Chapter 17
Economic Regulation, Water Pricing, and Environmental and Resource Costs: The Difficult Marriage Between Financial Sustainability, Investment Requirements and Economic Efficiency

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Abstract This chapter provides an overview of the financing patterns of the Italian water sector, which is segmented and characterised by a wide plurality of management systems and operators. In the last 25 years, Italy has introduced far-reaching reforms, which concerned in particular urban water supply and sanitation. The most important goal was to create the basis for an autonomous and self-sufficient water industry, driving the sector out of the public budget. Financial equilibrium of water undertakings and access to market-based finance have thence dominated over other possible aims of water pricing. Other sectors, and notably irrigation, continue to follow more traditional schemes. The chapter also discusses further reform opportunities with a view to turning water prices into economic incentives for a more sustainable use of water resources.

Keywords Water pricing · Economic regulation · Finance of water investments · Affordability · Economic instruments of water policy

17.1 Introduction

Italy has undergone a vast programme of reform and modernisation of its water management system in the last 25 years, which has especially affected public water supply and sanitation (PWS), often referred to as "integrated water service". The core of this reform concerned the design to establish a financially self-sufficient water industry, previously funded for the most part by the public budget. Consequently, patterns of water pricing system have been dramatically affected.

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This reform was a part of a vaster programme of fiscal consolidation. Its main driver was the need to alleviate the burden on the public budget, in a phase of dynamic expansion of investment needs, driven by the need to refurbish ageing infrastructure and comply with environmental policy; but also the obligation arising from the European Union (EU) Water Framework Directive (WFD) to achieve full recovery of financial and environmental costs, eradicate environmentally-unfriendly subsidies and design economic incentives to achieve sustainable water use and conservation of ecosystems.

An immediate and straightforward consequence of such a “perfect storm” is that water prices had to increase significantly – this actually happened, notwithstanding the fact that still now Italian water prices remain among the lowest in the developed world, and the average expenditure for water is still below affordability thresholds. The sudden and dramatic increase has raised political concern – culminated in the 2011 referendum – and made manifest the need to introduce further issues in the policy agenda: efficiency of water management, equity (interpersonal, intersectoral, interterritorial), as well as environmental and social sustainability.

Thence tariff design, price regulation and financial structure of the industry also needed a fundamental reform. This need remained for a long time latent, until 2011, when regulatory competences have been attributed to an independent regulator, ARERA.

In turn, other sectors of water management – notably irrigation, industry, and hydropower – have substantially maintained their features over time, even though the logic of cost recovery, financial equilibrium and removal of environmentally-harmful subsidies has penetrated in depth.

It can be said that the target of full recovery of financial costs has been achieved for most water services, and notably for PWS. Other sectors of water management, such as flood protection, rainwater and river restoration are still relying almost entirely on the public budget. In turn, the first steps towards the full implementation of the WFD principles have generated conceptual work and guidelines, but still very little practical consequences in terms of water tariff design and use of economic instruments.

In a previous work, I have discussed the historical evolution of the water pricing system and the establishment of the new regulatory paradigm (Massarutto 2018). In this paper we focus on the most recent developments and achievements and discuss the most likely directions of change. Section 17.2 will provide a background of the organisation and regulation of the Italian water management system, to enlighten the structure of financial flows that characterise it. Section 17.3 is dedicated to economic instruments of water management – a still neglected solution in Italy. Since the most notable changes have affected PWS, we shall concentrate on this sector, to which Sect. 17.4 is devoted. In Sect. 17.5 we shall complete the picture with some background information on the remaining sectors.

17.2 The Italian Water Management System and Its Financial Structure

17.2.1 Water Resource Ownership and Allocation

The structure of the Italian water management system is rather complex, as other chapters in this volume have enlightened. Many uses approach directly the natural resource through own abstractions and self-operation of wastewater and drainage. Others, in turn, use a collective service, under separate arrangements and with dedicated institutions for each sector. In this second group we can recognise genuine "public services" – services of general economic interest, in the European jargon – as well as private or communal ones; a distinctive feature that Italy shares with other EU countries, for example, Germany and the Netherlands, concerns private bodies that enjoy public status, such as landowners' associations or industrial syndicates. For this reason, they may be entitled to receive public funds, operate under state supervision, are subject to price regulation, must follow public procurement rules etc.

A typical feature of Italian water management system concerns sectoral fragmentation. Each sector relies historically on independent premises, is administered and regulated by specific institutions and is operated by independent operators. Although it is difficult to generalise, the following points summarise the main distinctive features in the Italian water sector:

Water resources, either surface or groundwater, are owned by the state as a public domain. Every use of water needs prior authorisation and is regulated through the institute of "concessions". Under a concession, users obtain the right to abstract water, use it and give it back to the environment, following the obligations foreseen in the concession document; licenses imply the payment of a fee ("*canone demaniale*").

Until 1994, this regime characterised surface waters only, while groundwater use was free and unregulated. Law no. 36/1994 extended the public domain to groundwater also. Therefore, at least nominally, groundwater abstractions have to follow the same licensing regime; however, the great number of individual abstractions – in the reach of tenths of thousands – makes the enforcement of this principle very difficult. Historically established uses have been often transposed into the concession regime, leaving patterns of water use mostly unchanged, especially in the case of agriculture.

Most water use systems access the water resource directly, i.e. ask for a use license and manage water through own premises. This approach is normally facilitated by the widespread availability of easily accessible natural resources. In some cases, however, water resources management implies the existence of artificial systems (reservoirs, large water transfers); we shall refer to these as "multipurpose bulk water supply systems", emphasising the fact that they typically supply bulk water to many retail distribution operators, either for irrigation or for industry and PWS. Again, we can identify different typologies.

In some cases, these are truly independent establishments. Ownership may be public: this is the case of Romagna Acque, serving the coastal provinces of Emilia-Romagna, and ENAS, managing reservoirs and bulk water transfers in Sardinia. Others are private concessionaires or public-private partnerships, particularly in the South (e.g., Sicilia Acque, SoriCal and Acquedotto Campano Occidentale).

A second category of bulk-suppliers concerns entities created for the sake of administering upstream regulation and storage works and allocating available flows to entitled subjects. For example, all the big subalpine lakes are artificially regulated at their mouth, and consortia of entitled users manage the gauging works.

Finally, a few bulk water schemes operate in the agricultural sector and provide water to irrigation systems. Occasionally they may also provide services to other water users, as in the case of CER (Canale Emiliano-Romagnolo), which provides complementary supplies to urban and touristic dwellings along the Adriatic coast of Emilia-Romagna, or EIPLI and Molise Acque, managing reservoirs and transfer schemes in South-Eastern Italy.

17.2.2 Sectoral Uses of Water and Their Management Systems

On the water demand side, we find either collective entities that provide water services to their associates, or independent individual systems. Table 17.1 illustrate an attempt to break down the relative shares.

Hydropower users generally belong to the latter category, especially when large facilities with upstream storage and flow regulation are present. Power producers usually operate the whole hydropower production and delivery system, including dams, reservoirs, bypass channels and all the concerned infrastructure works. Run-of-the-river plants are also usually independent. Sometimes, however, hydropower facilities are located along man-made artificial watercourses managed by third parties. This is for example the case of canals operated by Reclamation Boards (see below). Similarly, hydropower facilities may benefit from upstream water regulation (e.g. dams operated by third parties).

Public water supply and sanitation (PWS) concerns domestic users (representing 80–85% of the total), commercial and industrial premises, public administration. Coverage reach nearly 100% of residential population, the exceptions being

Table 17.1 Sectoral water management systems in Italy (breakdown by volume)

	Collective services	Self-supply
PWS	99%	1%
Agriculture	80%	20%
Industry	10–15%	80–85%
Industrial sewerage	70–80%	20–30%
Hydropower		100%

Source: Author's estimate

small isolated rural premises and dwellings that traditionally rely on local individual or community systems. Sewage collection is converging towards the standards set by the EU Urban Wastewater Directive, with still some failure especially concerning connections in rural areas and sewage treatment installations. After the reform initiated by Law no. 36/1994, PWS "integrates" water supply, sewage collection and sewage treatment under the joint responsibility of local authorities to be organised by inter-Municipal entities, named ATOs (which stands for "optimal-size areas"). Governance rules vary among Regions. Originally, there were 91 ATOs, later reduced to 72, covering completely the national territory,[1] although some of them still exist only on paper, and not all of them have completed all steps.

Each EGA (*Ente di governo d'ambito*, the authority responsible for each ATO) delegates operation of water services to professional companies, whose ownership can be either public or private. The law prescribes a single undertaking serving each ATO; however, it also allowed the possibility of having more than one operator if this does not imply prejudice of efficiency and effectiveness. The exact number of operators is unknown, since many still operate on a provisional entrustment. In 2018–2019, ARERA counted 131 operators serving 48 million inhabitants (85% of population), while in the remaining part of the Country the service is still run directly by Municipalities. Although slowly, however, the process of concentration goes on, either through the progressive consolidation of management units or inter-company agreements.

The largest share of *irrigation supply* derives from collective institutions (Reclamation Boards). Their creation dates back to the nineteenth century or earlier. These are private associations of landowners having a public status. Participation is mandatory for all landowners that fall within the designated area. Although regulated by the law (now devoted to Regions), Reclamation Boards enjoy a substantial autonomy and operate on a basis of cost recovery, even though they are entitled to receive grants and subsidies in many different forms, especially for capital expenditure.

Individual direct abstractions at the farm level increasingly integrate and often entirely replace collective irrigation, due to a more flexible, reliable, and timely water supply. Although estimates are rather imprecise, this form concerns 10–20% of irrigation water, but a far higher share in water-stressed districts, such as coastal areas or the southern part of the Po river basin (Zucaro 2011). More in particular, direct abstractions from groundwater concern high value-added cultures, and therefore water demand is much more inelastic (Massarutto 2003).

As for Reclamation Boards, Zucaro (2011) estimates a figure around 600 entities; most of them are very small and operate in mountain areas. Overall, they serve an irrigated surface of around 2.2 M ha (they were 2.7 by the year 2000, according to Leone 2005). The largest ones are associated to the National Reclamation and Irrigation Association (ANBI), which counts 132 consortia and 9 "second level"

[1] The Autonomous Provinces of Trento and Bolzano, due to their special autonomy, have a different and specific organisation.

consortia, which provide bulk services to other consortia. ANBI members cover a surface of 15 M ha; they cover 96% of total irrigable land and 91% of total irrigated land. More than 75% if total irrigated land is located in the North of the Country.

Reclamation Boards also perform important tasks in the field of *land drainage* in rural areas and management of small watercourses. *Flood protection* and riverbed maintenance in all other cases is a direct task of Regions, which sometimes have created dedicated institutions such as the AIPO (Interregional Agency for the River Po) in the Po river basin. An innovative trend about Reclamation Boards concerns the attribution of competences in the field of water resources management, environmental protection, and rainwater management, which provides the scope for public financial contributions. For example, Tuscany has designated the 100% of the Regional territory as a "reclamation area": this means that all landowners, including urban ones, are obliged to participate to the consortium and pay the related fee; Reclamation Boards perform a number of functions ranging from rainwater management, drainage, land reclamation, river ecosystem and landscape conservation etc.

Rainwater management is officially a task of Municipalities. Since 2/3 of sewage collection networks are mixed (rainwater plus wastewater), operation is very often delegated to PWS operators; in some Regions, these are also allowed to recover the cost directly through the PWS bill. On top of this, Reclamation Boards may provide "bulk drainage" services, since their networks may receive the outflow of urban rainwater systems and/or of sewage treatment plants; PWS are usually required to pay a contribution which ends in the water tariff.

Finally, for *industrial uses* self-supply is the general rule, especially when water is an important input in the production process (e.g., pulp, food, or textile industry). In some cases, special-purpose industrial aqueducts are in place. These may have installed innovative solutions tailored for specific industrial processes, including wastewater recycling. Typically, they are strategically located in areas that are designated for industrial settlements and are owned and operated by syndicates participated by client firms and a mix of local bodies (local authorities, chambers of commerce, special-purpose financial institutions). Other industries generally rely on the main public water supply system. Approximately 15% of water supplied by public aqueducts is destined to non-household uses.

Industrial sewerage is sometimes operated directly by individual companies, especially for large premises, but more often it is managed by dedicated collective establishments, particularly when industrial discharges require specific ad-hoc treatment. These systems can later discharge into public sanitation systems or directly into watercourses, depending on local situation and convenience. Facilities created to serve industrial premises, nonetheless, can share their treatment capacity with PWS, especially when these facilities are oversized and/or local industrial development has not managed to keep the path foreseen; often the management of these facilities has merged the PWS, in order to improve their financial viability, but the opposite may also happen, that is, industrial syndicates providing a "bulk supply service" to PWS operators.

In the lack of a systematic survey at the national level, it is not possible to provide reliable figures about the number and the economic dimension of the sector.

17.2.3 Regulatory Functions

The regulatory framework involves many government layers, whose interplay often lacks a precise allocation of tasks, thence causing overlap of competences and lack of jurisdiction (OECD 2013). Water resource regulation is framed by the EU and national legislation and implemented at the basin level through the "river district plan", elaborated by river district authorities (RDA). These are inter-governmental bodies whose ruling boards are expressed jointly by the central Government and concerned Regions.

The district plan identifies the actions needed to guarantee the desired ecological quality targets. Following the plan, Regions provide administrative tasks, such as water use licensing and pollution control.

Economic regulation of water services depends on the concerned sector. As for all public services ("services of general economic interest" in the EU jargon), their organisation should follow general framework rules. National legislation has tried to introduce market-based orientation for PWS (such as compulsory competitive tendering), but this approach was finally rejected by a popular referendum in 2011. At present, competent authorities (in the field of water these are normally local authorities) can choose among a range of solution that include own enterprises ("in-house" delegation) and many types of public-private partnership, including full delegation.

Figure 17.1 illustrates the governance scheme that concerns PWS. Services are delegated to professional companies – either public, private, or mixed – based on a contract, which usually entails a concession scheme (i.e., operators are responsible for investments at own risk). However, contracts are not sovereign for any detail. Price regulation and other aspects (such as definition of minimum standards) are ultimately the responsibility of an independent national authority (ARERA), which is also responsible for electricity, gas and solid waste.

For other segments of water use, the State is only responsible for frame legislation and provision of additional funds. All regulatory responsibilities are devoted to Regions and coordinated through River District Authorities. This applies for example to irrigation and drainage, since the framework governance of Reclamation Boards lies under Regional jurisdiction.

The complex structure of the water management system outlined above reflects an analogously complex structure of financial flows. Figure 17.2 provides a simplified diagram of financial transactions between different levels.

Each final user sustains a cost, which includes tariffs and charges paid to access water services and the costs sustained directly (e.g., for groundwater pumping). The positive difference between these costs and the value extracted from water (e.g., electricity or agricultural products sold to the market; direct utility obtained from

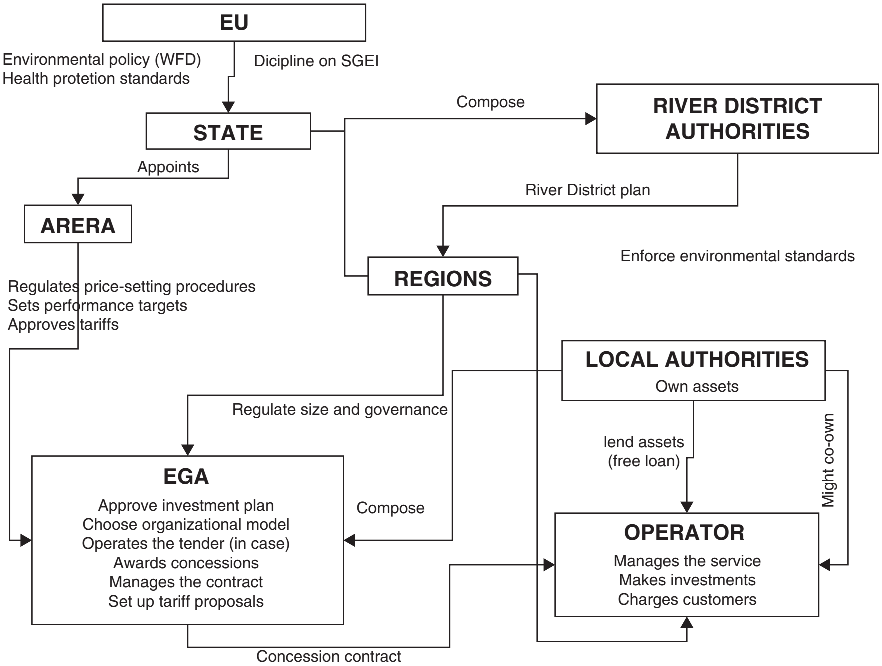

Fig. 17.1 Structure of the governance and regulatory system of PWS
Source: Author's elaboration

final consumption) represents in economic terms a rent, namely the additional price users would be willing to pay to continue using water.

Similarly, retail operators sustain some costs directly (labour, capital, goods and services acquired on the market) and pay for water services they receive from bulk suppliers or other retail operators. The same happens to bulk operators. Both retail and bulk operators must recover their costs out of the revenues received from their clients, eventually complemented by state transfers.

The subject that extracts water from the natural environment (either the bulk supplier, the retailer or the final user directly) is required to pay a charge to the resource owner (the State).

Finally, the State receives financial flows from taxation, but also finances the water sector through direct and indirect subsidies.

It is difficult thence to trace a proper and comprehensive balance of financial flows that intervene in such a complex system. Resources from the public budget originate mostly from Regions, but there are still important funding programs that are released by the State. For example, the extraordinary plan released 2019 has allocated 80 M€ to projects identified as "national priorities" by ARERA.

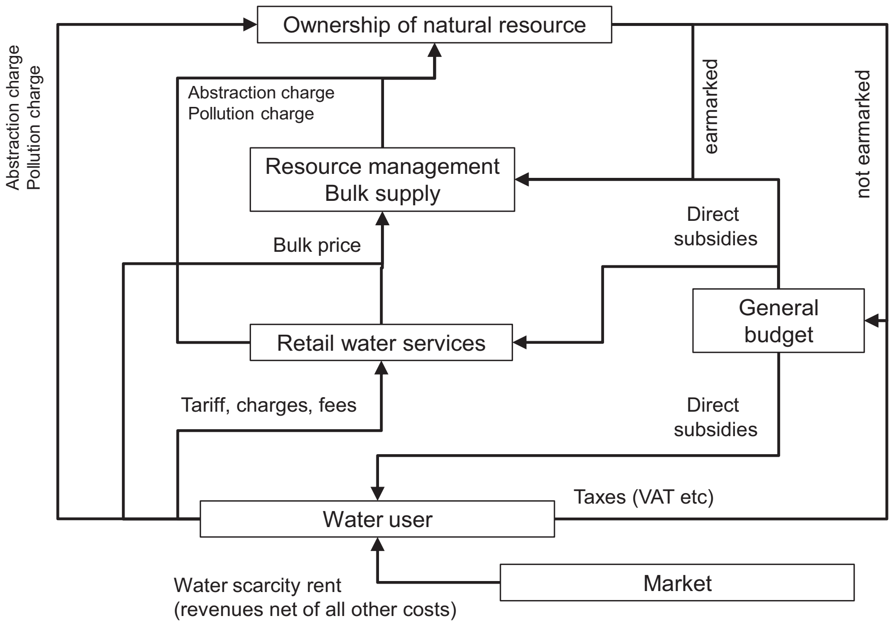

Fig. 17.2 The structure of financial flows characterising the Italian water management system
Source: Author's elaboration

Public funds still dominate the field of flood protection and riverbed maintenance. As said above, these functions are often performed by entities that are responsible for sectoral water uses – e.g., Reclamation Boards, which are thence entitled to receiving financial contributions. In principle, they operate on a cost-recovery level for the services they supply to associates, but this principle is fully applied for operational expenses only (Table 17.2).

17.3 Economic Instruments and Water Resources Management

As said in the previous section, abstraction licenses imply the payment of an abstraction charge. Rates are differentiated by sector. Other charges having similar nature indirectly affect the water domain, such as those regarding the extraction of inert materials from riverbeds, land development in river domains, chemicals used in agriculture (Zatti 2017).

In the case of hydropower, charging principles reveal the clear intention of capturing at least a part of the economic rent. Rates are a function of nominal electricity generation capacity (a standard measure of the potential production), regardless of

Table 17.2 Water management undertakings, financial structure and patterns of price regulation

	Cost-recovery	Pricing instrument	Role of public finance	Regulation	Pricing philosophy
Resource management	No	Abstraction charge	Total	Political decision	Administrative cost recovery Rent sharing (hydropower)
Bulk supply	Legally binding Public contributions admitted	Tariff	Residual (investments only)	Independent authority	
PWS	Legally binding	Tariff	Residual (investments only)	Independent authority	Recovery of efficient cost
Urban rainwater	Not binding	Tariff/local public finance	Total (PWS tariffs admitted)	Public accounting rules Independent authority (if included in PWS	Officially funded by public budget; recovery from PWS bills admitted
Reclamation boards (irrigation)	Legally binding for opex	Membership fee Communal charges	Residual (opex) Substantial (investments)	Public accounting rules Supervised by regions	Cash balance Benefit-based
Reclamation boards (land drainage)	Legally binding for opex	Membership fee Communal charges	Residual (opex) Substantial (investment)	Public accounting rules Supervised by regions	Benefit

Source: Author's elaboration

other characteristics of the site (quantity of water used, height of the dam, environmental impact, etc.). Hydropower producers have also to pay further fees to compensate local communities, which again depend on nominal capacity. These fees are set by a national law and have reached altogether around 30–40 €/kW, depending on facilities' size.

For all other uses, the reference unit of abstraction charges is the "module", corresponding in general to a volume of 100 l/s. For irrigation, the charge is reduced when flows in excess are returned.

Table 17.3 summarises abstraction charges applied throughout the Country – keeping in mind that each Region can now set charge levels and application rules.

Many Regions have recently changed charging rules and rates or have announced the intention of doing so. This is particularly the case of the hydropower sector, taking advantage of the fact that many concessions awarded in the first half of the twentieth century have recently expired. Decree-Law no. 135/2018 assigns to

Table 17.3 Abstraction charges in Italy (mod = 100 l/s)

	Hydropower						Irrigation		
	Resource ownership	Compensation fees to LA	PWS	Hygienic	Fish farming	Industrial	No restitution	With restitution	Unmetered
	€/kW		€/mod	€/mod	€/mod	€/mod	€/mod	€/mod	€/ha
Average	13.4	30–40	1664	2824	264.2	9646	35	8	0.33
Median	14.5	30–40	2110	603		13,474	46	–	0.40
Max	35.1	30–40	4008	98,816		41,361	190	50	2.64

Source: Author's elaboration on a direct inquiry

Regions the full ownership of hydropower facilities after concessions expire; Regions will later release new concessions via tendering process or to own companies.

Translated in the correspondent amount per cubic meter, figures in Table 17.3 mean that the abstraction charge amounts to an overall negligible value, a fraction of a €c/m^3. On a national basis, our estimate of annual revenues provides a meaningful figure only for hydropower (in the range of 200–300 M€/year, which also includes local community compensations). Massarutto and Pontoni (2015) estimate that the share of the hydropower rent accruing to Regions and local communities lies in the range of 13–21%.

Industrial charges generate another 40–50 M€. Revenues from other uses are negligible: both irrigation and public water supply generate less than 1 M€, still lower figures arise from other sectors of water use.

Abstraction of mineral water for bottling and thermal establishments are widespread diffused, given the abundance of natural sources. Abstraction charges in this case follow a binomial structure (partly depending on catchment surface and partly on volumes abstracted). The average charge is around 2 €/m^3, for an overall revenue estimated in around 18 M€, which corresponds to 13% if the industry net profit (Massarutto 2018).

Overall, abstraction charges do not represent at present neither a meaningful revenue source nor a serious incentive to water conservation. They are calculated as a fee aimed for recovering administrative costs for issuing licenses or – notably in the case of hydropower – to share the scarcity rent generated by the resource. No charge at all is levied for discharges into watercourses.

Italy has never adopted a coherent set of environmental economic instruments in the water sector, neither in the form of taxes nor of other market-based instruments such as tradeable water rights. Proposals towards a comprehensive reform have arisen in many occasions, including recent reports of the OECD (2013) and the EEA (Andersen et al. 2011). The consideration of environmental and resource costs of water use, which is foreseen by Article 9 of the EU Water Framework Directive but has never been implemented until now, offers a unique opportunity in this direction.

The Ministry of the Environment has issued in 2015 a guidelines document, that provides a definition of environment and resource costs (ERC), and methods to calculate it. This document aims at providing river district Authorities a common framework for drawing up the "river basin management plan", according to the WFD.

The river basin plan also identifies actions adopted by users to reduce environmental impact and pressures on the resource. For example, in the case of PWS, costs related to potabilisation of water and protection of water catchment are accounted as resource costs, while sewage treatment costs are an example of environmental costs. These costs are accounted separately and provide evidence of the degree of internalisation of ERC. In 2019, 6% of total PWS costs were reported as ERC. The tariff method for the third regulatory period (2020–2023) has included capital costs in the ERC, whereas previously only operational costs were considered.

However, the definition of ERC has not yet been translated into a coherent proposal of environmental taxation. River basin management plans account for all water uses, calculate ERC associated to each use and possibly use this information with the aim of drawing up policies aimed at reducing them, for instance by eliminating environmentally harmful subsidies, promoting water conservation and so on. Surprisingly, the debate around this issue has been very weak, and mostly confined in the academy.

In the case of PWS, for example, Massarutto (2012) calculates that a tax in the order of 0.10 €/m^3 could generate an annual cash flow of 600 M€, corresponding approximately to ¼ of the annual investments planned at present. This tax could apply to abstractions from the natural resource and be passed-through only up to a standard level of allowed leakage, to provide an incentive to PWS operators. Moreover, its rate structure could consider effluent quality and environmental costs of discharge, in order to penalise those with the lowest pollution abatement records.

In a recent contingent valuation study REF Ricerche (2020) survey the WTP of interviewees for "reducing negative externalities arising from their own water use", which is estimated in a mean 44 €/year per inhabitant. Building on this empirical result, they estimate the potential of internalisation of ERC in the water bill to an equivalent 2.2 B€/year.

One major obstacle concerns the identification of the government layer that should benefit from such a tax. Following the international experience, a potential candidate could be the River basin authority, possibly with a mandate of spending the money collected again in the water sector to alleviate financial needs of water operators. A promising option could be the adoption of a scheme that is similar to the French *Agences de l'Eau*, that is, concerning a system of water taxes aimed at fuelling the various public spending programs that concern water, e.g. in order to co-finance investments and avoid the need to rely entirely on market-based repayable finance.

Another option is to collect the ERC directly in the water bill and destine it to interventions in the same territory – as with the "FoNI" component we shall talk about later. This would reduce the redistributive potential and the possibility of adopting a "carrot-and-stick" approach rewarding "virtuous" operators and penalising those who perform worse.

17.4 The Evolution of PWS Price Regulation: Recent Developments

17.4.1 From the MTN to the MTI

Initiated in 1994 by Law no. 36/1994, the process of driving Italian water prices to full-cost reflectivity has finally nearly reached its target. Water bills not only allow the recovery of operational costs, but also seem to provide adequate resources to finance investment plans guaranteeing long-run financial equilibrium of water companies. This does not mean that the cost is 100% recovered in the water bill, since public finance in different forms still contributes 20% of total investment costs.

A significant acceleration has come from the attribution of regulatory competences to an independent authority (ARERA), occurred in 2011. Massarutto and Ermano (2013) have discussed the critical issues that characterised price regulation in the previous period and contributed to slowing the implementation of the 1994 reform.

Since its start, the new regulation has completed two quadrennial regulatory periods, and is in the process of starting the third one. Each regulatory period has an important intermediary phase, where significant changes have been introduced.

The regulatory model has been initiated in the transitional phase (2012–2013) and gradually implemented in the following periods. It is designed as a "building block" scheme; each tariff component follows specific rules. Table 17.4 summarises the most important innovations introduced in each step.

In the first 2 years (MTT), the main target was to set up the baseline and prepare a smooth transition to the new system. For this reason, the regulator identified a large number (21) of regulatory schemes, where each operator was positioned according to a combination of indicators signalling the differences between new and old regulation.

The allowed total revenue consists of operational costs (opex), capital cost (capex) and a non-revenue component aimed at anticipating financial resources for investments, in case available free cash flows are too meagre (this is typically the case of in-house public enterprises, whose own capital is very tiny).

Opex consists of two blocks: "endogenous" (OPEXend) and "refundable" (OPEXal). The latter consist of the cost components that are assumed to be outside the control of the operator, depending on exogenous factors: electricity, bulk supply, concession fees, local taxes, and charges. This cost component is fully reimbursed, with a mechanism that acknowledge in any year a provisional allowance based on the balance value of the year (a–2); eventual gaps will be compensated in year (a + 2).

All other operational costs are included in OPEXend. MTT defines the starting level of this component as a weighted average of the effective balance sheet of the reference year, 2011 (COeff), and the amount that was recognised in the former regulation (OP). The target is a landing point equal to the lower of both, to be reached in 4 years.

The approach to capital cost regulation marks a substantial innovation with respect to the past. The RAB is now based on *existing physical assets* calculated on an *ex-post* basis, whatever their ownership and whatever the source of funding. For this purpose, existing assets are stratified according to the year of realisation and values are systematically updated with inflation so as to correspond to their net reconstruction value; on the other hand, depreciation schedules are now calculated on the basis of true expected economic life. New investments enter the RAB with a two-years' time lag (i.e., an investment realised in year t will be considered in the regulatory cost starting from year t + 2).

Table 17.4 The evolution of rules for identifying cost components from 2012 to 2023

		Meaning	MTT (2012–2013)	MTI-1 (2014–2015)	MTI-2 (2016–2017)	MTI-2 (2018–2019)	MTI-3 (2020–2023)
Regulatory schemes	n.	Number of regulatory schemes	21	4	6	6	6
	Criteria		Actual costs vs costs allowed by previous regulation Time elapsed since the last previous tariff update Investment requirements	Changed service perimeter Investment requirements	Position vs. benchmark Investment requirements Changed service perimeter	Position vs. benchmark Investment requirements Changed service perimeter	Position vs. benchmark Investment requirements Changed service perimeter
	ΔMax	Max annual increase		6.50–9% dep. on scheme	4–9% dep. on scheme	4–9% dep. on scheme	3.7–8.45% dep. on scheme
OPEXend		Endogenous costs (to which a revenue-cap model is applied)	Definition of COeff based on allowed costs in reference year 2011 OPEXend = f (COeff; OP)	OPEXend (a) = OPEXend (a–1) * (1 + RPI-X) X = 0	OPEXend (a) = OPEXend (a–1) * (1 + RPI-X) X = 0	OPEXend (a) = OPEXend (a–1) * (1 + RPI-X) X = 0	OPEXend (a) = OPEXend (a–1) * (1 + RPI-X) X calculated as a function of Δ from standard cost function

(continued)

Table 17.4 (continued)

		Meaning	MTT (2012–2013)	MTI-1 (2014–2015)	MTI-2 (2016–2017)	MTI-2 (2018–2019)	MTI-3 (2020–2023)
OPEXal	COee	Electricity cost	Actual cost	Actual kWh consumed * standard price of electricity	Actual kWh consumed * standard price of electricity	Actual kWh consumed * standard price of electricity	Actual kWh consumed * standard price of electricity + reward for kWh saving
	Cows	Bulk water service cost	Actual cost	Actual cost	Bulk water: cost (a–2) Other: actual cost	Actual cost	Actual cost
	COfanghi	Cost of sewage sludge disposal	Included in OPEXend	Included in OPEXend	Included in OPEXend	Included in OPEXend	Actual cost if actual cost 2017 > 2% higher than allowed cost
	MT-AC	Lease fees paid to municipalities and other asset owners	Actual cost	Actual cost	Actual cost	Actual cost	Actual cost
	COres	Local taxes and charges Other unavoidable costs Provisions for delinquent payment	Actual cost Provision for delinquent payment not admitted	Actual cost Standardised provision for delinquent payment	Actual cost Standardised provision for delinquent payment	Actual cost Standardised provision for delinquent payment	Actual cost Standardised provision for delinquent payment

OPEXtel	OPnew	Cost-passthrough elements Cost for new services not offered in 2011: territorial enlargement, new services, quality improvements	Not foreseen	Allowed following an inquiry	Allowed following an inquiry	Allowed following an inquiry	Allowed following an inquiry
	OPqc	Cost-passthrough elements Cost for reaching minimum quality standard (commercial quality)	Not foreseen	Not foreseen	Allowed following an inquiry	Allowed following an inquiry	Min (ex-post actual cost; previous estimate)
	OPqt	Cost-passthrough elements Cost for reaching minimum quality standard (technical quality)	Not foreseen	Not foreseen	Not foreseen	Allowed following an inquiry	Min (ex-post actual cost; previous estimate)
	OPmis	Cost-passthrough elements Cost for reaching minimum quality standard (metering)	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Allowed following an inquiry
	OPsocial	Cost-passthrough elements Targeted tariff rebates for low-income	Not foreseen	Not foreseen	Input by EGA	Input by EGA	Input by EGA

(continued)

Table 17.4 (continued)

		Meaning	MTT (2012–2013)	MTI-1 (2014–2015)	MTI-2 (2016–2017)	MTI-2 (2018–2019)	MTI-3 (2020–2023)
ERC	ERCend	Environmental and resource costs (same perimeter as OPEXend)	Not foreseen	Not foreseen	Deducted from OPEXend based on actual costs in year (a–2)	Deducted from OPEXend based on actual costs in year (a–2)	Deducted from OPEXend based on actual costs in year (a–2)
	ERCal	Environmental and resource costs (same perimeter as OPEXal)	Not foreseen	Not foreseen	Deducted from OPEXend based on actual costs in year (a–2)	Deducted from OPEXend based on actual costs in year (a–2)	Deducted from OPEXend based on actual costs in year (a–2)
	ERCcapex	Environmental and resource costs (capital cost)	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Investments belonging to ERC categories separately listes
CAPEX	RAB	Regulatory asset base	Based on all investments made still in depreciation Reconstruction value = historical cost * inflation	Same	Same	Same	Same
	CIN	Net invested capital	Includes net RAB + standard operating capital – provisions made	Same	Same	Same	Same
	AMM	Depreciation of operator's assets	Regulatory economic life	Regulatory economic life Financial depreciation allowed in scheme III–IV	Regulatory economic life Financial depreciation allowed in scheme IV–V–VI	Regulatory economic life Financial depreciation allowed in scheme IV–V–VI	Regulatory economic life More detailed list of assets Financial depreciation allowed in scheme IV–V–VI

	OF	Standard cost of capital	Based on market values	Based on market values	Based on market values	Based on market values	Based on market values
	Ofisc	Standard provision for taxes	Based on tax legislation	Based on tax legislation	Based on tax legislation	Based on tax legislation	Based on tax legislation
	ΔCUITcapex	Compensation for capitalised concession	Limited to the capital cost of municipal assets	Limited to the capital cost of municipal assets	Limited to the capital cost of municipal assets	Limited to the capital cost of municipal assets	Limited to the capital cost of municipal assets
FoNI	ΔCUITfoni	Capital cost of assets owned by municipalities	AMM + OF+OFisc – (MT + AC) - ΔCUITcapex	AMM + OF+OFisc – (MT + AC) – ΔCUITcapex	AMM + OF+OFisc – (MT + AC) – ΔCUITcapex	AMM + OF+OFisc – (MT + AC) - ΔCUITcapex	AMM + OF+OFisc – (MT + AC) - ΔCUITcapex
	AMMfoni	Depreciation of assets funded with public grants and non-repayable contributions	Same as for CIN	Same as for CIN	Same as for CIN	Same as for CIN	Same as for CIN
	FNIfoni	Advance for new investment	Allowed in some schemes = ψ*(planned investment – capex) with $0.4 < \psi < 0.8$	Allowed in scheme III–IV = ψ*(planned investment – capex) with $0.4 < \psi < 0.8$	Allowed in scheme IV–V–VI = ψ*(planned investment – capex) with $0.4 < \psi < 0.8$	Allowed in scheme IV–V–VI = ψ*(planned investment – capex) with $0.4 < \psi < 0.8$	Allowed in scheme IV–V–VI = ψ*(planned investment – capex) with $0.4 < \psi < 0.8$
	Allowed destination		New investments Targeted tariff rebates	New investments Targeted tariff rebates	New investments	New investments	New investments
RC		Adjustments (allowed revenues/costs – actual revenues/costs)	Total revenue, OPEXal Unforeseen extraordinary expenses	Total revenue, OPEXal Unforeseen extraordinary expenses	Total revenue, OPEXal Unforeseen extraordinary expenses	Total revenue, OPEXal Unforeseen extraordinary expenses	Total revenue, OPEXal, OPqc, OPqt
INCENTIVE	Awards	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Foreseen
	Penalties	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Not foreseen	Foreseen

Source: Author's elaboration on ARERA deliberations nos. 285/2012; 643/2013; 664/2015; 580/2019

Therefore, depreciation costs are considered for all assets, including those that have not been financed by the operator; however, cash flows arising from public funds or from assets owned by Municipalities will be set aside in a fund that can be used for new investments or social purposes (the so-called "fund for new investments", FoNI – see below). Investments to be remunerated include working capital, calculated as a standardised function of revenues and operational costs, net of provisions set aside in previous years and any kind of non-repayable grants.

The regulatory rate of return is based on a calculation following the capital asset pricing model (CAPM), namely considering the risk-free rate plus a risk premium which is calculated from market data. An extra bonus of 1% is added, as a lump-sum compensation for the time lag of 2 years. A standard fiscal component is also added.

Finally, FoNI – perhaps the most innovative component – is intended as a particular kind of non-repayable contribution, and consists of an anticipation for new investments that final customers pay, conceptually similar to the connection fees that are paid as an installation cost when the contract is started. FoNI arises from three possible sources: depreciation of assets paid by public contribution (as we have just seen), capital costs (depreciation plus capital remuneration) of assets under Municipal ownership and a third component which depends on the relative size of expected investments and available free cash-flows.

The total cost calculated in this way represents a guaranteed total revenue for the operator. For this purpose, assuming constant volume of service, the rate structure of the previous year is multiplied per an updating factor, ϑ, corresponding the ratio between the total allowed cost for the new year and tariff revenues from previous year. Eventual gaps between total allowed revenues and actual revenues will be recovered in year (a + 2).

While the transitory scheme entered in operation, ARERA started collecting systematically unbundled accounting data and introduced more detailed monitoring of quality standards, to be used in the next steps. After 2 years, the "definitive" method was approved. This introduced a few marginal innovations with respect to MTT.

Regulatory schemes were reduced to four, depending on (i) the positioning of actual costs with respect to the average national cost and (ii) the size of investment needs relative to available free cash-flows. Positioning in the grid of regulatory schemes implies a different maximum tariff increase. The definitive baseline for OPEXend was finally set at the intermediate point between OP and COeff, abandoning the original design of piloting it towards the lower of both. Regulatory schemes were reduced. Regionally standardised provisions for delinquent payment were admitted as exogenous costs.

With MTI-2, further innovations were introduced. In the first place, ARERA set the minimum quality standards, separately for commercial and technical quality. Two specific cost components were introduced to pass-through these expected costs; later, this forecast should be verified, and allowed cost will be reduced to the minimum between ex-ante estimate and actual costs. Each operator had to forecast the additional cost needed to meet the standard; investment plans needed to be targeted to quality indicators and specifically referring to the specific critical issues – prior to 2018 investment plans used to be simple lists of programmed works, with no reference to targets. This fundamental innovation marks a decisive step towards a performance-oriented tariff system.

This new philosophy starts being implemented with MTI-3 (2020–2023). Its main novelties are the introduction of a system of awards and penalties related to the achievement of quality improvement targets. Moreover, for the first time ARERA introduces a standard cost function for benchmarking. The formula, which results from an econometric study, is the following:

$$
\begin{aligned}
\ln\left(CO_{TOT}^{S}\right) = {} & 3.2766 + 1.0315 * \ln\left(1 + PE\right) + 0.2817 * \ln\left(1 + PL\right) \\
& + 0.7841 * \ln\left(1 + WS\right) + 0.2263 * \ln\left(V\right) + 0.1455 * \ln\left(L\right) \\
& + 0.4685 * \ln\left(Pa\right) + 0.1418 * \ln\left(AE\right) - 0.0753 * PREQ1_{4} \\
& - 0.0611 * PREQ3 + 0.0281 * \ln\left(M1a\right)
\end{aligned}
$$

where *PE* = cost of electricity; *PL* = ratio of personnel cost to resident population; *WS* = bulk supply costs; *V* = volume of water supplied; *L* = total length of water mains; *Pa* = resident population + 0.25 of commuting population; *AE* = equivalent inhabitants served by sewage treatment; PREQ1, PREQ3 and M1a are indicators of technical quality.

Depending on the distance of actual 2016 costs to the formula and to the sign and the size of the gap between actual costs and allowed OPEXend, the operator will be assigned an efficiency improvement target ranging from 0 to 50% of the difference between actual costs and allowed costs. In practice, if the operator has been more efficient than OPEXend, a max 50% of this efficiency improvement will be shared with customers; if actual costs are higher, OPEXend will be maintained.

17.4.2 Tariff Structure

In 2018, ARERA introduced a widespread reform, with the aim of reducing the range of variability, introducing some rationalisation criteria and ultimately for equity reasons (TICSI). While the structure is still based on an increasing-block tariff (IBT), ARERA set more uniform rules for determining the width of blocks and to calculate rates for each block.

The tariff structure for PWS remained substantially the same since it was first regulated in 1974. The water supply charge includes a fixed charge a subsidised block (for residential clients only), an average block ("*tariffa base*") and up to three upper blocks with an increasing unit charge. Dimension of blocks can vary, while different schedules apply to different use categories (e.g., domestic, second houses, commercial, industry, etc.). Essential water endowments and poor households are entitled to rebates and special subsidised charges. Public uses (e.g., fire protection, hospitals, street cleaning, public buildings) have dedicated (and subsidised) charges.

Although metering is the general norm, there are still cases of (individual and collective) unmetered customers, whose tariffs are calculated on a flat basis, possibly considering some indicator of water quantity, such as the diameter of the pipe.

It is difficult to provide a picture that summarises the situation in the whole Country prior to the 2018 reform, since these general rules apply in very different ways across Italy. The number of different tariff schemes can be very large (up to 10–20 different types, according to the category of use). The size of blocks also varies significantly. However, charges for sewage collection and treatment follow a much simpler schedule since they apply a uniform volumetric charge to all uses.

The 2018 reform introduces some important novelties, with the aim of reducing the degree of variability and, at the same time, adopting a structure that is more coherently oriented at social and environmental sustainability, as well as cost responsiveness.

For residential uses, an important innovation consists in the consideration of the number of family components either for determining the fixed charge or the size of blocks. The subsidised block must correspond to an equivalent of at least 50 l/day per person. In this block, the rate must be in the range of 20–50% of the base rate. Operators are free to decide upon the other blocks.

Furthermore, the TICSI provides for domestic users below the poverty threshold a “water bonus” corresponding to a free provision of the subsidised block. This rebate is paid for by a dedicated national fund to which all water undertakings must contribute. Local regulators can dispose further targeted rebates, which will be financed by a dedicated component of the tariff paid by its customers (OPsocial).

Another important innovation introduced by TICSI concerns the discipline of actions to combat delinquent payment – a social plague, especially in the South where unpaid ratios reach an average 13.5% and peaks of 25–30% in some areas. Disconnections of residential uses are forbidden only in case the customer can demonstrate a financially distressed situation, and in this case supply restrictions are applied (reduced pressure). Increased frequency of billing for large consumers and the possibility of instalment plans, together with rebates and redesign of schedules, are aimed at further combating and possibly eradicating “water poverty”. The number of families that encountered troubles in paying utility bills reaches 4% of the total, aligned with Western European standards; however, once more the national average is misleading, being generated by a pretty low value in the North (2.2%) and a high value in the South and the Islands (7–7.5%); This aggregate indicator, however, considers altogether all basic utilities. On average, Italian families spend 252 €/month on essentials, and only 5.8% of this on water (Fig. 17.3).

Utilitatis (2020) shows how the average unit cost has varied among families according to the number of components (Fig. 17.4). TICSI has seemingly advantaged large families and penalised singles, even though the degree of redistribution does not seem dramatic until now. A standard family composed of three members and consuming 150 m^3 saves annually 2 € on average, with an average expenditure of 322 €. However, the adoption of TICSI is still lagging behind, since many operators have encountered implementation difficulties.

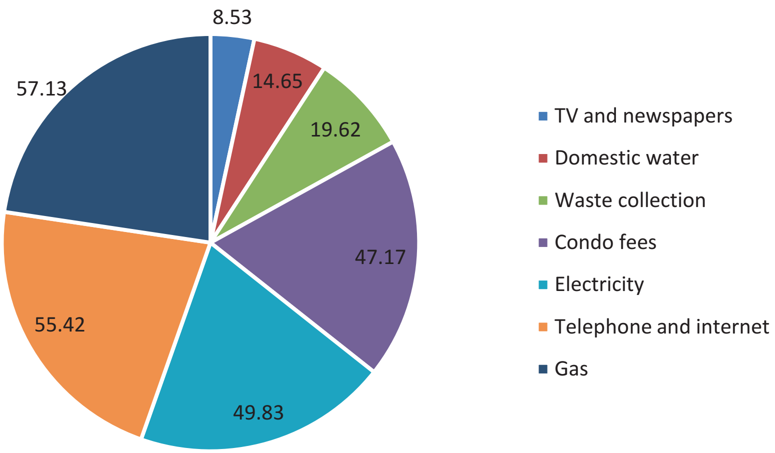

Fig. 17.3 Average monthly expenditure for living essentials (€/household)
Source: Author's elaboration on ISTAT

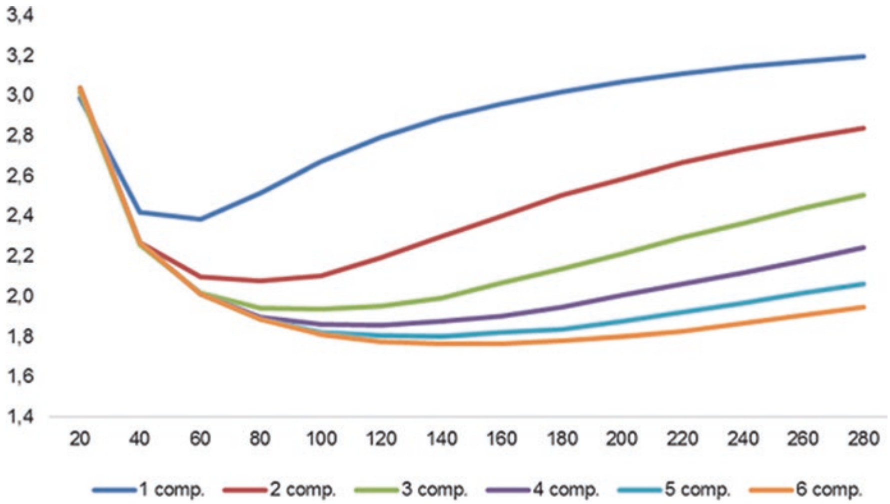

Fig. 17.4 Average unit cost of water according to consumption and number of family members
Source: Utilitatis (2020)

TICSI finally defines the maximum number of fees for non-domestic uses (industrial, agricultural, commercial, public, other) and specifies a number of "merit uses" that cannot be disconnected (e.g., hospitals, schools, prisons). All uses different from the domestic one can adopt proportional rates instead of IBT. In parallel, ARERA has also reformed the rate structure for industrial sewerage. The adopted scheme is based on a formula that includes a fixed charge (TF), a capacity payment component (TC) and a variable component (TV) depending on quantity and quality of effluents.

It is also remarkable to notice that the expenditure for bottled water is almost as big as that for PWS (12 €/month) (Massarutto 2018).

17.4.3 Tariff Dynamics and Affordability

Since the approval of the 1994 reform, tariff dynamics has been rather impressive, moving from 0.97 (the average tariff in year zero) to 1.37 €/m^3 in 2010 for water supply and sanitation (ANEA-Utilitatis 2011). The growth of expenditure is much larger, since 0.97 €/m^3 already includes some of the increases introduced by interim tariff regulations during the transition phase. Actualised estimates of the aggregate industry annual revenues in the pre-reform era were 3.37 billion € (Malaman and Cima 1999); the same aggregate in 2010 came to 7.61 billion € (ANEA-Utilitatis 2011). Hence, a first apparent outcome of the reform is that tariff revenues more than doubled, with a net increase of 4.14 billion €/year.

Since 2011, the price increase trend has continued. Since ARERA has not completed the procedure of approval of all tariff proposals submitted by AATOs, only partial results are available. Setting 2011 tariffs as the starting level ($t_{2011} = 1$), the average index grew to 1.024 in 2012 and 1.058 in 2013. Utilitatis (2020) estimates a further 15% increase between 2015 and 2019. Future dynamics is expected to be rather impressive as well. ATO plans foresaw an overall average tariff of 1.46 in equilibrium (after the full deployment of investment plans). Yet these were only the initial forecasts: after the first interim reviews, planned tariffs were revised and further increased to finance investments and guarantee balance-sheet equilibrium.

Average data, however, mask a very uneven situation. ARERA (2020) shows that for 17% of population (mostly located in the North-East) tariffs have decreased in 2018–2019, while a 42% of population show an increase. Although, again, no systematic data are available on a national basis, evidence from selected case studies shows that the MTI implies a much higher price increase – for the same planned investment – than the MTN, especially where the previous regulation had not opted for financial amortisation (Massarutto 2012) (Fig. 17.5).

Table 17.5 illustrates the structure of the typical schedule for a water bill. Despite the harmonisation efforts, variability ranges seem to be still quite large.

Figure 17.5 illustrates the annual expenditure of a typical representative family, also providing a range of minimum and maximum values. The national average is 99 € and 242 € respectively, with a minimum in the North-West and a maximum in the Centre. The variability is arguably influenced by technical features, such as the lower energy requirements in the North thanks to gravity pumping, and the higher/lower density of customers along the network.

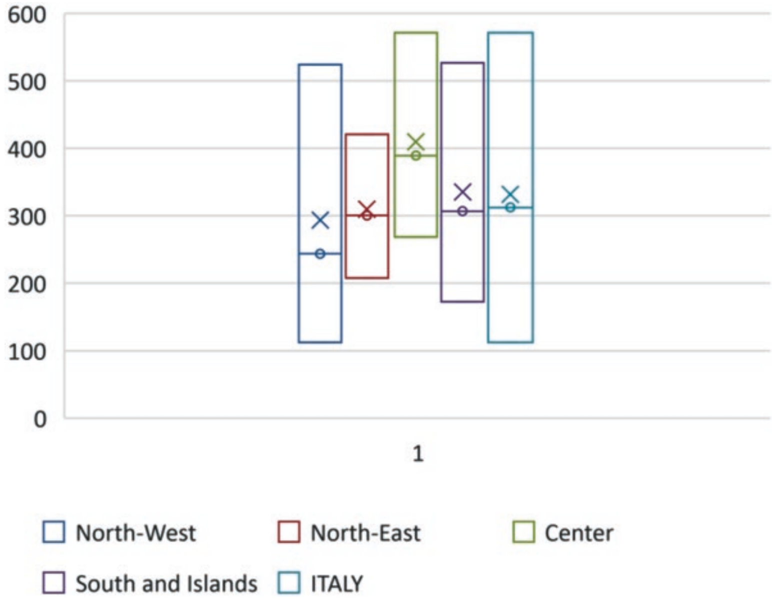

Fig. 17.5 Mean annual expenditure for a standard household of three components, consuming 150 m³/year in 2019
Source: Author's elaboration on ARERA (2020)

Table 17.5 Range of unit charge for a sample of water operators

			Min	Max	Weighted Average
			€/person³	€/person	€/person
Fixed charge					
Water supply			1.9	64.7	18.9
Sewage collection				17.1	4.5
Sewage treatment				25.5	8.6
Variable charge	m^3/person	m^3/person	€/m^3	€/m^3	€/m^3
Water supply					
Subsidised	0–111	79	0.113	1.324	0.545
Base	31–228	74.3	0.141	1.891	0.945
I block	81–486	84.3	0.29	4.67	1.639
II block	106–792	113.5	0.491	5.649	2.194
III block	131–		0.54	6.314	3.189
Sewage collection			0.094	0.859	0.253
Sewage treatment			0.29	1.077	0.602

Source: Author's elaboration on Utilitatis (2020)

Table 17.6 Indicators of affordability of water and sanitation services (IWS)

	% of IWS on average annual expenditure on total consumption	Incidence of IWS expenditure on the average income poverty line (%)
60 m³	0.47	1.39
150 m³	0.72	1.53

Source: Author's elaboration on Utilitatis (2014)

The 4.6% of population (1 ATO) spends in the range between 0 and 150 €/year. The most numerous classes lie in the median range, with nearly 30% of the population (12 ATOs) spending an average of 200–250 €/year. Further 22% of Italians (15 ATOs) spend no less than 300 €/year.

Finally, Table 17.6 illustrates the impact of water tariffs on families in terms of affordability. The first indicator (share of PWS expenditure on total family consumption) shows that IWS expenditure is still quite modest and far below the affordability thresholds that are commonly proposed in the international literature (3% on average). In turn, the second indicator shows some more worrying information concerning the impact on the poor. Families whose income is equal to the poverty line spend on average 1.39–1.53% of their income on IWS. This suggests probably the need to consider specific subsidies to poor families, which by no means should afford IWS alone, since the impact of price increases in other utilities (electricity, gas, transport) is even more relevant (Miniaci et al. 2008).

Despite tariff increases that took place in the last years, measures aimed at contrasting water poverty seem to have been effective.

17.4.4 Tariffs, Investments and Financial Sustainability

Water management is a capital-intensive industry, where the economic life of infrastructure and therefore the length of investment cycles is very long. Immobilisation of capital can last for 40–50 years or more. Therefore, financial sustainability of water companies is not simply a matter of "cost recovery", intended as a short-term equilibrium between revenues and financial costs; it rests instead on the existence of adequate and reliable free cash flows, depending very much on the financing model adopted.

Clearly, if finance comes from the public sector, financial equilibrium of water companies is easy to solve, since it will only concern day-by-day operation. In turn, it will condition the availability of resources for investments since they will depend on the overall macroeconomic stability. This is precisely the trap into which Italian water industry precipitated in the 1990s, where the distress of public finance made it simply unthinkable to obtain further resources from public debt, while investment requirements were compelling, either for refurbishing ageing networks or for expanding and modernising the system according to the requirements of EU environmental policies.

In many countries, water industry finance is mobilised by special-purpose financial intermediaries – the "*Waterschapbank*" in the Netherlands, the "State revolving funds" in the United States – or banks that are not sector-specific, but are specialised in lending to the public sector. This allows the water sector to benefit from soft loans and long repayment schedules; but again, must rely on credible commitments that the debt will be punctually repaid, with the explicit or implicit guarantee of the State. Absent the conditions that make similar financial institutions feasible, water operators must rely on financial markets, and thence must exhibit reliable and stable financial ratios to demonstrate creditworthiness.

Free cash flows are typically generated by depreciation, and thence the way capital assets are accounted for and depreciation calculated is fundamental. The Italian regulatory model has three interesting features with this regard. In the first place, depreciation and capital remuneration are based on reconstruction cost – historical values are systematically updated with inflation. This scheme is also adopted in other countries, for instance in Germany, and allows a dramatic improvement of cash flows, relative to traditional historical cost accounting. However, its benefits arise particularly when companies own historical assets created in the past with their own resources. This is typically not the case in Italy, where many water companies have been created from scratch, with very little initial capital, and most assets have been realised in the past using public funds that never entered in the water tariff.

A second important feature of the Italian model is the possibility of using financial amortisation – that is, adopt a depreciation schedule coherent with the duration of concessions and the time span of loans. Clearly, this implies that water prices must accelerate significantly, and remain high until the end of the concession.

The introduction of the "new investment fund" represents the third innovation, and possibly the most original one. As explained in Sect. 17.4.1, this is an additional cash flow, that is collected with the water bill but has a different nature; it can be assimilated to a special purpose tax that is tied to the same water management system. FoNI originates from the depreciation of past non-repayable grants and publicly owned assets, plus an additional anticipation that is proportional to the gap between normal free cash flows (depreciation of own assets of the water company) and forecasted investment need. FoNI must be spent within 2 years, otherwise the company will not be entitled to charging further of it; its revenues must be set aside as a capital reserve, cannot be distributed to shareholders and do not contribute to the value of assets that the company will receive after the concession expires from the new concessionaire.

Having access to the FoNI, water companies can finance new investments without recurring to debt. In turn, since FoNI flows are assimilated to non-repayable grants, the depreciation of investments acquired with this money will forever remain tied to investments, and no capital remuneration will be allowed on it. In other words, FoNI implies a trade-off between profitability and financial equilibrium: a company using FoNI instead of own resources will be less profitable and will have a lower net value of assets at the end of the concession; in turn, it will enjoy more stable balance between own resources and loans, and therefore sounder financial stability ratios. Even if tariffs must necessarily increase in the short-term, this effect is soon balanced by the fact that in the next years there is lower capital remuneration to account for, pushing prices to the opposite direction.

On a sample of firms, we have conducted an original study aimed at appreciating the effect of FoNI on financial equilibrium, debt levels and tariff dynamics. Everything else remaining equal, we have simulated to finance the investment plans with recourse to "normal" capital markets – bank loans lasting 30 years at an interest rate equal to the standard remuneration of capital applied by ARERA.

We have examined seven water companies of different size and operating in different conditions. In all cases, we have elaborated two scenarios, one in which FoNi has been applied at the ratio that was effectively chosen, and another one in which we assumed no FoNI was applied. Until now, our analysis has been constrained to the period from 2016 onwards, since the database lacks observations from the first 4 years, where FoNI has been extensively used. An extension of the study to overcome this gap is underway.

Despite this limitation, results are quite striking (Table 17.7). In the "no FoNI" scenario, financial indicators worsen dramatically, reaching and often trespassing the range of acceptable values – which means that such companies would probably not be able to obtain credit. Financial needs become significant – while FoNI allows some of them to have even a positive total cash flow.

Table 17.7 The effects of FoNI on financial sustainability of water companies in Italy

		ADSCR	DSCR MIN	Σ Financial need (M€)	Residual debt	Residual debt/terminal value	NFP/ NA	NFP/ EBITDA
	Reference value	> 1.2– 1.3	> 1			< 0.5–0.8	< 4	< 2
1	FoNI	4.48	1.93	−818	−83	−0.16	−0.56	−1.46
	No FoNI	1.74	0.39	579	574	1.1	−0.51	−13.36
2	FoNI	1.71	1.46	−243.19	53.92	0.24	0.86	2.79
	No FoNI	1.53	1.02	629.96	332.79	0.64	2.56	4.88
3	FoNI	6.09	4.18	−2.43	71.03	0.18	0.14	1.34
	No FoNI	2.87	2.3	59.77	138	0.31	0.25	3.29
4	FoNI	5.44	3.44	−25.33	12.48	0.18	−0.12	1.53
	No FoNI	2.63	1.49	45.46	46.57	0.58	0.21	4.76
5	FoNI	3.06	2.04	15.58	143.97	0.3	0.05	0.08
	No FoNI	2.43	1.68	16.6	194.6	0.4	0.25	0.68
6	FoNI	3.25	1.75	−71.23	12.17	0.54	1.35	1.01
	No FoNI	1.05	0.86	341.32	142.22	1.35	5.25	3.24
7	FoNI	6.76	0.67	−799.47	121.16	0.81	0.25	1.61
	No FoNI	3.07	0.34	210.62	564.09	1.01	1.05	2.09

Source: own elaboration on own database

17.5 Experiences with Other Sectors

17.5.1 Experiences with Irrigation Pricing

Reclamation Boards, which supply collective irrigation water, are not precisely equal to "service providers". They are in fact private associations, ruled by boards that represent landowners. Charges paid by associations resemble more "condo fees" than tariffs. On top of these, Reclamation Boards may obtain further revenues from the market (for instance, from the sale of electricity produced by hydropower plants located along the distribution network).

Accounting rules generally follow cash flows instead than accrual criteria. Legislation obliges consortia to reach annually a balance between revenues and expenses; although, public institutions may contribute grants and subsidies, which are registered in the accounts. In the past, this allowed many Reclamation Boards to elude cost recovery provisions, since public contributions constituted in practice systematic annual bailouts. Nowadays, budget equilibrium enforcement is stricter, especially for operational costs.

Figure 17.6 illustrates a breakdown of financing sources of Reclamation Boards in different river basin districts.

In Northern Italy, charges paid by associates cover the largest part of revenues, while an important source is also represented by revenues from market activities, such as hydropower production and services provided to other subjects (including PWS operators). Regional and State contributions, in turn, represent a figure around 10% maximum. In turn in central Italy and especially in the South and in the Islands the situation is reversed, with a share of public contributions around 50–80%.

As said above, public contributions in principle could compensate ecosystem services such as riverbed maintenance and flood protection. When paid as grants-in-aid for irrigation networks, the legal requirement is that investments contribute to

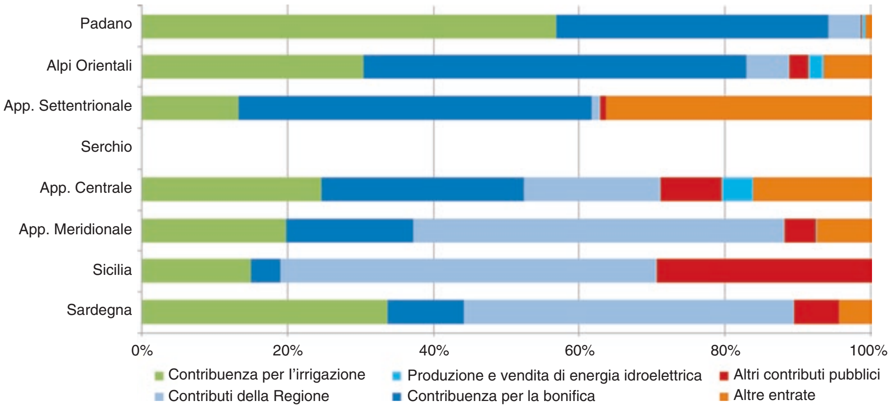

Fig. 17.6 Breakdown of financing sources of Reclamation Boards
Source: own elaboration on Zucaro (2011)

Table 17.8 Average normalised profit and loss accounts (operational cost = 100) for a sample of Reclamation Boards

	NW	NE	C	S + I	Italy
Fees paid by associates	91	93	101	56	87
Other revenues	19	13	10	13	13
Operational cost	100	100	100	100	100
EBITDA	9	6	11	−31	−0
Use of set-aside provisions	7	23	–	2	11
Depreciation and provisions	2	24	–	2	11
Net capital costs	1	0	0	3	1
EBIT	14	5	11	−34	−1

Source: Author elaboration on direct inquiry (*NW* North-West, *NE* North-East, *C* Centre, *S* South, *I* Islands)

water conservation and sustainable water use, although the criteria for assessing whether the criterion is fulfilled are rather fuzzy and discretional.

Table 17.8 illustrates the result of an original study we have conducted on a sample of 14 Reclamation Boards, located in nine Regions. Accounting data have been normalised and translated in a reclassified profit and loss account. A negative gross operational margin (EBITDA) means that direct revenues (from associates and market activities) do not allow break-even. This situation still occurs in the South and Islands Regions, while in Northern and Central Italy margins are positive, witnessing the capacity to self-finance at least a share of capital expenditure. User charges generally allow recovery of maintenance expenses, while public contributions fund new investments.

On the other hand, the construction of Italian irrigation network took place along a period of many centuries; most of it is fully amortised now. New investments do not fund extensions of irrigated surfaces and by no means imply further abstractions; rather, they concern incremental improvements of water use efficiency (e.g., substitution of open-air canals with pumped pipelines; introduction of drip irrigation and sprinklers to replace submersion), maintenance of river corridors, greening of water infrastructure and so on).

In fact, absolute water volumes used by agriculture are seemingly declining, in line with the overall reduction of agricultural activity. Estimates provided by past studies (IRSA-CNR 1999) considered theoretical requirements and licensed volumes rather than effective consumption and actual abstractions. Evidence from river district plans shows that consortia use only a fraction of licensed use rights. The latest survey available estimates a total abstraction of 2.1 billion m^3, 22% less than previous estimates (Zucaro 2011).

Metering and volumetric charges are still exceptional in the North, where associates pay a fee based on irrigated surface; however, this does not prevent to take into account water demand: surface fees can be differentiated according to cropping choices; guaranteed supplies and water-on-demand may imply extra charges. Even in the North, metering is increasingly adopted especially in areas characterised by high value-added crops and more unreliable sources of water supply, as in the case of Northern Apennines in Emilia-Romagna. Moving south, metering and volume charging becomes more frequent and widespread.

Although no systematic studies exist, evidence from case studies shows that the state-of-the-art, although non-optimal according to orthodox economic theory, is not completely unreasonable, given that significant investments would be required in order to adopt metering on a systematic basis, and these are not necessarily justified.

Table 17.9 provides the result of an original study we have carried out using the database collected by CREA (the national Institute of Agricultural Economics). The

Table 17.9 Average, minimum and maximum irrigation charges in 2012 (breakdown per macro-regions)

	North-West	North-East	Centre	South	Islands	Italy
Total surface associated to reclamation boards	949,410	3,805,119	2,362,702	3,916,712	1,148,181	12,182,124
Of which: Irrigated	58%	15%	6%	5%	5%	13%
Irrigation technology						
Submersion	80%	40%	17%	14%	12%	48%
Sprinklers	19%	49%	71%	42%	64%	38%
Drip	1%	12%	12%	44%	23%	14%
Water distribution technology						
Gravity	91%	64%	60%	63%	45%	76%
Pumped	9%	36%	40%	37%	55%	24%
Water use						
Average (m^3/ha)	8226	4078	3765	4823	5555	4931
Length of irrigation period (days/year)	141	164	188	208	196	180
Availability						
On demand	26%	65%	96%	48%	60%	51%
By turns	74%	35%	4%	52%	40%	49%
Charging method						
Surface	39%	49%	37%	50%	41%	45%
Volumetric (binomial)	39%	49%	37%	50%	41%	45%
Mixed	21%	3%	27%	0%	19%	10%
Charges per ha (surface only)						
Average	123	78	140	169	220	127
Min	35	17	55	45	170	17
Max	304	220	400	500	270	500
Charges per m^3 (binomial)						
Average fixed charge per ha	82	67	36	44	178	68
Average charge per m^3	0.12	0.24	0.14	0.20	1.57	0.31
Min charge per m^3	0.00	0.02	0.01	0.01	1.56	0.00
Max charge per m^3	0.24	0.86	0.22	0.40	1.57	1.57

Source: own elaboration on CREA

database, still under construction, collects structural and economic information for each consortium. Although the survey is still incomplete, it is useful for a general overview. At present, it covers 92 consortia (out of 136) and an irrigated surface of 1.5 million ha (57% of the total).

Where surface charges are applied, the average value is around 120–130 €/ha, with high fluctuations either among areas or within each area. Binomial charges typically entail a fixed charge (68 €/ha on average, again with significant fluctuations) and a variable charge, whose value is again quite variable. Only in the Islands we have found values around 1.5 €/m^3, while elsewhere the typical charges are 0.2–0.3 €/m^3 or lower.

On average, Zucaro (2011) calculates that the contribution per ha ranges from 40–60 €/ha in the North to 100–120 in the South. In Sicily, direct charges amount to around 50 €/ha, but public contributions reach more than 80% of total costs.

Massarutto (2003), for example, argues that most crops are actually not very responsive to marginal price, at the existing water price level, given the high value-added of crops. A case study in Friuli (North-East) shows that the frequency of drought events should be lower than one every 3–5 years to justify a systematic change of actual patterns of agricultural water use.

On the other hand, we must say that the use of economic instruments is still in its infancy. Many studies argue that incentive pricing for irrigation cannot automatically induce more sustainable patterns of use, whilst superior results could arise from a combined use of different economic instruments, such as water markets and insurance schemes (Mysiak et al. 2013; Cornish et al. 2004; Massarutto 2003).

In the Italian context, this is particularly true, especially if we consider that irrigation-driven water stress is not necessarily linked to high water consumption, but rather to the intensive use of water in high-value crops in water-stressed sub-regions, as happens in the southern reach of the Po basin (Massarutto and de Carli 2009; Viaggi et al. 2010). Poor design and scant political acceptance hamper at present a more widespread use of economic instruments.

We can argue that agriculture – as for PWS – awaits a more widespread use of economic instruments more for the sake of increasing the level of self-financing than to provide incentive to a more efficient use of water for irrigation. On the other hand, the problem of unsustainable extractions and guarantee of environmental flows seems to require institutional instruments (stakeholders' cooperation) rather than exclusively using economic instruments (water pricing and markets). Nonetheless, economic instruments could have a further role to play in the design of compensation schemes that could alleviate the burden of measures aimed at improving sustainability and reallocating water endowments. Evidence shows that willingness to pay of farmers – especially in the high value-added areas – is much higher than actual charges; whereas the capacity of the public budget to continue supporting investments is diminishing.

17.5.2 Experiences with Industrial Pricing

As discussed in Sect. 17.2.2, water services dedicated to industrial premises may be a part of the IWS or as separate activities. As already said, the latter case represents the least known part of the Italian water industry, with lack of systematic surveys. Evidence on a spot basis seems to show that these undertakings operate on a cost-recovery base, even if they might have benefitted from some public funds in the past, especially at the time of the initial investment, through direct injection of subsidies, soft loans, etc.

Industrial premises connected to the IWS pose, in turn, a number of issues that have recently attracted the attention of the national regulator.

A first important issue concerns the case for cross-subsidies. This is generally not the case for water supply. We have already pointed out that industries for which water represents an input in the production process normally rely on self-supply from direct abstractions, for which they pay the abstraction charge, but do not receive a service. Industrial and commercial premises connected to the IWS are normally doing so for sanitary purpose. This justifies treating them as any other commercial premise. In turn, the national legislation explicitly foresees the possibility of introducing a cross-subsidy in favour of domestic uses, and especially for low-income customers.

For industrial sewerage, the pricing structure is rather different from civil uses. According to Decree of the President of the Republic of 24 May 1977, the formula for calculating industrial charges was a function of pollution potential (Eq. 17.1):

$$T_2 = F_2 + \left[f_2 + dv + K_2 \left(\frac{O_i}{O_f} d_b + \frac{S_i}{S_f} d_f \right) + da \right] V \tag{17.1}$$

with T_2 = tariff; F_2 = fixed charge; f_2 = unit cost of collection; dv = average cost of primary treatment; O_i, S_i = chemical oxygen demand (COD) and suspended solids (SS) of the concerned effluent; O_f, S_f = total COD and SS treated in the facility; K_2, da = parameters capturing special features. Regions, which inherited regulatory functions, often introduced further parameters.

This scheme was supposed to apply to each treatment facility. This favoured a wide differentiation of tariffs for the same effluents even in the same territory. Figure 17.7 provides an example of the range of variability throughout the Country: while a difference among sectors is normal, given the different polluting potential, differences within the same industry is entirely due to the variability of cost between different facilities (Fig. 17.7).

Whilst being originally inspired to the polluter-pays principle, this formula has encountered criticism for many reasons. First, it does not take into account technological change occurred since 1977, charging the same price regardless the efforts aimed at reducing pollution (thence, contradicting the PPP). Second, charges are specific for each installation, with the result of generating rather different tariffs for similar effluents even in the same territory. Third, the structure does not include any

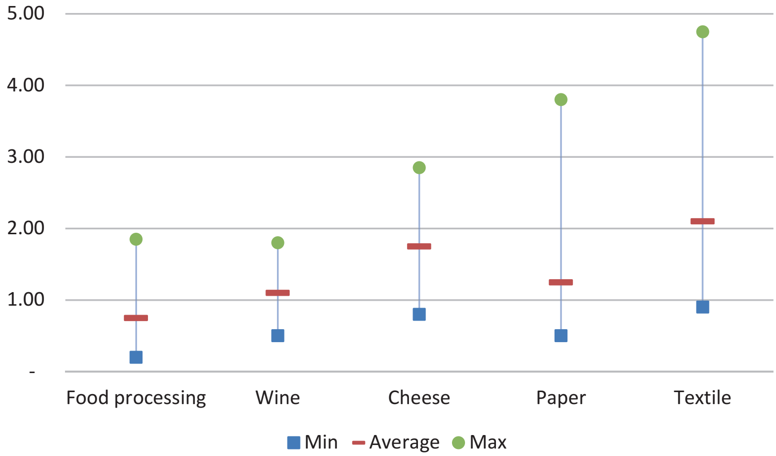

Fig. 17.7 Range of variation of industrial sewerage charges for selected industries in a sample of ATOs in 2010 (€/m^3)
Source: REF Ricerche (2014a)

fixed charge, resulting in an unfair pattern of cost allocation. Furthermore, the same rate applies to collection and treatment, which is probably unfair (collection has the same cost regardless pollution).

As already said, ARERA has introduced a uniform approach, at least for discharges into public sewage treatment plants. The new tariff will apply the same rates within any ATO; will apply a uniform rate for collection and a specific one for treatment, considering pollution abatement costs in a more effective way.

17.6 A Still Unfinished Puzzle

Although many pieces of the puzzle still must fall into place, the picture of the Italian water sector is beginning to assume its new shape. In a paper written over 10 years ago, we argued that the policy strategy initiated by Law no. 36/1994 was too radical and ambitious, and a more balanced strategy was needed (Massarutto 2012). The aim of the reform was, in short, to create a modern water industry, financially self-sufficient and entirely relying on financial markets leveraged by tariffs.

When the reform was launched, water tariffs were very low and barely visible in family budgets; neo-liberalism dominated the economic policy debate, globalisation was at its apex, and the “Washington Consensus” model inspired the debate among water experts. Treating water as a commodity like the others did not sound scandal.

This dream proved to be unrealistic: first, because it undervalued the need to accompany price increase with a more widespread adoption of modern regulatory tools and a closer attention to equity, meaning either fair cost-sharing rules and attention to affordability issues. Second, because it overvalued the capacity of financial markets to provide reliable sources or sufficiently cheap finance. Third, because it failed to reckon with political consensus, assuming that the deal could generate a "win-win" outcome for the largest majority; despite quasi-unanimity vote in the Parliament in 1994, the unsolved knots brought to the equally unanimous plebiscite with which Italians rejected the very idea that water should be treated as a commodity and sold for profit.

Some "cunning of reason" provided in order to avoid that the popular vote could bring Italian water back to the unsustainable model that legislation had tried to abandon; but made it clear that it should be substantially improved and completed.

The financial structure that the water industry is assuming is clearly taking advantage of acknowledging these weaknesses. Full-cost recovery continues to be a precondition of financial viability, but it has been recognised that this is not a synonymous to 100% relying on financial markets; recovering of capital cost is not a synonymous of easy profits milked from natural monopolies. Nor can cost recovery be trivialised in a sort of ex-post guarantee of matching costs with revenues.

With great difficulty Italy has managed to recover its water investments to a barely dignified 50 €/inhabitant, while other EU countries invest twice as much. Mobilising further resources is possible but requires an innovative financial alliance between the private and the public sector (Massarutto et al. 2008). Some innovative devices such as the FoNI have eased the access to credit; it seems possible to dare more sophisticated financial architectures, involving some degree of cost-sharing at wider territorial scales.

An opportunity in this sense is offered by the consideration of environmental and resource costs. These could be charged on the operator; whereas their transfer in the water bill may be limited according to the policy objectives (for instance, allowing to transfer only a given part of the abstraction charges, corresponding to the target level of leakage). A promising possibility concerns the use of water taxes, based on abstractions and/or pollution, either as an incentive to water users or as a complementary source of finance (Andersen et al. 2011; OECD 2013; Barraqué et al. 2018).

Once financial equilibrium has been restored, new challenges are on the horizon. Investment costs must be recovered, thence the issue of efficient capital endowment assumes paramount importance. A decisive step in this direction could be the resolute orientation towards performance-based regulation, launched by ARERA in the new regulatory period; yet this is just a first step in the right direction. An approach based on rewards and penalties should be extended to the achievement of water policy targets and not limited to commercial and technical quality (REF Ricerche 2014b; Conte et al. 2012).

Environmental policy and the emerging "circular economy" paradigm call for a more deeply entrenched integration between water policy and other domains – energy, waste, public works among others – and innovative interconnection between segments of water policy that remained so far independent – agriculture, industry, hydroelectricity, PWS.

At the same time, water pricing means using economic instruments to provide signals to water users. The debate about reforming water pricing structures is still confined to academic audiences and, at best, informs the policy recommendations issued by multilateral institutions. Proposals have been made, for example, to introduce more explicit incentive schemes, such as lump-sum rebates on fixed charges to promote water saving or pollution abatement. Installation of household equipment has demonstrated to be more sensitive to capital incentives than to marginal savings in the variable cost (Conte et al. 2012).

Affordability and water poverty are not yet a real issue at present, since annual family expenditure is still rather low compared with other EU countries, and one of the lowest in the OECD. However, projections of further increases show that this might not be true in the future once all investment costs will be transferred to consumers. Recent policy developments have attempted, quite successfully so far, to prevent affordability problems, insisting on targeted measures (such as the "water bonus"), but also continuing to rely on costly and relatively ineffective solutions such as the universally available subsidised block (Massarutto 2020).

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