The 4th Benchmarking Report on Quality of Electricity Supply

Continuity of Supply

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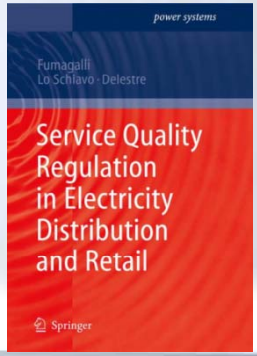
Outline

- Background
- Monitoring & Reporting of Continuity of Supply
- Continuity of Supply Indicators
- Treatment of Exceptional Events
- Continuity of Supply Data & Analysis
- Main findings & Results

Background

- **Continuity of Supply** refers to the ”availability of electricity”
- **CoS** is the **”oldest” type** of electricity quality;
  - CoS **originally not for regulation** purposes – mainly for **DSO’s internal needs**
  - Following deregulation of the electricity sector and the need for quality of supply (QoS) regulation of legal monopolies, CoS became an **important tool for regulation**
  - CoS is affecting **all customers** at **all voltages levels** (LV, HV) – therefore regarded as the **most suitable** technical quality aspect to use for **incentive-based regulation**
  - Recommended quality parameter in e.g. ”*Service Quality Regulation in Electricity Distribution and Retail*”, Springer (2007) by CEER and FSR



Background

- **Main findings from previous BR**
  - **Harmonization issues make quantitative comparisons difficult**
    - Aggregation rules
    - Weighting methods
    - Large variety of indicators are being used
    - Differences in recording methodology, etc…
  - **Strong interest for European benchmarking of CoS**
    - Best practices
    - Effect of regulation
  - **Overall trends observed in previous BR**
    - Overall downward trend for both number and duration of unplanned interruptions
    - Some countries with historically ”good” levels have shown further improvements
    - Stable number of short interruptions despite increasing number of remote control devices

Monitoring & Reporting of Continuity of Supply

- Point of view of the NRA, i.e. data collected by NRA
- Various definitions for short, long and transient interruptions are being used by NRA

TABLE 2.2B DEFINITIONS OF LONG, SHORT AND TRANSIENT INTERRUPTIONS

Country	Transient interruption	Short interruption	Long interruption
Austria Belgium (Brussels region) Estonia Germany Luxembourg			T>3 min
Belgium (Flemish region) Denmark Finland Norway Portugal Slovenia Sweden		T≤3 min	T>3 min
Belgium (Federal) Belgium (Walloon region) Lithuania United Kingdom		T<3 min	T≥3 min
Czech republic Hungary Italy Poland Romania	T≤1 sec	1 sec <T≤3 min	T>3 min
France	T<1 sec	1 sec ≤T<3 min	T≥3 min
the Netherlands			T>1 min
Spain	T≤0.5 sec	0.5 sec <T ≤3 min	T>3 min

Monitoring & Reporting of Continuity of Supply

- All 21 countries monitor unplanned long interruptions (i.e. > 3 min)
- 12 countries out of 21 monitor short interruptions (i.e. < 3 min)

TABLE 2.1 TYPES OF INTERRUPTIONS MONITORED IN THE DIFFERENT COUNTRIES

Country	Long Interruptions	Short Interruptions	Transient Interruptions	Unplanned Interruptions	Planned Interruptions
Austria	X			X	X
Belgium (Brussels region)	X			X	X
Belgium (Flemish region)	X	X		X	X
Belgium (Walloon region)	X			X	X
Belgium (Federal)	X	X		X	
Czech Republic	X			X	X
Denmark	X(4)	X(4)		X	X
Estonia	X			X	X
Finland	X	X		X	X
France	X	X	X(2)	X	X
Germany	X			X	X
Hungary	X	X	X	X	X
Italy	X	X	X	X	X
Lithuania	X	X		X	X
Luxembourg	X			X	X
the Netherlands	X			X	X(3)
Norway	X	X		X	X
Poland	X	X		X	X
Portugal	X	X(1)		X	X
Romania	X			X	X
Slovenia	X			X	X
Spain	X	X		X	X
Sweden	X			X	X
United Kingdom	X	X		X	X

(1) In Portugal, all interruptions (including short ones), are monitored at transmission level. But in accordance with the quality of service code, only long interruptions are reported.
(2) In France, the TSO monitors transient interruptions, but does not calculate any specific indicators for transient interruptions.
(3) In the Netherlands, planned interruptions are only monitored from 2006.
(4) In Denmark, all interruptions lasting 1 minute or more are monitored.

Monitoring & Reporting of Continuity of Supply

- Several countries (about 13) collect some information on the cause of interruptions
- About half of the countries have some degree of data disaggregation, e.g. urban/rural, cable/overhead lines, regions, per feeder or per customer, etc.

TABLE 2.4 LEVEL OF DETAIL IN THE PRESENTATION OF THE INDICATORS IN THE DIFFERENT COUNTRIES

Country	National	System Operators	Region	Feeder	Customer	Voltage level	Causes	Urban/ rural	Cable/ aerial
Austria	X	X				X[10]	X		
Belgium (Brussels region)			X			X[34]	X[16]		
Belgium (Flemish region)		X				X[6]	X		
Belgium (Walloon region)		X					X[17]		X
Belgium (Federal)	X		X			X[7]	X[18]		
Czech Republic	X	X	X		X	X[11]			
Denmark	X	X		X[39]	X[39]	X[39]	X[40]		X[41]
Estonia	X					X[33]			
Finland	X	X		X[3]		X[32]			
France	X	X	X		X[1]	X[2]	X[19]		
Germany	X					X[8]	X		
Hungary	X	X				X[12]			
Italy	X	X	X	X[26]	X	X[9]	X	X[22]	X[26]
Lithuania	X	X				X[35]	X[36]	X[37]	
Luxembourg	X					X[28]			
the Netherlands	X	X				X[30]	X		
Norway[5]	X	X	X		X	X[13]	X[20]		X[27]
Poland	X	X							
Portugal	X	X	X		X	X[29]		X[23]	
Romania	X	X				X[4]		X	
Slovenia	X	X		X				X[31]	
Spain	X	X	X			X[14]		X[24]	
Sweden	X	X							
United Kingdom	X	X		X		X[15]	X[21]	X[25]	X[25]

Monitoring & Reporting of Continuity of Supply

- Voltage levels monitored
  - Incident at LV level are monitored in 16 of the 21 countries
  - Incident at MV level are monitored in all countries
  - Incident at transmission level are monitored in 14 of the 21 countries

TABLE 2.3 VOLTAGE LEVELS MONITORED IN THE DIFFERENT COUNTRIES

Country	LV	MV	HV	Transmission
Austria		X	X	
Belgium (Brussels region)		X	X	
Belgium (Flemish region)				
Belgium (Walloon region)		X		
Belgium (Federal)			X	X
Czech Republic	X	X	X	
Denmark	X	X	X	X
Estonia	X	X	X	
Finland	X(1)	X	X	X
France	X	X	X	X
Germany	X	X	X	X
Hungary	X	X	X	X
Italy	X	X	X	X
Lithuania	X	X	X	X
Luxembourg		X	X	
the Netherlands	X	X	X	X
Norway(2)		X	X	X
Poland	X	X	X	X
Portugal	X	X	X	X
Romania	X	X	X	X
Slovenia		X		
Spain	X	X	X	
Sweden	X	X	X	X
United Kingdom(3)	X	X	X	

Monitoring & Reporting of Continuity of Supply

- Continuity of Supply indicators
  - Countries use different indicators for calculation of duration and frequency of interruptions, e.g. weighting based on No of customers, contracted power, ENS, No of trafos, etc.
  - This makes it difficult to directly compare the continuity of supply across different countries, i.e. quantitative analysis difficult

TABLE 2.6 INDICES FOR QUANTIFYING LONG INTERRUPTIONS USED IN THE DIFFERENT COUNTRIES

Country	Index	Weighting (n.a. for ENS)	Rules for measurements
Austria	ASIDI, ASIFI, ENS	Interrupted power, amount of energy not supplied.	The system operators are responsible for collecting the data. The regulator is only doing a plausibility check after receiving it. In practice SCADA is commonly used.
Belgium (Brussels region)	SAIDI, SAIFI, CAIDI	MV: number of distribution transformers. An improvement factor of 0.85 is used for transformer stations with a relatively high load. HV: amount of energy not supplied.	All HV customers are equipped with automatic meter reading.
Belgium (Flemish region)	SAIDI, SAIFI, CAIDI	MV: number of distribution transformers. An improvement factor of 0.85 is used for transformer stations with a relatively high load. HV: amount of energy not supplied.	All HV customers are equipped with automatic meter reading.
Belgium (Walloon region)	SAIDI, SAIFI, CAIDI	Number of customers	-
Belgium (Federal)	AIT, AIF, AID	Interrupted power	SCADA is used to determine opening of interrupting devices and duration of interruptions.
Czech Republic	SAIDI, SAIFI	Number of customers	-
Denmark	SAIDI, SAIFI, ENS	Number of customers ENS collected only for incidents above 100 kV	The Regulators guide for monitoring interruptions for distribution and regional transmission companies (3rd edition, March 2008).
Estonia	SAIDI, SAIFI, CAIDI	Number of delivery points.	-
Finland	SAIDI[3]		-
	T-SAIDI, T-SAIFI	Annual energy consumption.	
France	SAIFI, ENS, AIT	SAIFI: number of delivery points ENS; AIT: interrupted power.	TSO: Logging of circuit breaker opening and closing, registered by SCADA. DSO: The interruptions information system is connected with the MV and LV customers information system.
Germany	SAIDI, SAIFI	LV: number of customers MV, HV: nominal power.	-
Hungary	SAIDI, SAIFI	Number of customers	At MV and HV; SCADA should be used. At LV, estimating the number of customers interrupted is allowed.
Italy	Distribution: SAIDI, SAIFI[2] Number of interruptions per single MV customer Transmission: ENS, AIT SAIDI, SAIFI, [3]	Number of LV customers. Individual indicators, not weighted Number of transmission network users (final large customers, distributors, generators).	Connectivity models are required for all customers[1]
Lithuania	Distribution: SAIDI, SAIFI Transmission: ENS, AIT	Number of customers ENS, AIT - interrupted power	At HV and MV SCADA should be used. At LV, estimating the number of customers interrupted is allowed.
Luxembourg	SAIDI, SAIFI, ENS	SAIDI, SAIFI: number of customers ENS: interrupted power	
the Netherlands	SAIDI, SAIFI, CAIDI	Number of customers	
Norway	SAIDI, SAIFI, CAIDI, CTAIDI, CAIFI, ENS	SAIDI, SAIFI, CAIDI, CTAIDI and CAIFI are weighted on customers (end-user). ENS is calculated as a total value [4].	Standardised system for registration and reporting (FASIT) [5] applies for all companies. The network companies know exactly how many customers (end-users) are supplied from a reporting point (which is either a distribution transformer or an end user connected above 1 kV).
Poland	SAIDI, SAIFI	Number of customers	-
Portugal	Transmission: ENS, AIT, SAIFI, SAIDI, SARI	SAIFI, SAIDI: number of delivery points. ENS, AIT: interrupted power.	MV, HV, EHV: SCADA should be used. LV: information is available on customer connectivity, but without phase information. For single-phase and two-phase interruptions the number of customers interrupted is estimated.
	MV: END, TIEPI, SAIDI, SAIFI	SAIDI, SAIFI: number of customers END, TIEPI: interrupted power.	
	LV: SAIDI, SAIFI	Number of customers	LV: information is available on customer connectivity, but without phase information. For single-phase and two-phase interruptions the number of customers interrupted is estimated.
Romania	Distribution: SAIDI, SAIFI, ENS, AIT Transmission: ENS, AIT	Number of customers	-
Slovenia	SAIDI, SAIFI	Number of customers	Connectivity models and SCADA
Spain	TIEPI, NIEPI	Capacity of the MV/LV transformers plus contracted power of MV customers.	Connectivity models are required for all customers.
Sweden	Distribution: SAIDI, SAIFI Transmission: ENS, AIT	Number of customers	-
United Kingdom	CI, CML	Number of customers	Connectivity models are required for all customers.

Monitoring & Reporting of Continuity of Supply

- Audits on continuity data
  - Only about half of the countries perform on-site audits

TABLE 2.11 ON-SITE AUDITS ON CONTINUITY DATA

Auditing authority	Country
By the regulator	HU, IT, LT, NL, NO
By consultants on behalf of the regulator	UK
By consultants on behalf of the companies (results are submitted to the regulator, and if necessary the regulators can do an inspection) Under consideration	ES, PT FI, (from 2009) RO (from 2008), SE (from 2008)
No on-site audits	AT, BE, CZ, DE, DK, EE, FR, LU, PO, SI

TABLE 2.12 AUDITING PRACTICES

Country	How often	What is audited	Road map	On-site audited companies (of total companies)	Audit's result/effect
Hungary	Biannually	Recorded data and recording procedure	Yes	100% (of 6)	Fine for wrong data at repeated audits
Italy	Annually	Recorded data and recording procedure. On- site audit.	Yes	15% - 25% (of around 300 districts)	Validate continuity data and penalty in case of inadequate recording
Lithuania	Annually	Recorded data and recording procedure.	No	100% (of 4)	Validate continuity data. From 2008, penalty in case of inadequate recording
the Netherlands	Biennally	Recorded data and recording procedure.	Yes	100% (of 10)	Non-compliance with the Ministerial Regulation on Quality Aspects of Network Operation Electricity and Gas is reported to the Minister of Economic Affairs and can result in a penalty
Norway	Annually	Recording and reporting procedures.	Yes	10 audits annually (of a total of 135 companies)	Non-compliance with the regulation on quality of supply in the power system will result in an individual decision by the regulator. If the negative results are not rectified within a given time limit (e.g., change of procedures), compulsory fines (running) can be issued (e.g., daily) until the negative results have been rectified. A violation fine for having breached the regulations can also be issued.
United Kingdom	Annually	Recorded data and recording procedure. On-site audit.	Yes	100% (of 14 license areas)	Penalty for failure to meet the minimum data accuracy level.
Portugal (1)	Biennially	The systems and the procedures.	No	15% (of 13)	NA(1)
Spain	Annually	The systems and the procedures.	Yes	100% (of 320)	Penalty in case of non-compliance with order ECO/797/2002 (the road book)

(1) In Portugal mainland there are one TSO, one HV and MV DSO, and 11 LV DSO. The main distribution company in LV distributes 99.5% of the electrical energy. The audits are carried out by the TSO, the HV and MV DSO and the main LV DSO.

Treatment of Exceptional Events

- Impact on interruption statistics
  - Allow to better identifying trends and setting targets in incentive-based regulation
  - Generally defines events outside of the DSOs control, i.e. non-regulated events meaning no penalty
- Regulation of exceptional events
  - Direct compensation to customers (e.g. IT, UK, SE, FI)

FIGURE 2.13 MINUTES LOST PER LV CUSTOMER IN PORTUGAL DUE TO UNPLANNED INTERRUPTIONS

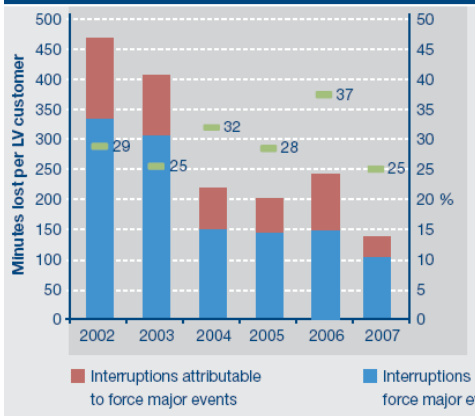
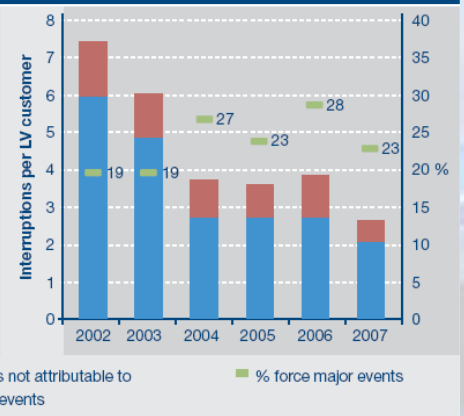


FIGURE 2.14 NUMBER OF INTERRUPTIONS PER LV CUSTOMER IN PORTUGAL DUE TO UNPLANNED INTERRUPTIONS



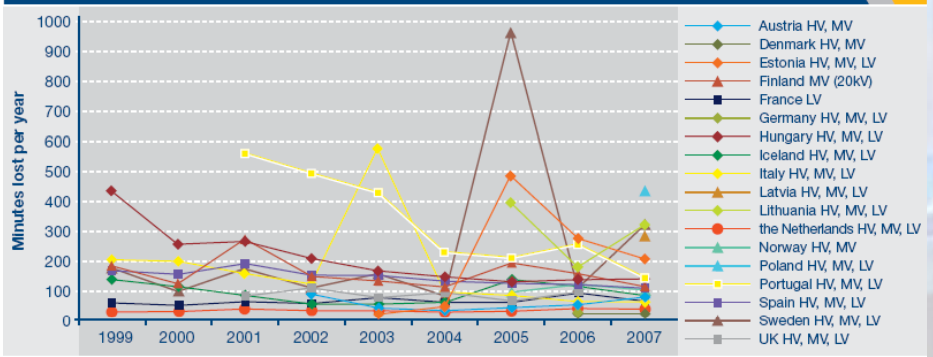
The previous figures highlight the distinction between the exceptional event and the force majeure event concepts in the two countries.

Continuity of Supply Data & Analysis

- Unplanned long interruptions including all events

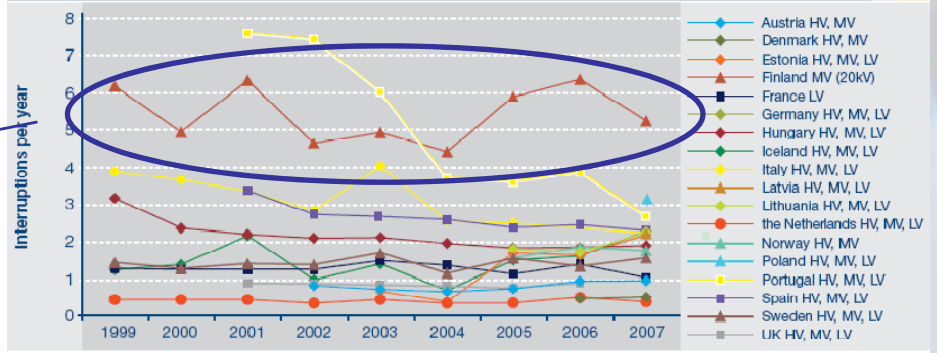
T-SAIFI weighted by No of distribution transformers, i.e. biased toward customers served by smaller distribution transformers

FIGURE 2.5 UNPLANNED INTERRUPTIONS INCLUDING ALL EVENTS; MINUTES LOST PER YEAR (1999 - 2007)



The voltage level (LV, MV, HV) is related to where the incidents occur. The French values in the figure are lower than the reality.

FIGURE 2.6 UNPLANNED INTERRUPTIONS INCLUDING ALL EVENTS; NUMBER OF INTERRUPTIONS PER YEAR (1999-2007)

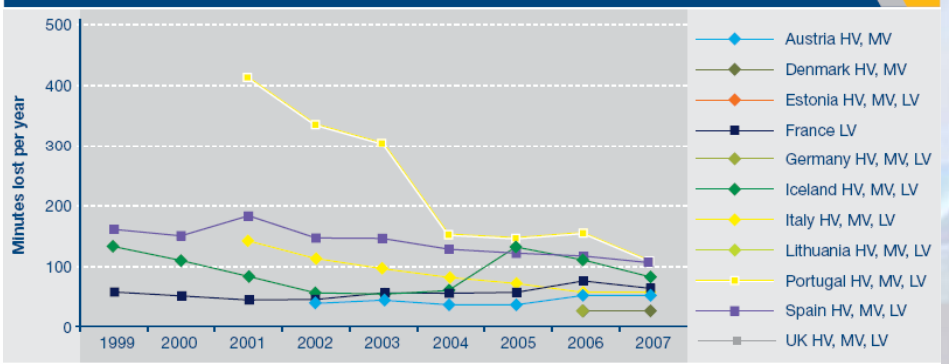


The voltage level (LV, MV, HV) is related to where the incidents occur. The French values in the figure are lower than the reality.

Continuity of Supply Data & Analysis

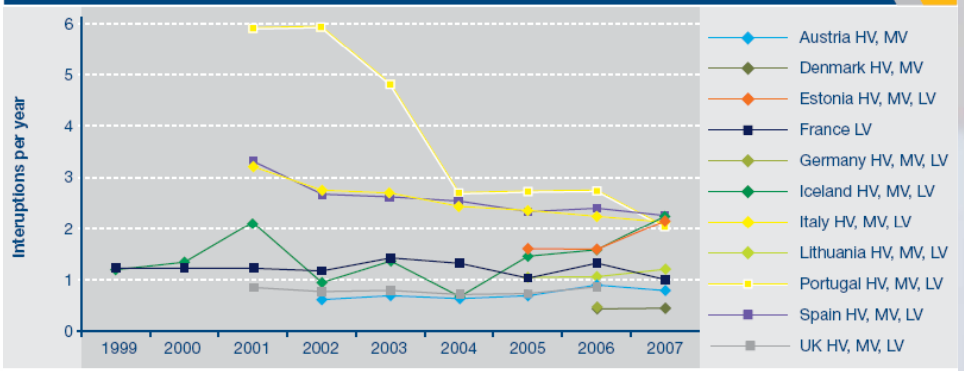
- Unplanned long interruptions excluding exceptional events

FIGURE 2.1 UNPLANNED INTERRUPTIONS EXCLUDING EXCEPTIONAL EVENTS; MINUTES LOST PER YEAR (1999-2007)



The voltage level (LV, MV, HV) is related to where the incidents occur. The French values in the figure are lower than the reality.

FIGURE 2.2 UNPLANNED INTERRUPTIONS EXCLUDING EXCEPTIONAL EVENTS; NUMBER OF INTERRUPTIONS PER YEAR (1999-2007)



The voltage level (LV, MV, HV) is related to where the incidents occur. The French values in the figure are lower than the reality.

Continuity of Supply Data & Analysis

- Trends in minutes lost and number of interruptions
- Continuity of electricity supply in Europe is improving
  - Customer minutes lost per year decreasing almost continuously since 2001
  - Number of unplanned interruptions stabilizing

FIGURE 2.3 TRENDS IN MINUTES LOST PER YEAR EXCLUDING EXCEPTIONAL EVENTS: NON-WEIGHTED AVERAGE AND STANDARD DEVIATIONS OVER ALL REPORTING COUNTRIES, EXCLUDING PORTUGAL

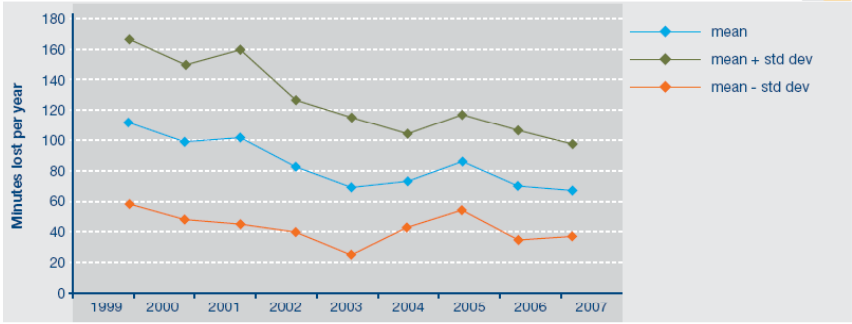


FIGURE 2.4 TRENDS IN NUMBER OF INTERRUPTIONS PER YEAR EXCLUDING EXCEPTIONAL EVENTS: NON-WEIGHTED AVERAGE AND STANDARD DEVIATIONS OVER ALL REPORTING COUNTRIES, EXCLUDING PORTUGAL

Continuity of Supply Data & Analysis

- Comparison of urban and rural networks
  - Continuity of supply is better in urban than in suburban and rural areas

FIGURE 2.9 COMPARISON OF UNPLANNED INTERRUPTIONS VALUES BETWEEN DIFFERENT AREAS IN 6 COUNTRIES; DURATION OF INTERRUPTIONS PER YEAR (1999-2007)

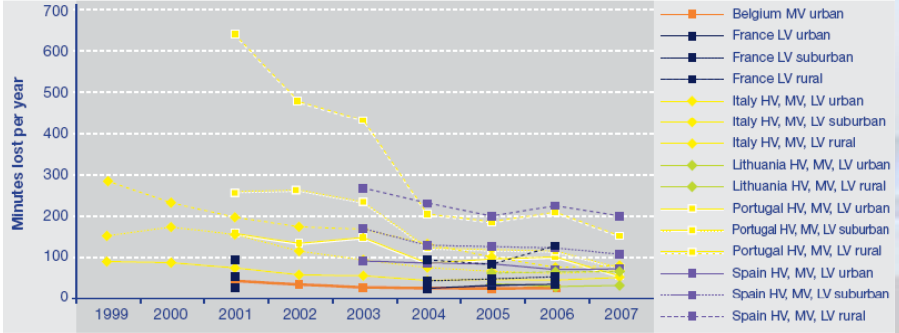
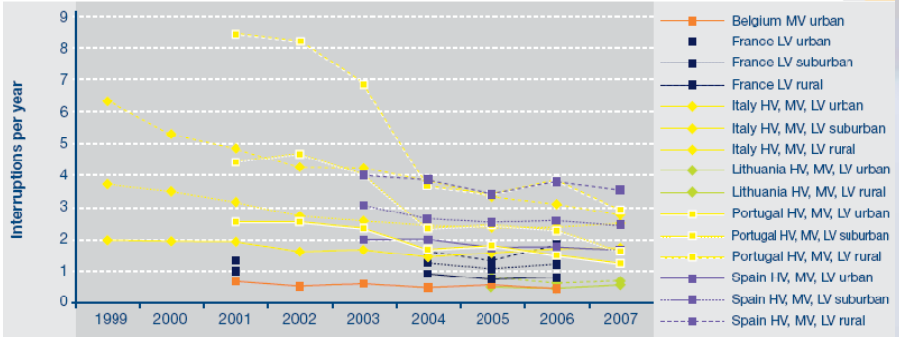


FIGURE 2.10 COMPARISON OF UNPLANNED INTERRUPTIONS VALUES BETWEEN DIFFERENT AREAS IN 6 COUNTRIES; NUMBERS OF INTERRUPTIONS PER YEAR (1999-2007)



Main Findings & Results

- **Monitoring schemes for long interruptions** are in place in **at least 21 European countries** and **about half also monitor short interruptions**
  - It is strongly recommended that some type of monitoring scheme for short interruptions is in place as customers have placed increased importance on fewer and shorter interruptions
- **Countries use different indicators and different weighting methods** to measure interruptions duration and frequency. This makes it **difficult to directly compare the continuity of supply across different countries**
  - It is recommended to reserve the terms SAIFI and SAIDI for weighting based on the number of customers
  - Other terms should be used when other weighting methods are used
- **CEER** is working with **CENELEC,** the European Committee for Electrotechnical Standardization, to **develop harmonized continuity indicators**, so as to improve the effectiveness of CoS monitoring schemes
- Only a **limited number of countries** consider **incidents at all voltage levels** in the continuity of supply statistics
  - It is recommended to monitor interruption also at LV

Main Findings & Results

- **Continuity of electricity supply in Europe is improving**
  - **Customer minutes lost per year is decreasing** almost continuously since 2002
  - **Number of unplanned interruptions stabilizing**
- **CEER exchanges best practices on quality incentive regimes** and **increases the penetration of quality factors when regulating DSOs**
- In sharing best practices, **many countries have now regulation and incentives for improving CoS**

Thank you for your attention!

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