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# Water-power in pre-industrial Veneto. Management and transformation of hydraulic energy through the archives of the Venetian magistrate of the "Provveditori sopra i Beni Inculti"

**Abstract**
In the Venetian state, the relationship between energy, technology, and politics underwent significant changes in the mid-16th century, when the State assumed control over water resources and established a special magistracy, the *Provveditori sopra i Beni Inculti* (Superintendents of uncultivated lands) to oversee their utilisation and grant their rights of use. This article provides an overview of the magistracy's functions and its archives. The aim is, firstly, to analyse their role as a source for the assessment of the use of water power in the Venetian mainland state in the medium and long term, from the Renaissance to the fall of the Venetian Republic in 1797. Secondly, to highlight the potential of this archival material for the study of water as a (proto-) industrial resource in one of the most advanced manufacturing areas of pre-industrial Italy.

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**Plan of the article**



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## INTRODUCTION

1 At the beginning of the 15th century, Venice turned its eyes from the traditional foreign and economic strategies of international sea trading and focused instead on Italian affairs. In a short span of years, the *Serenissima* became one of the main political and geographical powers of the Italian Peninsula. Because of this rapid expansion, Venice changed from a sea city, projected into the Mediterranean, to a State characterised by a variety of environmental habitats, from the Alps to the Adriatic lagoons, and through the mountains, hills and plains of Lombardy, Friuli, and Veneto. That multiplicity of territories went in tandem with economic areas diversified by their specialisation from their available resources.[1]

2 Moreover, one of the main features of the Italian side of the Venetian state in the 16th century was its well-developed economic context, which combined the Venetian attempt to promote a (not particularly efficient) economic policy of agricultural self-sufficiency through reclamation[2] and the use of the companion crop system, together with a widespread manufacturing environment inherited from the later Middle Ages. The latter was characterised – in the main cities, towns, and rural areas at the foot of the mountains – by a well-developed manufacturing presence in proto-industrial forms (especially for the textile sector, but also paper mills, sawmills, forges, mines, and spinning machines). Waterpower was the key to the spread and success of this model, which naturally flourished in the many watercourses (rivers, streams, canals, and springs) that flowed from the Pre-Alps to the lower Veneto plains. The relationship between energy, politics, technology and culture[3] also became clearer in the mid-16th century Venetian State, when the *Serenissima* brought under state ownership water, and centralised control over the right to use it with the creation of a special magistrate: the *Provveditori sopra i Beni Inculti* of Venice (i.e. Superintendents of uncultivated lands).

3 This article briefly describes the magistracy and its archives so as to analyse its role as a sources for assessing the use of water power in the Venetian Mainland State in the medium and long term, from the Renaissance to the fall of the Venetian Republic in 1797. It deals with the description and the potential of its archival documentation, both methodologically and in conjunction with other contemporary sources, to investigate the exploitation of water as a (proto-) industrial resource in the case of one of the most advanced manufacturing areas in pre-industrial Italy. This vast archival source, in fact, can provide a useful and rich case study for the early modern period from which to draw insights into the recourse to a soft- and renewable energy source within our broader contemporary (and scholarly) consensus on raising awareness of the importance of energy efficiency.[4]

## THE *PROVVEDITORI SOPRA I BENI INCULTI* AND THEIR ROLE IN THE VENETIAN ECONOMIC AND ENVIRONMENTAL WATER POLICY

4 "*Et poiché tutte le acque d'ogni sorte sono giurisdizion del Dominio*" (i.e. *And since all waters of all sorts are governed by the Republic*). With these words the Venetian Senate justified the constitution of the *Provveditori sopra i Beni Inculti* in February 1557.[5] The new magistracy – made

1 Abbreviations used in the notes: ASVe (=Archivio di Stato di Venezia); PBI (= Provveditori sopra i Beni Inculti, serie Atti). The calendar adopted in the original sources has been normalised when it differs to the current use (i.e. the Venetian year used to begin on 1 March).
On the long-term relationship between Venice and its mainland dominions, see the framework analysed in Knapton, 'The Terraferma state'; and for the economic and manufacturing aspects Demo, 'Industry and production in the Venetian *Terraferma*', and Demo, 'Wool and silk', together with Mocarelli, 'Manufacturing activity in Venetian Lombardy' for the Lombard areas of the state.

2 Aymard, *Venise, Raguse et le commerce du blé* , 20-36, and Ciriacono, *Acque e agricoltura*, 85-106.

3 On this connection see the considerations in Zachmann, 'Past and present energy societies', and for the modern period the essays in the same book.

4 Zachmann, 22.

5 ASVe, PBI, b. 7, cc. 43r-44r (6 February 1557; in the original as 1556 *more veneto*).

permanent the previous autumn –[6] was a direct emanation of the Senate itself (and, more generally, of the Venetian ruling class ) to govern the water affairs of the Italian territories placed under the lion's wings.[7]

5 Initially, Venice's policy towards the control of water in the state remained mild. In the previous period, there had been no common strategy, and the rights to the resource had been managed differently according to the change of rulers, together with local customs and a legal basis rooted in civil law. Water ownership and rights to access were controlled by families with a feudal tradition, who had held them since the Middle Ages, after they had been granted the rights by higher powers (e.g. the Church, the emperor, or they local representatives). Water was also controlled by the jurisdiction of the cities at the head of each district, but it could be part of the commons shared by smaller communities and managed according to their customs. Where water was scarce, it was more strictly regulated. On the other hand, in water-rich areas, such as in much of the north-eastern Italian peninsula, customary practice was generally considered sufficient; as long as the primacy – and sometimes the taxing rights – of communes, noble families, or the Church, were recognised by potential users.

6 Venice was thus initially confronted with a series of situations that its political bodies were not prepared to deal with, also due to Venetian justice having never been combined with civil law (*ius commune*), the latter being alien to Venetian law. The *Serenissima* therefore, decided during the first century and a half of the mainland State's existence, not to regulate water, except in cases that concerned Venice itself or its main interests, such as the control of the main rivers to safeguard the lagoon, or local claims and projects that could harm the Venetian economy. Everything else remained regulated as it was, and even Venetian families were largely excluded from Veneto water affairs. Water management, in the sense of waterpower to move mills, plants and wheels for manufacturing, was then only directly linked to the business management of the merchant-entrepreneur families from the Mainland State who participated in the proto-industrial economy, and particularly in the development of its textile industry.

7 However, in the mid-16th century, a far-reaching reform of the central administration of the Venetian state led to the establishment of new magistracies, and to the a redefinition of the boundaries between the social and political action of the capital and the governance of the mainland. In this context, water became for the first time a concern of the State. This resource, vital to human and animal life, as well as to agriculture and industry, was no longer subject to local self-regulation, customs, and to the balance between civil law and local laws that had governed it since the Middle Ages. Thus, the institution of the *Provveditori sopra i Beni Inculti* in 1557 suddenly placed water under the direct jurisdiction of the central power. It was administered by a group of three magistrates solely responsible for granting the rights of water use to private individuals.

8 From that moment on, the *Serenissima* preciously declared water to be the property of the state, and every Venetian subject had to apply (and pay a fee) to be granted the right to use it (*utile* domain). The initial intention behind the centralised control of the resource was to provide support for the development of agricultural activities, and the reclamation business, as the

**6** ASVe, PBI, b. 4, c. 1r-v (10 October 1556). A first attempt to establish a magistrate to oversee the land reclamation needed to expand cultivation due to population growth dates back to 1541, but was abandoned in the face of opposition from the *Savi alle Acque*, who already had jurisdiction over the Venetian lagoon and the main rivers. New attempts were made in 1545 and 1549, when the magistrates were assigned study functions. However, the outright origin dates to the period between 1556 and 1558, when the magistrate was confirmed for the last time. In the meantime, the *Provveditori* had acquired control not only over land reclamation, but more generally over water concessions (competence over the hydraulic basin of rivers flowing into the lagoon remained with the *Savi alle Acque*). As with other Venetian political bodies, they held legal, executive and judicial power in their area of jurisdiction.

**7** For the broader framework of their role and action see Mozzi, *I magistrati veneti alle acque e alle bonifiche*, 15-62.

name implies in relation to uncultivated lands. However, it soon became evident that the supervision of all water resources by the central government resulted in the State exerting control over waterpower for the manufacturing sector too; for any type of machinery and site, and for any category of applicant.

**The magistrate's supervision of water and the early modern Venetian Mainland proto-industry**

9 The link between the new Venetian magistrate and hydraulic power was not only based on competence, but also on the very environmental nature of the state. As is well known, before the steam engine (and in these parts of Italy until the 19th century), the main source of kinetic energy was water, a renewable and versatile resource.[8] The entire proto-industrial system of the *Serenissima* was largely based on water-powered machines. By turning the mill wheels the kinetic force of the water flow was transformed into the power to drive all kinds of machinery used by craftsmen for their own industry. Moreover, using the "water motor", all of this was done more efficiently and economically (once the large initial investment to build the mill and machinery had been repaid) than through human or animal power.[9] The flow, and hence the energy, was constant throughout the year and needed no rest, but resulted in homogeneous movement of the machines, which enhanced the qualitative result of the artifacts.

10 These "motors" of hydraulic movement (generally referred to as mills "*mulini*" or wheels "*rode*" in the sources)[10] shared the same underlying technological structure, which was then adapted to different types of industries[11] and, in the early modern period, marked the landscape of the Venetian state.[12] Indeed, the latter was characterised by an abundance of water, both above and below ground, in the form of rivers, streams and springs. Native watercourses were later channelled for agricultural and industrial purposes. The latter, known locally as "*rogge*" (i.e., ditches or millraces),[13] were also useful in making the flow more constant and homogeneous and in protecting plants from the risks of flooding or hydraulic mismanagement. Each of these modifications, whether to mills, "*edifici*" (as the machinery were called)[14] or main and service watercourses, involved a request for authorisation and a subsequent bureaucratic procedure at the *Beni Inculti*. Moreover, the abundance of water was made easier to use by the natural topography, with a gradient that facilitated its flow from the Alps to the plains. Finally, the presence of vast forests provided ample building materials.[15]

11 At first, then, most of the demands came from the aristocratic families of the mainland, who had long claimed rights to the water since earlier times. For them, the new Venetian legislation represented a favourable situation to exploit the resource from the hands and customary practices of the rural communities. If before they had benefited from a recognised authority for a certain share and for certain purposes, the

8 Malanima, *Economia preindustriale* and Malanima, *Uomini, risorse, tecniche nell'economia europea dal X al XIX secolo*, and for the broader European context *Economia e energia, secc. XIII-XVIII* (esp. Munro, 'Industrial Energy from water-mills in European economy', and Benoit and Bertier,'Energie hydraulique, innovation et transformation du milieu à la fin du Moyen Age et à la Renaissance').

9 On this topic see the contextualisation in Rauch, 'The role of water: A multi-purpose resource', 59-61. Indeed, the various chapters of this book, and the case studies it analyses, provide a wealth of information on proto-industrial sites of early modern Veneto.

10 In the absence of a description, in contemporary sources the two terms are to be understood as interchangeable.

11 Howard, 'The proto-industrial architecture of the Veneto'.

12 Cosgrove, *Il paesaggio palladiano* and Panciera, 'Paesaggi protoindustriali'.

13 Panciera, 'The typology of water-wheels in the Veneto', 75.

14 Compared to the current use of the term "*edificio*" in Italian (as a general building), in 16th-century northern Italy the word was used to identify a piece of machinery of large size and complex carpentry. With the same seeming contradiction, the term "*macchina*" at that time would refer to a building, usually the one housing the machinery. Finally, in the Venetian area, the term "*mulino*" (mill) could generally refer to a flour-mill as well as to any other industrial mill (Howard, 'The proto-industrial architecture', 37). This vocabulary is shared within the *Beni Inculti*'s archive and must be considered when studying the source.

15 Rauch, 'The role of water', 59-60 and Howard,'The proto-industrial architecture', 34-36.

fact that Venice, as the sole owner of the water, was actually selling the right to use it meant that, once bought, and after the state's privatisation of water, they could profit from it, against the complaints from the rural population and others who might be interested; or they could rent their rights. It was, therefore, a process of early encapsulation of the resource in the state domain,[16] but one that primarily benefited those who were sufficiently rich, influential, and quick to join the 'rush' to secure the rights to use it. Also in the form of water power.

12 The reason for this is that, since the 14th century, the provincial elites of Veneto had led the region's proto-industrialisation as merchant-entrepreneurs who did not limit their assets to land and rents, but were also active in a wide range of commercial activities.[17] They held a large share of the mills and other water-powered machinery, but, interestingly, the water rush, which first occurred in the case of water for agricultural use, did not appear for manufacturing until the mid-17th century. Early requests for waterpower were usually genuine emergencies aimed at improving production. The attitude changed, though, after the 1630s, when manufacturing progressively relocated to the rural parts of the state, accompanied by a new demand for water to build or modify the plants.

13 From the water petitions, the prominent role of hydraulic power for industry can be seen in three main areas. Firstly, the main cities and the towns at the head of smaller districts, where demands for water meant requests to strengthen existing manufacturing sites in place since the later Middle Ages. Secondly, the towns and villages at the foot of the pre-alpine region, along the spring line, which benefited from the water that collected from the mountains and springs to support a widespread manufacturing system, often controlled by the main urban families, and in which the Venetians were rarely able to participate until the 17th century. Finally, the pre-alpine areas of the dominion, where, in the absence of a developed and fertile agriculture, the mills represented the main alternative for the livelihood of both the local population, who worked in the exploitation of woods and mines (and later also textiles), and the elites who invested in these sectors, coming both from the subject towns and from Venice itself.

14 As expected, the attitude of the mainland elites was later followed by the Venetian patrician families, who gradually invested in land bought locally or at state auctions. These families were also involved in the reclamation business and capitalised upon their membership of the same oligarchic group that decided the state's water policy. Moreover, it is worth noting that not all the families within the oligarchy seemed to be interested in the water business in the early stages, and that investments were more frequent and significant in the case of members of those factions that favoured a Venetian policy aimed at strengthening the Italian side of the state, such as the Contarinis, the Pisanis, and the Mianis.

15 In particular, the *Beni Inculti* archives show that these were the families that strengthened Veneto's industrial centres, either through direct ownership of mills and other plants or, more frequently from the 17th century onwards, by using their water rights to lease them to emerging entrepreneurs. In this way, they indirectly supported the new manufacturing districts that were being created, such as the paper mills or the ceramics cluster that was emerging in the Bassano[18] area. A process illustrated by the documentation in this archive.

16 Venice was one of the first ancient Italian states to establish public ownership of water and to regulate its distribution only through rights of use, as in Moscati, 'Il diritto delle acque nell'economia moderna', 532-533. On the general legislation on the matter, with a selection of edited document, see Cacciavillani, *Le leggi veneziane sul territorio, 1471-1789*, 15-44 and 213-254.

17 Their role is analysed in Demo, *L'«anima della città»* and Panciera, *L'arte matrice*.

18 As in Vianello, 'Rural manufactures and patterns of economic specialization: Cases from Venetian Mainland' and Favero, 'Old and new ceramics'.

## THE ARCHIVE

16 The archival documentation of the *Provveditori sopra i Beni Inculti*, held at the State Archives in Venice, comprises over 870 archival units, both in the form of registers, and of hundreds of folders containing "*filze*" (i.e., organic units made up of individual documents grouped together as part of a continuous thematic series)[19], for a total of several thousand documents dating from the 1550s to the early-19th century.[20] However, the quantitative element is not the most remarkable aspect of the preservation of this vast archival material; what stands out in terms of scientific research is the highly diversified typological collection of documents. The archives of the *Provveditori sopra i Beni Inculti* contain a wide range of different types of documents, such as technical letters, maps, surveys, petitions, and the granting of water rights. The sources relating to individual petitions find their counterpart in documentation concerning the entire population and, more generally, the State, such as the registration of laws and decrees from the same magistracy or the other primary Venetian political bodies concerning the regulation of water for agricultural and proto-industrial use, as in the case of the use of water for mills and manufacturing plants.

17 Accordingly, this corpus of documents provides a step-by-step account of the changes in the use and economic development of water and water power in the Venetian state during the period of the *Serenissima*. In addition, the wide scope of the archive's content allows us to deduce, on the one hand, the extent of the state's extensive control over this resource, as a source of hydraulic power, and, on the other, its use as the main energy for the proto-industrial development of Veneto and its management by private individuals. Finally, the archive is fundamental to the study of water energy in relation to mixed-use production facilities and the latter's transformation and change of use according to the economic development of specific areas and the availability of the resource.

### The archival fonds

18 The wide range of issues dealt with by the *Beni Inculti*, including all uses of water, means that the archive is characterised by a great variety of types and documents, divided into several subseries. There is no need to describe them in detail here, and I will limit myself to listing their main functions.

19 The first group comprises regulations relating to water between the 16th and 18th centuries. It is a diverse set of laws, covering all types of matters related to this resource in the medium and long term. Further to the primary sector provisions, the manufacturing sector is also concerned with the laws relating to the acquisition and management of hydraulic power, and the resolution of conflicts between private individuals over its use. These regulations resulted from both the internal activity of the magistrates and, most importantly, of the implementation of the laws approved by the main Venetian political bodies, such as the Great Council or the Council of Ten. However, it was predominantly the Senate that was concerned with this matter. Indeed, in addition to the group of *capitolari* ("chapters of ordinances"), [21] registers that collected all the legislation, there is a long set of senatorial decrees that have been preserved between 1651 and 1797 in a separate subseries of *decreti*.

20 For instance, it was the Senate, that, between the 1620s-1630s, promoted the spread of hydraulic

**19** The name "*filza*" recalls the fact that in the *Serenissima*'s archives those typological documents and folia were originally strung on a long nail or string and periodically tied together into stored files.

**20** The archive is described in the inventory available at this address: <https://www.archiviodistatovenezia.it/images/Inventari/500_Provveditori%20sopra%20beni%20inculti.pdf>(accessed 18 December 2024).

**21** The *capitolari* comprise indexes and summaries (also coeval) and consist mainly of three registers created in chronological order between 1557 (with copy entries for legislation from the end of the 12th century) and 1765. In the 18th century, when the *Serenissima* reorganised its record management, they were copied into two new registers. This time, they were divided by subject and date to 1778. They are easier to consult (now as ASVe, PBI, bb. 7-8 'capitolare in tema di acque' I and II) for specific topics in the history of energy.

silk spinning plants in the state for the production of *orsoglio* "*alla Bolognese*" (*organzine*), by means of tax concessions and privileges.[22] Venice was not in the habit of adopting direct centralised policies in the industrial sector, so it is all the more interesting to see how it did so in this case, starting with the concession of energy, which was essential to move this technology and large machinery. The choice centred on the free concession of hydraulic power for this specific aim. First, in 1635, the Senate guaranteed the free use of water for this purpose on all of the state's watercourses, except where navigation was seriously impeded. Then, in 1654, the decision was reaffirmed. It specified that "[all] the [...] waters shall be freely granted" for this end, despite the opposition of third parties.[23] From these years, therefore, there is a boom in the archival documentation relating to silk industry, and we can find evidence in the group of sources relating to the interaction between the magistracy and the petitioners, which constitutes a second large typological set.

21 The interaction between the three *provveditori* and the applicants for water can be divided into three main strands. Firstly, a series of petitions were sent by private individuals to the *Beni Inculti* or other higher political bodies, such as the *Signoria*, the Council of Ten or the Senate, and then passed on to the magistrate. Thousands of them are collected in 47 folders. If the documented request was successful, the right of use was granted, with the concessions (numbering in thousands) also being collected in over 30 folders. In each case, every decision by the *Provveditori* had to be recorded, the evidence of which remains in a series of registers and files (*terminazioni*). All these grants, changes of ownership, or changes of use were then also listed in registers which were designed to keep updated information concerning patrimonial aspects (*catastici*). They were divided by territorial district and constitute a rich source for long-term quantitative and serial analyses. They can also be collected typologically, such as for the 18th century *catastici* for the identification of mills in the state.[24] These sources have been widely used by scholars and have proven themselves to be primary evidence in such cases as Panciera's analyses on proto-industrial development in the Vicenza and Bassano districts.[25]

22 Hundreds of applications, whether for allocation, confirmation of old rights of use, or to change the use of water already in their possession, arrived every year and added to this documentation. Each application had to follow a specific bureaucratic process,[26] made up of successive steps, in which a series of technical feedback and inspections were inserted between the request and the investiture. It is these intermediate steps that constitute the most interesting set of documents in the field of energy history, since they involve the work of surveyors and their reports. In this way, surveys and information of a more specific technical nature are derived.

23 The composition of this technical staff initially comprised three 'ordinary' surveyors and a selection of four 'extraordinary' technicians. All of them were Venetian citizens and held the necessary accreditation from the magistrates, who commissioned them to undertake the inspections. The group was further expanded through the recruitment of additional extraordinary experts, whose geographical distribution was determined by their place of residence and who were also similarly accredited with the *Beni Inculti*.[27] The set of their appraisals is

22 Mattozzi, 'Intraprese produttive in Terraferma'. On the development of silk proto-industrial sites and machineries in Italy, and their technological evolution as linked to water energy for spinning see Poni, *La seta in Italia* (263-326 for the Venetian state region) and Davini, 'A global supremacy: The worldwide hegemony of the Piedmontese reeling technologies, 1720s-1830s'.

23 ASVe, PBI, b. 8, c. 201r-v (29 August 1654).

24 ASVe, PBI, bb. 719-723.

25 See Panciera, 'La formazione delle specializzazioni economiche territoriali nel Sei e Settecento' and Panciera, 'Le attività manifatturiere del Vicentino tra XVI e XVIII secolo e la cartiera di Dueville'.

26 It is described in Cosgrove, *The Palladian landscape*, 140-166.

27 ASVe, PBI, b. 8, cc. 5v-6v (26 April 1571). The involvement of personnel from the mainland can be justified by the need for technicians who would be well-acquainted with those territories.

comprised of 36 folders (containing hundreds of subfolders), which are consistent in terms of content, as they are all technical reports, but can vary regarding typology.[28] The great number of reports are, however, those resulting from the technical evaluation of the feasibility of the requests made to the magistracy, and their impact on water resources and other beneficiaries. They usually contain the measurement of the flow and volume of water, and an assessment of its sufficiency in relation to the proposed project, a description of the site, and, in the case of hydraulic installations, a generally detailed description of them. The surveyors (*periti*), always working in pairs, also produced a map or drawing (see below), and in the report they explained the modifications and the best hydraulic interventions to be followed by the beneficiary. Last but not least, they estimated the rate to be charged, subject to the discretion of the political representatives.

24 A political magistracy was not enough to regulate a technical subject. The new "*officio*" was then soon joined by specialists with technical expertise, who were essential at the management level.[29] They also had to eliminate distortions and malpractices that undermined the implementation of the new institutional management plan. On the one side, the State needed to keep the fiscal and accounting aspects in order, but on the other the focus was on water management, which required experts with technical, scientific and practical knowledge. The magistrates needed good surveyors to oversee the implementation of the state's political-economic projects and control the water-use actions of private individuals.[30]

25 In the earliest stages, the *Beni Inculti* had relied on the services of professionals hired on an occasional basis. However, it soon became evident that this approach was not proving to be a reliable one. Consequently, in 1569, the ad hoc personnel who had initially been assisting the magistrates were replaced by the aforementioned group of official surveyors selected by the *Provveditori*.[31] Furthermore, the duties of the new permanent technicians were defined by law. The technicians, who had to be '[...] familiar with these waters', were required to undertake a comprehensive examination. This meant taking precise measurements and preparing reports and drawings of the work to be conducted. Moreover, a report under oath was also to be submitted. It fell upon them to proceed with on-the-spot investigations, both by inspecting the watercourses, the land, the buildings and the machinery, and by informing the population of the changes and requests submitted to the magistrate. They were charged with collecting statements from the inhabitants of the land and all areas concerned and checking whether there were any opponents who could request the magistrate to halt the work or the transfer of water. Lastly, they had to assess the possible damage to the property owned by private individuals or the State (starting from the good condition on watercourses). Hence, from this set of reports, combined with the descriptions contained in the applications, it is possible to draw a precise picture of the nature and type of hydraulic motion systems that have been built or converted over time.

26 Finally, an important part of the archive consists of the subseries of the so-called "*processi*", which literally translates as "trials", but to be intended as case files, which collate all of the documents attached to the application (in the original or as certified copies) and much of that produced

**28** In the 1590s, for example, the *Provveditori* sent the *perito* Bartolomeo Galese to survey districts of Verona, Vicenza and Treviso in order to locate all the rice fields and water mills that could interfere with the process of land reclamation (ASVe, PBI, bb. 263-264). For Vicenza, the result was a complete list of all the mills and water-powered machines in the countryside, with the exception of the city of Vicenza itself.

**29** Their duties and work are illustrated in Vantini, 'Periti agrimensori, notai: cartografia e cartografi "minori" tra amministrazione periferica e magistrature centrali negli ultimi due secoli della Repubblica Veneta'.

**30** On water-technological expertise in early modern Venice see Ciriacono, 'Scrittori d'acqua e politica delle acque' and Ciriacono, *Building on water*i, 62-156.

**31** ASVe, PBI, b. 8, cc. 2r-3v (26 February 1569).

during the bureaucratic process of evaluation and eventual granting of water-use rights. This set of documents thus explains the character and scope of the requested intervention and, by its nature of aggregator of different typological records, it represents an invaluable source for the study of hydraulic power in the long term.

27 Venice had exempted those who could prove that they had held water rights for at least 30 years prior to the creation of the *Beni Inculti* (i.e., since at least 1526) from paying the tax, but in the event of a change of ownership or inheritance, the new owner had to apply for confirmation. In order to do this, the documentation attached to the petition covered significant periods of time and different documentary sources, ranging from tax assessments (*estimi*) to private documents (wills, sales, and other notarial deeds), court judgments, technical reports and anything else that might have been useful. Similarly, applications for new acquisitions or changes of use could be accompanied by various types of documents to support a successful claim.

28 Accordingly, the set of thousands of case studies (contained in over 100 archival units, and thousands of files, preserved in alphabetical order) are a rich source for understanding the use of hydraulic power in early modern northern Italian plants of the most varied industrial typologies. Their added value lies in their ability to bring together documents of different types and dates, thus providing, first, information on the context and characteristics of the installations since the Middle Ages and, second, references for extending the research to other public and private archives, both in Venice and in the original areas where the mills were located. A brief example of this approach is proposed in the last section.

**Cartography: Maps and drawings**

29 Maps and other drawn material were originally included in the archive, as part of the technical surveys and projects sent to the *Beni Inculti* together with private petitions, or as the result of the inspections by the magistrates' technical officers.[32] They often accompanied the surveyors' reports, as prescribed by the default procedure, and are an important source for understanding the position of water-moved plants in the wider environmental and agricultural context in which they were located. The maps – particularly those from the earliest period and up to the late 17th century – may sometimes lack refined technological detail, showing mills as sketchy houses with wheels, but they do include the production sites in the watery environment, and indicate the number and type of wheels used to move a variety of water-powered machinery, as well as the buildings in which they were housed.

30 The objective is further achieved when the drawings and maps are analysed together with the exhaustive descriptions added to them by surveyors. On the one side, they contain technical information such as the water flow rate, how the new installations would have affected it, or where new mills would have been built, and the number and typology of new wheels and plants. On the other, they usually describe the *status quo* of the current situation: the landowners of the area, and the water right-holders; they also draw the main and secondary rivers, channels, canals, ditches or streams and their derivations; they pinpoint owned rights, and report who could be harmed by the changes, or any risk that could emerge and where. Later, as technical drawings and maps became more accurate, building could be analysed more closely, such as by assessing the height of floors and structures to understand the types of machinery they might contain.[33] In addition, the description of the relationship between watercourses and the installations themselves, as well as the interaction between watercourses for hydraulic movement and secondary watercourses, became more precise.

31 However, the use of the maps is currently hampered by the fact that they were separated from the original collection in the last century. The decision was taken for conservation reasons,

32 On the technical personnel of the *Serenissima* charged with cartography, see Salgaro, 'Cartografi e cartografia'.

33 See, for instance, the analysis in Howard, 'The proto-industrial architecture of the Veneto', 37-44.

i.e. to preserve materials that are often difficult to handle due to their large size and folding. This resulted in the creation of a separate subseries in which the drawn sources were separated from the file in which they were originally included. While the archival bond was maintained, the physical conservation bond was broken. Although this problem is partly remedied by the extensive explanatory captions on the maps themselves, it also forces the scholar to work on reassembling them using the finding tools provided. Reuniting the map or drawing with the file that held it, and with the technical report for which it was made, therefore entails working on the 'virtual' re-composition of the file between two now separate subseries. This is not always possible, mostly due to the loss of the maps in past centuries. However, when it is, the potential of the analysis offered by the technicians and engineers who drew the documents strongly consolidates the understanding of how hydraulic energy was used. The most direct way of doing so is to use a set of photographic reproductions of the maps, now gathered in a designated catalogue. They are grouped by location, and each sheet indicates the archival signatures, the people involved, the date, and a brief description of the installation and the demands made on it. It is therefore easy to determine whether the graphic documentation relating to a case study still exists, as well as to assess it in digital form or from the original.

32 The written description then finds its counterpart in the image, and the textual explanation contained in the report is embodied in the letters, coloured lines, drawn buildings, and water-powered installations. They also – not without significance – describe the details of the buildings themselves, including the position of the wheels, and the presence of outbuildings useful for production. They also show the location of these structures on the watercourse, and whether they were isolated or flanked by other structures, attached or nearby, in order to assess the energy capacity of such ensembles. Finally the rougher drawings, most of which are still attached to the files, also serve the same purpose, albeit less precise. These sketches, sometimes drawn up by non-specialists such as the applicants or their agents, are still useful, despite their crudeness and the lack of legends and captions, because they provide such basic information as the location in the hydrological context and a plan of the works required to increase the flow rate or to convert the installation to industrial use.

**The archive's limitations**

The need to reconstruct the archival links between maps and documents relating to the same events is not the main limitation of the source, nor is it the most difficult to overcome. 33

The real limitation is the lack of data for an economically important part of the State: Venetian Lombardy. The so-called *Oltremincio* (i.e., the region on the other side of the river Mincio), comprising the districts of Brescia and Bergamo, was one of the most industrialised areas of the Venetian Mainland State from the time of its annexation, in the 15th century, and its industrial importance increased further at the end of the 17th and during the 18th century. However, Venice relinquished control over water in these areas and withdrew from any attempt to centralise its jurisdiction and management, as in the case of the Veneto and Friuli sides of the *Terraferma*. In Venetian Lombardy, the situation continued as it had been before the creation of the *Beni Inculti* magistracy, and water could still be privately owned and freely traded. This means that the archive lacks the kind of material that would give us the opportunity to understand the evolution of water-energy use and the private-public discourse linked to any change in the industrial interests coming from those peripheral regions. 34

Unfortunately, the same is true in the case of the capital itself, as the archive lacks any direct information on Venice and its lagoon industries. However, if this problem could be partially overcome by using the archives of other magistrates who oversaw the lagoon (e.g. the *Savi alle Acque*), in the case of Lombardy we can only resort to the quantitative and partial data contained in 35

the *catastici* for Bergamo, Cremona and Crema, especially for the 18th century. Thus, research is limited to the early modern Veneto and Friuli. To analyse the Lombard framework, local sources, then, get the primacy role.

**Finding aids**

36 The study of the information contained in the archive is simplified by a series of complementary finding tools that allow the identification of documents relating to specific case studies, or to find them listed on the basis of topographical and/or onomastic criteria (i.e., individuals and families holding water rights). It consists of a group of 9 indexes covering three main categories of materials: cadastral records (*catastici*, indexes n° 47-48-49), grants (indexes n° 45-46) and case files ("*processi*", indexes n° 41-42, 44).[34]

37 They are designed to be intuitive to use. Cadastral indexes, for example, provide the basic information needed to locate the record in the main register of the district of interest. They list the localities affected by one or more claims, the purpose for which the water was petitioned (e.g. mill, paper mill, sawmill, etc.) and the folia on which the records can be found.

38 The indexes for grants and for "*processi*" allow examination by type. For the grants' series, the two indexes cover all the information recorded in registers and that recorded in loose files now gathered in archival units according to chronological order. They provide the basic data for each grant: 'firm' ("*ditta*") (i.e., the holder/s of the water rights), place, date, archival reference and a very brief description of the matter.

39 More flexible and richer is the set for the subseries "*processi*". In this case, two summary indexes (n° 41-42) give the name of the water holders, the locality, the district to which the latter belonged, the type and name of the watercourse used, and finally the archival reference. The data are classified according to the holders' name or the water site. Finally, index n° 44 combines the various dossiers according to the following scheme: 'firm' (i.e., owner/s), location, summary, date, and archival unit in which the dossier is found. Thus, starting from various criteria such as site, family/individual, or type of industry (or agriculture), it is possible to browse the indexes in order to identify the types of business to be analysed. Starting from the topographical or onomastic criteria, it is possible to delve deeper into the index containing a more detailed summary and, once the selection has been made, to move on to the original file for a more in-depth analysis. This way, from the quantitative data easily available from the "*catastici*" and "*investiture*" series, it is possible to proceed to a qualitative analysis of the cases of interest.

## THE ARCHIVE AND ITS NETWORK OF SOURCES. THE "*PROCESSI*": A HISTORY OF WATER ENERGY IN THE LONG TERM

40 The typological variety and the long period of time covered by the documentation collected in the files of the so-called "*processi*", highlight two main aspects in the usage of hydraulic motion in the Venetian state. Firstly, the very long duration of the mills' installations. Mills would often operate in the same place for centuries, and many of those found in the sources were already in existence for decades, if not hundreds of years. Given the long-term use of hydraulic energy (as a renewable 'motor'), what adapted to economic developments was then the machinery it powered. It was therefore as common to ask for a mill to be converted into a new manufacturing machinery as to build a new one. During periods of economic expansion, such as the Renaissance, the source indicates an increase in the number of plants. Conversely, from the mid-17th century onwards, a shift in the reconfiguration of manufacturing districts within the Venetian state resulted in a preference for reconversion. This transition led to entrepreneurs and manufacturers opting to reuse existing plants in line with emerging economic trends, rather than building new ones. Consequently, energy took precedence over other industrial needs, and the availability

**34** Another index deals with land reclamation consortia (n° 49bis). They are all available in paper form at the State Archives in Venice, and digitally on the institute's information system "More Veneto" (<https://asve.arianna4.cloud/>) (accessed 18 December 2024).

of waterpower was considered as significant – if not more important – than the provision of raw materials; after all, even water could be considered a form of these natural materials.

41 The second aspect that characterises the evolution of the exploitation of the resource was its use in multifunctional plants complexes, where the same watercourse was able to move several wheels (and thus several different types of machinery), passing from building to building in succession; or within multifunctional sites, where different machines and industries operated together. This could lead to frequent disputes between users of the installations, as downstream plants could be damaged by a slower and weaker flow rate. However, this also shows how the management of the resource could be made more efficient through sharing. Besides, this also demonstrates the potential for enhancing the efficiency of resource management through collaborative efforts. By adopting this approach, it was possible to avoid wastage of hydraulic power and to distribute the expenses of plant maintenance and technological-environmental implementation initiatives.[35] Finally, it highlights its perfect integration into the environment: once the machines were done working, the same watercourse could be used for irrigation, with appropriate canalisation.

42 An example of the first situation is the application made by the Rizzotti family in 1739 for the reconfirmation of their water rights to move a mill in the village of Asolo.[36] Situated at the transition between the Pre-Alps and the plain, Asolo benefited from the course of the Musone stream, which had its source a short distance upstream, and flowed rapidly towards the plain. Since the 15th century, it had been the site of a series of mills, used both for milling and for industrial purposes, particularly for the production of woollen cloth. In their request, the Rizzottis explained why they needed to have their rights reaffirmed: they were the heirs of the previous owners. This was no small step, however, as the building had previously been in the hands of the Gambarini family, since at least the early-16th century, passed down through the male and (later) female lines. The change of ownership had led to a dispute that culminated in the capital's courts, yet it is not the latter that interests us, but the information about the mill. We know that it had existed for over 230 years, that it was vertical and built on dry land, that it had two wheels, and that it had its own secondary millraces. All this information is contained in the last will of Bartolo Gasparini, who owned the building in 1509. The testator had forbidden the transfer of the plant, but over time the wheels were passed on to different people as individual “motors”.

43 Moreover, the right to use the water to move them had been obtained by means of confirmation since the creation of the magistracy, because the family could prove that the plant had existed for more than 30 years when the *Beni Inculti* were established. In order to confirm this again, certified copies of fiscal extracts (*estimi*) from 1511, 1530, 1539 and 1561 were presented. From these, we can deduce that in that century the mill had “*rode a palla*” (paddle wheels),[37] but, by comparing the different sources, we also get information on the changes that the plant underwent. By the time of the reconfirmation in 1739, the wheels had changed to “*rode a coppedello*” (overshot wheels), as in the 18th-century description. Over time, therefore, a qualitative improvement in the use of hydraulic power had been achieved, with a direct investment in technological change: the efficiency of overshot

35 Given the high cost of digging secondary ditches to supply water to the plants, ensure a constant flow of water, and protect against flooding, it was cheaper to integrate the "*mulini*" and the wheels, or to line them up.

36 ASVe, PBI, b. 493, fasc. “Rizzotti Giuseppe e consorti”. The grant is dated 25 August 1739. The record file gathers the granting of water rights, and several documents in certified copies (not only the fiscal records and the testaments mentioned in the text but also excerpts from judicial sentences). Each source contains its original archival reference, meaning that scholars can quickly learn of which external archival source (or archive) they can use for further investigation.

37 On mill and wheel typologies in early modern Italy see Galliazzo, *I mulini d’Italia*. On the technology see also Reynolds, *Stronger than a hundred men*, and Munro, ‘Industrial energy from water mills’.

wheels usually exceeded that of a paddle wheels by roughly 50-70%.[38] This was facilitated by the slope of the site, located in a hilly area.

44 The network of sources can be much richer and more diverse in cases where the process brings together several water-powered mills, as this usually implies a condition related to a multi-functional industrial complex. This can be done by analysing a locality and/or a specific water-course,[39] but also by following the family histories gathered in the same file, with subfiles for different applications submitted over time or for several plants.

45 This is what happens when we analyse the majolica production of the Antonibon family[40] in Nove, a village in the northern Vicenza plain, along the Brenta river and not far from Bassano. In the 18th century, Nove quickly became the main centre of ceramics production in the Venetian state, thanks also to the existence of a well-established secondary canalisation of the waters of the Brenta in the form of ditches (*rogge*), the most important of which was called Isacchina.[41]

46 The area also benefited from the presence of the same Brenta river and its tributaries for the supply of alluvial materials, sand, pebbles, quartz and calcium carbonate for the production of materials for ceramic mixtures. These pastes were obtained by grinding the minerals with special hydraulic mills called "*pestasassi*". The availability of the raw material at a low cost, combined with the ownership of the mills and the rights to the water to move them, were key elements in the reduction of production costs that quickly allowed the Nove ceramic industry to flourish.[42] As a direct consequence, the success of the industry increased the number of plants.

47 With this purpose in mind, in 1721 Giobatta Antonibon applied to the *Beni Inculti* for a water concession to build a "*pestasassi*" mill (i.e., a mill for grinding stones and minerals) to support its growing ceramics industry. The aim was to employ the hydraulic power currently being wasted, since the irrigation ditch on which he wanted to build the mill was discharging its water for irrigation. He proposed to leave it for that purpose, having first made good use of it. It is no coincidence that this was a derivation of what was already known at the time as the "*seriola delli consorti de' molini*" (i.e., mills' consortium ditch), since many plants had grown along the *"roggia"* (i.e., millrace) over the centuries. However, the flow of the watercourse, as confirmed by the magistrate's surveyors, was also capable of supporting another mill, smaller in size and equipped with only one wheel.[43] Within a few years, the same mill would be able to drive a second wheel for crushing stones and grinding pigments, as requested by Giobatta's son, Pasquale Antonibon.[44]

48 The growth of the Antonibon factory also meant that other mills previously owned by the family needed to be adapted to the same use.[45] In this sense, the documents attached to the petitions allow us to reconstruct how, from the 14th century onwards, a group of industrial buildings for different purposes were built on this irrigation set of ditches and millraces. All of them were able to operate thanks to the correct management of the flow of the water from the main "*roggia*" and the gradual addition of water to strengthen it by the digging of new canals.

49 For example, the accompanying documents explain (and authenticated copies prove) how, in 1398, the neighbouring commune of Marostica had granted the right to use water in perpetuity to move a millstone and a sawmill in the site

38 Panciera, 'The typology of water wheels', 74.

39 As in the case of the village of Solagna, along the river Brenta in Scuro, 'Hydraulic installations and water resources in the Venetian Republic'.

40 Favero, 'Old and new ceramics', 284-290, and Favero, 'Privilegi d'industria e diritti di proprietà nelle manifatture di ceramica della Repubblica di Venezia (XVII-XVIII secolo)'.

41 Howard and Scuro, 'Nove'..

42 *Ivi*, p. 219.

43 ASVe, PBI, b. 417, fasc. "Giobatta Antonibon, 1721-1722". The file contains both the application and the two surveyors' reports.

44 ASVe, PBI, b. 417, fasc. "Pasquale Antonibon, 1743". The initial application was sent in September 1747, while the grant dates 10 June 1749.

45 ASVe, PBI, b. 417, fasc. "Pasquale Antonibon, 1757".

from where the ditch was later extended. In the following century, the need for more power led to the digging of new canals from the nearby Brenta river. By the beginning of the 16th century, the number of wheels in the same building had increased to eight, despite the Venetian order of 1525 to reduce them to the original number. Nevertheless, exactly a century later, in 1625, six wheels (plus the saw) remained, and the Antonibon, Poan and Rossi families held the rights on them, with two wheels each. Later, the industrial complex expanded further, and in 1682 the Rossi family asked to add a forge near the sawmill.[46]

50 In the meantime, the number of plants had increased, and two of the wheels and the water rights to move them had passed from hand to hand, until they were purchased by the noble Priuli family of Venice, for 500 ducats each, in 1698. The Priulis added them to the ditches and mills (also used for textile machinery) that they already owned in the nearby town of Bassano and its rural villages. In 1670 the Roberti family built another complex of mills on the same "*roggia*", including a building with hydraulic wheels to move fulling machineries and other equipment for processing wool. They were converted for spinning silk "*alla bolognese*" (i.e., *Bolognese* style silk spinning water machinery) in the following year.[47] All these mills, with different industrial uses, were driven along the same main watercourse, implemented by secondary channelling strategies to maintain the flow rate. While this is not the place for an exhaustive description of the structures and industries involved, suffice it to conclude by pointing out how, starting with the initial analysis of a file belonging to the Antonibon family, the typological variety of the documents contained therein allowed to trace back information on the previous situation, and the exploitation of hydraulic energy for almost four centuries. Furthermore, the availability of writings, notarial deeds, and tax sources describe the transfers of ownership and possession of the motive power over time and between different families. Once these have been identified, access to the files relating to them expands the richness of the context, including the industrial environment in which the hydraulic power was moved. In certain cases, it is necessary for the historian to reconstruct the steps involved. Yet in other fortunate ones, it is also possible to find contemporary reconstructions, such as the collection of documents contained in a printed booklet, now in one of the Roberti files,[48] which was produced at the end of the 18th century as an addendum to a dispute over the rights and maintenance of the Nove's ditches complex; and which, like the individual documents produced by other claimants for other installations, contains information from the end of the 14th century.

51 In sum, the study of the documentation produced within the *Beni Inculti* magistrates' office – both the legal and institutional documentation relating to the granting of water-use rights, and the technical documentation – offers essential information for the study of hydraulic power within the early modern Venetian state. Such documents also make it possible to locate the areas most closely linked to this energy, as well as the progressive development of proto-industrial sectors – all from both a quantitative and qualitative perspective.

52 At the same time, the analysis can be broadened to include the long-term technological, political and cultural relations between the central power and the peripheral territories and actors, thanks to the set of sources and external matrix production (both public and private) included in the archive. It thus allows the researcher, after having identified the cases, sectors or regions to study, to extract crucial information for moving the research to the field.

46 ASVe, PBI, b. 494, fasc. "Giacomo Rossi, 1682".

47 ASVe, PBI, b. 493, fasc. "Roberti". The water used was also leased from the Venetian Emo family, who owned its rights.

48 ASVe, PBI, b. 493, fasc. "Stampa nobili signori Roberti [...] contro nobildonna Cattarina Balbi Angaran [...]".

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