The INOGATE Programme

Service quality regulation: framework and experience

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Why quality regulation?

Why are regulators concerned with quality?

- Consumers value quality
- Incentives in cost reduction: risk of quality deterioration
  - Price cap regulation
  - Privatization (also state-owned companies)
    - Profit motivation is the accepted indicator of managerial efficiency
    - Strong emphasis on economic results in monopolistic activities and/or in activities characterized by market dominance

Service quality regulation in Europe

- Implemented, but not as extensively as expected
- Incentive regulation in practice is more difficult than in theory!
Theoretical framework/1

Introduction of specific incentives for quality is a necessary measure to contrast cost-reducing incentives.

An incentive scheme for quality:
- Performance standards
- Rewards and penalties that reflect consumer valuation of quality

Profit-maximizing regulated utility expands quality to the point where marginal benefit of additional quality to consumers equals the firms marginal cost of increasing quality (Sappington, 2005)
- Optimal level of service quality
Providing quality has a cost for the regulated utility.
Customers incur costs as the result of a poor level of quality.

The optimal level of service quality: min of total cost function.
In practice

- Service quality is multi-dimensional
- Incentive mechanisms on operational and capital expenditures
- Consumers preferences can vary widely among consumers
- Measuring quality can be difficult
- Consumers and other operators can affect quality with their behaviour

- No simple policy to regulate quality: different instruments are employed to induce regulated firms to deliver the desired level of quality on different quality dimensions
Evidence from research and experience/1

- Effectiveness of quality regulation?

- **Ter-Martirosyan (2003)**, 78 major electric utilities from 23 states of the U.S.
  - Price-cap regulation reduces the utility’s operational and maintenance expenses at the distribution level
  - Implementation of explicit quality benchmarks reduces the average duration of outages per customer

  - Regulation provided adequate incentives for utilities to reduce costs, prices, and energy losses while maintaining quality of service

- **Reichl et al. (2008)**, Austrian distribution sector (quality is not regulated)
  - A decrease on tariffs leads, even in a short time frame, to a lower supply reliability (significant correlation between tariffs and quality)
  - The econometric estimates show that a 1 €/MWh decrease in the distribution tariff results in a 1.36 minutes increase in the annual average interruption duration per installed capacity in the following year
Evidence from research and experience/2

- Assessments of national experience with quality regulation in electricity networks
  - Terszyanszky (2005) on Hungary
  - Lo Schiavo et al. (2005) and Ajodhia et al. (2006) on Italy
  - Langset et al. (2001) and Seljeseth et al., (2005) on Norway
  - Nilsson (2005) on Sweden

- Variety of different regulatory designs
- Effectiveness of the regulation in practice
- Comparative incentive properties of the applied regulatory schemes (both short-term and long-term performance of network utilities)
Evidence from research and experience/3


www.energy-regulators.eu
  > publications and press 2009
    > CEER ERGEG papers
  > Electricity

Quality dimensions

ELECTRICITY SERVICE

COMMERCIAL QUALITY

• CALL CENTERS
• BILLING
• COMPLAINTS
• RECONNECTIONS AFTER NON-PAYMENT DISCONNECTIONS
• READING
• APPOINTMENTS
• NEW SUPPLY ESTIMATES
• CONNECTIONS TO NETWORK
• PROVIDING SUPPLY
• METER INVESTIGATIONS

CONTINUITY OF SUPPLY

• UNPLANNED SUPPLY INTERRUPTIONS (LONG AND SHORT)
• PLANNED (NOTIFIED) SUPPLY INTERRUPTIONS
• VOLTAGE INVESTIGATIONS
• VOLTAGE VARIATIONS
• VOLTAGE DIPS / SWELLS
• RAPID VOLTAGE CHANGES
• FLICKER
• HARMONICS
• UNBALANCE

VOLTAGE QUALITY

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
Objectives and instruments (output regulation)

**REGULATION OF QUALITY**

- MAKE INFORMATION AVAILABLE
  - SET RELIABLE MEASUREMENT RULES FOR QUALITY FACTORS
  - PUBLISH ACTUAL QUALITY LEVELS

- PROTECT WORST-SERVED CUSTOMERS
  - SET AND MAINTAIN GUARANTEED QUALITY STANDARDS
  - DETERMINE INDIVIDUAL COMPENSATIONS FOR STANDARD MISMATCHING

- PROMOTE QUALITY IMPROVEMENT
  - LINK QUALITY AND REVENUES (TARIFFS)

- FAVOUR AND TEST MARKET MECHANISMS
  - PREFER CUSTOMER CHOICE WHENEVER POSSIBLE AND SAFE

**PREREQUISITE**

**INCENTIVE QUALITY REGULATION**

**COMPETITION**

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
Objectives and instruments (output regulation)

**REGULATION OF QUALITY**

- **MAKE INFORMATION AVAILABLE**
  - Set reliable measurement rules for quality factors
  - Publish actual quality levels

- **PROTECT WORST-SERVED CUSTOMERS**
  - Set and maintain guaranteed quality standards
  - Determine individual compensations for standard mismatching

- **PROMOTE QUALITY IMPROVEMENT**
  - Link quality and revenues (tariffs)

- **FAVOUR AND TEST MARKET MECHANISMS**
  - Prefer customer choice whenever possible and safe

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**PREREQUISITE**

**INCENTIVE QUALITY REGULATION**

**COMPETITION**

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ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
Reward and penalty scheme

The regulated tariff (the allowed revenues) of a regulated firm is (are) increased or decreased in proportion to:

- the distance from the performance standard, set by the regulator, and
- an incentive rate, defined as a monetary value per unit change in quality.

Countries with reward and penalty schemes:

- Italy (started in 2000, renewed in 2004 and 2008)
- Norway (started in 2001)
- Great Britain (started in 2002, renewed in 2005)
- Ireland (started in 2002)
- Hungary (started in 2003)
- Sweden (started in 2003)
- Portugal (started in 2004)
- Estonia (started in 2006)
- Netherlands (started in 2007)
- Germany (forthcoming)
# A framework for quality regulation in practice

<table>
<thead>
<tr>
<th>Make Information Available</th>
<th>Protect Worst-Served Customers</th>
<th>Promote Quality Improvement</th>
<th>Favour and Test Market Mechanisms</th>
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</thead>
<tbody>
<tr>
<td><strong>Commercial Quality</strong></td>
<td>Publication of data</td>
<td>Guaranteed Standards</td>
<td>Quality of call centres</td>
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<tr>
<td><strong>Continuity of Supply</strong></td>
<td>Regulatory measurement guidance and publication</td>
<td>GS on multiple and very long interruptions</td>
<td>Reward and penalty schemes</td>
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<tr>
<td><strong>Voltage Quality</strong></td>
<td>Voltage quality monitoring</td>
<td>Voltage quality minimum standards</td>
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</table>

**Energy cooperation between the EU, the littoral states of the Black & Caspian Seas and their neighbouring countries**
The Italian experience

ELECTRICITY SERVICE

COMMERCIAL QUALITY

- CALL CENTERS
- BILLING
- COMPLAINTS
- RECONNECTIONS AFTER NON-PAYMENT DISCONNECTIONS
- READING
- APPOINTMENTS
- NEW SUPPLY ESTIMATES
- CONNECTIONS TO NETWORK
- PROVIDING SUPPLY
- METER INVESTIGATIONS

CONTINUITY OF SUPPLY

Focus: interruptions in distribution networks

VOLTAGE QUALITY

- UNPLANNED SUPPLY INTERRUPTIONS (LONG AND SHORT)
- PLANNED (NOTIFIED) SUPPLY INTERRUPTIONS
- VOLTAGE INVESTIGATION
- VOLTAGE VARIATIONS
- VOLTAGE DIPS / SWELLS
- RAPID VOLTAGE CHANGES
- FLICKER
- HARMONICS
- UNBALANCE

SUPPLY

TRANSMISSION and DISTRIBUTION

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
# The Italian experience/measuring

## Measuring continuity indicators

**UTILITY:** ENEL Distribuzione Spa  
**INTERRUPTIONS:** UNPLANNED, LONG  
**TERRITORY:** ALL AGGREGATE  
**YEAR:** 2004  
**UP TO MONTH:** 12

### CAUSE TRASM. HV MV LV TOTAL

<table>
<thead>
<tr>
<th>DURATION (CML, SAIDI)</th>
<th>TRASM.</th>
<th>HV</th>
<th>MV</th>
<th>LV</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Majeure</td>
<td>0,0</td>
<td>0,0</td>
<td>14,9</td>
<td>1,1</td>
<td>16,0</td>
</tr>
<tr>
<td>Users' or third party's respons.</td>
<td>2,3</td>
<td>0,1</td>
<td>11,2</td>
<td>1,5</td>
<td>15,0</td>
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<tr>
<td>Utility's responsibility</td>
<td>0,0</td>
<td>3,0</td>
<td>45,6</td>
<td>14,4</td>
<td>63,1</td>
</tr>
<tr>
<td>Total all causes</td>
<td>2,3</td>
<td>3,1</td>
<td>71,7</td>
<td>17,0</td>
<td>94,1</td>
</tr>
</tbody>
</table>

### NUMBER (CIs, SAIFI)

<table>
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<tr>
<th>NUMBER (CIs, SAIFI)</th>
<th>TRASM.</th>
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<th>MV</th>
<th>LV</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Majeure</td>
<td>0,00</td>
<td>0,00</td>
<td>0,08</td>
<td>0,00</td>
<td>0,09</td>
</tr>
<tr>
<td>Users' or third party's respons.</td>
<td>0,14</td>
<td>0,01</td>
<td>0,28</td>
<td>0,01</td>
<td>0,44</td>
</tr>
<tr>
<td>Utility's responsibility</td>
<td>0,00</td>
<td>0,10</td>
<td>1,87</td>
<td>0,14</td>
<td>2,11</td>
</tr>
<tr>
<td>Total all causes</td>
<td>0,14</td>
<td>0,11</td>
<td>2,23</td>
<td>0,15</td>
<td>2,64</td>
</tr>
</tbody>
</table>
Reward and penalty scheme

Electricity distribution tariff (national, unique) changes with
- the average duration of interruptions per consumer - SAIDI indicator - for long (longer than 3 minutes), unplanned interruptions (exclusions: see p.17)
- indicator is measured separately in more than 300 territorial districts (homogeneous population density)

\[ p_t = p_{t-1} \cdot (1 + RPI - X + Q) \]

- Yearly values of Q are calculated, ex post, on the basis of companies’ performances
Distribution tariff is unique: an equalisation fund is needed to manage rewards/penalties

The equalization fund:
- (+) Penalties paid by utilities for under-performing districts
- (-) Incentives paid to utilities for over-performing districts
- (-/+ ) Parameter Q: difference between rewards and penalties
The Italian experience/objectives

**Main objectives**

- Enhance the overall level of continuity
- Reduce the gaps between North and South
  - Reduce variation of regional and district levels around the average
  - Peculiar objective (in Italy: unique distribution tariff)

- Performance standards are defined per district
- Convergence in performance of all districts with equal population density to the same quality level, in the medium term (12 years)
- Dead-band and upper/lower bounds
- Recalculation of performance standards every 4 years
The Italian experience/standards of performance

Higher improvement requested for worse-performing districts: convergence effects

Dead-band and upper/lower bounds
The Italian experience/recalculation of standards

CUSTOMER MINUTES LOST (SAIDI-net)

{|net of interruptions not attributable to distribution companies|}

TARGETS

ACTUAL LEVELS

1° REGULATORY PERIOD

2° REGULATORY PERIOD

REFERENCE STANDARDS

Example: URBAN AREAS

YEAR

1998/99

1999/00

2000/01

2001/02

2002/03

2003/04

2004/05

2005/06

2006/07

TARGETS

ACTUAL LEVELS

REFERENCE STANDARDS

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
The Italian experience/scope: 1st to 2nd review period

The number of regulated quality dimensions has significantly evolved over time

First review period

SAIDI long unplanned interruptions (above 3 minutes)
- Exclusions: Force Majeure; external causes (third parties damages); transmission and HV networks

Second review period

External causes: included on a voluntary basis (performance standards revised)

Exceptional events
- Force Majeure: implementation problems
- Statistical methodology: voluntary basis
- GS on number of long, unplanned interruptions for MV customers
The Italian experience/scope: 2nd to 3rd review period

- SAIDI improved by 70% (wrt 1999)
- Regulated companies
  - Increasing capital expenditures
  - More automation
  - Network management (Petersen coil)

![Graph showing the improvement in SAIDI over time.](image)

- CAGR: 16% per year

### Key Figures
- **Media '98/99**: 386
- **2000**: 420
- **2001**: 533
- **2002**: 562

### Density Categories
- **High density (urban)**: 82
- **Medium density (sub-urban)**: 159
- **Low density (rural)**: 82

**Note:** The graph illustrates the progression in capital expenditure over the years.
The Italian experience/scope: 3rd review period

- Regulation of SAIDI: confirmed

- Innovations:
  - RPS: frequency of interruption
  - RPS: short interruptions (shorter than 3 minutes)
  - GSs: maximum restoration times:
    - to protect customers in case of very long and widespread interruptions, including those caused by exceptional events
    - to introduce incentives for utilities to ensure prompt supply restoration under all circumstances (within the boundaries of ensuring safe working conditions for their personnel)
  - Incentive scheme for small utilities (previously exempted)
  - Data: number of faults on MV and LV networks
    - refined statistical methodology: RPS, GS
The Italian experience/economic incentives

- **First review period**
  - Specific information regarding customer valuations of higher and lower levels of quality was very limited
  - Rewards/penalties: large enough to provide meaningful incentives for the companies to improve quality

- **Second review period**
  - Customer survey to investigate consumer willingness-to-pay (WTP) for quality
  - Results of the survey were used to redefine penalties and rewards
  - Confirmed for the third period
The Italian experience/customer survey

CUSTOMER OUTAGE COST SURVEYS
ITALIAN ELECTRICITY LOW-VOLTAGE END-USERS POPULATIONS (2003)

Legenda

(WTA + WTP)/2
Incentive and penalty unit parameter
WTP: Willingness to accept compensation
WTA: Willingness to pay
The Italian experience/measuring and auditing

- Measuring, registration, and reporting rules are the foundation of the incentive scheme.

- Standardization, completeness and quality of the data collected have significantly increased.
  - data available on line on AEEG website

- Audits on data and recording procedures have been conducted regularly by internal personnel.
  - the auditing procedure has been refined over time
The Italian experience/ auditing

AUDITS BY AEEG ON CONTINUITY DATA

Legenda
- 1998-99
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
The EU experience/voltage quality

- Standards for ‘non-technical’ aspects of voltage quality
  - Ex: Responding to voltage complaints within maximum ‘waiting’ time
- Technical Norms (EN 50160) for technical aspects

- Measuring campaigns: Hungary, Norway, Italy

- Measuring guidelines and Voltage Quality Standards
  - Norway, France, Hungary, Portugal, Spain

- Introduction of Premium Quality Contracts
  - France, Italy, Norway
The Italian experience/voltage quality

- Monitoring campaign on MV network
  - Measures collected by two sets of voltage quality recorders
    - 400 recorders installed on MV-busbars of HV/MV transformers
    - 200 recorders installed on MV customer connection points
  - Voltage quality database (weekly updates) available to all consumers: dedicated website

- Survey on costs sustained by Italian industrial users for two voltage disturbances
  - Momentary interruptions (shorter than 1 second)
  - Voltage dips

- European energy regulators (ERGEG) and the European Committee for Electrotechnical Standardization (CENELEC):
  - review of the European Standard EN 50160
The Italian experience/consultation

- Consultation has always been at the basis of the decision making process: above-average complexity

- **Second review period**
  - Started eight months in advance (April 2003)
  - Document contained a large share of quantitative information and data regarding the effects of the regulation
  - For the first time the process included multiple consultation rounds and also the number of public auditions was unusually large
  - Final deliberation: expected impact on tariff under different scenarios of improvements
The Italian experience/consultation and RIA

- Third review period
  - Regulatory Impact Assessment (trial period, tariff)
    - Policy alternatives
    - Stakeholders opinions
    - Impact of proposal (cost/benefit)
  - Started 15 months in advance (September 2006)
  - Contained different options for distribution and transmission quality regulation
  - Different evolution of initially preferred options
    - Opinions received and qualitative and quantitative analysis
  - Instrument for ‘better regulation’
The Italian experience/results

AVERAGE EXTRA-PRICE FOR CUSTOMERS

Customer minutes lost (SAIDI)
(excluded large transmission blackout and load shedding)

0 20 40 60 80 100 120 140 160 180 200

INTERRUPTIONS ATTRIBUTABLE TO DNOs
INTERRUPTIONS NOT ATTRIBUTABLE TO DNOs
The Italian experience/results

Customer minutes lost (SAIDI)
(excluded large transmission blackout and load shedding)

SAIDI: 285 270 262 242 162 156 117 87 61 58
Northern regions
Central regions
Southern regions
Italy (globally)

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
The Italian experience/results

Average number of long interruptions per customer per year (excluded large transmission blackouts and load shedding)

ENERGY COOPERATION BETWEEN THE EU, THE LITTORAL STATES OF THE BLACK & CASPIAN SEAS AND THEIR NEIGHBOURING COUNTRIES
Lessons of experience

1. Measurement rules play a fundamental role

2. Quality regulation in practice is an evolutionary process

3. Regulation is adapted to the specific industrial and institutional factors of each country
   • Independency (accountability)
   • Commitment

4. Effective consultation and transparency