Smart metering, ToU and automation: regulatory experience in Italy

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Ethical code of ARERA, 10(2)
1. Key figures of the Italian power system
   - Demand and supply
   - Market structure

2. Smart metering 1\textsuperscript{st} generation
   - First generation: results over 15 years
   - ToU: effects of mandatory ToU pricing in default supply regime

3. Smart metering 2\textsuperscript{nd} generation
   - Empowering «Chain 1» for granularity and throughput time
   - A tool for customer awareness and automation: «Chain 2»
FINAL USES: electricity demand in Italy

Total demand 2017:
320 TWh/yr

Self-consumption:
30 TWh/yr (estimate)

Prosumers
0.7 Million

System peak: 55-59 GW
~20 GW min.load night,
~30 GW Sundays, daylight

Household consumption
2,100 kWh/user avg/yr
3.3 kW capacity limit
Relatively high number of customers still in the default supplier regime. Law 124/2017 decided to remove this regime from July 2020.
Households: total price = 18,98 eurocent/kWh
(reference user: resident, 3 kW, 2700 kWh/year; 2018 2Q)

The growing impact of RSE has reduced in a first stage wholesale prices levelling differences between peak and off-peak
AGENDA

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ELECTRICITY SMART METERING: back-ground in Italy

• Metering operated by **DSOs**; extremely relevant difference with UK
  
• **First generation (1G) started in 2001** voluntarily by Enel DSO, that completed its own customer base in 2006

• Other DSOs compelled by the Regulator (2007-2011)

• **35 M customers** with smart meters; **400 M readings/year**

• Excellent **cost** position: CAPEX 1G around 80 euro/unit

• Regulatory **lifetime** of smart meters: 15 years

• **E-distribuzione** (Enel DSO) engaged in second generation (2G) technical development

• Law mandate to ARERA for functional requirement 2G, defined with decision 87/2016; 2G roll-out started in 2017
ELECTRICITY SMART METERING IN ITALY: benefits

BENEFITS 1G

- Time-of-use energy pricing (mandatory)
- Monthly readings
- Almost no estimated bills
- Easy switch (spot reading)
- Minimum “vital” service
- Better service, e.g. prompt reconnection
- Energy balance in LV networks

1G METERING TARIFF
(Euro/point, current values 2004-2016)

References to tariff decisions:
Del. 5/04; Del. 275/06
Del. 348/07; Del. 199/11
Del. 654/15
Time-of-Use price (LV customers in Default Supplier Regime)

Default Supplier Regime («maggiore tutela»): Household & Small business customers that do not choose their own supplier

DSR energy prices regulated by AEEG are differentiated per time-bands on mandatory basis:

- Household: 2 bands peak vs. (mid-level+off-peak)
- Small business: 3 bands

- In the free market customers can be supplied with «flat» prices (no ToU mandatory requirement for energy prices).
- Consumptions are however read separately for timebands even for free market customers (DSO is the metering operator).
Time-of-Use price (LV customers in Default Supplei Regime)

- **Individual information about separated consumption per band:** in occasion of the change (2010-11), each involved customer received bills with differentiated consumption (3 bands) at single price for 6 months in advance of the first ToU bill

- A large survey has been conducted on a controlled panel of 8000+ customers in order to make a **fact-based comparison** of consumption behavior **before and after** the introduction of the TOU. Main results:
  
  ➔ percentage of customers with at least 2/3 of consumption in low-price timeband: +5%
  
  ➔ percentage of customers that have moved consumption from higher-price to lower-price timeband: 60.1%
  
  ➔ very limited consumption shift (as absolute values)

Source: Benini, Gallanti, Grattieri, Maggiore, «Impact of a mandatory time-of-use tariff on the Italian residential customers», RSE 2012
Time-of-Use price: customers’ preferences

- Although all LV customers are metered according to the same rules, ToU pricing is mandatory only for those in default supplier regime (around 21.5 Million household customers).

- Customers supplied in the free market can choose the pricing among different offers: single price, two bands, three bands.

- In the free-market, 2 customers out of 3 prefer an offer without ToU pricing (7.2 Million customers out of 11.5 Million household customers in the free market).

![Yearly average wholesale prices (nation-wide) per hour [€/MWh]](chart.png)
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**SMART METERING: system architecture from “1G” to “2G”**

New concept: distinction between

- **Chain 1**: from meter to retailer (validated data), *similar to 1G, empowered*
- **Chain 2**: from meter to customer (directly, real time data but non validated): *new*
CHAIN 1 & CHAIN 2: concept of 2G (Regul. decision 87/2016)

**«Chain 1»**
- Purpose: billing and network management
- Validated data, SLA
- Daily collection
- Operated by DSO
- Back-up channel

**«Chain 2»**
- Purposes: customer awareness and value offering for suppliers
- Close to real-time, not validated data
- Continuous flow
- Interoperable with 3rd party IHDs
- No back-up channel
Usefulness of Chain 2

- Different use cases have been investigated: can be grouped in **four** categories:
  - **customer awareness**: e.g. alert for exceeding thresholds in Italy: *power is limited via breaker*
  - **home automation**: e.g. load shifting with deferrable loads; peak shaving using “smart” energy management in Italy: *economically relevant because network tariff is largely capacity-based*
  - **market participation**: e.g. customer energy flexibility sold directly to the Ancillary Service Market, even through an aggregator in Italy: *trials ongoing*
  - **innovation in retail offering**: e.g. new services and “prepayment” in Italy: *never used before*

- Meter operator (DSO) cannot carry out commercial activity beyond the meter: hence, *interoperability* is necessary
**CHAIN 2 (new with 2G): real-time communication**

- "frequent asynchronous data": level of used power capacity changes very rapidly; in order to avoid **disconnection due to limitation of contractual power** an alert can be sent.

- Requirements: sampling **up to every 1 second** "frequent asynchronous data" are not to be stored (strong **privacy issues**).
CHAIN 2 (new with 2G): interoperable In-Home Device

- IHDs developed by third parties (integrated with home ecosystem)
- Standard communication protocol (for both DSO and device provider)
- Developed by CEI (standardisation body) with industry consensus: July-2017 (CEI TS 13-82/85)
- Physical layer PLC in CLC “band C”, further layers under development
- Monitoring phase under course, very good performance (end-to-end)
- Release 2.1: cooperation with Agcom on further options for chain 2 - consultation paper ARERA n.245/18

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<thead>
<tr>
<th></th>
<th>Frequent - 1 retry</th>
<th>Rare - 4 retry</th>
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</thead>
<tbody>
<tr>
<td>Avg</td>
<td>98,79%</td>
<td>98,23%</td>
</tr>
<tr>
<td>5° percentile</td>
<td>97,28%</td>
<td>100 %</td>
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<tr>
<td>1° percentile</td>
<td>50,64%</td>
<td>0 %</td>
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% success rates in daily samples
2G SMART METERING ROLL-OUT PLAN (e-distribuzione)

Average cost (over 15 years): 94 € per meter-2G (regulatory decision 222/2017)

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Suggested reading on the Italian case (innovation)

**CHANGING THE REGULATION FOR REGULATING THE CHANGE**

Innovation-driven regulatory developments in Italy

ICER Distinguished regulatory scholar Award 2012

[http://www.iern.net/portal/page/portal/IERN_HOME/ICER_HOME/ABOUT_ICER/Distinguished_Scholar_Award_2012](http://www.iern.net/portal/page/portal/IERN_HOME/ICER_HOME/ABOUT_ICER/Distinguished_Scholar_Award_2012)

Suggested reading on the Italian case (smart metering)

**SMART METERING: AN EVOLUTIONARY PERSPECTIVE**

Guidelines and lessons learnt from the Italian regulatory experience

Highly Acknowledged Paper ERRA regulatory research Award 2017


Thank you for your attention

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