDI	w/o exc. events (All networks)	Only urban areas	X	X
UNPLANNED, SAIFI	w/o exc. events (All networks)	Only urban areas	X	X
UNPLANNED, MAIFI	w/o exc. events (All networks)	Only urban areas		X
UNPLANNED, SAIDI	w/o exc. events (All networks)	Only suburban areas	X	
UNPLANNED, SAIFI	w/o exc. events (All networks)	Only suburban areas	X	
UNPLANNED, SAIDI	w/o exc. events (All networks)	Only rural areas	X	X
UNPLANNED, SAIFI	w/o exc. events (All networks)	Only rural areas	X	X
UNPLANNED, MAIFI	w/o exc. events (All networks)	Only rural areas		X



#### 2.4.1 Interruptions originated on different voltage levels

Considering all facts and issues discussed above, strengthened by the fact that incidents on MV contribute to the continuity indices the most (at least 70%), the available aggregated data of all those comparable indices that comprises the interruptions that occurred on MV was benchmarked among the CPs.

Due to the identified problems concerning the calculation of indices SAIDI and SAIFI on transmission level, the following analysis covers only the incidents that occurred on HV, MV and LV voltage levels. The contribution of Extra High Voltage (EHV) is therefore not considered in the analysis.

Table 12: Unplanned SAIDI (all events; HV, MV, LV) - the distribution of incidents according to their voltage level [%]

Country	2011	2012	2013	2014	avg
Albania – LV	n/a	n/a	n/a	n/a	n/a
Albania – MV	n/a	96.33	84.60	77.57	86.17
Albania – HV	n/a	15.88	33.10	34.25	27.74
Bosnia and Herzegovina (E RS only) - LV					
Bosnia and Herzegovina (E RS only) - MV					
Bosnia and Herzegovina (E RS only) - HV					
FYR of Macedonia - LV					
FYR of Macedonia - MV					
Kosovo* - LV		92.5	89	93	91
Kosovo* - MV					
Montenegro - LV					
Montenegro - MV					
Serbia - LV					
Serbia - MV					
Ukraine - LV	86.3	75.6	86.2	91.9	85.0
Ukraine - MV	428.1	429.3	435.7	435.9	432.3
Ukraine - HV <sup>10</sup>	4.4	6.9	5.2	6.5	5.8

<sup>10</sup> Not attributable to exceptional events.

Table 13: Unplanned SAIFI (all events; HV, MV, LV) - the distribution of incidents according to their voltage level [%]

Country	2011	2012	2013	2014	Avg
Albania – LV	n/a	n/a	n/a	n/a	n/a
Albania – MV	n/a	29.22	42.60	39.71	37.18
Albania – HV	n/a	7.19	10.50	12.15	9.94
Bosnia and Herzegovina (E RS only) - LV					
Bosnia and Herzegovina (E RS only) - MV					
Bosnia and Herzegovina (E RS only) - HV					
FYR of Macedonia - LV					
FYR of Macedonia - MV					
Kosovo* - LV		96	96	93	95
Kosovo* - MV					
Montenegro - LV					
Montenegro - MV					
Serbia - LV					
Serbia - MV					
Ukraine - LV	0.52	0.52	0.64	0.66	0.58
Ukraine - MV	3.41	3.68	3.83	3.94	3.72
Ukraine - HV <sup>11</sup>	0.12	0.14	0.11	0.12	0.12

In average, about 85% of SAIDI and SAIFI are reasoned by incidents on MV. It is important to point out that incidents at EHV were not considered in this analysis – from the experience in the EU Member States, this portion is very small, especially if observed in the networks with relative small ratio of undergrounding on MV and LV.

#### 2.4.2 The evaluation of the impact of exceptional events

**A difference between the same type of indices comprising the exceptional events and those excluding exceptional events was identified in several CPs.** This may be an indication of the presence of the exceptional events in the continuity indices - according to the CPs' rules on classification of interruption causes.

The following analysis provides a comparison of the indices including interruptions that were recorded in all networks with exceptional events included and those reported with exceptional events excluded (SAIDI and SAIFI due to incidents at MV only). The disaggregated data on continuity indices without exceptional events that include the interruptions recorded at HV, MV and sometimes also LV (Ukraine)

<sup>11</sup> Not attributable to exceptional events.

voltage levels was aggregated and compared with the aggregated indices comprising the exceptional events: according to the definition, latter should comprise also the interruptions recorded at EHV.

The contribution of interruptions recorded on MV (supposedly without exceptional events) in the aggregated indices (covering interruptions in all networks and supposedly comprising exceptional events) is shown in the tables below (

Table 14,

Table 15): by analyzing the extent of the contribution on MV we can assume the contribution of interruptions recorded at EHV (also LV and/or HV, depending on each CP) and those caused by the exceptional events in the indices.

Table 14: Unplanned SAIDI (all events) - Contribution of MV to the aggregated value [%]

Country	2011	2012	2013	2014
Albania - MV				
Albania - Other (HV, EHV, exceptional events)				
Bosnia and Herzegovina - MV				
Bosnia and Herzegovina - Other (HV, EHV, exceptional events)				
FYR of Macedonia - MV				
FYR of Macedonia - Other (HV, EHV, exceptional events)				
Kosovo* - MV				
Kosovo* - Other (HV, EHV, exceptional events)		7.47	10.78	6.69
Montenegro - MV				
Montenegro - Other (HV, EHV, exceptional events)				
Serbia - MV			52.58	
Serbia - Other (HV, EHV, exceptional events)				
Ukraine - MV <sup>12</sup>	428.1	429.3	435.7	435.9
Ukraine - Other (LV, HV, EHV, exceptional events) <sup>13</sup>	221.4	305.6	267.2	1972.2

<sup>12</sup> Not attributable to exceptional events.

<sup>13</sup> Including exceptional events.

Table 15: Unplanned SAIFI (all events) - Contribution of MV to the aggregated value [%]

Country	2011	2012	2013	2014
Albania - MV				
Albania - Other (HV, EHV, exceptional events)				
Bosnia and Herzegovina - MV				
Bosnia and Herzegovina - Other (HV, EHV, exceptional events)				
FYR of Macedonia - MV				
FYR of Macedonia - Other (HV, EHV, exceptional events)				
Kosovo* - MV				
Kosovo*- Other (HV, EHV, exceptional events)		3.21	3.97	6.86
Montenegro - MV				
Montenegro - Other (HV, EHV, exceptional events)				
Serbia - MV			73.1	
Serbia - Other (HV, EHV, exceptional events)				
Ukraine - MV <sup>14</sup>	3.41	3.68	3.83	3.94
Ukraine - Other (LV, HV, EHV, exceptional events) <sup>15</sup>	1.45	1.64	1.73	9.62

Due to the identified problems related to the robustness of the provided data, the impact of different sets of voltage levels considered in the calculation of indices<sup>16</sup> is difficult to evaluate. If the presence of exceptional events is neglected, the difference between the aggregated value of indices and the values containing the interruptions on MV only represents the contribution of other voltage levels to the aggregated value of indices, including the EHV (the contribution of interruptions that could be attributed to the transmission exceeds the EU average). Possible reasons for this are:

- the “leakage” in recording of interruptions on MV (mostly manual processing): the portion of interruptions recorded on MV is lower than expected;
- differences between CPs as regards rules and practice for the recording of interruptions and, even more, the calculation of indices SAIDI and SAIFI on EHV level (transmission) due to different weighting methods used for calculation and the usage of estimation methods;
- differences between CPs as regards rules and interpretation of exceptional events.

<sup>14</sup> Not attributable to exceptional events.

<sup>15</sup> Including exceptional events.

<sup>16</sup> i.e. inclusion/exclusion of interruptions recorded at EHV/LV level in different sets of indexes.

### 2.4.3 Network characteristics

An overview on available system data of particular CPs is given in Table 16. The networks vary a lot across CPs in their size and structure.

Table 16: Information on network, equipment, energy supplied, number of customers

SYSTEM DATA	measure unit	Albania	Bosnia and Herzegovina	FYR of Macedonia	Kosovo*	Montenegro	Serbia	Ukraine
Item # 1 - Length of networks		2014	2014	2014	2014	2014	2014	2014
total length of circuits - EHV network	km				188		3498	22332
total length of circuits - HV network	km			212	1043	1300.4	5910	41200
length of cable circuits - MV network	km			2777	1166	1420	13118	47108
total length of circuits - MV network	km			8662	6543	5890	48557	349268
length of cable circuits - LV network	km			3697	423	1686.42	15456	38313
total length of circuits - LV network	km			15452	11243	13216	110018	415606
<b>Item # 2 - Energy</b>								
transmitted/distributed energy (all customers)	TWh				5.2	3.267	28	133.9
distributed energy (only MV and LV customers)	TWh			4.973	4.6	2.426	25	85.8
<b>Item # 3 - Customers</b>								
number of MV connection points of final customers	number			1021	234	546	4348	92201
number of LV connection points of final customers	number			699948	491586	384186	3579080	20776431
<b>Item # 4 - Equipment</b>								
Number of MV feeders starting from HV/MV or EHV/MV transf. stations	number			1480	352			22825
Number of MV feeders equipped with remote control (SCADA)	number			642	149			13975 <sup>17</sup>
<b>Item # 5 - General info</b>								
Number of Distribution System Operators	number			2	1	1	5	44
Customers served by the largest Distribution System Operators	number			700.897	491823	384732	935158	1836659
Customers served by the three largest Distribution System Operators	number			700.897	There is only one DSO	384732-	2715105	4563995

**Remark:** total length as sum of length of underground cable circuits, bare overhead lines and insulated overhead lines (overhead cables). Distributed energy excluding self-consumption.

<sup>17</sup> 2013 data.



## 2.5 Continuity standards and incentive schemes

The following section provides an overview of the existing frameworks of continuity of supply regulation in the CPs. It will also illustrate which indicators and standards are used in this regard.

In the subsequent sections different terminology is used for the required performance defined by the NRAs by means of setting the targets on continuity at the system level:

- continuity standards set on system level;
- overall (continuity) standards;
- (average) required performance;
- (average) performance targets.

While some of the terms are not often used, some have a sound base in the CEER documents<sup>18</sup>. However, harmonization has not been achieved yet.

The regulation frameworks are assessed on two different levels:

1. Continuity standards at system level with the quality reward/penalty regimes;
2. Continuity standards at single-customer level with the customer compensation schemes

**The development of the regulation frameworks in the CPs is on an initial stage in the prevailing number of cases.** The main emphasis is put on continuity monitoring, however, from the responses on questionnaires provided by many CPs, it can be concluded that activities for assuring the maintenance and improvement of continuity levels, as well as activities to protect the worst served customers are ongoing or will be started soon.

Table 17: An overview on existing continuity standards and incentive schemes

Standards and regulation	Overall standards	Individual standards	Overall reward/penalty scheme	Individual compensations
Distribution	Kosovo*	MD, ME <sup>19</sup> , RS <sup>20</sup>		
Transmission	Kosovo*	RS	-	-
Definition of worst served customer	-			

<sup>18</sup> i.e. papers on smart grids, such as: Status Review on Regulatory Aspects of Smart Metering (Electricity and Gas) as of May 2009 ([http://www.ceer.eu/portal/page/portal/EER\\_HOME/EER\\_PUBLICATIONS/CEER\\_PAPERS/Customers/Tab/E09-RMF-17-03\\_SmartMetering-SR\\_19-Oct-09.pdf](http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Customers/Tab/E09-RMF-17-03_SmartMetering-SR_19-Oct-09.pdf)), Final Guidelines of Good Practice on Regulatory Aspects of Smart Metering for Electricity and Gas ([http://www.ceer.eu/portal/page/portal/EER\\_HOME/EER\\_PUBLICATIONS/CEER\\_PAPERS/Customers/Tab2/E10-RMF-29-05\\_GGP\\_SM\\_8-Feb-2011.pdf](http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Customers/Tab2/E10-RMF-29-05_GGP_SM_8-Feb-2011.pdf)) etc.

<sup>19</sup> Individual standards: for individual large industrial customers (e.g. KAP-Aluminium Plant) connection to 110 kV in which technical processes require special conditions regarding continuity and quality of supply.

<sup>20</sup> Defined by the Decree on Conditions for Electricity Delivery and the Grid Code.

<b>Responsibility</b>	AI, BA, ME, UA (NRA); MK, RS, Kosovo* (Shared)
<b>Publication of indices</b>	AL (monthly), BA, Kosovo* (annually)
<b>Intention/plans for implementation</b>	MK (2016-2018), ME (2012), RS (2013-2015), UA (ongoing)

**No explicit regulatory or other definitions of the *worse served customer* are applied. Not all CPs publish data on indicators but, if, they are published mostly on annual basis.** Only Albania reported monthly publication.

Montenegro protects special large industrial customers only by individual standards on continuity of supply. Serbia also applies individual standards applied and set minimal requirements on duration of interruptions but no compensation scheme. Also in Kosovo\*, the overall standards on continuity of supply were applied for 2011.

The economic effects and outcomes of the regulatory actions cannot be addressed, due to lack of data availability.

## 2.6 Expected developments on continuity of supply regulation

The regulation of continuity of supply will be for sure subject to further changes and developments in the future. Many CPs that have not implemented related rules yet will do so, while others will focus on improving their regulation. Making use of the experience and good regulatory practice within the EU will be of great help to CPs.

CPs are working towards a more comprehensive approach in regulation of continuity of supply, some of them analyzing the possibility to introduce the reward-penalty mechanism (a link between the continuity and tariffs).

All observed CPs have initially put emphasis to improvement and assurance of the preconditions for the regulation of continuity of supply. Monitoring of continuity of supply on all levels with the highest level of detail, backed up with harmonized and standardized rules shall be wrapped up with the continuous publication of data. The transparency of the achieved level of continuity of supply is the very first step in a long journey towards better regulation.

## 2.7 Findings and recommendations on continuity of supply

Monitoring is applied in all CPs that participated in the survey. As a first objective pursued by the regulators and as the core component of the service quality regulation framework, **monitoring has widely reached the phase that can start to back-up regulatory decisions** successfully. Different approaches to the regulation- driven by CPs' legal frameworks and, in particular, different monitoring

methodologies used, combined with different geographical, meteorological characteristics, different networks structures and age- make benchmarking of actual levels of continuity of supply difficult.

The comparative analysis of the monitoring schemes and the continuity of supply regulation across CPs shows that **regulators have generally approached continuity issues with emphasis on long interruptions first, treating the planned and unplanned interruptions separately. Distinction is made between different voltage levels and the classification of the interruptions by its cause is as well applied. In several CPs both number and duration of interruptions are available and almost harmonized combinations of indicators (SAIDI, SAIFI) are used. Short interruptions are barely recorded.** Few examples of regulatory practices with advanced regulation instruments applied, by means of continuity standards and incentive schemes, are identified in the region as well.

Monitoring schemes are developing and are currently in different development stages:

- monitoring is focused mostly on long interruptions;
- monitoring on transmission level is not applied in all CPs;
- monitoring is performed in different level of detail;
- different sets of indicators are used, although basic indicators (i.e. SAIDI, SAIFI, ENS) are widely used;
- not all incidents are considered in the statistics (i.e. LV).

**A lack of harmonization in the basic monitoring rules is also identified, but it is not predominant.** The lack of emphasis on monitoring of continuity at the transmission level in some CPs may be result of an underestimation of its importance due to the robust network design enabling high reliability (“n-1” operational criteria), apparent low number of customers connected to the transmission network, the problem of weighting (atypical customers, specifics in calculation of certain continuity indexes) and the estimation (i.e. “ENS” based indices).

All CPs are encouraged to strengthen their efforts on further developing and optimizing their monitoring process and make further steps towards comprehensive and robust monitoring schemes. The transparency of data and its quality is essential. Findings and recommendations are provided as follows:

- **Finding #1:** *Rules, business processes and tools for automatic logging of interruptions are not applied in all countries*

Many CPs reported only limited use of SCADA and prevailing manual recording of interruptions. Lack of rules for automatic recording of interruptions has a direct impact on completeness, robustness and the quality of data on interruptions collected. Decisions taken (by the regulator or the system operator) on the basis of such data may be misleading. Also auditing such data is time consuming and not efficient.

☞ **Recommendation #1:** *Efficient rules for automatic logging of interruptions have to be introduced*

Implementations of SCADA and its Distribution Management System (DMS) functions in a wider scope that to a larger extent enable automatic logging (at least for EHV, HV and MV voltage levels) is crucial for efficient monitoring of continuity of supply.

It is recommended that all CPs define rules for automatic logging of interruptions. These rules on recording should be harmonized. Deviations or CP specific rules should be adequately upheld.

▪ **Finding #2:** *Harmonization of interruption definitions is not achieved and the monitoring schemes are lacking comprehensiveness and efficiency*

Some minor differences in definitions of interruptions exist. Available norms (EN 50160) and guidelines of good practice (5<sup>th</sup> CEER Benchmarking Report on Quality of Electricity Supply, 2011) are used. Not all types of interruptions are monitored. Transient interruptions are not monitored by any of the CPs and monitoring schemes are lacking efficiency: the main problem is in the way how the interruptions are recorded – in the absence of SCADA or Advance Metering Infrastructure (AMI) (i.e. for recording the interruptions on LV), manual logging of interruptions and data processing does not assure required efficiency and reliability of data.

☞ **Recommendation #2:** *Monitoring of all basic interruptions types should be introduced, based on harmonized definitions*

It is recommended that all CPs harmonize their definitions for basic interruption types (firstly long, secondly short and, if justifiable, transient). Available norms and examples of good practice could be used as a basis for harmonization process.

Harmonization should aimed at meeting the following criteria:

- *long interruptions*                      > 3 min
- *short interruptions*                    > 1 s and ≤ 3 min
- *transient interruptions*                ≤ 1 s

This way, the definitions of interruptions would be aligned with the definitions of interruptions provided by EN 50160 as well as with European practices (5<sup>th</sup> CEER Benchmarking Report on Quality of Electricity Supply, 2011).

Short interruptions do also have a negative impact on business and industrial customers, aside of household customers, and should therefore also get appropriate attention by the regulators. It is recommended that some type of monitoring scheme for short interruptions is in place.

The fact that SCADA will be implemented in many CPs from scratch provides a good opportunity for the CPs to plan appropriate SCADA functions and the appropriate level of network coverage by SCADA, to ensure automatic recording of short interruptions. SCADA is usually implemented starting at the highest voltage levels and moving to the high-load-density parts of the lower-voltage levels. Short interruptions occur mainly in the low-load-density parts of the lower-voltage levels. This important technical issue needs to be considered when planning the introduction of SCADA. The costs

needed for such comprehensive monitoring scheme will be lower in comparison to the situations where existing SCADA lacking functionality is upgraded. It is important for CPs to consider all related aspects; among those are rules for aggregation of interruptions that occur in a short time span.

NRAs should also decide on the extension of monitoring schemes with the transient interruptions.

▪ **Finding #3:** *Continuity statistics do not include incidents at all voltage levels*

None of the CPs has established efficient monitoring schemes for recording interruptions on all voltage levels. While interruptions are recorded separately according to the particular voltage level in most CPs, the monitoring is not always performed on all voltage levels. Usually, data is collected on the HV and MV level only. LV has not been sufficiently covered yet - in the early stage, a similar status was observed in the EU. Consequently, whenever interruptions on the LV level are not monitored, the consumers connected to these levels (which are all domestic customers and the majority of non-domestic customers) will be affected more than suggested by the provided data.

The lack of monitoring or inefficient monitoring at LV level could result in a significant underestimation of the number and duration of interruptions experienced by low voltage customers (unplanned and planned), especially in urban areas, but also on CP level. Indeed, even if each incident in LV will affect much fewer customers than each incident on MV and higher voltage levels, incidents on LV cannot be neglected: the resulting interruptions often last longer<sup>21</sup> than interruptions due to incidents at higher voltage levels and are also important in number<sup>22</sup>. The SAIDI contribution from LV therefore might be even underestimated.

📌 **Recommendation #3:** *Interruptions should be also monitored at LV level*

All CPs are encouraged to include monitoring of interruptions at all voltage levels including LV in the continuity of supply statistics. The cost-benefit analysis should be performed to evaluate different possibilities:

- automated recording based on AMI;
- development of methods for estimation of duration and number of affected customers (i.e. using functions of call centers);
- other (i.e. protection equipment in LV feeders under supervision of SCADA).

Wherever manual logging is applied, system operators should be more vigilant regarding manual entries of outages in LV networks. This can be supported by appropriate organizational and technical measures.

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<sup>21</sup> LV networks are usually radial networks without redundancy.

<sup>22</sup> According to the experience in some EU countries, the contribution of interruptions from LV to the continuity indicators (SAIFI and SAIDI) varies from 7% up to 30% on national level - this analysis is based on the evaluation of impacts of incidents on LV network that are mostly estimated based on notification through the phone calls (AMI is not installed).

▪ **Finding #4:** *Categories of interruption causes vary between CPs*

Information on causes is essential for DSOs to improve continuity of supply. This is also true for the NRA to identify and approve appropriate investments in time. Such information should be collected by system operators as detailed as possible. There is no need for harmonization of the certain types of causes, but it may be useful to achieve harmonization of main categories.

Especially, the treatment of so called “third party” causes is sometimes mixed with the cause category of “exceptional events”.

▢ **Recommendation #4:** *The basic cause categorization should be harmonized*

The harmonization of basic cause categories between the CPs is recommended. Also, a clean split between third party and exceptional events categories is highly recommended.

We recommend the use of the following three main cause categories:

- the responsibility of system operator;
- third party; and
- exceptional events

Each interruption cause (not necessarily harmonized) shall be linked to the appropriate category. The usage of causes like “other”, “not available”, “unexplained” as main categories should be avoided as much as possible. Such causes may be used only as sub-types, being therefore linked to the particular cause category.

Among the interruption causes in the category “third party”, the responsibility of another system operator (DSO or TSO) for an interruption shall be distinguished from the others by its own dedicated type of cause: the interruptions caused by another system operator need to be easily identifiable in the processes of determining the responsible party for the damages caused by interruptions.

The distinction between the main cause categories (to avoid mixing the “third party” and “exceptional events”) shall be achieved by clear definitions.

▪ **Finding #5:** *Level of detail in calculating continuity indicators differs among CPs*

Due to the fact that continuity is benchmarked using indices that include exceptional events and that explicit information on such events was not provided, any conclusion on trends would be misleading. More historical, year-to-year data would be needed for “in-depth” analyses.

The calculation on the level of individual system operators, region and area is not a common practice in CPs. Only two CPs calculate the indices in such detail. Also, only few CPs reported that they calculate indices per network type (according to the population density) - among them only 3 CPs provided data on such indices. In each of these three CP the continuity of supply is much better in urban areas than in rural areas.

The lack of disaggregated CoS data hinders NRAs and system operators in their decisions (regulatory, R&D) on measures to be taken.

📌 **Recommendation #5:** *Logging of interruptions shall comprise all necessary details to enable disaggregated calculation of continuity indices*

Network operators should use the extended set of interruption properties<sup>23</sup> when recording and post-processing interruption data. Such comprehensive approach enables the calculation of disaggregated indices. For that purpose, system operators should meet the technical preconditions for obtaining such data and implement the appropriate business processes for backing up the necessary post-processing of data.

System operators should be required to provide aggregated and disaggregated continuity data (on voltage levels, network types, etc.) to the NRA.

For NRAs, it is important to calculate the indices per system operator with a view to benchmark their performance and identify possible larger differences in the level of continuity of supply. The calculation of indices according to the network type (rural/suburban/urban networks) provides the essential information for decisions on measures for improvement of continuity of supply.

It is therefore recommended that indicators are calculated for each system operator separately, as well as according to the population density (urban/suburban/rural). The latter requires rules for classification that may not be harmonized, due to differences in the network structure and geography, as well as demographic characteristics of CPs. Non aggregated calculation of indices will ensure better flexibility for NRA when designing regulatory incentive schemes<sup>24</sup>.

NRAs are encouraged to continue monitoring of CoS based on an extended set of indicators. Historic data, aggregated and disaggregated data (on voltage levels, network types, etc.) is essential for identifying trends and performing correlation analyses. Monitoring scheme should evolve in such a way to assure CoS data for wider time-spans, as well as in greater detail: disaggregated data should be calculated in order to identify problems and direct priorities.

▪ **Finding #6:** *Lack of explicit information on the use of concepts of “exceptional events” hinder the impact analysis of “exceptional events” on the level of continuity*

Some interruptions are considered to be due to exceptional events and they are either not considered in the continuity statistics or are treated separately. From the available information, it is hard to evaluate the real use of the concept of “exceptional events”, even if its application is widely reported by CPs. Different CPs use different criteria for defining an interruption as exceptional event.

Where exceptional events are displayed in the statistics, knowledge on the contribution of exceptional event is of utmost importance when analyzing continuity of supply data. Although concepts of “exceptional events” are reported to be applied, the impact of exceptional events is not clearly clear – the estimated contribution of exceptional events is more or less constant. This indicates that the concepts of “exceptional events” are not properly defined or used – the classification of incidents as an

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<sup>23</sup> Control area, i.e. population density (urban/suburban/rural), voltage level, network type (cable/overhead), cause, sub-cause etc.

<sup>24</sup> For example the differences in the level of continuity of supply according to the population density should be considered when applying the minimal continuity standards.

exceptional events may comprise also the interruptions due to the weather circumstances that occur once a year or more often (as lightning etc.).

📌 **Recommendation #6:** *Proper use and transparency of concepts of “exceptional events” should be assured*

The possibilities for harmonization of definitions on exceptional events should be explored. It is recommended that CPs harmonize the definition by means of the common characteristics of the natural and non-natural exceptional event. An exceptional event that is beyond the control of the system operator is characterized as:

1. unforeseeable;
2. unpredictable;
3. unpreventable;
4. unavoidable.

All four event characteristics must be confirmed for the event to classify as “exceptional”. Furthermore, the weather circumstances that occur once a year or more often should not be considered as exceptional events. Lightning should not be treated as an exceptional event anywhere in the Energy Community since it is a foreseeable and predictable event in all CPs. The CP specifics aggravate the harmonization in further detail<sup>25</sup>. Harmonization of such detail is not feasible.

Until adequate harmonization has been achieved, it is recommended for each CP to transparently use the definitions and designations of their own regulation. The use of expressions, like “exceptional events”, with an apparent intuitive meaning, but without a clear definition of the manner in which it is used can result in misinterpretation.

Network operators should appropriately and reasonably minimize effects of events that are outside of their control, in line with appropriate regulatory schemes.

▪ **Finding #7:** *The set of indicators in use does not provide a complete picture of continuity of supply*

Most of the CPs calculate SAIDI and SAIFI for distribution networks and ENS (also AIT) for transmission networks. The main interruption properties (duration and frequency) are therefore covered on distribution level only.

Some CPs do not calculate indices for transmission, some reported the use of (rough) estimation when calculating indices. Besides, indicators that express the level of continuity in terms of interruption frequency in transmission networks are not calculated.

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<sup>25</sup> For example, if snowstorms are not an exceptional event in the northern countries, it could be seen as an exceptional event in southern parts of the Energy Community.



📖 **Recommendation #7:** *The number of continuity indices used should be extended*

The use of multiple indicators to quantify CoS provides more information and, therefore, more possibilities to observe trends. Frequency and duration should be observed from different aspects, using different indicators.

CPs are encouraged to gradually extend the set of continuity indicators used. For a balanced view on the achieved level of CoS, indices should always cover both duration and frequency of interruptions. The recommended set could be SAIDI, SAIFI, MAIFI for distribution and ENS, AIT, SAIFI and MAIFI for transmission. The following transmission user types can be used for the calculation of SAIFI and MAIFI (transmission):

1. using three types of transmission users: HV transformation stations (counted each as 1 user, independently from number and size of transformers installed), HV/EHV final customer (large industry) and producers connected to transmission grid) or
2. using of the whole number of the affected network users (at the transmission and all lower voltage levels (distribution)).

Whenever the first option is chosen, the results should be accompanied by information on the weighting method. Also, the aggregation of the indicators calculated using different user types (i.e. in the transmission and distribution levels) should be avoided. The minimal set of indices used for measuring the level of continuity of supply in distribution and transmission should be harmonized.

▪ **Finding #8:** *Publication of continuity data is not performed in all CPs and differs*

The publication of continuity data is not performed by all countries. Also, the frequency of reporting varies across countries. Publication of continuity data usually does not consider exceptional events.

📖 **Recommendation #8:** *Publication of continuity data on a regular basis with explanatory notes*

Publication of data is one of the primary regulatory instruments and should be applied as soon as data is available. Published comparison of company performance is very effective: it simulates a competitive environment and encourages companies to make improvements. Comparisons on supranational level are useful for NRAs in the process of developing and improving their quality regulation schemes and CP related performance.

It is recommended that system operators publish CoS data regularly and at least once a year. System operators should provide explanatory notes on the data published. NRAs should likewise regularly publish CoS data aggregated on CP level, including remarks regarding system operators' performance.

It is recommended for any publication of continuity of supply data to include information on included and excluded interruptions, together with information about those situations that are treated specifically. This especially applies to exceptional events.

In case of exclusions disaggregated CoS data should be provided for regulatory purposes.

The cooperation and the exchange of experience between the CPs via the ECRB provide helpful support. The examples of good practice and lessons learned on EU level should also be considered.

- **Finding #9:** *Minimal continuity standards and incentive schemes are rare and have different formulations*

The regulation framework in CPs is mostly in an initial stage. Therefore, incentive schemes on system level (reward/penalty schemes based on overall continuity standards (references) influencing the tariff) or individual level (guaranteed standards with the compensation payments to customers) are rare. According to the maturity of the continuity regulation, such status is not uncommon and expected. The few schemes that are applied are not similar and are rather simple.

- ▣ **Recommendation #9:** *Gradual implementation of incentive mechanisms is encouraged*

The examples of reward/penalty regimes already applied for several years in many countries of the EU show their positive impact in improving or preserving the level of continuity of supply. It is therefore recommended that each CP develop its own reward/penalty regime taking into account its specific conditions<sup>26</sup>. The development of regulation should be gradual and the prerequisites for incentive schemes at any level should include robust monitoring scheme and audits.

It is recommended that a step-by-step approach is used in setting minimal standards on continuity of supply. Robust historical data is a prerequisite for such decisions. Gradual implementation of minimal standards (in the form of overall and guaranteed standards) will encourage the development of different incentive mechanisms (reward/penalty schemes and/or compensation payments) to maintain and further improve the level of continuity supply.

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<sup>26</sup> Network development, investment levels, regional differences and automation projects

### 3. VOLTAGE QUALITY

#### 3.1 Introduction

This chapter provides an overview of the existing practice in voltage quality monitoring and regulation on transmission and distribution level in CPs. Review and analysis of collected voltage quality data shows that activities towards the introduction of voltage quality monitoring and regulation have started in all CPs. However the activities are only in an initial stage and consequently CPs were not able to provide a complete set of data on all voltage quality aspects. The following aspects were analyzed:

1. Voltage quality regulation and legislation;
- 2a. Voltage quality monitoring system (VQMS);
- 2b. Data collection, aggregation and publication from VQMS;
3. Voltage quality indicators;
4. Actual data for voltage dips, other VQ parameters and mitigation measures; and
5. Studies on estimation of costs due to poor voltage quality.

Information provided by the CPs on these categories is provided in

Table 18.

Table 18: Indication of provided voltage quality information by different CPs

EnC Contracting Party	Voltage quality regulation and legislation	Voltage quality monitoring system	Data collection, aggregation and publication	VQ indicators	Actual VQ data and mitigation measures	Studies on estimation of costs due to poor VQ
<b>Albania</b>	Yes					
<b>Bosnia and Herzegovina</b>	Yes	Yes	Yes	Yes	Yes	
<b>FYR of Macedonia</b>	Yes	Yes	Yes	Yes		
<b>Kosovo*</b>	Yes			Yes		
<b>Montenegro</b>	Yes			Yes		
<b>Serbia</b>	Yes			Yes		
<b>Ukraine</b>	Yes			Yes		

The table shows that **most of the data is not available yet**. The analysis of this chapter therefore focuses on an overview of the development status of voltage quality monitoring and regulation in the individual CPs.

## 3.2 Voltage quality legislation, regulation and standardization

Data regarding voltage quality implementation via legislation, regulation and standardization are provided by all the CPs. This implies that CPs have recognized the need for introducing voltage quality requirements into their legal and regulatory framework. Most of the CPs have adopted standard EN 50160 and other VQ and EMC related standards and have created VQ provisions in line with those standards. However, **direct obligations and procedures regarding voltage quality monitoring and regulation are still not clearly defined in the legislation and therefore need to be more directly addressed in the future by adjustments and improvements of legislation and regulation in the CPs.**

### 3.2.1 Introducing EN 50160

The majority of CPs implemented EN 50160, mainly as a voluntary standard or, also, in legislation and regulation. It is usually defined in the general conditions of supply or network codes, either by a reference to EN 50160 or by directly using the limits required by EN 50160 in legislation or regulation. Consequently, **EN 50160 can be considered the basic instrument for voltage quality assessment in the CPs.**

EN 50160 is mainly applied on low and medium voltage levels up to 35 kV. In the majority of CPs where it is implemented, EN 50160 is predominantly used as a standard for supply voltage variations. The implementation status of EN 50160 in each of the reporting CPs is presented in Table 19.

Table 19: EN 50160 implementation status

EnC Contracting Party	Implementation status	Different standards from EN 50160 and the way they are enforced
Albania	Voluntary standard	Yes, national law
Bosnia and Herzegovina	Yes partially, General conditions of supply and Grid Code; BA: fully from 2016 Republika Srpska: fully from 2015	Yes, national law, grid/distribution code
FYR of Macedonia	Yes partially <u>MKC EN 50160:2009</u> , Grid Code;	Yes, national law, grid/distribution codes
Kosovo*	Yes	Yes, distribution code
Montenegro	No	Yes, grid/distribution codes
Serbia	Voluntary standard.	Yes, national law, grid/distribution code
Ukraine	implemented as a voluntary standard	Yes,

### 3.2.2 Legislation and regulations that differ from EN 50160

All CPs have introduced voltage quality requirements **going beyond EN 50160** in their legislation and regulation. Voltage quality standards that are different from those indicated in EN 50160 are implemented for some voltage characteristics, mainly via laws and network codes, as presented in Table 19. In Ukraine, voltage quality limits for different voltage characteristics are defined by an interstate standard on voltage quality, GOST 13109-97, approved by the *Interstate Council of standardization, metrology and certification*.

The limits that are defined in legislation and network codes on supply voltage variations mainly correspond to EN 50160 for MV and LV level. In some CPs more strict requirements for supply voltage variations are in place. Voltage limits on other voltage levels are mainly  $\pm 5\%$  for 400 kV,  $\pm 10\%$  or  $\pm 5\%$  for 220 kV and  $\pm 10\%$  for 110 kV. Currently applied voltage quality standards in observed CPs are shown in Table 20.

Table 20: VQ standards enforced/used at national level

EnC Contracting Party	Supply voltage variation standards	VQ standards for other voltage characteristics
Albania	400 kV: $\pm 5\%$ , $-10\%$ ; 220, 150, 110 kV: $\pm 10\%$ ; 35 kV: 31-39 kV; 20 kV: 24 kV (highest voltage); 10 kV: 10,75 kV (highest voltage); 380 V, 220 V: $+10\%$ , $-15\%$	No
Bosnia and Herzegovina	Partially EN 50160, IEC 60038 400kV: $\pm 5\%$ ; 220kV: $\pm 10\%$ HV, MV: $\pm 10\%$ LV: $\pm 10\%$ (RS), $+5\%$ , $-10\%$ (BA)	Yes, IEC 61000-3-6, IEC 61000-3-7 IEC 61000-3-12, national standards
FYR of Macedonia	EHV: $\pm 5\%$ ; HV, MV: $\pm 10\%$ LV: $+5\%$ , $-10\%$	No, <u>MKC EN 50160:2009</u>
Kosovo*	400 kV: $\pm 5\%$ , (exceptional event $\pm 10\%$ ); 220 kV: $\pm 5\%$ , (exceptional event $\pm 10\%$ ); 110 kV: $\pm 10\%$ , (exceptional event 88 to 130kV); MV, LV: (35kV, 20kV, 10kV, 6.3kV, 400 V, 230V): $+10\%$ ; $-15\%$	Yes
Montenegro	400 kV: $+5\%$ ; 220 kV: $\pm 10\%$ ; 110 kV: $\pm 10\%$ ; 35 and 10 kV: $\pm 5\%$ LV: $\pm 10\%$ ;	No
Serbia	400kV: $\pm 5\%$ ; 220kV: 200-240kV HV, MV, LV: $\pm 10\%$	
Ukraine	All voltage levels: $\pm 5\%$ (95% of the time) $\pm 10\%$ (marginal voltage variation) or EN 50160:2010 (with some amends: LV voltage 220 kV) (must be determined in contract)	Yes, GOST 13109-97 and EN 50160:2010

### 3.2.3 Obligations for monitoring voltage quality

Monitoring voltage quality requires monitoring of voltage quality parameters with voltage quality monitoring instruments in such a way that provides a system-wide evaluation. In some CPs, a direct

obligation for the TSO/DSOs to measure voltage quality parameters on a continuous basis or at pre-defined intervals has been introduced by legislation and regulation.

However, **in the majority of the CPs detailed procedures and obligations for the establishment of a voltage quality monitoring system have not been defined in the legal and regulatory framework yet.** Only in FYR Macedonia legislation defines detailed procedure and obligations for the implementation of a voltage quality monitoring system: in line with the provisions for implementation of a voltage quality monitoring system, the legal framework in FYR of Macedonia also prescribes provisions for collection, aggregation and publication of voltage quality data from the voltage quality monitoring system.

In the other CPs, no specific requirements regarding voltage quality measuring have been implemented in legislation and regulation, except for Bosnia and Herzegovina where the General Conditions<sup>27</sup> require that measurements of voltage quality have to be in accordance with IEC 61000-4 or with the respective standard in Bosnia and Herzegovina (BAS). In some CPs certain requirements for voltage quality monitoring instruments still exist from the time before the NRA was operational.

In the majority of the CPs, TSO/DSOs are legally obliged to install a voltage quality recorder only upon request of an end-user who experiences problems due to insufficient voltage quality at its own connection point. For the rest of the reporting CPs, the common practice is that voltage quality monitoring is performed even if the TSO/DSOs are not legally obliged to do so. In most of the cases, the costs are covered by the TSO/DSO, while in some CPs the costs are charged to the customer in case that the voltage quality proves to comply with the requirements. A possibility for an end-user to install its own voltage quality recorder and use measurement in a dispute with the TSO/DSOs is not recognized in the majority of the CPs, except in Ukraine where such a procedure is defined. Monetary penalties in cases where quality limits are not met are foreseen only in Ukraine.

#### *3.2.4 Individual information on voltage quality*

The obligation of providing individual information on voltage quality is still not legally defined in the majority of the CPs. Only in Bosnia and Herzegovina TSO/DSOs are legally obliged to inform the end-user about the past or expected future voltage quality levels. However, it seems that even without legal obligation, TSO/DSOs inform customers about voltage-quality levels upon their request.

An overview of the legal obligations covered in Sections 3.2.3, 3.2.4 and 3.2.5 is provided in **Error! Reference source not found.21.**

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<sup>27</sup> Of FERC.

Table 21: VQ measurement obligations

EnC Contracting Party	VQ measurement by the system operator		VQ measurement at end-user's request		TSO/DSO's obligation to inform user on voltage quality
	TSO	DSO	TSO/DSO's recorder	user's recorder	
<b>Albania</b>	Yes, hourly	Yes hourly	Yes	No	No
<b>Bosnia and Herzegovina</b>	Yes	Yes	Yes	No	Yes
<b>FYR of Macedonia</b>	Yes	Yes	Yes, operator pays if request justified	No	No
<b>Kosovo*</b>	No	No	Yes	No	Upon user's request
<b>Montenegro</b>	Yes	Yes	Yes, no pre-defined payment by user	No	No
<b>Serbia</b>	No	No	No	No	No
<b>Ukraine</b>	Yes	No	Yes	Yes	No

In most of the CPs, the responsibility for improving the overall voltage quality and/or rectifying voltage disturbances is shared between the State Inspectorate, the TSO/DSOs, customers and the NRA. However the responsibilities are not clearly legally defined. The role of the NRA is mainly limited to approving codes, while the direct authority for voltage quality regulation is not defined.

### 3.2.5 Emission limits

In order to regulate the impact that customer installations have on the voltage quality of the transmission and distribution network, **the majority of the CPs has imposed legislation defining emission limits for individual customer.** Maximal levels of disturbances concerning voltage quality for the end-user installations that are connected to the network are usually defined by the grid and distribution codes<sup>28</sup>. However, **different approaches are identified in defining emission limits.** In the majority of the CPs, such as Bosnia and Herzegovina, Montenegro and Kosovo\*, emission limits are defined in terms of voltages according to international standards, such as IEC standards and EN 50160. A different approach is used in Serbia, where maximum levels of electricity current emissions are set for the installations connected to the network.

Penalties for customers in case of violation of the maximum levels of disturbances- other than disconnection- are not envisaged in any of the observed CPs.

<sup>28</sup> Namely in the chapters dealing with connection to the transmission and distribution network.

### 3.3 Voltage quality monitoring systems and data

A voltage quality monitoring system has been implemented only in Bosnia and Herzegovina and consequently actual voltage quality data has been provided by Bosnia and Herzegovina only. Other CPs still have not installed any voltage quality monitoring system.

#### 3.3.1 *Development of voltage quality monitoring systems*

Bosnia and Herzegovina has voluntarily implemented a voltage quality monitoring system for the purpose of statistics and research. Voltage quality monitoring is mainly done on the HV/MV delivery points between the TSO and the DSO with portable instruments, namely with 1 instrument per location and type of network points monitored, on a rolling basis. Pre-defined tariffs exist for the cost of monitoring.

#### 3.3.2 *Smart meters and voltage quality monitoring*

In most of the CPs, smart meters have not been introduced for the time being. In some CPs a small number of smart meters has been already installed but those meters do not allow voltage quality monitoring and there are no such functionality requirements for smart meters imposed.

#### 3.3.3 *Data collection, aggregation and publication from VQMS*

Taking into account that most of the surveyed CPs still do not have a voltage quality monitoring system implemented, they also do not have any practice and procedures established for data collection, aggregation and publication.

Consequently, only Bosnia and Herzegovina provided information on current practice in collection, aggregation and publication of voltage quality data from the voltage quality monitoring system: collected data is stored in the central computer and available upon request of the NRA and network users. These data have been published only in the studies, since responsibility for publication has not been defined yet.

#### 3.3.4 *Actual data for voltage dips, other VQ parameters and mitigation measures*

Almost no CP was able to provide any actual data on voltage dips and other VQ parameters. Additionally, there are no reported data on mitigation measures from any of the CPs concerned.

Only Bosnia and Herzegovina has provided some monitoring data of VQ parameters. Bosnia and Herzegovina has reported a value of 132 voltage dips per HV substation delivery points per year estimated based on 33 voltage dips registered in the measurement campaign at a limited number of locations (6) during parts of 2008 (91 day). Data for the following years were not available. In the period 27March to 2 May 2010 high voltages were recorded in 400 kV and 220 kV network in Bosnia



and Herzegovina, where practically in all nodes at 400 kV and in some nodes at 220 kV, voltages exceeded the upper limits up to 32% of the total measuring time. In order to resolve VQ problems in the network, a study has been made and non-allowed voltages were identified.

### 3.4 Findings and recommendations on voltage quality

- **Finding #1:** *EN 50160 is implemented in most CPs*

EN 50160 is implemented in the majority of the CPs, mainly as voluntary standard, but also by legislation and regulation. It is usually defined in the general conditions of supply or network codes, either as a reference to the EN 50160 or by taking over the limits given in the legislation and regulation. EN 50160 is mainly applied on low and medium voltage levels up to 35 kV. Additionally, it is predominantly used as a standard for supply voltage variations. In most of the CPs EN 50160 has not been translated into local language.

Voltage quality standards that differ from EN 50160, such as IEC 61000-x-x have been introduced for some voltage characteristics, mainly via legislation and network codes. Different standards are introduced for different reasons: historical, different network characteristics, introducing new stricter limits, etc.

📌 **Recommendation #1:** *Introduction of EN 50160 and IEC 61000-x-x in CP standardization, legislation and regulation*

CPs that have not adopted EN 50160 are encouraged to do so. Those CPs that have adopted, but have not translated EN 50160 should make the effort to translate EN 50160 in order to have precise definitions in national language and to allow further development of terminology. This also applies to other widespread standards like IEC 61000-x-x.

Implementing provisions in legislation (i.e. grid codes or voltage quality rules) that are consistent or stricter than EN 50160 and IEC 61000-x-x is recommended. Those CPs that have done this already should further improve the precision of definitions, limitations and exceptions. Since most CPs have been focused on supply voltage variations, efforts should be extended to encompass all voltage characteristics mentioned in EN 50160. Deviations from EN 50160, IEC 61000-x-x and other should be avoided as much as possible keeping in mind national specifics.

The previous recommendations are preconditions for NRAs to make efficient decisions on voltage quality regulation.

- **Finding #2:** *Legislation and regulation do not address voltage quality monitoring*

Detailed procedures and obligations for the establishment of a voltage quality monitoring system have not been defined in legal and regulatory frameworks of the majority of the CPs. FYR Macedonia is the only CP where legislation defines detailed procedure and obligations for implementation of a voltage quality monitoring system.

🔗 **Recommendation #2:** *Introduction of voltage quality monitoring obligations*

Direct obligations, as well as detailed procedures for establishment of a voltage quality monitoring system, should be defined in the legislation and regulation in all CPs. Provisions regarding requirements for voltage quality instruments, collection, aggregation and publication of voltage quality data from the voltage quality monitoring system should be established as well.

▪ **Finding #3:** *Voltage quality monitoring systems have not been implemented*

Voltage quality monitoring systems for continuous voltage quality monitoring have not been installed in any of the CPs and therefore they were not able to provide relevant data on actual voltage quality levels. Only in Bosnia and Herzegovina, a voltage quality monitoring system for the purpose of research has been voluntarily installed, and consequently some data has been provided.

🔗 **Recommendation #3:** *Voltage quality monitoring systems should be implemented*

CPs should encourage T/DSOs to develop voltage quality monitoring systems for continuous voltage quality monitoring in their networks. Monitoring should take place at locations at which a good estimation of the voltage quality as experienced by customers can be made. It is further acknowledged that data from continuous voltage quality monitoring can provide useful information for T/DSOs, resulting in significant cost savings and information to support investment decisions.

Having in mind that implementation of voltage quality monitoring systems has not started yet in CPs, it is recommended for the CPs- prior to the implementation- to undertake joint activities towards harmonization of voltage quality parameters and measurement methods.

The principle aims of compulsory or regulator-controlled monitoring should be to verify compliance with voltage-quality requirements (both overall and for individual customers); to provide information to customers on their actual or expected voltage quality; and to obtain information for the setting of appropriate future requirements. This should be considered when deciding about the need for compulsory or regulator-controlled monitoring.

▪ **Finding #4:** *Individual voltage quality verification is available in the majority of the CPs*

In majority of the CPs T/DSOs are legally obliged to provide individual voltage quality verification upon request of end-users who experience voltage quality problems. In several CPs, even without a legal obligation, in practice T/DSOs perform individual voltage quality verification. In most of the cases, costs are paid by the T/DSO, while in some CPs costs are paid by the customer in the case that voltage quality proves to comply with the requirements. An obligation of providing individual information on voltage quality is still not legally defined in the majority of the CPs.

🔗 **Recommendation #4:** *Introduction and development of individual voltage quality verification provisions*

The legal obligation for T/DSOs to provide individual voltage quality verification upon user's request should be adopted in all CPs. This obligation should be accompanied by a detailed description of the

procedure by the T/DSOs ensuring that all relevant information about the procedure is available to customers, including definition and allocation of costs related to the verification.

Statistics on complaints and verification results should be used by system operators for identifying areas that need improvements or at least for identifying areas that should be investigated further. NRAs should use such statistics for regulatory decisions regarding voltage quality.

It is further recommended that statistics on complaints and verification results are correlated with results from continuous voltage quality monitoring (if in place).

In the verification process, the system operator should make reasonable efforts to identify the cause of the disturbance.

▪ **Finding #5:** *Emission levels of network users*

In most CPs legislation defining emission limits by individual network users has been imposed. Emission limits are usually defined by grid and distribution codes<sup>29</sup>. Different approaches are identified in defining emission limits. In most CPs emission limits are defined in terms of voltages according to international standards, such as IEC standards and EN 50160, except in Serbia where maximum levels of electricity current emissions are set.

Penalties for customers in the case of violation of emission limits- other than disconnection- are not envisaged in any of the CPs.

📄 **Recommendation #5:** *Provisions regarding emission levels should be developed*

Emission limits from individual customers are necessary to maintain the voltage disturbance levels within the voltage-quality requirements without excessive costs for other customers. The limits on emission should be reasonable for both T/DSOs and the customers causing the emission.

Introduction of emission limits for individual network users by legislation or regulation should go hand in hand with the legal establishment of voltage quality standards that TSO and DSOs have to comply with.

In case of violations of emission limits by a network user, mitigation measures should be coordinated by the TSO and DSOs.

A network user should pay penalties or be obliged to carry out corrective measure if user's installation is the source for a voltage complaint.

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<sup>29</sup> Namely in the chapters dealing with connection to the transmission and distribution network.

## 4. COMMERCIAL QUALITY

### 4.1 Introduction

The answers received indicate that regulation of Commercial Quality (CQ) is still in an early stage in all assessed CPs.

The questionnaire used for the present survey stressed the complexity of CQ with multiple suppliers and regulated entities like DSO and Universal Service Providers (USP). A brief examination of a supposedly simple business process, like solving a Voltage Quality complaint, reveals that CQ standards are strongly correlated with the market design and legal framework. **For most CPs this implies the need to further develop legislation and practice to accommodate even basic service quality regulation.** For example, concerning the process of solving a Voltage Complaint, precise definitions of triggers and time intervals are crucial, as well as defining the entity on which a certain trigger/event/process applies to, since it is really different if the customer calls his supplier in comparison to the scenario where the customer calls to DSO directly.

### 4.2 Overview of Commercial Quality Standards in CPs

As suggested by the previous CEER Benchmarking Reports, CQ requirements have been categorized in two main and two supplementary types:

- **Guaranteed Standards** (GSs) refer to quality levels which must be met in each individual case. If the company fails to provide the level of service required by the GS, it must compensate the customer affected, subject to certain exemptions. The definition of guaranteed standards includes the following features:
  - performance covered by the standards (e.g. estimation of the costs for the connection);
  - maximum time before execution of the performance - commonly determined in terms of response (fulfilment) time (e.g. 5 working days);
  - economic compensation to be paid to the customer in case of failure to comply with the requirements.
- **Overall Standards** (OSs) refer to a given set of cases (e.g. all customer requests in a given region for a given transaction) and must be met with respect to the whole population in that set. Overall standards are defined as follows:
  - performance covered (e.g. connection of a new customer to the network)
  - minimum level of performance (commonly in % of cases), which has to be met in a given period (e.g. in a 90% of new customers have to be connected to the distribution network within 20 working days).
- **Other Available Requirements** (OAR). In addition to GSs and OSs regulators (and/or other competent parties) can issue requirements in order to achieve a certain quality level of service.

These quality levels can be defined by the regulator, e.g. a minimum level which must be met all customers at all times. If the requirements set by the regulators are not met, the regulator can impose sanctions (e.g. financial penalties) in most cases.

- **Only Monitoring** (OMs). Before issuing GSs and OSs, regulators (and/or other competent parties) can monitor the performance of DSOs, suppliers, universal suppliers and/or metering operators, in order to understand the actual quality level and to publish - when deemed appropriate - the actual data on services provided to the customers..

Commercial quality has been reviewed by using the following four groups of indicators:

- Connection (Group I);
- Customer Care (Group II);
- Technical Service (Group III);
- Metering and Billing (Group IV).

The assessment shows an overwhelming use of explicit provisions regarding quality where standard is applied to all (100%) cases (Table 22). Although such provisions are in essence GSs, in line with the benchmarking guidelines, such standards are labeled as OARs because there is no compensation for individual customers and often there is no penalty defined for the company. For most of these standards, penalties are based either on vague and imprecise general penal provisions or simply do not exist (even if required by primary legislation). Additionally, it should be mentioned that the OARs present in the CPs are usually not influenced by the NRA, but are rather defined by primary or secondary legislation.

Table 22 shows that commercial quality in CPs is enforced largely by OAR (91 within the total of 116).

Table 22: Commercial quality

Country	Guaranteed standards (GS)	Overall standards (OS)	Other available requirements (OAR)	Only Measuring (O/M)	Total
Albania	0	3	0	0	3
Bosnia and Herzegovina	0	0	13	3	16
FYR of Macedonia	0	0	13	0	13
Kosovo*	0	8	11	0	19
Montenegro	0	0	10	0	10
Serbia	0	0	15	6	21
Ukraine	0	0	13	0	13
<b>TOTAL</b>	<b>2</b>	<b>14</b>	<b>91</b>	<b>9</b>	<b>116</b>

Table 23: Number of Commercial Quality Standards for each indicator

Standards	GS	OS	OAR	O/M	Total
<b>I. CONNECTION</b>					
I.1 Time for response to customer claim for network connection		2	8		10
I.2 Time for cost estimation for simple works		1	3		4
I.3 Time for connecting new customers to the network		4	7		11
I.4 Time for disconnection upon customer's request			7	1	8
<b>TOTAL FOR CONNECTION INDICATORS</b>	<b>0</b>	<b>7</b>	<b>25</b>	<b>1</b>	<b>33</b>
<b>II. CUSTOMER CARE</b>					
II.5 Punctuality of appointments with customers			1		1
II.6 Response time to customer complaints and enquiries (including 6a and 6b)			7	2	9
II.6a Time for answering the voltage complaint		1	6	2	9
II.6b Time for answering the interruption complaint			3	2	5
II.7 Response time to questions in relation with costs and payments (excluding connection)			5		5
II.8 Call Centres average holding time					0
II.9 Call Centres service level					0
II.10 Waiting time in case of personal visit at client centres					0
<b>TOTAL FOR CUSTOMER CARE INDICATORS</b>	<b>0</b>	<b>1</b>	<b>22</b>	<b>6</b>	<b>29</b>
<b>III. TECHNICAL SERVICE</b>					
III.11 Time between the date of the answer to the VQ complaint and the elimination of the problem	1	1	4		6
III.12 Time until the start of restoration of supply following failure of fuse of DSO		4	1	1	6
III.13 Time for giving information in advance of a planned interruption		2	5		7
III.14 Time until the restoration of supply in case of unplanned interruption	1		3	1	5
<b>TOTAL FOR TECHNICAL SERVICE INDICATORS</b>	<b>2</b>	<b>7</b>	<b>13</b>	<b>2</b>	<b>24</b>
<b>IV. METERING AND BILLING</b>					
IV.15 Time for meter inspection in case of meter failure			6		6
IV.16 Time from the notice to pay until disconnection			9		9
IV.17 Time for restoration of power supply following disconnection due to non-payment			7		7
IV.18 Yearly number of meter readings by the designated company			8		8
<b>TOTAL FOR METERING AND BILLING INDICATORS</b>	<b>0</b>	<b>0</b>	<b>30</b>	<b>0</b>	<b>30</b>
<b>TOTAL</b>	<b>2</b>	<b>15</b>	<b>90</b>	<b>9</b>	<b>116</b>

Table 23 shows that there is no particular group with a prevalent number of standards. This means that **CQ is equally developed** (or rather equally undeveloped) **in all indicator groups**, with the exception of group II – Customer Care which has twice as many indicators in comparison to other groups.

If the total number of standards per indicator is considered (

Table 23 23), it is visible that indicator “I.3 Time for connecting new customers to the network” has the highest number of standards. Closely behind are indicators dealing with connections claims and disconnections (I.3, I.4 and IV.16). Also, handling complaints is important with a high total of standards (II.6, II.6a).

For the present benchmarking the distinction between standards applied to DSOs, Suppliers and Universal Suppliers is presently not informative since national electricity markets are developing. Therefore, an overview of standards and data availability with respect to relevant company is skipped. However, some remarks will be given in chapters analyzing particular groups of indicators.

It should be noted that the current benchmarking is more focused on commercial performances of the DSOs and less on performances in the competitive sector of supply.

The analysis also proved that no adequate statistical data exists for most CQ indicators.

## 4.3 Main Results of Benchmarking Commercial Quality Standards

### 4.3.1 Group I – Connection

Most electricity legal frameworks encompass commercial standards regarding connections. CPs have similar standards and approaches to monitoring connection issues. This of course accounts for predominant use of OAR standards as explained earlier.

Connection-related activities have a complex structure. Nevertheless, the four quality indicators (as presented in **Error! Reference source not found.** 24) defined in the questionnaire used for the present survey represent the whole process for connection. The questionnaire put emphasis on the division between LV and MV customers (requesting information on voltage levels that a standard applies to). However, CPs instead rather differentiate connection procedures based on the type of customer. In addition to the obvious household type, categorizations in different CPs distinguish between legal entities, commercial customers on different voltage levels, etc. Connection procedures revolve around those types and “simple works” do not rely on common criteria.

Due to the current levels of market opening, standards for connection related activities in CPs apply to the DSO.



Table 24: Commercial Quality Standards for Connection-Related Activities

Quality Indicator	Countries (grouped by type of standard)	Standards (median value and range)	Compensation (median value, GS only)	Company involved
Time for response to customer claim for network connection	OS: AL OAR: BA, MK, ME, RS, UA, Kosovo*	25 days (15 - 30 days)	-	DSO
Time for cost estimation for simple works	OS: AL OAR: BA, MK, Kosovo* None: ME,RS, UA	21 days (8 - 30 days)	-	DSO
Time for connecting new customers to the network	OS: AL, Kosovo* OAR: BA, MK, ME, RS, UA None:	20 days (4- 45 days)	-	DSO
Time for disconnection upon customer's request	OAR: MK, ME, RS, UA, Kosovo* O/M: BA None: AL	12 days (3- 30 days)	-	DSO

#### 4.3.2 Group II – Customer Care

Customer Care relates to the group of indicators with the least number of standards. For certain indicators none of the CPs has adopted standards. Of course it can be argued that this is a direct reflection of the low level of competition. Another reason that can be valid is that liberalization of energy sectors is lagging behind comparing to EU countries.

Direct interaction with customers is not monitored – starting with the lack of call centers (used by DSOs and incumbent suppliers), appointments and visits are not planned/recorded, etc.

Another aspect is that DSOs and incumbent companies have not been focusing on customers and many customer care indicators encountered in this benchmarking were purely statistical information on certain commercial activities. For example, customer complaints are recorded and average times can be calculated (or more often estimated). However, as a rule, **DSOs and incumbent companies do not have customer relationship management or any similar system**, so there is no possibility to track a specific customer with a specific issue. That is the reason why CPs cannot obtain data regarding indicators related to customer care as defined in the questionnaire used for the present survey.

Table 25: Commercial Quality Standards for Customer Care Activities

Quality Indicator	Countries (grouped by type of standard)	Standards (median value and range)	Compensation (median value, GS only)	Company involved
Punctuality of appointments with customers	OAR: BA None: AL, MK, ME, RS, UA, Kosovo*	-	-	DSO
Response time to customer complaints and enquiries (total, including 6a and 6b)	OAR: BA, MK, ME, UA, Kosovo* O/M: RS None: AL	26 days (15 - 30 days)	-	DSO
Time for answering the voltage complaint (as part of q6)	OAR: BA, MK, ME, UA, Kosovo* O/M: RS None: AL,	16 days (2- 30 days)	-	DSO
Time for answering the interruption complaint (as part of q6)	O/M: RS OAR: MK, ME, Kosovo*, UA None: AL, BA	20 days (15- 30 days)	-	DSO
Response time to questions in relation with costs and payments (excluding connection)	OAR: BA, ME, UA, Kosovo* None: AL, MK, RS	8 days (1h- 8 days)	-	DSO
Call Centres average holding time	-	-	-	-
Waiting time in case of personal visit at client centres	-	-	-	-

Table 25 clearly shows that all CPs lack standards related to Call Centers and do not record visits/appointments. This information has been intentionally left in the table to emphasize the need to develop technical systems designed for customer care.

#### 4.3.3 Group III – Technical Service

This particular group of quality indicators is the most diverse group within Commercial Quality. The reason is that different CPs use different approaches for CQ regulation and are at different development stages. This is not evident from the benchmarking data presented in this report, but was observed in the answers and remarks given by the CPs.

Standards related to technical services in principle correspond to standards during the contract period and are tied to technical services of the DSO. All CPs identified the DSO as company in charge. Nevertheless, it was observed that standards for technical services (and the legal framework governing the supplier business) must be developed to accommodate scenarios where customers contact the DSO directly or their supplier for technical services.

Table 26 Commercial Quality Standards for Technical Services

Quality Indicator	Countries (grouped by type of standard)	Standards (median value and range)	Compensation (median value, GS only)	Company involved
<b>Time between the date of the answer to the VQ complaint and the elimination of the problem</b>	OS: Kosovo* OAR: BA, RS, UA None: AL, MK, ME	25 days (1 - 60 days)	-	DSO
<b>Time until the start of restoration of supply following failure of fuse of DSO</b>	OS: Kosovo* OAR: MK, UA O/M: BA None: AL, ME, RS	12 hours (1 - 24 hours)	-	DSO
<b>Time for giving information in advance of a planned interruption</b>	OS: Kosovo*, MD OAR: BA, MK, RS, UA None: AL, ME	3 days (1 - 10 days)	-	DSO
<b>Time until the restoration of supply in case of unplanned interruption</b>	O/M: BA OAR: MK, RS, UA None: AL, ME, Kosovo*	18 hours (2- 24 hours)	-	DSO

#### 4.3.4 Group IV – Billing and metering

**Billing and metering is the only group of quality indicators where CPs reported standards that apply to companies other than the DSO.** This is not surprising, since the development of markets starts with payments and measurements (in this case electricity metering).

Although the indicators in this group (as shown in the first column of Table 27)

Table 27 are instantly recognizable, the actual standards and ranges used by different CPs show that **billing and metering should be developed in terms of definitions needed for precisely defining standards**. For example, the indicator “Time from the notice to pay until disconnection” may be viewed as “time from sending the notice...” or “Time from the notice is received...”

Similar to the group “Technical Services”, standards within “Billing and Metering” depend whether or not customers must rely on a supplier for billing and metering or can directly communicate or carry out business with the DSO or the metering company.

Table 27 Commercial Quality Standards for Billing and Metering

Quality Indicator	Countries (grouped by type of standard)	Standards (median value and range)	Compensation (median value, GS only)	Company involved
Time for meter inspection in case of meter failure	OAR: BA, MK, RS, UA, Kosovo* None: AL, MK	14 days (2 - 30 days)	-	DSO, MO
Time from the notice to pay until disconnection	OAR: BA, MK, ME, RS, UA, Kosovo* None: AL	13 days (3 - 30 days)	-	DSO
Time for restoration of power supply following disconnection due to non-payment	OAR: BA, MK, ME, RS, UA, Kosovo* None: AL,	2 days (1 - 7 days)	-	DSO, SP
Yearly number of meter readings by the designated company	OAR: BA, MK, ME, RS, UA, Kosovo* None: AL	8 Meter Readings per Year (2-12)	-	DSO, SP, USP, MO

#### 4.4 Findings and recommendations on commercial quality

In general, commercial quality is in an early development stage in all surveyed CPs. Therefore, all general recommendations for developing quality of service standards can apply. However, there four issues specific for the CPs that should be recognized. It should be also mentioned that Commercial Quality in the CPs should be considered in a broader perspective. Customer rights are definitely lagging behind in comparison to customer rights in the EU.

- **Finding #1:** *There is an overwhelming use of standards that apply to all customers*

There is an overwhelming use of explicit provisions that apply to all (100%) customers (cases). These provisions are in essence GS but they do not entail compensation for individual customers or a penalty for the company.

- ▢ **Recommendation #1:** *Existing standards that apply to all customers should be more specific*

At first sight, it would not be difficult to develop such OARs into GS. It would be a simple matter of defining compensation for individual customers. However, that approach would be risky since quality standards should be introduced gradually – initially starting with measuring performance. Applying a GS without a proper quantitative analysis can affect companies financially much more than expected or initiate an tremendous number of complaints that must be handled (by the utility or the NRA).

Therefore, starting from the existing standards, new ones should be created based on the following approach:

- Exemptions should be possible, allowing some flexibility until a proper percentage of cases can be defined within a GS;
- Definitions should be developed in order to allow monitoring and acquisition of data (proper regulatory decisions or standards can be adopted only based on statistical data);
- For those standards or regulatory provisions that lack compensation for customers or penalties for companies, the most appropriate penance should be found. In other words, an investigation should be made regarding compensation vs. penalty or GS vs. OS (or even a combination) to accommodate practice and regulatory schemes.

Of course, OAR standards are not predetermined to be supplemented by a GS. With a gradual approach for creating standards, an OAR can be transformed into one or more different standards of different type. The process can also maintain the original OAR standard if necessary.

The 5<sup>th</sup> CEER Benchmarking Report on Quality of Electricity Supply showed that countries in the Central East of Europe (CEE) use predominantly guaranteed standards. Due to similarities between CEE countries and the CPs, it may be worthwhile to investigate their experiences in CQ.

- **Finding #2:** *CQ standards are not specifically applied to suppliers or operators*

Commercial Quality Standards may be applied to different market participants and operators. As the benchmarking questionnaire suggests, standards can apply to DSOs, suppliers, universal service providers and others. Currently, the distinction between standards applied to DSOs, suppliers, universal service providers is not informative for the CPs since electricity markets are at early development stage.

☞ **Recommendation #2:** *CQ standards should be created having in mind different entities (DSOs, SPs, USPs, etc.) and different market models*

The existence of different entities (DSOs, SPs, USPs, etc.) requires that standards should be defined with very specific definitions and with specific business processes in mind. For example, CQ standards related to interruptions can be different depending of the (retail) market model. In one market, customers could be compelled to call their supplier for power restoration with no direct contact with the DSO. In another market, customers could have the choice to call either their supplier or the DSO. Consequently, “Time until the restoration of supply in case of unplanned interruption” is not universally applicable and may distort benchmarking results.

This also implies that NRAs should have deep insight in the procedures of suppliers.

It may be argued that CQ standards should be tied to regulated activities (DSO/USP/ regulated SP). However, using CQ standards for all market players may be beneficial in a couple of ways:

- required publication of CQ performance can be used as a tool for making the market more active by forcing the suppliers to differentiate by CQ performance;
- with new market entrants, some customer groups could be troubled (i.e. residential customers switching to new suppliers) by dominant incumbent electricity companies, so CQ standards are necessary to resolve certain problems;
- poor performance of a supplier may indicate to the NRA a more serious issue afflicting the supplier.

It should be emphasized that the Directive 2009/72/EC calls for regulation of CQ, particularly with Article 3 dealing with “Public service obligations and customer protection”.

- **Finding #3:** *CQ standards are usually loosely defined*

During the benchmarking, it was observed that many CQ indicators were rather obvious (according to the wording), but only superficially defined. Minor differences in legal provisions or practice between CPs showed that standards need to be defined on precise terms and supported with explanations and exceptions.

The indicator “Time from the notice to pay until disconnection” can be used here to clarify. The standard should precisely define the initial trigger and define the closing event. Otherwise, there could be questions like – does this standard imply time counted from the post of notice or from the reception of the notice?

- ▢ **Recommendation #3:** *CQ standards should be based on specific and precise definitions*

This issue does not need a specific solution since the recommendation is rather obvious. However, NRAs and DSOs should cooperate by sharing experiences or participating in benchmarks. By doing so, the development of definitions and standards will be more efficient and rapid.

Of course, practice of EU MS should also be considered.

Since most CPs did not provide historic data, it would be beneficial to commence with measuring performance in any way possible. The framework for measuring performance will gradually evolve, producing basis for introducing adequate definitions and standards.

- **Finding #4:** *DSOs and incumbent companies do not place emphasis on interaction with customers*

DSOs and incumbent companies have not been focused on customers but predominantly on their own activities. Most of their statistical data which can be correlated with commercial standards is related to the “system”. Historically, they had no need to track a specific customer with a specific issue. Consequently, data regarding commercial quality, especially to customer care, is not available.

- ▢ **Recommendation #4:** *DSOs and suppliers should implement Customer Relationship Management (CRM)*

DSOs and suppliers should implement IT solutions for Customer Relationship Management (CRM). Apart from inherently adopting customer care, the use of such tools is essential for CQ standards.

The most important paradigm for companies is to implement the ability to track a specific customer with a specific issue. Apart from having better and more efficient relations with specific customers, statistics on an issue (time, cases, etc.) are statistics relevant for CQ standards related to Customer Care.

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