2.7 Italy: network costs versus decentralised system

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2.7.1 Introduction

The diminishing economies of scale and the gradual cost reductions of renewable technologies make distributed generation (DG) the most convenient alternative for new electricity generating installations (Lorenzoni 2014; Lorenzoni 2015; REN21 2016). The establishment of a decentralised electricity market is essential for compliance with the decarbonisation commitments of the Paris Agreement (UNFCCC 2015; IEA 2016), even if in the framework of European targets (European Commission 2014) each member state may implement different instruments for the transition to sustainable energy (Kuzemko et al. 2016). The Italian market represents a significant case for the analysis of the evolution towards low-carbon electricity systems as a remarkable increase in renewable capacity installed in the last six years was possible within a market characterised by a real liberalisation process even with a large share of the former incumbent Enel (ARERA 2018). However, whilst Italy has already met its 2020 decarbonisation goal for the electricity sector, some policies currently in place may be detrimental for the further development of decentralised energy resources (DER): in order to revert this trend, the draft National Energy and Climate Plan presented in December 2018 set ambitious goals to further increase decarbonisation (Ministero dello Sviluppo Economico, Ministero dell'Ambiente, Ministero delle Infrastrutture 2018).

This chapter provides an overview of the most significant regulatory and market aspects that have enabled Italy to meet its target, and of the barriers that are hampering further actions. The second section describes the institutions and characteristics of the Italian electricity market as well as the most important decarbonisation policies; the third section analyses the outcomes of

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such policies. The fourth section focuses on the main governance drivers and barriers for decentralisation, and the fifth section provides concluding remarks.

2.7.2 The impact of European policies on the decentralisation of the Italian electricity market

From nationalisation to liberalisation: a short description of institutions and market players

In 1962 the per-capita electricity consumption in Italy was still lower with respect to other comparable countries; the centre-left government decided to nationalise the industry and to establish the single vertically integrated utility Enel, in order to give access to every consumer under the same conditions, and to sustain economic growth (Ranci 2014).

The establishment of the National Regulatory Authority (NRA), thirty-three years later, to promote competition, efficiency and transparency whilst maintaining a high quality of supply, was a precondition for the liberalisation of the market (Legge 481/1995). According to the European Directive 1996/92/CE, the first step to promote the participation to the free retail market was to give access to 'eligible consumers'; the Italian decree (D.Lgs. 79/1999) declared 'eligible' those consumers with a decreasing annual consumption threshold (from 100 GWh down to 0.1 GWh from 1999 to 2007), while the others were supplied in the regulated captive market, where supply conditions were defined by the NRA. This hybrid solution was unstable: since July 2007 everyone has access to the free retail market; however, the captive market, where a single buyer ensures electricity supply, is still available and serves the majority of households (ARERA 2018). The wholesale market is managed by Gestore dei Mercati Energetici (GME), which sets criteria for neutrality, transparency, and competition amongst producers: Terna is the transmission system operator.

Enel remains dominant across supply and distribution: with respect to distribution networks, in 2017 Enel Distribuzione (currently e-Distribuzione) managed 85 per cent of total electricity supply volumes (ARERA 2018). Enel is also the largest supplier in the retail market (85.4 TWh): a deliberation from the NRA is stricter in terms of the obligation of functional unbundling (ARERA 2015d). In general, the Italian territory is provided with scarce natural resources and fossil fuels are not available: the dependence from foreign sources is 75 per cent, with oil and gas still accounting for around 60 per cent of the energy mix (Unione Petrolifera 2016).

With respect to the electricity market agenda the Italian Government has acted as a policy-taker, building its policies according to EU priorities (Font 2002; Clò 2014). The same approach has been adopted with respect to decarbonisation commitments to be implemented in Italy after the EU signature of the Paris Agreement (UNFCCC 2015).

Table 3: Electricity generation (GWh) by renewable energy sources in Italy.

	2013	2014	2015	2016	2017	2018**
Hydro	52,773	58,545	45,537	42,432	36,199	49,28
Wind	14,897	15,178	14,844	17,689	17,742	17,492
Solar	21,589	22,306	22,942	22,104	24,378	22,653
Geothermal	5,659	5,916	6,185	6,289	6,201	6,08
Bioenergy*	17,09	18,732	19,396	19,509	19,378	19,219
TOTAL	**112,008**	**120,677**	**108,904**	**108,023**	**103,898**	**114,724**
Gross National Consumption	330,043	321,834	327,94	324,969	331,765	332,849
RES/Gross National Consumption	**33.94%**	**37.50%**	**33.21%**	**33.24%**	**31.32%**	**34.47%**

*Bioenergy includes: solid biomass (including the organic fraction of municipal solid waste), biogas, bioliquids, and biomethane.

**Provisional estimations.

Source: GSE, 2019a.

The governance of decarbonisation policies

The generous incentive schemes for renewable energy sources (RES), the cost reductions of low-carbon technologies and the flattening electricity demand due to the economic crisis have made possible that sustainable sources represented around one third of the Italian electricity generation mix in the last 6 years, as can be seen in Table 3 (GSE 2019a).

Since 1991 the Italian law declared RES projects of 'public interest' and 'public utility', and the related works 'urgent' and 'not deferrable' (Legge 9/1991). After the Directive 2001/77/EC, Italy promoted a policy (D.Lgs. 387/2003) that simplified the permitting process for these facilities. Gestore dei Servizi Energetici (GSE) is the legal entity in charge of managing the incentives for RES and purchases electricity from these generators.

The main support schemes adopted by GSE are:

- **Tariffa Onnicomprensiva (feed in tariff):** for renewable generators (excluding PV and including wind, hydro, bioenergy) entered into operation before 31 December 2012 with a capacity installed up to 1 MW (200 kW for wind); it envisions a fixed amount for each kWh produced, differentiated according to the source, for 15 years.
- **Green Certificates (GC):** for net electricity produced by RES facilities entered into operation before 31 December 2012; from 1 January 2016 GC are replaced by feed-in-premium incentives until the end of the right to obtain GC (20 years).

- **Conto Energia, incentive scheme for PV, which comprises:**
  - A feed-in-premium scheme for PV projects entered into operation before 26 August 2012.
  - A scheme for PV plant entered into operation from 27 August 2012 to 6 July 2013: feed-in tariff for projects with a capacity installed lower than 1 MW_p and feed-in-premium for larger units, with a prize for net self-consumed electricity (GSE 2016).

The diversity of instruments and dates highlights the fact that the Italian regulatory framework has not provided reliable instruments for the promotion of DER. The policies to support PV provide a particularly interesting story in these terms, with frequent and sometimes random changes of rules. For example, support for PV started in 2005, and the incentive was then modified in 2007 (D.M. 19 February 2007), in 2010 (D.M. 6 August 2010; Legge 129/2010), in 2011 (D.M. 5 May 2011), and finally in 2012 (D.M. 5 July 2012). During these years, the cost of installations decreased faster than the premiums and in 2011 nearly 10 GW were installed. In 2012 the Government passed a decree to end support for PV as soon as the overall cost of the programme reached €6.7 billion/year.

Other very important support schemes in relation to the development of a decentralised system are 'Scambio Sul Posto' and 'Ritiro Dedicato' (Nextville 2013). 'Scambio sul Posto' or net metering (ARERA 2012), is a commercial agreement with GSE valid for low-carbon units up to 200 kW: the electricity generated by an on-site installation and injected into the grid can be used to offset the electricity withdrawn from the grid itself. A total of 524,600 users have adopted this method of net metering, a total capacity of 4.5 GW (ARERA 2016a). Since 2009 this has been based on market values: users pay the total amount for their consumption and in return receive a fair contribution set at retail market prices for the electricity produced. Until 2012 this scheme was compatible with other incentives, but this is no longer the case. 'Ritiro Dedicato' (Simplified Purchase and Resale Agreement) (ARERA 2007) is a simplified formula for low-carbon facilities under 1 MW of capacity. Producers sell the electricity generated to GSE instead of selling it through bilateral contracts or directly on the wholesale market; they are remunerated with guaranteed minimum prices, while larger units receive the average monthly price set on their zonal wholesale market. 51,119 plants adopted this scheme voluntarily, a total capacity of 11.6 GW (ARERA 2016b).

In spite of the numerous regulatory turnarounds, Italy successfully complied with its decarbonisation targets, reaching 69 per cent of its target in 2011: at the end of 2015 the reduction in CO_2 emissions was 34 per cent higher than the 2020 target (ENEA 2016a). With the steady growth of the last decade, RES gained a central role in the energy sector, in both operation and policy. This was at the expense of fossil thermal electricity generation, which accounted for 82.6 per cent in 2007 and 56 per cent in 2014; electricity-related

CO_2 emissions amounted to 591.1 gCO_2 per kWh in 1990 falling to 323.6 gCO_2 per kWh in 2014 (ENEA 2016b).

National/regional policies and geographical dimension

In the Italian Constitution of 1948, energy production, transmission and distribution became state competencies, but with a constitutional reform in 2001 (L. Cost 3/2001) a division of legislative powers made the subject a matter of concurrent competencies between national and regional entities: the Italian Government establishes the general principles of the sector, complying with the supranational EU framework, while regions legislate within their territories according to such principles. The aim of this configuration was to relieve the state from an excess of tasks and to simplify the administrative procedures in the sector. A constitutional reform, which among other objectives, aimed to give back exclusive responsibility to the state in the energy field (D.D.L. Cost 2016), was rejected following a referendum in December 2016.

The geographical dimension is significant not only in terms of legislative competence: in general, northern regions consume more electricity and are characterised by a larger number of installations from RES (including hydro). Southern regions are affected by lower consumption and higher prices for electricity, mainly due to bottlenecks in the transmission grid: it often happens that RES generation is higher than total load (ARERA 2016a). Figure 14 illustrates the geographical distribution of DG in terms of number of substations involved for more than 5 per cent of total time in power flow inversions.

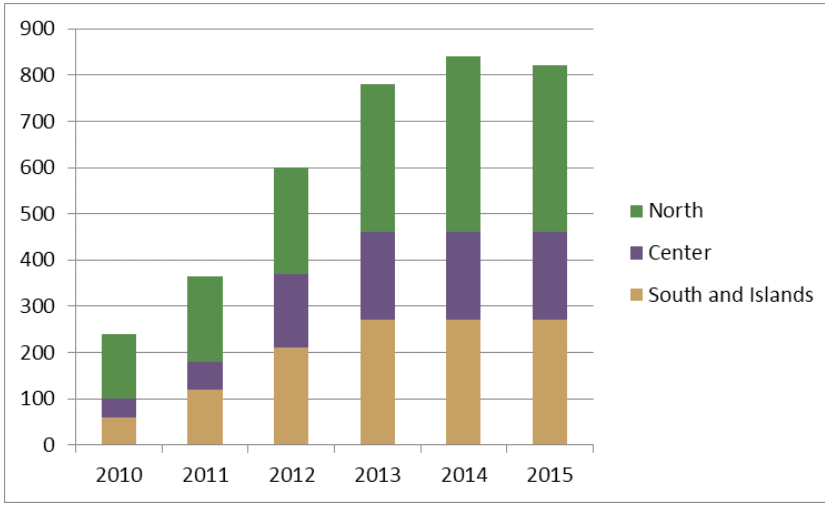

Figure 14: Number of HV/MV substations with power flow inversions > 5 per cent of total time.

Source: ARERA (2016a).

Importance of consumers in policy debate

In the last few years, the NRA devoted increasing attention to unfair commercial activities from suppliers, mainly with regards to billing processes. In general, consumer unions complain about high bills and lack of transparency from suppliers: from 2011 to 2013 the number of complaints increased from 335,000 to 500,000, 70 per cent of which related to households' contracts (Federconsumatori 2014). The liberalisation also raised concerns related to energy poverty for low-income users and a social bonus was made available for households in need (D.Lgs. 102/2014, ARERA 2015c). In spite of this, energy policy is still dominated by the supply-side operators and the diffusion of new contractual relationships based on DG hardly finds proper support from NRA.

2.7.3 The status of decentralisation in the Italian electricity market

In 2017, the Italian gross domestic product slightly increased and the electricity demand followed the same dynamics (provisional results account for +2 per cent with respect to the previous year). Despite this signal, and as a result of improved efficiencies in the system and reduction of demand from energy-intensive sectors, the electricity demand stabilised at the same level as in 2007 (319 TWh) (Ministero dello Sviluppo Economico 2018). The electrification of heat and transport, proposed in some decarbonisation scenarios, has not yet impacted on demand, as electricity consumption still accounts for approximately 20 per cent of total final energy consumption. This shrinking demand pattern does not by itself facilitate the full transition to a sustainable system, with the sector still relying on centralised regulation and managing overcapacity.

The contribution of RES

PV and hydro together account for around 70 per cent of total installed renewable capacity (in 2008 hydroelectricity represented 95 per cent of total RES in Italy). From 2010 to 2015, 23 GW of renewable facilities were installed, with nearly 20 GWp of PV; however, the decrease of incentive schemes in 2013 brought about an interruption in the constant growth of decentralised sources, as seen in Figure 15 (GSE 2019b).

Overcapacity and low profitability in the wholesale market

In 2004 the Italian electricity market (IPEX) started as a pool (central dispatch), and allowed bilateral contracts. IPEX is managed by GME and it actually entails a spot electricity market (MPE), a forward electricity market (MTE) and a platform for physical delivery of financial contracts. MPE is currently divided into three specific segments: day-ahead market (MGP); intra-day market (MI); ancillary services market (MSD, operated by Terna). MGP is a zonal market, with the particularity of a single price on the consumer side (PUN, the

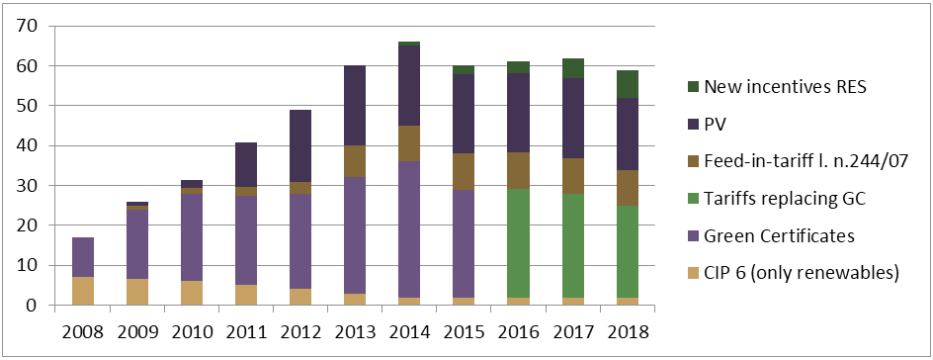

Figure 15: Subsidised electricity (TWh) generated from RES, according to incentive instrument.

Source: ARERA (2018).

weighted average zonal price) and a zonal price whenever congestion rises on the supply side. In general, the average price in the IPEX is higher with respect to other European countries (except France) because of a market largely based on gas supplies.

The large share of RES impacted the operation of IPEX, with a negative spark spread for combined cycles occurring in many months since 2012 and negative results for most of thermal generators.

Table 4: Comparison of prices available on wholesale markets in Europe.

YEARS	IPEX (Italy)	EPEX (Germany)	North Pool (Northern Countries)	OMEL (Spain)	EPEX (France)
2004	51.60	28.52	28.91	27.93	28.13
2005	58.59	45.97	29.33	53.67	46.67
2006	74.75	50.78	48.59	50.53	49.29
2007	70.99	37.99	27.93	39.35	40.88
2008	86.99	65.76	44.73	64.44	69.15
2009	63.72	38.85	35.02	36.96	43.01
2010	64.12	44.49	53.06	37.01	47.50
2011	72.23	51.12	47.05	49.93	48.89
2012	75.48	42.60	31.20	47.23	46.94
2013	62.99	37.78	38.35	44.26	43.24

Source: RSE (2015).

In general, GSE operates on IPEX as a non-programmable RES collector and bids in the day-ahead market at zero; this behaviour drives marginal units out of the market and favours the decline in the clearing wholesale electricity price. Conventional generation facilities are excluded from the merit order in a growing number of hours, especially during day-time. In order to recover the profits lost on the day-ahead market, they are therefore obliged to bid at higher prices at night (when PV plants do not generate) and on the ancillary service market (MSD) (Clò, Cataldi & Zoppoli 2015). In the first third of 2016, such activities brought to an increase in dispatching costs for an amount of €745 million with respect to the previous year (Biancardi 2016), and were considered as improper manipulations by the regulator.

Considering these aspects, the establishment of a proper capacity market would guarantee an adequate generating capacity to meet expected consumption and reserve margins (ARERA 2015f). The approved scheme (D.M. 30 June 2014) will replace the transitory system in force since 2004, which was structured as capacity payment, and entails a mechanism according to which producers will receive remuneration for the generated capacity that they make available. The final approval of the capacity market design was planned for the end of 2017, but was delayed.

Towards full liberalisation in the retail market

Twenty years have passed from the beginning of the liberalisation process, but still the majority of households (58 per cent) purchase electricity according to the regulated price. However, this trend is changing and the number of households accessing the competitive retail market is increasing: in 2017 most supply contracts for new consumption units were signed according to the liberalised framework (ARERA 2018). On average, families in the captive market consume less than families supplied in the free market (1.852 kWh/year against 2.119 kWh/year), because larger consumers are more likely to search for cheaper options; nonetheless, prices on the free competitive retail market can be higher than regulated ones, often because these offers include forms of electricity-related services.

Reforms (ARERA 2015c) are in place to encourage this shift to the free market model and reduce the role of the single buyer: the end of the captive market is expected by June 2020. However, in the presence of significant informative asymmetries, the single buyer is still a useful benchmark for the market.

In general terms, the energy bill structure is composed of 4 sections (ARERA 2018): in 2017 the energy-commodity cost section, which is related to the wholesale market price of the energy and the commercial margins of the retailer/reseller accounted for 44%, while taxes and network costs represented 13% and 20% of the whole amount, respectively. The second most significant portion of the bill is represented by general system charges, which cover the costs that the system bears for the incentive schemes to renewables and high-efficiency cogeneration, as well as other costs which are generally referred to

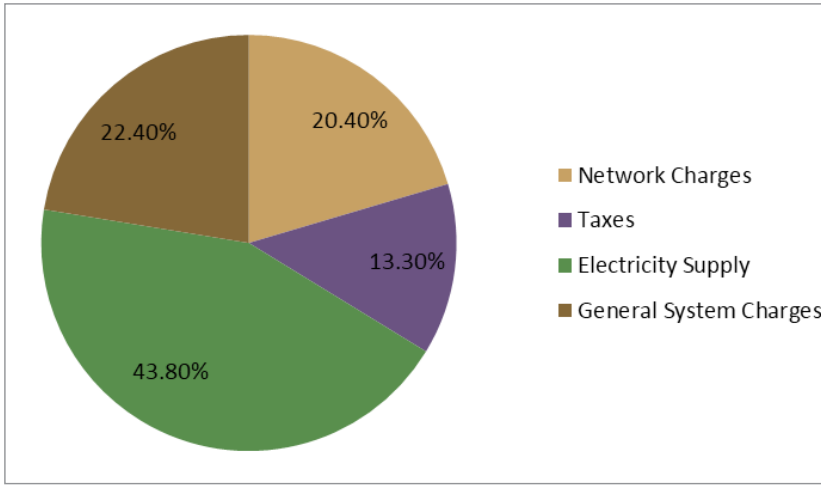

Figure 16: Costs structure for a household consuming 2,700 kWh per year and with a withdrawal capacity of 3 kW in the captive market.

Source: ARERA (2018).

the electricity system (including the nuclear plants decommissioning, the support to national railways electric systems, the bonus for fuel poverty, etc.). This latter portion accounts for 22 per cent of the total bill, and nearly 80 per cent of such overheads are devoted to incentive schemes for RES. Each of these cost items can be split into a 'trinomial structure' already presented above: a fixed value (€/connection point/year), a power capacity value (€/kW/year, based on the power capacity of the connection point), and a volumetric variable value (€ per kWh), as seen in Figure 16.

2.7.4 The Italian regulation for distributed energy resources

The previous paragraphs have already described the Italian electricity market, which complies to the requirements of the European Directives (unbundling and Third Party Access): with respect to the grid connection of renewable generators, network operators are obliged to connect them at a cost that is proportional to the distance from the connection point. However, the owner of a renewable energy plant does not have alternative solutions to self-consumption or sale to the grid. The direct sale of electricity to other consumers, as well as load aggregation, is forbidden, with the exception of the one-to-one supply under SEU (Sistemi Efficienti di Utenza, efficient user system) scheme, a regulated business model for electricity sales from DG, described below.

The biggest concern for the Italian regulator is related to the payment of system costs when a growing number of consumers are becoming self-producers, reducing the withdrawal from the grid (and the related participation to grid costs), but taking full advantage of grid services. As a matter of fact, in the current framework, innovated by the Decree 244/2016, all the electricity consumers are obliged to pay network tariffs and general system charges only on the energy withdrawn from the public network.

The current system for the recovery of the costs for transmission and distribution services is based on a price cap mechanism on operating costs (to encourage cost reductions in managing infrastructure) and a rate of return mechanism on capital costs (to stimulate investments for network adequacy) (Legge 290/2003). This regulation until 2012 made possible significant investments in transmission (€7 billion) and distribution networks (€18 billion) (Polo et al. 2014). In a recent consultation the NRA proposed to introduce an approach based on total costs (*totex*) for the remuneration of services, suggesting also the aggregation of smaller DSOs (ARERA 2015a). In general, the NRA itself recognises the need to establish mechanisms to coordinate the strategies of generation facilities and to take advantage of the flexible demand.

Governance barriers for distributed energy resources

Households' electricity tariff reform: displacing efficient consumers and on-site generators

As highlighted in the previous section, only around 40 per cent of the total costs included in the electricity bill is exposed to market competition. This structure (Ranci 2014) was aimed to keep the electricity costs for small capacity withdrawals for households (3 kW) as low as possible, without being affected by volatility. Tariffs were given a progressive structure for the recovery of network costs (transmission, distribution and measurement) and overheads: the charges grew proportionately to consumption and therefore larger consumers were burdened with the recovery of fixed costs.

Under the current scheme (ARERA 2015b), a growing portion of the bill is due to a fixed charge, and the final price is more cost-reflective. According to the NRA, the new tariff structure is favourable for consumers that put in place energy savings initiatives, because the energy component still represents at least 70 per cent of the total bill; on the other side, this scheme also supports the development of the electric options for transport and heat (electric vehicles and heat pumps), see Figure 17.

However, even if larger consumers are granted with economic savings (€164/year for families consuming 4,000 kWh/year), this reform seems detrimental for families with an annual consumption which is lower than the average and that own an on-site generation plant. Moreover, the adoption of information and control technologies in energy management to reduce electricity loads and shifting consumption to off-peak periods is delayed, if not fully displaced.

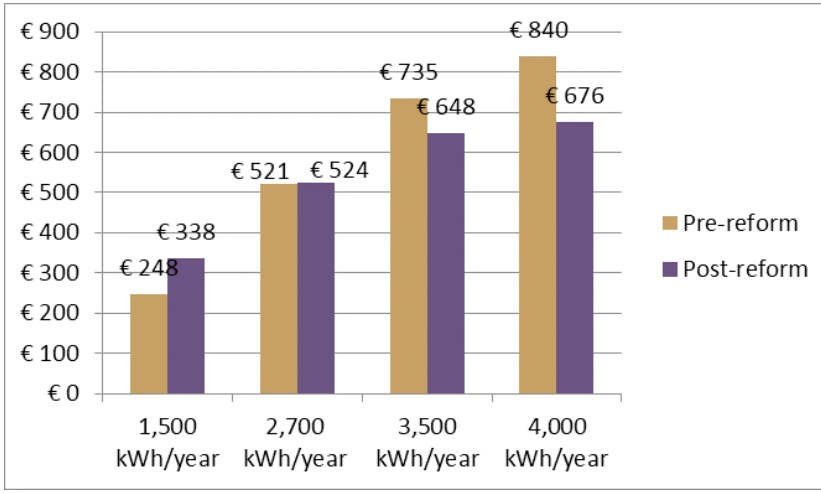

Figure 17: Comparison of total costs of the electricity bill pre and post reform for 3 kW user.

Source: Energy and Strategy (2016).

Demand response and grid services from renewables and storage

Since 2004, eligible consumers have been allowed to bid on the demand side of the wholesale market, however, demand-side resources do not have access to the balancing market and are not allowed to provide ancillary services, which are only provided by generators with installed capacity above 10 MVA. With regard to balancing responsibilities, RES are charged for their imbalances since 2012 with a given tolerance, under a continuously changing regulation (ARERA 2012). This rule exposed the balancing market to expensive manipulations and the rules are again under revision.

Thanks to the fact that Italy was the first country in Europe that adopted smart meters on a large scale, with more than 95 per cent of low-voltage consumers currently equipped with this technology (Meeus & Saguan 2011), the use of demand resources to manage the grid is feasible. Since 2010, a time-of-use tariff (peak and off-peak) has been mandatory for consumers in the captive market, and retailers offer time-of-use prices to all types of consumers; in spite of this only consumers with contracted capacity higher than 55 kW are charged on an hourly basis.

The Italian NRA, with Resolution no. 300/2017/R/eel (ARERA 2017), has started a process to open the ancillary services market to non-relevant and non-programmable generation units, as well as to consumption units and to storage systems. To this aim, such installation can be aggregated in virtual units (UVA, which stands for Unità Virtuali Abilitate – Virtual Enabled Units) and take part in the market as a single aggregated participant. In the abovementioned Resolution, four types of virtual units are addressed:

- UVA-C, aggregation of consumption units situated in the same area (areas are defined by Terna);
- UVA-P, aggregation of non-relevant generation units (either programmable or non-programmable and including storage systems) situated in the same area;
- UVA-M, aggregation of non-relevant generation units (either programmable or non-programmable and including storage systems) and consumption units situated in the same area;
- UVA-N, aggregation of both relevant and non-relevant generation units, and possibly of consumption units, connected to the same node of the transmission grid.

Currently (June 2019), pilot projects have already been activated and these units have already taken part in the ancillary services market, but it is too soon to evaluate their effectiveness.

The case of small islands

The Italian coastal areas are characterised by several small islands, which are not connected to the mainland electricity network. While they can represent an opportunity to develop local systems entirely reliant upon low-carbon sources, most of these islands are supplied by fossil-fuel generators, largely oversized compared to winter demand, in order to cover summer peak loads (Smart Island 2016). The decarbonisation of these local systems has never been undertaken because consumers on these islands have been subsidised by the rest of final consumers (€60 million/year) (ARERA 2014a): they pay the same tariffs as the rest of the country, plus local operators can recover costs in entirety, leading to significant profit and opposition to establishing more innovative solutions.

Governance drivers for distributed energy resources

A regulation-driven model for decentralisation: SEU

The business model created by the Italian regulatory framework for distributed generation, Sistemi Efficienti di Utenza (SEU), is affected by significant limitations. A SEU is a system where one or more plants (RES or high-efficiency CHP plants) managed by the same producer (which could also differ from the end user) are directly connected through a private connection (with no obligation to connect third parties) with one final consumer and all the elements of the SEU (plants, consumption site, connection, network) are included in an area available to the final consumer itself (ARERA 2013). The regulation for SEU, which has already been affected by retroactive changes, has so far mainly supported PV projects with an installed capacity lower than 20 kW_p (GSE 2016), and represents a significant barrier for the development of the scheme with regard to the one-to-one restriction and the ownership of the whole area where the plant is installed.

In January 2019, Italy submitted to the European Commission its draft proposal of the National Energy and Climate Plan (NECP) (Ministero dello Sviluppo Economico, Ministero dell'Ambiente, Ministero delle Infrastrutture 2018). The Plan is aimed to accelerate decarbonisation, to enhance the energy decentralisation and to ensure security of supply, while promoting energy efficiency and the electrification of consumption. Among the main goals of the Plant there is the increase of the quota of energy generated by RES up to 30% of the national gross energy consumption and a 33% reduction of greenhouse gas for non-ETS sectors emissions.

The NECP also declares the intention to proceed with the transposition of the Directive 2018/2001 (Directive 2018/2001), with particular reference to individual and collective self-consumption initiatives (energy communities). To enhance their development, the main instrument should be the application of network and system charges only on the electricity which is procured from the network, while the electricity which is self-consumed should not be burdened by such charges. The transposition is still in process at the time of writing (June 2019), but it is likely that it will enhance the quota of self-consumption, with particular reference to renewable generation units: 80% of self-consumed energy is currently produced by gas-fired cogeneration plants (GSE 2018).

Other support policies for decentralisation

Various support measures are available, but they are not conceived in the perspective of creating a full, decentralised energy system.

In 2004 the Italian legislator introduced a white certificates system (D.M. 20 July 2004) with an obligation placed on electricity and gas distributors (with a threshold of 50,000 consumers). Distributors are allowed to invest in energy efficiency initiatives themselves or to purchase the certificates from ESCOs that undertake investments in this field.

Tax deductions (Legge 296/2006) of up to 65 per cent of the investment cost over a ten-year time span are available for energy efficiency measures such as solar heating collectors, condensing boilers, high-efficient heat pumps and biomass boilers. Such deductions have been the key driver for energy efficiency improvements in the building sector in Italy, with more than 14.2 million interventions from 1998 to 2016 (Servizio Studi Camera dei Deputati 2016).

Further incentive for energy efficiency initiatives and renewable thermal energy is provided by 'Conto Termico' (D.M. 28 December 2012; D.L. 91/2014), a contribution available for public authorities and households that covers part of the costs incurred and is paid off in annual instalments, from 2 to 5 years.

Storage tests and smart grid tests

Many European and national programmes provided funding for storage facilities and smart grid solutions, in order to facilitate the integration of RES and establish new modalities for the operation of transmission and distribution grids; one of the largest project in Italy financed the refurbishment of 1,605

km of transmission and distribution lines in Southern Regions (Ministero dello Sviluppo Economico 2014). Moreover, several smart grid projects were also implemented by the incumbents themselves, thanks to the possibility to include these expenses in the cost-recovery mechanism: Enel Distribuzione in 2015 committed itself for a total amount of € 343 million under different financial agreements (Mori 2015). Terna installed 35 MW of storage units in southern regions to increase the flexibility of the system and to absorb excess power from non-dispatchable RES in off-peak hours (Terna 2016).

NRA defined the mechanisms for the selective promotion of investments towards smart distribution systems in areas with a large penetration of DG (ARERA 2015a). These projects are related to new anti-islanding protection schemes, and real-time operation, monitoring and control strategies. However, the NRA itself encountered barriers in carrying out these projects, and the most significant one has been the lack of involvement and participation of active users. Even if the distributor covered all the costs, some users have rejected the experiment because they lacked direct immediate benefits and were scared by the problems that could occur during the process.

Relying on conventional network operators to test smart grid solutions is preferable in terms of the stability of the system, but this solution is risky with respect to the exclusion of other operators that could supply more innovative technologies to regulate DG.

2.7.5 Conclusions

Italy complied with the European decarbonisation targets, even if the regulation of the electricity system was not able to promote a proper coherent governance for the transition towards a decentralised paradigm. As a matter of fact:

- The reform of the household's tariff is not in favour of efficient consumption units and does not support local generators; moreover, the expected results in terms of electrification of final uses are not guaranteed;
- The restrictions on aggregation and on the provision of services from DG, as well as the barriers to coupling storage units and generators, hamper the adoption of innovative technologies; in this perspective, the adoption of Virtual Enabled Units can represent a significant innovation, which however is still at its early stage;
- In principle the authors agree with the opportunity to fully implement the liberalisation process, but considering that significant informative asymmetries are still available in the market, an aggregator with no-profit target like the single buyer still represents a useful benchmark for the market;
- The prohibition to sell electricity from local plants to adjacent entities is preventing the establishment of decentralised supply, but the commitment for the transposition of the Directive 2018/2001, with particular reference

to energy communities and to jointly acting renewable self-consumers can be a driver for decentralisation.

In spite of the latest improvements, these policies have resulted in the protection of the rent of incumbents. Conversely, the low-cost technologies available allow sustainable facilities and demand aggregators to provide network services; the integration of thermal and electric loads could also facilitate the management of intermittent electricity sources if efficient solutions are in place.

Driving the change in the energy sector requires great regulatory vision and the ability to balance the needs of the incumbents with the opportunities opened up by the innovative options. The flattening electricity demand and the shrinking prices do not make it easy to put in place novel instruments, but the new market design should fit with low-carbon and decentralised energy sources.

2.7.6 References

ARERA. (2007), Delibera n. 280/07. Modalità e condizioni tecnico-economiche per il ritiro dell'energia elettrica ai sensi dell'articolo 13, commi 3 e 4, del decreto legislativo 29 dicembre 2003, n. 387/03, e del comma 41 della legge 23 agosto 2004, n. 239/04. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2012), Deliberazione 20 dicembre 2012 570/2012/R/EFR. Testo integrato delle modalità e delle condizioni tecnico-economiche per l'erogazione del servizio di scambio sul posto: condizioni per l'anno 2013. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2013), Deliberazione 12 dicembre 2013 578/2013/R/EEL. Regolazione dei servizi di connessione, misura, trasmissione, distribuzione, dispacciamento e vendita nel caso di Sistemi Semplici di Produzione e Consumo. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2014a), Memoria 3 luglio 2014 332/2014/I/EEL. Conversione in legge del Decreto Legge 24 Giugno 2014, n. 91. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2015a), Documento per la consultazione DCO 255/2015/R/EEL. Smart Distribution System: promozione selettiva degli investimenti nei sistemi innovativi di distribuzione di energia elettrica. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2015b), Documento per la consultazione DCO 34/2015/R/EEL. Riforma delle tariffe di rete e delle componenti tariffarie a copertura degli oneri generali di sistema per i clienti domestici di energia elettrica. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2015c), Delibera 4 giugno 2015, 271/2015/R/com. Avvio di procedimento per la definizione del percorso di riforma dei meccanismi di mercato

per la tutela di prezzo dei clienti domestici e delle piccole imprese nei settori dell'energia elettrica e del gas naturale- tutela 2.0. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2015d), Delibera 296/2015/R/com. Disposizioni in merito agli obblighi di separazione funzionale (unbundling) per i settori dell'energia elettrica e del gas. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2015f), Deliberazione 10 marzo 2015 95/2015/I/eel. Proposta al Ministro dello Sviluppo Economico per l'anticipazione della fase di piena attuazione del mercato della capacità. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2016), Relazione 339/2016/I/EFR. Stato di utilizzo e di integrazione degli impianti di produzione alimentati dalle fonti rinnovabili e degli impianti di cogenerazione ad alto rendimento. Relazione sullo stato dei servizi. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2017), Delibera 5 Maggio 2017, 300/2017/R/EEL. Prima apertura del Mercato per il Servizio di Dispacciamento (MSD) alla Domanda Elettrica ed alle Unità di Produzione anche da fonti rinnovabili, non già abilitate, nonché ai sistemi di accumulo. Istituzione di progetti pilota in vista della costituzione del Testo Integrato Dispacciamento Elettrico (TIDE) coerente con il Balancing Code Europeo. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

ARERA. (2018), Relazione annuale sullo stato dei servizi e sull'attività svolta. Milan: Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

Biancardi, A. (2016), Audizione di rappresentanti dell'Autorità per l'Energia Elettrica, il Gas e il Sistema Idrico. Commissione Industria, Commercio, Turismo del Senato. Resoconto n. 255 del 13/07/2016.

Clò, A. (2014), L'impervio e incompiuto cammino verso il mercato unico europeo dell'energia, in Riforme elettriche tra efficienza ed equità, 1st ed., A. Clò, S. Clò, F. Boffa, Ed. il Mulino, Bologna.

Clò, S., Cataldi, A. & Zoppoli, P. (2015), The merit-order effect in the italian power market: the impact of solar and wind generation on national wholesale electricity prices. *Energy Policy, 77*, 79–88.

Decreto Legislativo 16 marzo 1999, n. 79. Attuazione della direttiva 96/92/CEE recante norme comuni per il mercato interno dell'energia elettrica.

Decreto Legislativo 29 dicembre 2003 n. 387. Attuazione della direttiva 2001/77/Ce relativa alla promozione dell'energia elettrica prodotta da fonti energetiche rinnovabili nel mercato interno dell'elettricità, Gazzetta Ufficiale della Repubblica Italiana, del 31 gennaio 2004 n. 25.

Decreto del Ministro delle attività produttive di concerto con il Ministro dell'ambiente e della tutela del territorio e del mare del 28 luglio 2005. Criteri per l'incentivazione della produzione di energia elettrica mediante conversione fotovoltaica della fonte solare.

Decreto Legislativo 8 febbraio 2007, n.20. Attuazione della direttiva 2004/8/CE sulla promozione della cogenerazione basata su una domanda di calore utile nel mercato interno dell'energia, nonche' modifica alla direttiva 92/42/CEE. **Decreto del Presidente** del Consiglio dei Ministri, 11 maggio 2004. Criteri, modalità e condizioni per l'unificazione della proprietà e della gestione della rete elettrica nazionale di trasmissione.

Decreto Legislativo n. 102/2014. Attuazione della direttiva 2012/27/UE sull'efficienza energetica, che modifica le direttive 2009/125/CE e 2010/30/UE e abroga le direttive 2004/8/CE e 2006/32/CE.

Decreto Legge 24 giugno 2014, n. 91. Disposizioni urgenti per il settore agricolo, la tutela ambientale e l'efficientamento energetico dell'edilizia scolastica e universitaria, il rilancio e lo sviluppo delle imprese, il contenimento dei costi gravanti sulle tariffe elettriche, nonche' per la definizione immediata di adempimenti derivanti dalla normativa europea.

Decreto Legge 30 dicembre 2016 n. 244. Proroga e definizione di termini. Decreto Legge convertito con modificazioni dalla Legge 27 febbraio 2017, n. 19.

Decreto Ministeriale. (2007), Decreto Ministeriale 19 febbraio 2007, Criteri e modalita' per incentivare la produzione di energia elettrica mediante conversione fotovoltaica della fonte solare, in attuazione dell'articolo 7 del decreto legislativo 29 dicembre 2003, n. 387.

Decreto Ministeriale. (2010), Decreto Ministeriale 6 agosto 2010. Incentivazione della produzione di energia elettrica mediante conversione fotovoltaica della fonte solare.

Decreto Ministeriale. (2012), Decreto Ministeriale 5 luglio 2012. Attuazione dell'art. 25 del decreto legislativo 3 marzo 2011, n. 28, recante incentivazione della produzione di energia elettrica da impianti solari fotovoltaici (c.d. Quinto Conto Energia).

Decreto Ministeriale. (2012), Decreto Ministeriale 28 dicembre 2012. Incentivazione della produzione di energia termica da fonti rinnovabili ed interventi di efficienza energetica di piccole dimensioni.

Decreto Ministeriale. (2014), Decreto Ministeriale 30 giugno 2014 – Disciplina del mercato della capacità.

Directive 1996/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity. Brussels: European Parliament

Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market. Brussels: European Parliament

Directive 2003/54/EC of the European Parliament and the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC. Brussels: European Parliament

Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Brussels: European Parliament

Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC. Brussels: European Parliament

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. Brussels: European Parliament

Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast). Brussels: European Parliament

Disegno di Legge Costituzionale S. 1429-D. (2016), Disposizioni per il superamento del bicameralismo paritario, la riduzione del numero dei parlamentari, il contenimento dei costi di funzionamento delle istituzioni, la soppressione del CNEL e la revisione del titolo V della parte II della Costituzione" (approvato, in seconda deliberazione, dal Senato con la maggioranza assoluta dei suoi componenti, già approvato, in prima deliberazione, dal Senato, modificato, in prima deliberazione, dalla Camera, ulteriormente modificato, in prima deliberazione, dal Senato e approvato, senza modificazioni, in prima deliberazione, dalla Camera).

ENEA. (2016a), Analisi trimestrale del sistema energetico italiano. Rome: Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA).

ENEA. (2016b), Parigi e oltre. Gli impegni nazionali sul cambiamento climatico al 2030. Rome: Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA).

Energy and Strategy. (2016), Energy efficiency report. Milan: Energy & Strategy Group.

European Commission. (2014), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A policy framework for climate and energy in the period from 2020 to 2030.

Federconsumatori. (2014), Politiche, caro bollette, mercato energia: quail risposte per I consumatori?

Font, N. (2002), La politica ambientale, in S. Fabbrini, F. Morata, L'Unione Europea. Le politiche pubbliche, Roma-Bari, Laterza, 2002.

GSE. (2016) Rapporto Attività 2015.

GSE. (2018). Audizione X Commissione Senato, 18 Settembre 2018.

GSE. (2019a), Rapporto Attività 2018. Rome: Gestore Servizi Energetico (GSE).

GSE. (2019b), Rapporto Statistico 2017. Rome: Gestore Servizi Energetico (GSE).

IEA. (2016), Re-powering markets. Market design and regulation during the transition to low-carbon power systems. Paris: International Energy Agency.

Kuzemko, C., Lockwood, M., Mitchell, C. & Hoggett, R. (2016), Governing for sustainable energy system change: Politics, contexts and contingency. *Energy Research and Social Science, 12*, 96–105.

Legge n. 9, 9 gennaio 1991. Norme per l'attuazione del nuovo piano energetico nazionale: aspetti istituzionali, centrali idroelettriche ed elettrodotti, idrocarburi e geotermia, autoproduzione e disposizioni fiscali.

Legge n. 481, 14 novembre 1995. Norme per la concorrenza e la regolazione dei servizi di pubblica utilita'. Istituzione delle Autorita' di regolazione dei servizi di pubblica utilita'.

Legge 27 ottobre 2003, n. 290. Conversione in legge, con modificazioni, del decreto-legge 29 agosto 2003, n. 239, recante disposizioni urgenti per la sicurezza del sistema elettrico nazionale e per il recupero di potenza di energia elettrica. Deleghe al Governo in materia di remunerazione della capacità produttiva di energia elettrica e di espropriazione per pubblica utilità.

Legge n.296, 27 dicembre 2006. Disposizioni per la formazione del bilancio annuale e pluriennale dello Stato (legge finanziaria 2007), in Gazzetta Ufficiale del 27 dicembre 2006 n. 299.

Legge n.129, 13 agosto 2010. Conversione in legge, con modificazioni, del decreto-legge 8 luglio 2010, n. 105, recante misure urgenti in materia di energia. Proroga di termine per l'esercizio di delega legislativa in materia di riordino del sistema degli incentivi.

Legge Costituzionale 18 ottobre 2001, n. 3. Modifiche al titolo V della parte seconda della Costituzione.

Lorenzoni, A. (2014), Nel mercato futuro dell'energia è problematico lo spazio per le "vecchie" utility, see http://www.qualenergia.it/articoli/20140529-nel-mercato-futuro-energia-problematico-lospazio-per-le-utility.

Lorenzoni, A. (2015), Come il fotovoltaico italiano sta mostrando la strada del cambiamento, see http://www.qualenergia.it/articoli/20150323-come-il-fotovoltaico-italiano-sta-mostrando-la-strada-del-cambiamento.

Meeus, L. & Saguan, M. (2011), Innovating grid regulation to regulate grid innovation: From the Orkney Isles to Kriegers Fliak via Italy. *Renewable Energy, 36*, 1761–1765.

Ministero dello Sviluppo Economico. (2014), Rinnovabili ed efficienza energetica. Un racconto lungo una programmazione. I fondi europei 2007-2013 un'opportunità di sviluppo per il Sud.

Ministero dello Sviluppo Economico. (2018), La situazione energetica nazionale nel 2017.

Ministero dello Sviluppo Economico, Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Ministero delle Infrastrutture e dei Trasporti. Proposta di Piano Nazionale Integrato per l'Energia e il Clima. 31/12/2018.

Mori, S. (2015). Audizione presso X e XIII Commissioni del Senato della Repubblica. 6 maggio 2015.

Nextville. (2013), Vademecum Nextville 2013. Fonti rinnovabili. Milan: Edizioni Ambiente.

Polo, M., Cervigni, G., D'Arcangelo, F.M. & Pontoni F. (2014), La regolazione delle reti elettriche in Italia. IEFE Research Report no. 15 – June 2014.

Ranci, P. (2014), La liberalizzazione del mercato elettrico al dettaglio tra efficienza ed equità sociale, in Riforme elettriche tra efficienza ed equità, 1st ed., A. Clò, S. Clò, F. Boffa, Ed. il Mulino, Bologna.

REN21. (2016), Renewables 2016 global status report. Retrieved February 10, 2019, from www.ren21.net/wp-content/uploads/2016/05/GSR_2016_Full_Report_lowres.pdf

Ricerca sul Sistema Energetico (RSE). (2015), Energia elettrica, anatomia dei costi. Milan: Editrice Alkes.

Servizio Studi Camera dei Deputati. (2016), Il recupero e la riqualificazione energetica del patrimonio edilizio: una stima dell'impatto delle misure di incentivazione. 9 September 2016.

Smart Island. (2016), http://www.smartisland.eu/

Terna. (2016), https://www.terna.it/it-it/azienda/chisiamo/ternastorage.aspx.

UNFCCC. (2015), Adoption of the Paris Agreement, 12 December 2015.

Unione Petrolifera (2016). Data Book 2016. Energia e Petrolio.