

Analysis of trends and perspectives of adult education in the field of wastewater management in Germany and Italy

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Executive Summary

The water industry is essential to providing clean water, making those who work in this field essential, as without them people wouldn't be able to access this precious resource. Adult education has an important role from this point of view because it equips individuals with the skills and knowledge required on the labour market, especially in this field, which is not that popular. Encouraging dialogue between education and enterprises is essential not only to bring education closer to the environment, but also to tackle environmental challenges with a focus on wastewater.

Action is needed and therefore INADE aims at raising awareness, under the present challenges, about the need of skilled workforce in the field of environment / water treatment / management, at building capacity to work transnationally and at bringing the EU dimension at local level simply increasing the role of adult education.

The Italian water sector sustains a large and still very successful industrial sector. Nevertheless, education levels of the staff employed in industrial water management and treatment are insufficient to cope with future challenges arising from globalization, tightening legislation, digitalization, and other megatrends such as climate change.

One of the key factors that contributes to future risks of the industrial water sector is insufficient investment in water infrastructure and funds to operate and maintain the infrastructure at industries and municipalities.

Life-long learning and professional development are less common in Italy than in countries with comparable importance of the manufacturing industries such as in Germany. Italy also has very few professional water organisations such as the German DWA, DVGW and education organisations such as the BEW in North-Rhine Westphalia, which offer a broad range of formal and informal education programmes for professionals in all levels of education.

Specialized trainings such as the EQF Level 3 and 4 degrees in Germany have improved the quality of the education and the competence of the staff working in the water sector.

New opportunities arise from digitalisation of the education and the water sectors allowing to access employees in remote locations and optimizing operation and maintenance of water and wastewater systems. The recent developments based on artificial intelligence can further support the growth of efficient and targeted management and operation of water infrastructure but can also lead to massive job losses across a range of knowledge-driven sectors.

Several recommendations are given to develop the Modern Education Framework and transpose the findings of this report into application.

1 Introduction

1.1 General Background

Choosing a career can be difficult in the sense that with so many options, it might look complicated to make a decision. On the other hand, every human on this planet needs clean water to live, as water represents a primary resource. Working in the water treatment and management industry helps people contribute to the sustenance and development of our modern society in a meaningful way. Climate change, manifested with higher and lower rainfall patterns and higher summer temperatures has been posing a major challenge for water management across the EU, putting a lot of stress on scarce resources. It is fundamental to communicate the importance of developing appropriate and relevant skills for the water and wastewater industry and informing stakeholders and our target group about the labour market needs associated with the introduction of new technologies, trades and competences.

Adult education plays an important role in shaping the future of our society. Developing equal learning opportunities in present, has a powerful connection to sustainability in the future. Aging workforce is another key factor affecting the workforce growth in many western countries along with population decrease and massive school dropouts. Based on these facts it becomes mandatory to tackle the actual limitations and bottlenecks of the learning and training opportunities for adults, to better grasp the situation on the labour market in Italy and Germany and be able to design proper instruments to reach the set EU priorities.

“Projects like *ERASMUS Life skills* demonstrate that learning opportunities are more likely to encourage and motivate adult learners if they are related to local needs...”, true indeed but we must acknowledge that individuals will always want to see the relevance of what they learn. This is why adult education must not only be attractive for individuals who know what they are looking for, but also prove their relevance to current and future generations who risk their qualifications because of school leaving. School dropouts also threaten the workforce growth, which will surely slow down. Ageing workforce is becoming critical not only for the economy but also for policy makers trying to understand how to better protect workers of different age groups. This concern is actually related in part with the inability of the society to adapt to social, professional and mental developments. The demographic transition along with declining levels of fertility and a constant inferior percentage of the young generations has been causing unprecedented changes in the age structure of the population worldwide. It is the right moment to assess the situation as it might have a lasting impact on where and the way people work. Is the system aligned with the needs of adult learners? What about the labour market needs? Are adult learners now more aware of the importance of education and training? Are they willing to invest in it? Can they afford it?

1.2 Overall Objectives

Most developed countries are experiencing a growing gap between labour-market demand in key sectors and the availability of proper trained and qualified professionals. The adult education sector is affected by cuts in government budgets in most EU Member States, making

it a real challenge for adult education providers to maintain and improve the quality of their training programmes. On the other hand, privatisation and commercialisation of education make programmes less accessible due to high fees for course enrolment, therefore excluding those from more disadvantaged backgrounds. We are slowly witnessing a power shift from national structures of decision making to multilateral organisations, encouraging a form of standardization in education, somehow against the character of non-formal adult education that is often organised bottom-up by communities. Labour market needs are confronted with the introduction of new technologies, trades and competences fostering the development of emerging skills needed in the water sector, for the green transition of the water and wastewater industry. INADE aims to address these challenges by the following specific objectives:

- I. Blending German know-how in formal adult education, dual system, with Italian know-how in non-formal/ informal education.
- II. Refining high-quality learning opportunities for adults with a focus on environment and in particular wastewater as well as the role of the digital sector.
- III. Providing tools and recommendations that can be used for and with our target groups.

1.3 Tasks and Deliverables

INADE focuses on following tasks and provides the following deliverables:

A. Assessment of actual limitations of learning opportunities for adults

Review the existing German and Italian education system with a focus on the rising gap between labour-market demands, EU priorities in key sectors like environment/ water management/ wastewater and the availability of proper trained and qualified professionals. The purpose of the analysis is to offer the proper input in order to be able to design proper instruments helping reach the EU targets. The Analysis informs also on the possibilities and importance of recycling and reuse of industrial wastewater.

B. Concepts for an overarching framework transferable across the EU

Development of innovative and viable solutions which will contribute at improving the availability of high-quality learning opportunities for adults.

Deliverables:

1. An *analysis of actual limitations and bottlenecks of learning and training opportunities* for adults, how the problem can be tackled through transnational partnership.
2. The *MEF, a modern education framework for high quality learning opportunities* for adults adapted to adult needs, in the context of present EU challenges, incorporating digital utilities.

2 Methodology

The methodology applied for the analysis of the deficits and boundary conditions of the sector education and the development of the modern education framework follows a three-stage approach with the following individual steps (cf. Fig. 1):

- **Acquisition of basic data** including sector employment situation, economic outlook, demographic trends
- **Analysis of the problem** with a detailed review of the industrial sector, identification of present and future demand and an identification of the deficits of the education and training
- **Development of an action plan** as subsequent step in form of the modern education framework for high quality learning opportunities (MEF), which is presented in Deliverable 2.

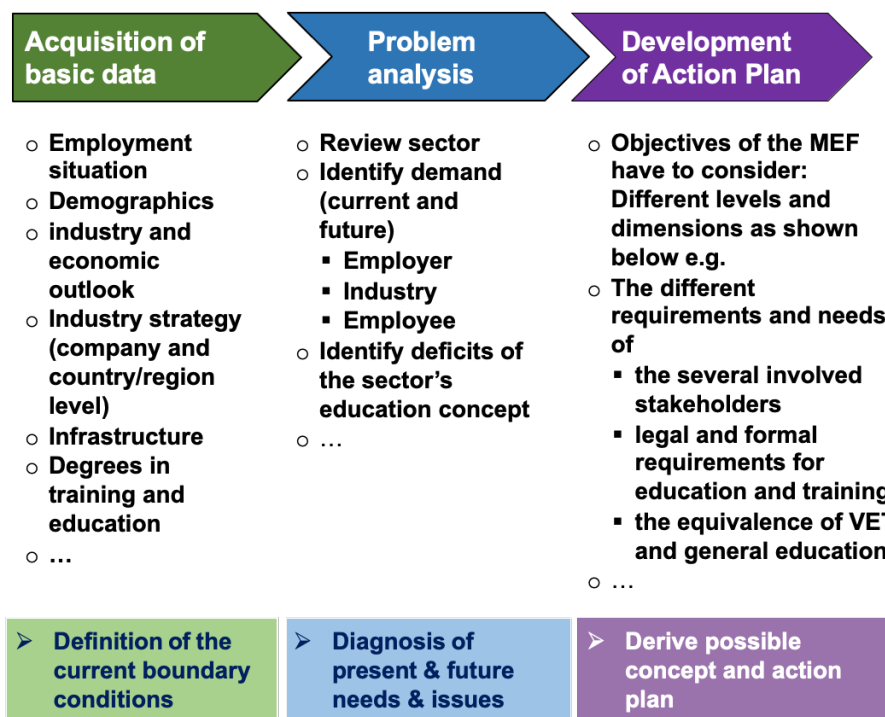


Figure 1 Workflow in action planning for the analysis of the deficits and boundary conditions of the sector education and the development of the modern education framework (MEF)

3 Analysis of the framework conditions

3.1 Situation of the water resources

3.1.1 Situation of the European water resources

Compared to other global regions, Europe avails of rather abundant water resources. While particularly northern Europe and many central and western European regions can rely on vast water resources, southern Europe and other parts of the continent are often exposed to water stress where water demand exceeds the available water supply, at least during certain periods of the year. In 2019 29% of the EU territory were affected by water scarcity at least during one season.

Water supply in the EU mainly relies on abstraction of surface waters such as rivers, reservoirs, and lakes as well as of groundwater. Since the year 2000 the total water abstraction in the EU decreased overall by about 15% with an increasing share of groundwater-based supply which in 2019 amounted to 23% of the abstracted water compared to 77% coming from surface water bodies (EEA 2022¹).

Table 1 Facts and figures of the European, German and Italian Water Sector

	EU	Germany	Italy
Population	446.83 million	84.27 million	60.21 million
Area of the country	4,223,262 km ²	357,592 km ²	301,230 km ²
GDP per capita	\$ 37,180	\$ 48,398	\$ 36,812
Available water	3 500 km ³ /a	188 km ³ /a	250 km ³ /year
Precipitation (average)	N/A	ca. 800 mm/a	832 mm/year
Water used	N/A	17.1 %	30 %
Water consumption	144 L/cap • a	128 L/cap • a	241 L/cap • year
Piped water supply	N/A	99 %	96 %
Connection to WWTP	82 %	97 %	65 %
No. water companies	N/A	6 000	1 200
No. of WWTPs	N/A	9 300	3 691
No. of employees	N/A	100 000	39 000 (water & gas)
Main water user	agriculture / industry	energy / industry	agriculture / industry

¹ EEA 2022 Water abstraction by source and economic sector in Europe, <https://www.eea.europa.eu/ims/water-abstraction-by-source-and>

In 2005 for Europe as a whole, the largest share of the abstracted water (38%) was used in agriculture, while domestic uses, industry and energy production accounted for 18%, 11%, and 33%, respectively, with significant differences across the European regions.

In most Mediterranean countries, around 50 to 80% of the abstracted water is used for agriculture, whereas in the central and northern countries agricultural use of the abstracted water is limited to less than 5%. The large amount of water dedicated to irrigation in the southern countries is problematic since most of these countries have been classified as water stressed, and face problems associated with groundwater over-abstraction such as aquifer depletion and saltwater intrusion as well as increasing stakeholder competition between agricultural water use often at low to nil cost and industrial water use at ever increasing cost involving alternative water sources such as recycled water and desalination.

The total renewable freshwater resource of a country is the total volume of river run-off and groundwater recharge generated annually by precipitation within the country, plus the total volume of actual flow of rivers coming from neighbouring countries. Dividing the total renewable freshwater resource by the number of inhabitants leads to water availability per capita. Thirteen countries have less than 5,000 m³/capita/year while Nordic countries generally have the highest water resources per capita. The Mediterranean islands of Malta and Cyprus and the densely populated European countries, i.e., Germany, Poland, Spain and England and Wales, have the lowest water availability per capita. The water availability is an annual data which therefore does not reflect at all seasonal variations.

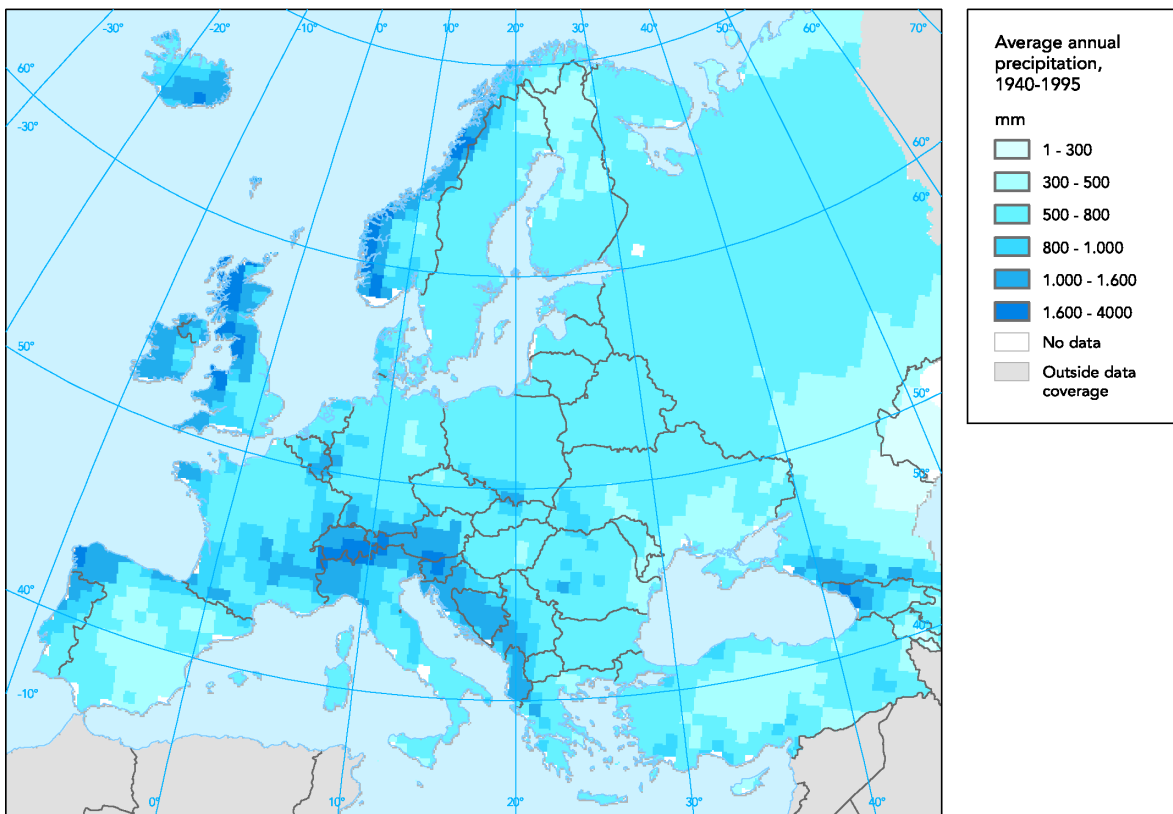


Figure 2 Average annual precipitation in Europe (EEA, 2012, <https://www.eea.europa.eu/data-and-maps/figures/average-annual-precipitation>)

As shown in Fig. 2, some regions Europe are quite water-rich sustaining large industrial clusters which involve high water consumption such as in chemical and pharmaceutical industries. In Germany for example, the water withdrawal for industry and power supply amounted to 33.04 km³ (equivalent to 85% of the total withdrawal), and even in Italy the total water for industry amounted to 16.3 km³ against 12.9 km³ for agriculture (equivalent to 30% and 23% of the total withdrawal). The western part of Germany as well as northern Italy receive high amounts of rainfall and benefit from the water supply from large rivers such as the Rhine River and the Po River both fed from the precipitation-rich alpine region.

The water use by industry is particularly high in Germany, Italy, the Netherlands and Sweden and is mainly covered through self-supply and to lesser degree from public water supply.

Table 2 Water use in the manufacturing industry (NACE) by supply category (2000-2020) in million m³ (Eurostat, 2022²)

	Public water supply					Self and other water supply				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Belgium ^(e) (e)	111.9	108.7	104.1	90.3	93.5	1 548.7	1 279.6	1 266.1	999.1	1 088.6
Bulgaria	64.9	46.4	34.1	31.5	25.7	462.2	293.2	185.8	186.3	186.9
Czechia ^(*)	:	:	:	:	:	:	314.0	243.7	226.7	203.1
Denmark ^(*)	:	:	36.1	39.8	35.1	:	:	23.5	22.8	25.8
Germany ^(*)	360.2	349.6	318.2	355.7	:	:	:	4 337.1	4 060.0	:
Estonia	:	:	7.0	7.9	7.4	:	:	21.0	28.0	58.9
Ireland	:	:	:	:	:	:	:	:	:	:
Greece ^(*)	:	:	73.4	73.4	120.5	:	:	116.1	116.1	65.0
Spain ^(e) (e)	371.7	435.3	334.0	317.5	359.8	1 416.5	1 047.7	739.0	624.7	624.7
France	:	:	:	:	:	:	:	:	:	:
Croatia (e)	12.8	12.8	12.3	11.0	11.3	95.0	95.8	95.4	97.0	93.6
Italy	:	:	:	323.8	:	:	:	:	3 418.6	:
Cyprus ^(*) (s)	:	2.6	2.7	1.9	2.0	19.1	2.6	2.6	1.3	1.8
Latvia	2.7	0.9	0.2	0.5	0.3	27.0	24.1	19.4	13.8	10.1
Lithuania ^(*)	:	8.0	8.1	9.2	10.4	:	33.1	26.2	31.1	32.8
Luxembourg	:	:	:	:	:	:	:	:	1.9	3.5
Hungary ^(*)	35.3	11.4	6.5	6.3	8.5	:	:	:	:	:
Malta (e)	2.7	2.4	1.9	2.0	2.3	1.0	1.0	1.0	1.0	1.0
Netherlands ^(*) (*)	215.0	142.8	138.0	128.3	144.6	3 091.6	3 440.6	3 575.7	2 908.9	3 102.3
Austria	:	:	:	:	:	:	:	:	:	:
Poland	26.4	20.3	12.5	18.7	21.2	744.5	650.8	615.2	640.6	621.7
Portugal ^(*)	:	8.1	17.1	:	:	:	:	280.6	:	:
Romania	:	:	:	:	:	:	:	:	:	:
Slovenia	19.0	12.4	9.4	9.3	10.8	:	:	:	40.8	37.1
Slovakia	:	:	:	:	:	:	:	:	:	:
Finland	:	:	:	:	:	:	:	:	:	:
Sweden	90.0	102.0	107.0	53.0	:	1 906.0	1 893.0	2 071.0	1 729.0	:
Iceland ^(*)	5.0	:	:	:	:	:	:	:	:	:
Norway ^(*) (e)	833.0	185.4	165.1	:	:	:	969.0	862.1	:	:
United Kingdom ^(*)	:	:	263.0	:	:	:	:	:	:	:
North Macedonia ^(*)	38.5	:	:	:	:	:	:	:	:	:
Albania	:	:	:	:	2.0	:	:	:	:	2.2
Serbia	39.8	36.6	14.8	13.5	15.0	122.5	153.0	117.4	107.5	67.9
Turkey ^(*) (*)	23.5	50.3	74.5	44.4	47.3	1 446.4	1 173.3	1 615.0	2 353.9	2 760.0
Bosnia and Herzegovina	:	:	:	:	:	:	:	44.4	66.2	52.7
Kosovo* ^(*)	:	:	5.5	4.8	6.1	:	:	:	:	:

(:) not available;

(e) estimated data (Belgium: 2005 - 2020 ; Spain: 2000, 2005 and 2020; Norway: 2005 and 2010; Croatia: 2010 - only for self and other supply)

(s): 2020 - self and other water supply: Eurostat estimate

(*) 1999 data instead of 2000 data

(*) 2001 data instead of 2000 data

(*) 2004 data instead of 2005 data

(*) 2006 data instead of 2005 data

(*) 2009 data instead of 2010 data

(*) 2011 data instead of 2010 data

(*) 2014 data instead of 2015 data

(*) 2018 data instead of 2020 data

(*) 2019 data instead of 2020 data (Cyprus: only for public water supply)

(*) 2020: provisional data

² https://ec.europa.eu/eurostat/statistics-explained/images/6/6a/Tab_4_-_Water_use_in_the_manufacturing_industry_%28NACE_C%29_by_supply_category%2C_2000-2020_%28million_m%29.png

3.1.2 Water resources in Italy

In Italy 100% of the urban population and 97% of the rural population have access to water. 20% of the bathing water does not satisfy bathing water standards. 70% of the population has access to sanitation. Water supply is becoming a social and economic emergency in the South, such as in Apulia, Basilicata, Sicily and Sardinia, primarily because of increasing water demand and lack of management practices. Further associated decreases in mean precipitation could aggravate this situation. Water stress might increase by 25% in this century.

In Italy, the total meteoric inflow is of about 300 billion m³/year (data of Regione Emilia Romagna). The highest percentage of these precipitations, a little more than 40%, is concentrated in the northern regions, 22% in the central ones, 24% in the southern regions and just 12% in the two largest islands, i.e. Sicily and Sardinia. The water resource availability, however, is estimated to be only 58 billion m³/year, 72% of which derivable from surface resources (springs, rivers, lakes), while 28% from underground resources (water tables close to the surface). Almost 53% of the utilizable surface resources are localized in northern Italy, 19% in central Italy, 21% in southern Italy, and 7% in the two largest islands.

Moreover, about 70% of the underground resources is localized in the large flood plains of northern Italy. Not many underground resources are utilizable in southern Italy, being confined in the short stretches of coastal plains and in a few inner areas. These data confirm the uneven distribution between northern and southern parts of the country and the reduction trend caused by the concurrent decrease in precipitation and increase in evapotranspiration and water utilization.

Vulnerabilities - Italy

The expected impacts of climate change on water resources across southern European regions include further reductions in quantity, quality and availability, with increasing frequency and intensity of droughts, especially in summer. In particular, an increasing frequency and severity of river flow droughts could occur, with annual river flow decline and possible summer water flows reduction by up to 80%. Also, groundwater recharge shows a declining trend, with consequent shrinking of fresh groundwater resources, especially in coastal areas.

In many parts of Italy, particularly in the south, it has become ever more difficult to meet demand for water. The recent years of drought and the constant increase of water demand for the civil sector have made irrigation supply more problematic. Wastewater reuse could represent a viable solution to meet water demand. Several projects on wastewater reuse are implemented. Also, desalination will probably play an important role in water supply of coastal regions as it is the case in several other Mediterranean countries such as Malta, Cyprus, Spain and Israel.

Figure 3 presents a SWOT analysis of the Italian water sector. Scarce investments and old infrastructure present a critical burden of the water sector, particularly in public-private partnerships. The global competition amongst regions and the increasing influence of large corporates further increase the pressure on the water sector and the risk of inadequate investments on infrastructure and payment of staff for design, construction and management.

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • Starting from 1994 the industry was gradually regulated, defining optimal areas to be served (ATO), tariff method and identifying an independent authority (AEEG) • A process of mergers and aggregations involved several utilities in the last decades • It is possible to adapt different governance models, from direct management by municipalities to public, mixed and private utilities 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • Scarce investments per capita and old infrastructure • Tariffs too low • Geographic fragmentation still remains high • Large impact of geographical features on efficiency and investments • Poor performance of public-private partnerships in terms of investments • Scarce attention of public-private partnerships to water savings and to disclosure on water quality
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • EU policies will induce the Italian government to pay more attention on water issues • Firms can improve their efficiency through a process of growth, getting scales economy • Private investors would positively affect efficiency through new management practices • Great need of water education for more sustainable use 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • The global economic downturn affects negatively investments • The unstable legal framework reduces the attractiveness of the water industry • The increasing exploitation of water by citizens and firms raises the risk of shortages in some regions

Figure 3 SWOT Analysis of the Italian water sector

Adaptation strategies to water stress

Adaptation strategies in Italy include:

- the promotion of water labelling of goods and products,
- water emergencies regulations in order to address water crises, providing both technical and financial support for emergency measures,
- ad hoc organizations for crisis management, (like a “Drought control room” for drought events in the Po River basin, and a “Coordination Unit for the management of water resources” shared between Puglia and Basilicata regions) in order to regulate the use of water and take the necessary measures to prevent water crises,
- a number of structural funds include irrigation networks as well as drinking-water distribution networks, not only for water emergencies; in terms of cohesion funds, Italy has a water programme, useful for water crisis prevention too,
- a National Plan for irrigation that involves water management and allocates specific funds to tackle the effects of extreme events (including droughts). Measures include voluntary actions for water economies in agriculture through a pact with agriculture organizations, and avoiding the exploitation of waterbeds in the neighbourhood of wetlands of high natural value,
- plans to combat drought and desertification.

Wastewater treatment

Italian households including certain industries generate in 3034 urban areas around 15.6 million m³ equivalent to 78.0 million population equivalents of wastewater (EC 2022). The European Urban Wastewater Treatment Directive (UWWTD, 91/271/EEC) stipulates that wastewater needs to be treated before discharge to avoid pollution to the environment. Also, for water reuse an appropriate treatment of the wastewater before upgrading the effluent to the required recycled water quality is essential. In Italy, the urban wastewater is treated in 3691 plants across the country before it is discharged.

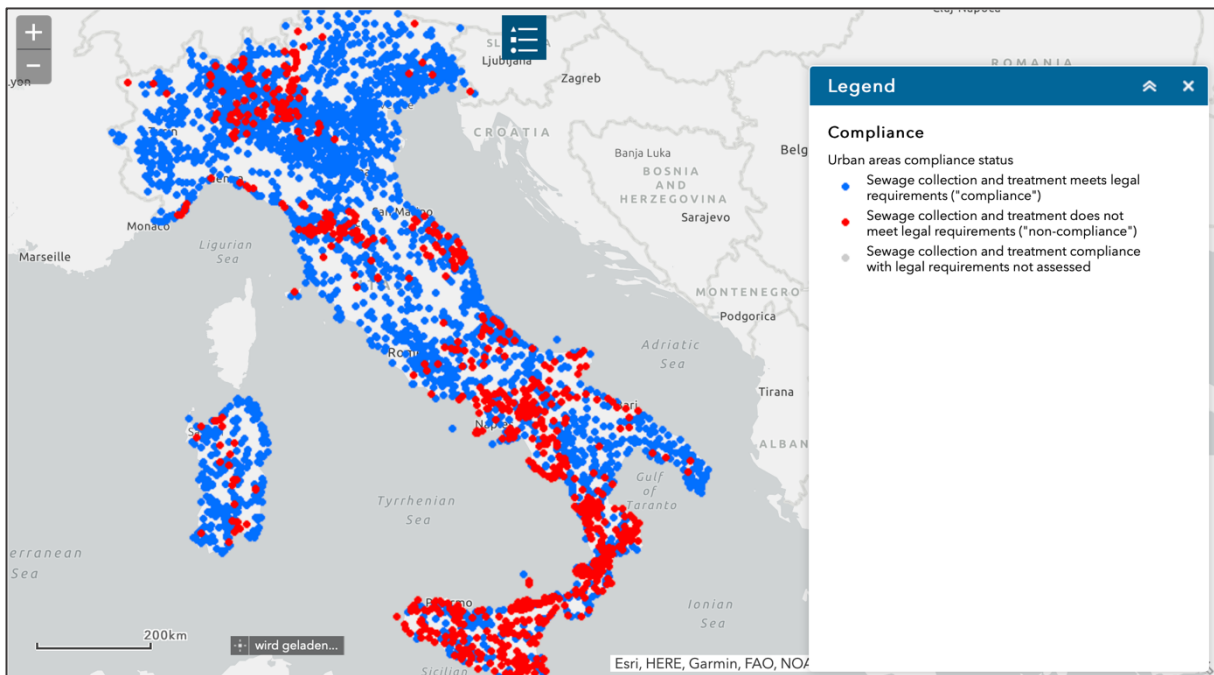


Figure 4 Urban areas in Italy non-compliant with the legal requirements of the UWWTD (EC 2022, WISE FRESHWATER³)

Figure 4 highlights the shortcomings of urban areas meeting the requirements of the UWWTD. It becomes obvious that many regions of the country from the rich North to the more South in particular fail to meet the legal requirements (cf. Fig. 5). Amongst the old member states of the EU, Italy has the highest degree of non-compliance.

The ongoing revision of the UWWTD will further tighten and extend the treatment requirements further increasing the pressure on the Italian wastewater sector.

³ <https://water.europa.eu/freshwater/countries/uwwt/italy>

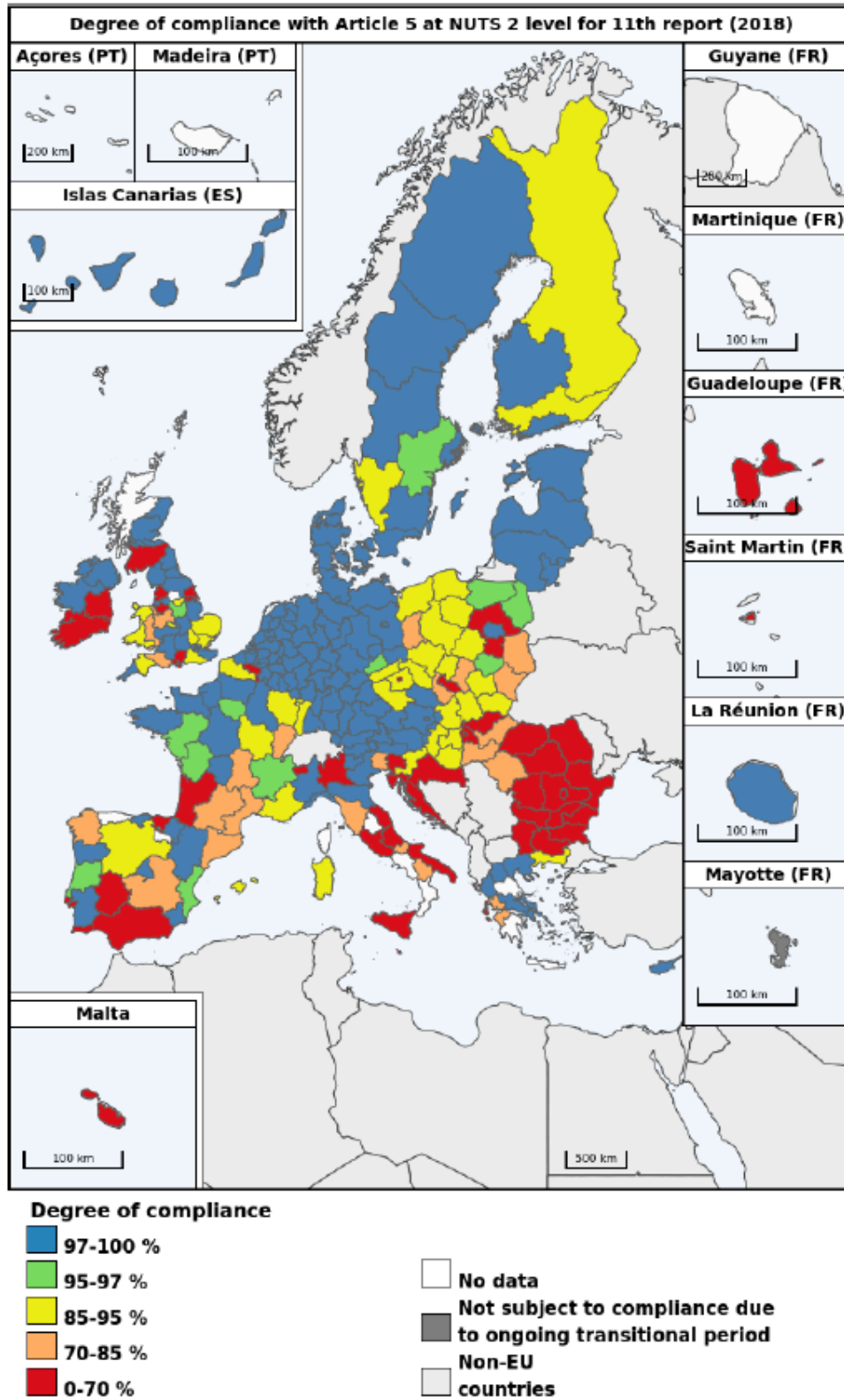


Figure 5 Compliance with UWWTD Art. 5 (European Commission, 2018)

3.2 Demographic development

3.2.1 Population and aging society

According to EUROSTAT, on 1 January 2022, there were 446.8 million people living in the European Union (EU). The most populous EU Member State is Germany, accounting for 19 % of the EU total population, while Italy represents 13%. (Table 2). As shown in the chart below, there is a negative balance for both countries, with a notable difference. The negative balance, behind its numbers, reflects a long-term development that has been apparent for several decades in Europe, respectively an aging population. Often perceived as a threat to the future of our society, the fact is that in 2020, the EU population aged 65 and over totalled for 20% (in Italy 23%, Germany 22%), compared to 16% in 2001. The major problem is that the number of older people is increasing while the number of young people is declining. Many countries, including Germany and Italy are struggling with the demographic realities that eventually affect the composition and proportion of the workforce, causing a skill shortage.

Another way of understanding the trend of the ageing society is by looking at the median age, which has substantially increased in time, from 38 years in 2001, to 42 years in 2011 and 44 years in 2021, with the highest rates in Italy (48 years), Germany, Portugal and Greece (all 46 years). An aging population means an aging workforce that may lead to a conflict of interests between younger and older workers.

On the other hand, an aging population has to face many challenges at different levels such as economic, cultural, political, but also in relationship with the society itself. The rate of natural increase of a population depends on the birth and death rates, which are strongly influenced by the population age structure.

Over the years though, the number of births in the EU has been declining at a relatively steady pace. The young generation (0 to 19 years old) has decreased from 23% in 2001 to 20% in 2020 (in Italy 17,7%, Germany 18%)⁴. Among the Member States, the largest decreases in the number of live births between 2001 and 2020 were recorded in Portugal (-25 %) and Italy (-24 %). During the same period, the number of deaths has increased, lately of course, due to the impact of the COVID-19 pandemic.

Overall, the data emphasises the demographic profile, characterized by an aging population resulting from the decrease in birth rates and the increase in the number of elderly people. Consequently, the present demographic changes will have in the near future a great impact on the composition of the workforce. The aging workforce impacts on national productivity, economic growth and global competitiveness, because their contribution to the labour market affects not only the economic and social well-being of themselves, but also the standard of living of current and future generations. With an aging population and a shrinking young generation, it becomes a huge policy challenge focused on an impetuous investment in a new generation of education and infrastructure.

⁴ Source: Eurostat: Demografia in Europa – visualizzazioni statistiche, Unione Europea 2021, pag.7

Table 3 Demographic balance in thousands per 2021 (Eurostat, 2022; online data code: demo_gind)

	Population, 1 January 2021	Live Births	Deaths	Natural change (¹)	Net migration and statistical adjustment (²)	Total change between 1 January 2021 and '22	Population 1 January 2022
EU	447 000.5	4 066.1	5 297.5	-1 231.4	1 059.7	-171.7	446 828.8
Belgium	11 554.8	118.3	112.3	6.0	70.4	76.4	11 631.1
Bulgaria	6 916.5	58.7	149.0	-90.3	12.7	-77.6	6 838.9
Czechia	10 494.8	111.8	139.9	-28.1	50.0	21.9	10 516.7
Denmark	5 840.0	63.5	57.2	6.3	27.1	33.4	5 873.4
Germany	83 155.0	795.5	1 023.7	-228.2	310.3	82.1	83 237.1
Estonia	1 330.1	13.3	18.6	-5.3	7.0	1.7	1 331.8
Ireland	5 006.3	58.4	33.1	25.4	28.3	53.7	5 060.0
Greece	10 678.6	85.3	143.3	-58.0	-16.8	-74.8	10 603.8
Spain	47 398.7	336.2	449.3	-113.0	147.1	34.1	47 432.8
France	67 656.7	738.6	657.1	81.5	104.4	185.9	67 842.6
Croatia (³)	4 036.4	36.5	62.7	-26.2	-131.1	-157.3	3 879.1
Italy	59 236.2	399.4	709.0	-309.6	56.5	-253.1	58 983.1
Cyprus	896.0	10.2	7.1	3.0	5.7	8.7	904.7
Latvia	1 893.2	17.4	34.6	-17.2	-0.3	-17.5	1 875.8
Lithuania	2 795.7	23.3	47.7	-24.4	34.7	10.3	2 806.0
Luxembourg	634.7	6.7	4.5	2.2	8.5	10.7	645.4
Hungary	9 730.8	94.0	156.1	-62.1	20.4	-41.8	9 689.0
Malta	516.1	4.4	4.2	0.2	4.6	4.9	521.0
Netherlands	17 475.4	179.4	171	8.5	106.8	115.3	17 590.7
Austria	8 932.7	86.1	92.0	-5.9	52.1	46.3	8 978.9
Poland	37 840.0	331.5	519.5	-188.0	2.3	-185.8	37 654.2
Portugal (⁴)	10 298.3	79.6	124.8	-45.2	99.0	53.8	10 352.0
Romania	19 201.7	178.5	334.5	-156.0	-7.6	-163.6	19 038.1
Slovenia	2 109.0	19.0	23.3	-4.3	2.5	-1.8	2 107.2
Slovakia	5 459.8	56.6	73.5	-16.9	-8.2	-25.1	5 434.7
Finland	5 533.8	49.6	57.7	-8.1	22.5	14.4	5 548.2
Sweden	10 379.3	114.3	92.0	22.3	50.7	73.0	10 452.3
Iceland	368.8	4.9	2.3	2.5	4.9	7.5	376.2
Liechtenstein	39.1	0.4	0.3	0.1	0.1	0.3	39.3
Norway	5 391.4	56.1	42.0	14.1	19.8	33.9	5 425.3
Switzerland	8 670.3	89.6	71.2	18.5	47.8	66.2	8 736.5
Montenegro	620.7	7.0	9.2	-2.1	-0.9	-3.1	617.7
N. Macedonia (³)	2 068.8	18.6	28.5	-9.9	-222.2	-232.1	1 836.7
Albania	2 829.7	27.2	30.5	-3.3	-32.9	-36.1	2 793.6
Serbia (⁵)	6 871.5	62.2	136.6	-74.4	0.0	-74.4	6 797.1
Turkey	83 614.4	1 079.8	:	:	:	1 065.9	84 680.3
Bosnia & Herzeg.	:	:	:	:	:	:	:
Kosovo (⁶)	:	:	:	:	:	:	:

(-) Not available

(¹) Live births minus deaths

(²) Total change minus natural change

(³) The negative statistical adjustment in 2021 is due to the use of the population data from Census 2021

(⁴) Population on 1.01.2022 is based on the provisional results of the Census 2021

(⁵) Due to a lack of data on migration, the demographic balance is based exclusively on the natural change

(⁶) This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

A shrinking young generation is not only an issue in Italy, but a European problem. In 2021, 15 % of the population was aged below 14, compared with 17 % in 2001, a decrease of 2 percentage points (p.p.). The share of the age group 15-19 in the total EU population was 5% in 2021, compared to 6 % in 2001, a decrease of 1 p.p. In 2021, the share of children aged below 14 was highest in Ireland (20 %), France and Sweden (both 18 %), and lowest in Italy, Portugal and Malta (all 13 %). These conditions though are best reflected in the education system.

3.2.2 Education system in Italy

In Italy, education is mandatory until the age of 16, this is why when completing the lower secondary education, all children aged 14 need to choose between four different schools: high school, technical education, vocational education and leFP. Their choice will eventually reflect on their skills development and also occupational attainment in future.

The situation of the pupils registered in the upper secondary education public schools, in the academic year 2020/2021, shows that half opted for the general education (high school), 31,5% for technical education and 18,1% for vocational education, with the major participation in Lombardy (386.862 pupils)- See Annex table 8. Analysing the statistical data provided by the Ministry of Education we notice that while the technical education has been almost constant, the variations are between the general education and the vocational one, with a sensitive increase, by almost 4% of the vocational education. The warning given by the statistical data regarding vocational education, underlines that only 0,1% chose the water management and environment sector, slightly less than 2019/2020 when it was 0,2%.

Generally, there has been a continuous decreasing trend in the number of pupils enrolled. The report of the Ministry of Education⁶ outlines for the year 2019/2020 a drop by 23.000 pupils in primary school, respectively 4,6% while in secondary school by 20.000 pupils, which totals for 2,75% less compared to the academic year 2018/2019.

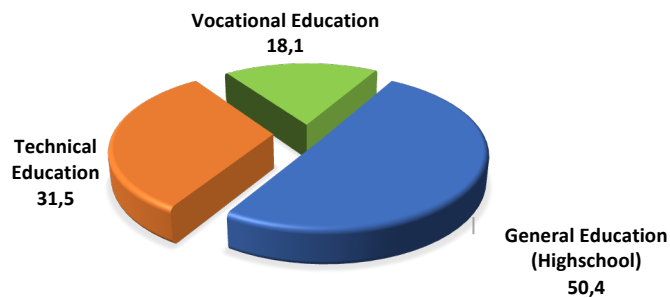
There are 91.775 less pupils in the academic year 2020/2021, respectively in pre-primary, primary and secondary education and, on the other hand 10.000 more pupils with disability. This is actually the sector where Italy invests the most. While the expenditure on tertiary education in 2019 was 8%, half the EU average (16%), the share of expenditure allocated to pre-primary, primary (36%) and to secondary education (47%) is above the EU average of 33% and 39% respectively. Even so, Italy's expenditure on education changed in time. In 2019 Italy invested 3.9% from its GDP, even less than in 2009 (4.5%), compared to the EU 4.7%. The total general government expenditure was 8% compared to 10% in the EU. Investment reaches education not only in terms of quantity, meaning amount of money invested, but also in terms of quality, respectively spending in the right direction. The general objective should be to support the mission of education: offering everybody equal opportunities, but what often happens is that financing reaches more the privileged/ good ranking schools and universities, thus failing to reduce the inequalities between them. In addition, due to increasing privatization

⁵ MIUR, Gestione Patrimonio Informativo e Statistica, *Focus "Principali dati della scuola – Avvio Anno scolastico 2020/2021"*

⁶ MIUR, Gestione Patrimonio Informativo e Statistica, *Le iscrizioni al primo anno dei percorsi di istruzione e formazione, Anno scolastico 2019/2020*

and commercialization of adult education, it becomes more and more difficult for the public sector to sustain funding and provide good quality of education. This is even more the case, especially since statistical data shows that the registration to universities (age group 19-25) is decreasing too, contributing at an alarming trend for the future available/competent workforce. According to the data from the Ministry of Education and Research, Italy faced in the 2021 academic year 3,3% less students enrolled compared to 2019, first time after the positive trend which began in 2013/2014.

Pupils in secondary education according to type of Education- academic year 2020/2021



Upper secondary education- developments

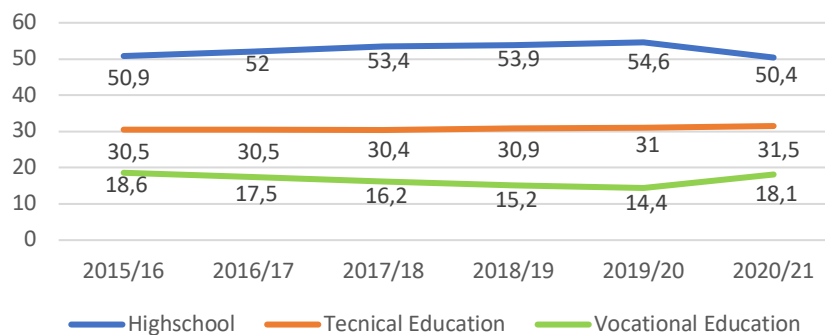


Figure 6 Pupils in secondary education developments

In 2020, despite the chaos caused by the coronavirus and the need for online classes, for which nobody was ready, there has been an increase by 5% to graduate programs, meaning there were 330,898 new entrants to a degree course, out of 463,000 Matura graduates compared to 313,141 in 2019. One year later, however, enrolments are 3.3% less. Despite improvements in completion rates and in the average duration of studies, Italy’s tertiary educational attainment rate continues to lag behind the rest of the EU. In 2020, the share of 25–34 year-olds with tertiary educational attainment was the second-lowest in the EU at 28.9%, below both the EU average of 40.5% and the new EU-level target of at least 45% by 2030. Although the economically strong regions of Italy are projected to receive a population increase in the decades to come (cf. Fig. 7), the situation is amplified by the high rate of the NEET (Not in Education, Employment or Training), associated with its assumed potential to address a broad array of vulnerabilities among youth, touching on issues of unemployment, early school leaving and labour market discouragement. This socio-economic phenomenon is

not a new one and the Italian government warned about a “lost generation” already in 2016, when referring to this particular group.

After falling steadily in recent years, the share of young people aged 15-24 not in education, employment or training has grown in the current crisis, from 18.1% in 2019 to 19% in 2020, compared to the EU average 11.1%⁷. Of particular concern is the 25-29 age group, where the proportion of NEETs in 2020 was 31.5%, significantly higher than the EU average of 18.6%. Even with the positive trend, the outbreak of the pandemic has reversed this tendency again, resulting in a significant increase in the percentage of NEET in the European Union. A recent study carried out in 2021 by the consortium AlmaLaurea shows that from 196.558 graduates interviewed one year after their graduation, more than 40% were not working and not interested in looking for a job. The information should not be overlooked, but carefully used in the view of new possible reforms necessary for updating the system.

Learning and career guidance become an important element for defining processes and activities that support individuals to make decisions or informed choices about their education, training and work pathways. The basic purpose of career guidance is to acquaint individuals with their occupational choices. Students need it in order to better plan for their future career endeavours based on their skills and interests, thus enhancing the conformity between academic and career experiences.

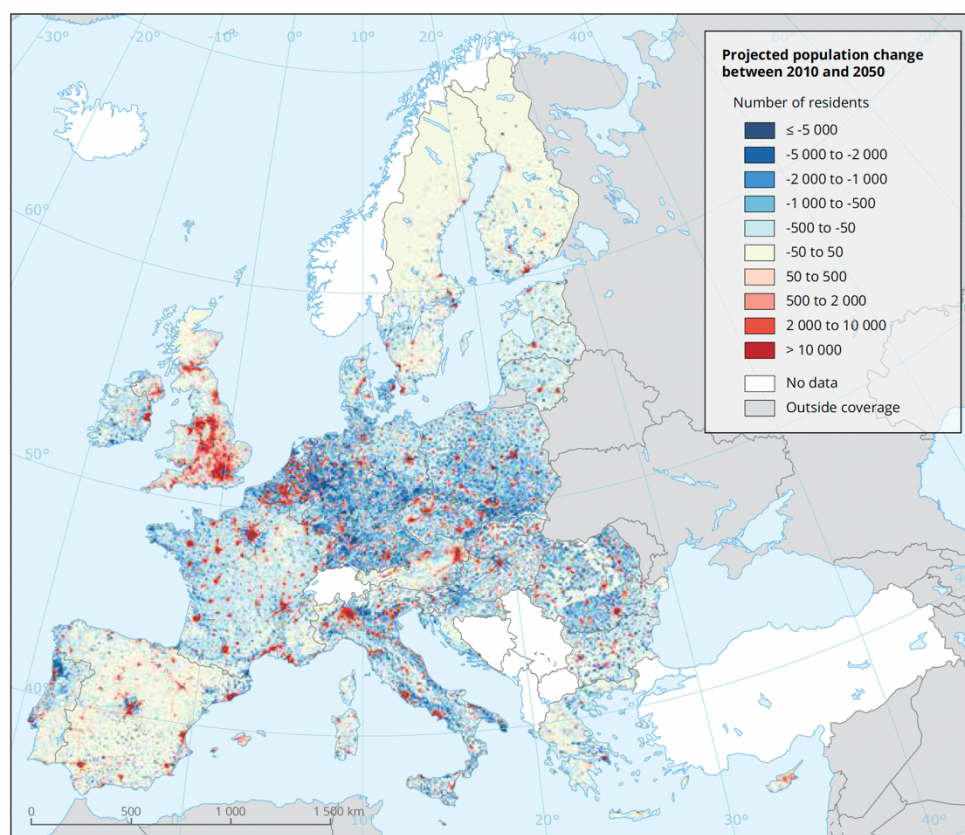


Figure 7 Projected population change in Europe between 2010 and 2050 (Kompil et al. 2015)

⁷ European Commission, Education and Training Monitor 2021, <https://op.europa.eu/webpub/eac/education-and-training-monitor-2021/en/italy.html>

3.3 Socio-Economic Conditions

Regional discrepancies are common across the world, and according to statistical data they began to deepen in the European Union in 2008, with the financial and economic crisis. Similar to Germany, Italy is marked by significant structural and economic contrasts in terms of economic performance, demographic patterns and institutional quality. Vast areas of Northern Italy are characterised by urban growth poles and labour markets offering attractive living conditions. The on-going migration to the North causes a lot of pressure on the infrastructure systems and the need to diversify the employment opportunities. The North-South disparities in particular with respect to the labour market, make opportunities and equality for all individuals regardless of their economic and social background a difficult task.

With a declining share of young citizens, who are likely to be most technologically dynamic, the socio-economic conditions are directly influenced by the unemployment rate. In September 2021, the youth unemployment rate in Italy was 29.8%. Although the 2008 labour market crisis affected the entire Italian working population, it particularly impacted the youngest. Between 2008 and 2014 alone, the share of unemployed individuals aged between 15 and 24 years increased by more than 15%. Despite a steady decline observed after 2014, youth unemployment was almost 30% in 2020. The good news is that the reopening of the economy after the COVID-19 restrictions contributed to a solid output growth in the second quarter of 2022. And yet, many Italian SMEs force young graduates to emigrate, considering their preparation too academic for the labour market needs.

The problem lies in the fact that work and career pathways in general, have undergone lately significant transformations due to social, economic, but mostly due to latest technological developments. By consequence, the labour market has become a dynamic and complex environment demanding of new skills, competencies, and attributes. Since the rapid changes did not go with proportional investment and innovation in education, hence the inequalities. Most studies show that education is the driving element for people to be successful, to have the necessary prerequisites to compete on an increasingly competitive labour market, overall offering high potential for personal development and reorientation on a transforming labour market.

Geographical mobility has always been a reality during the history of humankind, but with the latest demographical variations, international migrations become an important factor in the transformation of societies, as they are significantly changing the demographic profile of the native societies, especially those characterised by aging and demographic decline like Italy and Germany. In 2020 as a matter of fact, according to Eurostat⁸, 22% of all immigrants into EU Member States were recorded in Germany (729 thousand persons), 14% in Spain, 9% in France and 8% in Italy (247 thousand). Immigrants into these four Member States made up for more than half of all immigrants entering EU Member States in 2020.

In the past 10 years, the number of Italians leaving the country has been constantly growing, outnumbering the ones who decide to come back (980,000 expatriates compared to 400,000

⁸ Eurostat – immigration,
https://ec.europa.eu/eurostat/databrowser/view/MIGR_IMM1CTZ__custom_900456/bookmark/table?lang=en&bookmarkId=82bf2523-a514-4caa-9cfc-88c060f91729

repatriates), thus leaving a negative balance between expatriates and repatriates of approximately 69,000 units per year from 2015 onwards. The Istat report on 2020 shows that of 160,000 Italians who left the country, 1 in 3, so more than 40,000 are aged between 25-34 and almost half (approximately 18,000) which totals for 11%, have a tertiary education. In the light of 2020 travel restrictions, the number of Italians migrating to main EU countries did not change substantially. Compared to 2019, there has been an 18% increase of Italians leaving to the United Kingdom (36,000 people), and an 15% increase to Belgium, while to Germany amounted to 17,000, decreasing by 12%. The flow of emigrants to the United Kingdom increased in 2016, once Brexit was announced and had been growing until 31 December 2020, when Great Britain officially left the EU. The situation was due to the fact that many Italian citizens, probably already present in the UK, did not registered as residents, and formalised their position later on, once they understood that Brexit was becoming a reality. Such numerous exits, probably regularisations, have never been followed by a significant number of repatriations to Italy until 2020, the year in which approximately 10.000 Italians moved back from the UK. The problem lies in the fact that the more highly skilled Italians leave, the worse the domestic economic performance, which perpetuates the tendency for future generations to also leave.

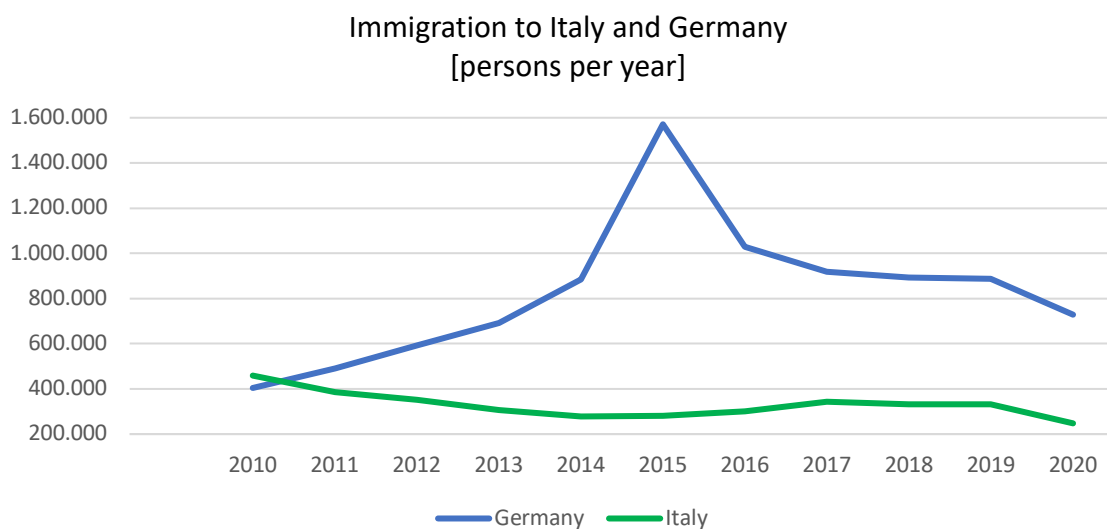


Figure 8 Immigration in Italy and Germany

Building upon these realities, the United Nations carried out a study focusing on population decline and population ageing. Ever since the publication of the influential study, already in 2001, on “replacement migration” (1) this notion has noteworthy entered the public as well as the scientific debate over migration. The new challenges of declining and ageing populations require comprehensive reassessments of many established policies and programmes, including those relating to international migration. Focusing on these critical trends, the United Nations report considers replacement migration for eight low-fertility countries (Germany, Italy, France, Japan, Republic of Korea, Russian Federation, United Kingdom and United States) and two regions (Europe and the European Union). Replacement migration refers to the

international migration that a country would need to offset population decline and population ageing resulting from low fertility and mortality rates.

Therefore, migration becomes a challenge both for those who leave but also for hosting countries. In this context, education is an important step that characterises the path of immigrants. The transition becomes crucial for young immigrants, for whom education represent also a measure of their integration. From early 2000s, Italian schools have been experiencing a steady increase in the number of enrolments of foreign citizens along with, as already explained, a downward trend in the number of Italian pupils. According to the data provided by the Ministry of Education, in the academic year 2020/2021 overall, there were 10% of pupils with foreign citizenship in the public Italian schools, respectively 12,7% in pre-primary education, 12,8% in primary education, approximately 11,7% in lower secondary education and 7,6% in secondary education⁹.

The National Institute for the Evaluation of the Education and Training System (INVALSI) analysed how foreign pupils/ students engage in education, to understand if they have the same aspirations for the future compared to their Italian counterparts¹⁰. The Study describes the Italian approach, which is based on the integration of diversity in an educational system which is structurally inclusive, operating in two ways, promoting welcoming environments for both Italian and non-Italian pupils, respectively identifying teaching strategies to encourage the inclusion of foreigners in Italian schools, such as teaching Italian language L2 or intercultural activities. Both ways play a significant role to guarantee everyone a full chance of educational success and the free choice to develop their talents and interests. According to literature, school expectations and school attainment are strongly related. Analysing the statistical data provided by the European Commission in the Education and training monitor on 2021, it appears that most early leavers from education and training, aged 18-24 are the non-EU born, respectively 35.2% in 2020. Even so, the situation is slightly better compared to 2010 when they reached 44.4%, but there is still a way to go in order to reach the EU 2030 target, respectively < 9%. Despite improvements in completion rates and in the average duration of studies, Italy's tertiary educational attainment rate continues to lag behind the rest of the EU. It is important to underline the fact that tertiary attainment is particularly low among the foreign-born population, respectively 13.6% against the EU average of 36%.

In other words, the pace at which technology and science are changing daily life makes it necessary to engage with new knowledge throughout life: lifelong learning. In our society, shaped by digital progress, learning is the prerequisite for securing a broad-based standard of living worth living for. The willingness for lifelong learning requires a corresponding motivation in people. Attractive jobs based on continuous training, higher salary, skills development, better organized working environment, special attention at the gender gap and the work-life balance and welfare are apparently proper incentives.

The Water Sector is essential to providing clean water, making those who work in water related jobs also essential as without them, people wouldn't be able to access this precious resource. Nevertheless, the warning given by the statistical data regarding vocational education in Italy, underlines that only 0,1% chose the water management and environment sector, slightly less

⁹ MIUR, Gestione Patrimonio Informativo e Statistica, *Focus "Principali dati della scuola – Avvio Anno scolastico 2020/2021"*

¹⁰ Educational, Cultural and Psychological Studies Journal, Issue nr.20, December 2019, pag. 83

than 2019/2020 when it was 0,2%. Although advances in technology can offset a scarcity of workers to some degree, the water industry has been facing difficulties in finding proper qualified workers to meet all technological demands. Generally speaking, most people interested in finding a job are focused on security, meaning they look for long term labour contracts and a salary to reflect the rising living costs. They often do not fancy to start at the “Ground up” & build relations but dream at getting a high position and an important role in a company right away. Often a slightly tough start, not necessary with the highest remuneration, allows to get to know people in the company and get a better understanding of its activity. The problem nowadays it that societies are driven by targets, numbers, results and as a consequence this is the mentality of the young generations. Professional water operators help communities develop cost-effective solutions for various problems through research and implementation. These jobs allow taking a hands-on approach to help solve a problem. Companies operating in the water sector empower their workers by giving them excellent on-the-job training. Due to the universal need for water, jobs in this sector are available not only in Italy but also in Germany, being maintained by a large percentage of individuals who are getting close to their retirement age.

3.4 Situation and perspectives of the industrial sector in N Italy

The Italian industrial sector ranks second after Germany with a share of 16% of the total EU value of sold industrial production well ahead of France, Spain, Poland and the Netherlands (cf. Figure 9).

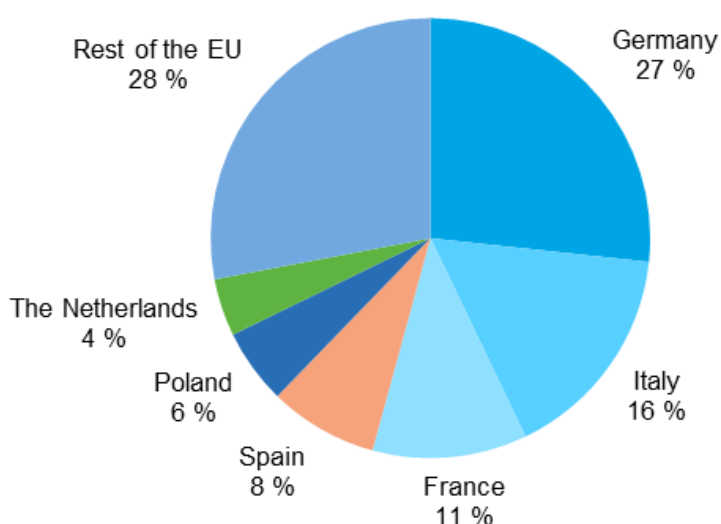


Figure 9 EU value of sold industrial production, by country (% of sold industrial production, Source: Eurostat 2021)

3.4.1 Situation in the industrial sector in Northern Italy

It is well known that the food industry is one of the undisputed leading sectors of the Italian economy. Based on innovation and a long tradition it offers the highest standards in terms of safety and quality. Furthermore, Italy is amongst the world leaders in many other relevant sectors like design, automotive, construction and infrastructure, aerospace technologies, medical and pharmaceutical industry, capital goods, thanks to a policy based on high quality products and not on quantity.

According to the Foreign Ministry Reports, about a quarter of the total Italian companies invest in the green economy, in products meant to have a friendly impact on the environment, the country also ranking 1st in the EU for the highest percentage of recycled waste and for the share of renewable energy in the gross domestic consumption (17,4%). With approximately 1920 operational facilities, after Germany, China and USA, Italy is the 4th biogas world producer. The design industry in Italy hosts 16% of companies active in this field at EU level, employing more than 50.000 people, totaling for 16,6% of EU design workers; Milan hosts the highest concentrations of design schools in the world, and more than 25% of companies in this field. Also in the wood industry Italy is an important player in the world, with important industrial

districts in the North focused in Brianza, Alto Adige, Bassano, Livenza e Quartier del Piave, Quarrata, Bovolone, Treviso, Venezia, Manzano.

Among TOP100 luxury goods companies in the world, 24 are based in Italy, ranking the country 1st worldwide from this point of view, 33.9% of the added value generated by the fashion industry comes actually from Italy. According to the data released by Confindustria Moda, the first quarter of 2022 closed with an increase in turnover of +19.3%, higher than the what was expected, respectively +14%. The trend in orders was also very positive, showing +15% compared to the same period in 2021. However, a strong concern about the future of the sector emerges, due to the Russian-Ukrainian conflict weighing on exports in terms of raw materials and energy rising costs. The price increase for metals, precious and non-precious affects for example, the Eyewear and Goldsmiths, the increase in packaging is reported primarily by Textile-Clothing, Footwear and Leather Goods, the increase in hides and skins affects Footwear, Tanning, Fur and Leather Goods. But also, the rising cost for chemicals, textiles and components in general affects all realities across the industry, 9 out of 10 companies reporting substantial overall price increase.

The fashion industry (textile, clothing and footwear) represents almost 10% of the Italian manufacturing, approximately 70% of Italian exports come from the haute couture, with significant market shares 16% in footwear and 21% in leather goods. If the eyewear and Jewellery is concentrated in the north, the footwear and leather production move towards the center and south of the country, while the clothing and textile hubs are located in Como, Biella, Gallarate, Castel Goffredo, Brescia, Carpi, Treviso, but also in Bari, Napoli, Empoli, Rimini, Marche, Abruzzo, Perugia, Salento, Val Seriana, Arezzo, Prato.

According to international statistics like the World bank data, Italian Manufacture ranks seventh in the world, accounting for 88% of the total country's production. Along the centuries Italy has been able to combine tradition and innovation, through manufacturing processes focused mostly on quality, human relations, with a proper respect for the environment and a sustainable use of resources. Following Germany, Italy has the second largest manufacturing base in Europe with a strong integration in the EU value chain and is Europe's leader for secondary raw material recycled in the manufacturing industry. Based on ISTAT indicators, metallurgy and fabricated metal products represent 14% of the total production while machinery and equipment 12%. Machinery is actually the first sector of Italian export (18%), taking into account that 67% of the total production is exported. Main industrial districts are located in Brescia, Bergamo, Varese, Vicenza, Lecco, Mantova, Trentino Alto Adige, Padova, Verona, Parma, Reggio Emilia, Modena, Vigevano, Rimini, Pesaro, Bologna, Biella, Piacenza, Udine e Pordenone.

Even if nowadays Italy is no longer in top 5 world car producers, still is an important player on the market, in fact 9% of companies use industrial robots compared to the 7% Eu average. In 2019 the automotive industry registered 93 bn turnover, representing 5,6% of the Italian GDP, and actually the 253.000 employees count for 7% of the entire manufacture sector. The marine industry is also influential due to the fact that 45,7% of the superyachts orders in the world are produced in Italy, the country being thus a worldwide leader, ahead of the Netherlands, United Kingdom, Germany and Mexico.

Lombardy is actually the first manufacturing region in Italy. Even though only 17% of the national population is located in Lombardy, the region accounts for a fifth of the Italian GDP and a fourth of exports. It is considered a knowledge hub, an innovative place for startups and multinational companies, hosting approximate 6,800 MNCs for a total workforce of 697,000 and a turnover of 312.5 billion euros. In 2020 there were 73 113 active companies in manufacturing with a total workforce of approximately 953 946, most of them 76,3% small companies, with 0-9 employees. In Piemonte there were 28 540 active companies in manufacturing, engaging 387 315 workers, 80% the size of 0-9 employees. In Veneto, out the 41 838 active companies in manufacturing in 2020, approximately 75,5% were small companies (0-9 employees), and engaged a total workforce of 522 489. According to the same ISTATdata, the situation is similar also in Emilia-Romagna where out of the 33 805 active companies in manufacturing, over 77% were the size of 0-9 employees, and involved 446.652 workers.

Italy’s main trade partner is Germany. Based on ISTAT indicators, *Trading economics* summarizes Italian manufacturing production as shown in the chart below:



Figure 10 Sectors’ share in trading from Italy

In 2017, the reports elaborated by the Italian Chamber of Commerce declared 2016 as one of the most uncertain and complex periods in the global geo-political landscape. Brexit, the election of Donald Trump to the US presidency and the problem of migrants had certainly contributed to increasing the general climate of uncertainty and instability, both intercontinental and European. Even so, Milan continued to be Italy's gateway: in 2016 exports returned to the 2012 levels, recording an increase of 3.9%. Nobody could have imagined that in fact, 2016 was quite a mild year compared to what was about to come. During the period of Covid, the worldwide picture emerging from the indicators is one of widespread distress, manifested first

of all by an unprecedented fall in GDP, which has not even spared the local systems, weakening not only their productive capacity but also their competitiveness on international markets. Like an earthquake, the Coronavirus emergency made the foundations of our economic and social organisation tremble deeply. Some structures collapsed, others were profoundly damaged, and still others have been able to withstand the shock, demonstrating that they have the defences within them to withstand even the most violent shocks.

During the year of 2020, the crisis triggered by the pandemic hit the Italian economy hard, generating an 8.9% drop in GDP, a negative dynamic that produced strong unequal effects in various production sectors.

At the beginning of 2021, Italy had to face an unprecedented crisis that, despite the considerable resources allocated by the government, determined a widening of the social gap and a worrying increase in the level of poverty. According to ISTAT's preliminary estimates at that time, there were more than 2 million Italian households in absolute poverty in 2020 (7.7% compared to 6.4% in 2019), the highest rate since 2005.

The industrial sector recorded significant decreases in added value during 2020, with deficits exceeding EUR 38 billion (-10.3%). The strong impact regarded the textile, clothing, leather and accessories industries (-23.1%) and the mechanical engineering sector, the machinery sector (-15%), with decreases of more than 5.5 billion. Significant losses were recorded by metal products (-12.2%) and the transport equipment (-15.9%) sectors. The handicrafts registered also a serious loss (-5%), a sector facing difficulties already for a few years now, because of the high pressure from foreign competition, especially in the low-tech segments. According to the 2022 data released by the Chamber of Commerce, there are just over 27,000 active manufacturing industries in Lombardy, totalling for 9%, compared to 11.4% in 2009.

Apparently, the construction industry was the only one managing to hold some sort of stability (+0.7%), showing positive results in the last five years against the current economic crisis, probably also thanks to government incentives, such as the super ecobonus, and the numerous development sites opened in the area of Milano and generally speaking in Lombardy.

Nevertheless, facing such a profound crisis, like all other developed countries, in 2021, according to the information provided by the chamber of commerce, the Italian economy regained a momentum that allowed it to recover 104 billion euro in production lost in the year of the pandemic, and 11.2% in industrial activity, which actually grew by 12.2% in 2021, thus surpassing pre-crisis levels. First of all, in the textiles, clothing, leather and accessories sector, the surplus of EUR 1.8 billion (+9.4%) in 2021 marked a positive trend, but still left a gap of approximately -14%. The mechanical engineering sector, respectively the machinery sector registered a substantial recovery, with more than EUR 5.3 billion (+16.2%), which made possible to recover almost the entire gap from 2019.

On the other hand, the positive results recorded by metallurgical activities, +15.5% compared to 2020, show that this part of the industry managed to recover too. Last but not least, 2021 highlights a positive trend also in the rubber-plastic products industries +13.9%. Unfortunately, the world economy plunged back into uncertainty at end of May 2022, with the Russian invasion in Ukraine. The big challenge our governments face is a strategic perspective, in the

form of a sustainable industrial approach because the industrial policy will determine the extent to which enterprises will be able to rebalance their international production networks for a major economic resilience and the strengthening of the supply-chain.

3.4.2 Employment situation in the water sector of North Italian industry

Employment in the water sector is part of a complex landscape. On one hand, the industrial sector provides employment and income generation opportunities across the globe, industrial capabilities representing a key driver of resilience, but on the other hand, industry is one of the biggest water polluters, discharging about 300-500 million tons worldwide of heavy metals, solvents, toxic sludge, and other wastes each year, according to UN's estimates. Contaminated water can affect the food chain through the use in agriculture and its uptake by plant and animal life. From this perspective there is an intense debate at EU level over the water industry, in the sense that policymakers are trying to find the most effective strategies for efficient water management, focusing on governance and organizational choices. Italy is facing many challenges in terms of technical efficiency, economic profitability, and financial sustainability of its water utilities as well as water scarcity.

Having an insight into the information regarding the general framework, released by the Chamber of Commerce, at the end of 2020 in the macro-area of Milan, Monza Brianza e Lodi there were 468.799 companies registered, out of which 383.726 active, highlighting a decrease of 0,4% compared to 2019, divided as follows: 305.395 in Milano, 63.946 in Monza, 14.385 in Lodi.

Overall, the dynamics of the labour market present the marks of the difficult pandemic months, Italy having lost approximately 724.000 workplaces during 2020, mostly fixed-term labour contracts. Also in Milano, Monza Brianza e Lodi the labour market indicates the milestone faced by the production system in 2020, with a share of employed people decreasing by 1,1%, a rising unemployment rate among the active people in search of a job especially due to the so-called depressed or de-motivated people in search for a job. The situation in detail reflects an employment rate of 68,7% in Milano, and 68% in Monza Brianza in 2020. Of important concern was the situation of young people under 30, as in the province of Milano the unemployment youth rate reached 14,1%, while in Monza Brianza 17,2% and 15,1% in Lodi.

Social distancing and limitations to mobility, the long lock-down periods of certain activities and the collapse of consume, determined a profound crisis, forcing the governments around the world to rethink the global economic policies. In terms of employment, the available data on the total number of employees show that the highest proportion is in services, which in fact employ more than 900,000 people, or 59.6% of the total, followed by trade (17.3%) and manufacturing (14.4%). 2020, as could be guessed, was a negative year with an impact on all sectors, especially manufacturing and trade, the only exception being the construction sector.

The year 2021 recorded a slight recovery in employment in the sense that with a GDP growth of 6% and +12,2% for the industrial production, employment in Italy increased by 0.8%, meaning 169.000 more employed according to ISTAT data, but still more work to be done in order to reach the pre-pandemic indicator. The economy in Lombardy followed also a positive trend in 2021, increasing by 7%, an indicator higher than the one corresponding to the national

value, but which did not have such a significant impact on the dynamics of the labour market, in the sense that employment recorded only +0,4%, respectively 0,6% for the macro-area of Milano, Monza Brianza e Lodi. The genre composure varies, if in Milano the feminine component was still decreasing (-0,7%), in the province of Monza Brianza grew by 3,6% and in Lodi by 3,1%, compared to the masculine component 4,6%.

Generally speaking, 2021 was positive for enterprises, after all cancellations and new entries in the Companies Register, the result was +86.000 companies; in total 468.847 for the macro-region of Milano, Monza Brianza e Lodi, out of which 383.614 active companies, respectively 306.249 in Milan, 63.392 in Monza, and 13.973 in Lodi. Active companies in Milan equal to a third of the total regional, placing Milan the second metropolitan city after Rome, with a density of economic activity of 94,5 companies for every 1.000 residents. Companies managed by young people, under 35, had a good performance too, respectively +1,2%, thanks to the implementation of new technologies where the young generation excels, even though the unemployment rate of this vulnerable group remains alarming, approximately 17% in 2021.

According to 2020 ISTAT data, in the water supply sewerage, waste management and remediation activities, there were 207.562,69 active jobs (employees, respectively 36.784,46 females and 170.778,23 males), 8.474,72 self-employed (1.764,82 females and 6.696,77 males), 3.062,69 outworkers (669,59 females and 2.393,10 males) and 5.204,48 temporary workers (954,70 females and 4.249,78 males). These figures show that actually in the total number of active jobs, the employees represent almost 1,7%, the self-employed 1,8%, outworkers 1% and the temporary ones 1,9%¹¹. The situation is somehow balanced if we take into consideration that companies active in this sector correspond to 0,2% of the total number of active companies in 2020 (NACE 2007), respectively 10.064 units. Even so, ISTAT data shows that actually despite crisis or financial turmoil, the trend is lightly positive compared to 9.231 units in 2015, or 9.237 in 2018. As the water industry is challenged by a changing workforce, technological and regulatory shifts, water systems must identify and invest in concrete benefits in order to attract new employees in this line of work as the share of young people aged 15-29 was only 0,6% in 2020, most of the employees being over 50 years old 46,3%. The situation is better in the case of temporary workers, where the share of 15-29 people is 21% compared to 24% over 50, but there are more than 57% aged 50 and more in the case of the self-employed people. Whereas compared to 2018, the number of employees aged 50 and more increased approximately by 1,8%, the share of 15-29 people decreased by 1,14%. The positive aspect is that also the share of the age group 30-49 slightly grew from approximately 93.727 in 2018 to 96.226. As regards the self-employed, even if their number increased only by 786 people from 2018, most of them, respectively 744, are 50 years old and more. The situation of the temporary workers is slightly different, in the sense that in 2020 their share decreased most in the age group 30-49, respectively with 650 people.

Most probably the milestone that emerges from the current analysis lies in education and training. Developing learning opportunities in present, has a powerful connection to sustainability in the future. As EAEA background paper on adult education and sustainability underlines already in 2018, due to increasing privatisation and commercialisation of adult education, it becomes more and more difficult for the public sector to sustain funding and

¹¹ <http://dati.istat.it/?lang=en#>

provide good quality of education. Ageing workforce, as we can see, is another reality, not to mention the slowdown risk affecting the workforce growth. Compared to the challenges Italy has to face in the water sector, there is an urgent need for a change towards having the necessary qualified human resources. The idea is supported by the statistical data, meaning that if we don't take into consideration the 3% for which there was no data available in 2020, we notice that most employees, respectively over 44% have a diploma of lower secondary education, followed by 32,46% with a diploma of upper secondary education, almost 8% with a master's degree and only 440 people with a research doctoral degree. In addition, 5% have no formal education and primary school certificate. It could be that some of the figures are discouraging, but compared to 2008, there are actually slightly less people with no formal education, almost 1,1% more with a diploma of upper secondary education and 83 more people with a research doctoral degree.

Examining factors associated with recruitment and retention in the industry but also analogous sectors may help community water systems plan for the future and identify the right ways to engage current employees and attract new staff. For sure most employees in the water supply sewerage, waste management and remediation activities are Italians, counting for 90%, but the rest 10% are actually more extra-EU, respectively 13.612 in 2020, and 11.101 in 2018, than from other EU member states, respectively 5.213 in 2020 and 4.847 in 2018. The need to keep up with the rapid scientific and technological development and floods of big data is pressing. Today's graduates in the water sector are challenged to understand complex and interconnected systems as they have not only to integrate information from different disciplines but also to lead the way toward increasingly creative, resilient and sustainable solutions. The positive link between employment and learning is obvious: learning leads to employment, this is why a skilled workforce is important for innovation, productivity, competitiveness and entrepreneurship.

3.4.3 Perspectives of the industrial sector in Northern Italy

Developing the industrial sector is at the centre of international efforts for the recovery of the global economy, based on the fact that industrial capabilities are a key driver of resilience, the industrial sector providing employment and income generation opportunities across the globe. There are many voices describing Italy as a country invaded by foreign capital, where local companies relocated their own business in order to be able to face rising costs, taxation and competition, contributing, along with the multinational companies, at the impoverishment of the national economy.

Nevertheless, multinational companies play an important role in host countries' domestic value chains, creating large volumes of output, value added, international trade and jobs, and in addition generating also important indirect effects. According to the 2019 ISTAT data and the reports of the chamber of commerce, multinational Italian enterprises were present in 173 countries with 24.765 companies, 1,8 million employees and a turnover of 567 billion €. On the other hand, there were 15.779 multinational enterprises with foreign participation in Italy, slightly exceeding 1,5 million employees and a turnover of more than 624 billion €. Even if the share of foreign enterprises reaches just 0,4% in the total active enterprises in Italy, indicators

show that their value is greater in terms of employees 8,7%, value added 16,3 and 19,3% turnover, being directly responsible for 32,1% of Italian exports and 50,7% of imports. Due to their bigger size compared to local companies (an average of 85,8 employees compared to an average of 3.7 employees for local companies), also the added value/ employee is nearly doubled (88,8 thousand compared to 47,5 thousand).

Analysing the performance of Italian regions on a medium term, a positive tendency emerges during 2011-2020 regarding companies with foreign participation in Milano, Monza Brianza and Lodi and the number of their employees, in line with the rhythm at national level. Even though it is nearly impossible to have an exact image of the situation due to the different census methodology by the very diverse institutions, based on the Italian Chamber of Commerce Reports, it is to say that at the beginning of 2020 there were 5.300 companies with foreign participation in the provinces of Milano, Monza Brianza e Lodi, with more than 569.000 employees and a turnover of 268,7 billion €. According to the latest updates, one year later, meaning at the beginning of 2021 there were 6.766 companies with foreign participation in Lombardy, divided as follows: 4.699 in Milano, 481 in the province of Monza Brianza, and 52 in Lodi. Another important share would be the controlled foreign corporations (CFC) in Lombardy, all detailed in the tables below. The data excludes enterprises without employees, which have never reached 100.000 € in turnover, and is available per headquarter even if many have different active units in the whole country.

Table 4 Italian companies with foreign participation

Location	Companies		Employees		Turnover	
	N	% in Italy	N	% in Italy	Mil €	% in Italy
Milano	4.699	31,4	496.695	34,5	221.121	37
Monza Brianza	481	3,2	59.449	4,1	22.959	3,8
Lodi	52	0,3	3.958	0,3	1.539	0,3
Bergamo	338	2,3	46.540	3,2	11.248	1,9
Brescia	329	2,2	24.413	1,7	5.998	1,0
Como	208	1,4	9.151	0,6	3.136	0,5
Cremona	63	0,4	5.760	0,4	1.640	0,3
Lecco	87	0,6	4.872	0,3	1.363	0,2
Mantova	54	0,4	4.515	0,3	2.457	0,4
	80	0,5	7.728	0,5	2.402	0,4
Sondrio	15	0,1	1.523	0,1	448	0,1
Varese	360	2,4	30.138	2,1	10.049	1,7
Lombardia	6.766	45,3	694.742	48,3	284.360	47,5
Italia	14.950	-	1.439.844	-	598.292	-

Regarding the perspectives of the industrial sector, it is to say that the industrial world has entered a new development area where concepts long experienced in the past are no longer available, where technology is driving stakeholders to overcome limits in the context of new

paradigms seeking for affirmation. Italy is no exception to the backlash against globalization observed in developed countries, many scientists perceiving it as one of the main causes for the economic malaise. Generally speaking, globalization has been creating a more articulated world, in many aspects marked by greater inequalities, due to the need of extending market boundaries through privatization and a deregulation process. What happened was that large productions have been relocated to developing countries due to lower costs, and favored imports from respective countries, pushing down the prices, but also generating a rise in consumer demand in the respective developing countries. Trade liberalization and capital movements supported the relocation process, but what actually matters is the scale of the various economies, in the sense that while the smaller ones need to focus their development on specialization, the bigger actors benefit from a market that can activate supply also in a non-competitive climate. The issue reflects on the long term, meaning that once developed countries transferred their production activities, the question they had to face was: how sustainable is it to remain there?

Over the time, Italy has been experiencing a GDP loss compared to the USA, or other EU-partners, while imports from abroad doubled in real terms. Such a reality is mainly the result of the structural transformation of China, which became a World Trade Organization member in 2001, and which managed to reduce its dependence on imports thanks to the high degree of industrialization achieved, in the benefit of its domestic demand. According to an analysis conducted by IGIER-Bocconi and supported by J.P. Morgan, we understand that the changes in Italian import / export have substantially affected industries such as textiles, electrical and optical equipment, toys and furniture, non-metallic minerals, mainly the industries in which Italy had a long and strong competitive advantage. While imports from China increased, proportionally the number of Italian manufacturing companies in respective sectors and the number of their employees decreased dramatically. The data released by the Minister of Foreign Affairs and International Cooperation is presented in the two tables below¹².

Table 5 Italian trade balance with China in the years 2019 to 2022

Italian Exports to China	2019	2020	2021	Jan-Nov 2021	Jan-Nov 2022
Total (mil.€)	12.969,31	12.887,47	15.690,98	14.154,33	14.682,13
Differences (%)	-1,2	-0,6	22,1		3,7

Italian Imports from China	2019	2020	2021	Jan-Nov 2021	Jan-Nov 2022
Total (mil.€)	31.662,62	32.144,4	38.542,64	34.801,16	54.069,63
Differences (%)	2,5	1,5	19,4		55,4

The reality is obvious, Italy imports more than double than it exports to China, and taking by the value of the goods, it is the third country in the world Italy imports from, after Germany and France. One of the reasons why export growth in Italy has been low is Chinese competition on

¹² https://www.infomercatiesteri.it/scambi_commerciali.php?id_paesi=122#

the export markets; from back to 1990-2008 when Italian GDP was superior to the Chinese one, we have come to witness times when Italy faces inequalities in the income distribution and an impoverishment of the middle class whilst in China a huge middle class emerges. As mentioned before, globalization generates both risks and opportunities; on one hand the strong survive, and excel by exporting on the international markets, but on the other hand many Italian SME have been forced to shut down their historical production, being too much exposed to increased pressure from foreign sources.

The global value chain disruptions had a high impact during the COVID pandemic, many companies faced difficulties delivering orders because of shortages of key components like chips and electronic components, raw materials, chemicals etc, which saw a quick but substantial price increase due to broader problems of technological change, complications in the organization of shipping and logistics.

Reality proved the downsize of the Italian dependency from imports, not to mention the threat for the high value market because China is able to buy all high-quality raw materials and produce at low cost, resulting in products obviously with a competitive price. The UN's industrial development report on 2022 explains, in the case of countries with high foreign debt and a strong dependence on imports, how an increase in import prices, international interest rates and foreign debt servicing may compromise balances of payments and government budgets, putting at risks its recovery pace and opening up to new types of domestic crisis. Under such situations, one would logically consider investments in order to bring back production in Italy. For the moment, there is a limited concentrated effort to bring back productions that had been transferred abroad, because of the foreseeable dampening effect represented by the development of structured supply networks in the economies involved and by their parallel dissipation in their homeland. The idea was underlined already in 2018 in one of the working papers of Confindustria regarding industrial development - the rise, decline and legacy of globalization.

We are all aware that is very easy to destroy, but difficult to rebuild, nevertheless though, not impossible. The UN's report on 2022 stated that in order to build domestic industrial and production capabilities, it is necessary to continue with an industrialization agenda, develop institutional frameworks and expand the focus of foreign direct investment attraction. Capabilities and digitalization are not built overnight, nor are they an immediate consequence of the investments, but they are a growing area of concern for the water sector along with artificial intelligence, even if the argument transcends the mechanics of the water treatment.

3.5 Legal framework

3.5.1 German Legislation

The German legislation is based on the hierarchy of norms. That means that higher-ranking law either supersedes lower-ranking law on the same subject or that the lower-ranking law is just supplementary or subsidiary or in line with the higher-ranking law. European legislation has priority of application over German legislation; however, every derived legislation must be in accordance with the Basic Law (Grundgesetz). The hierarchy of norms is depicted in Fig. 11.

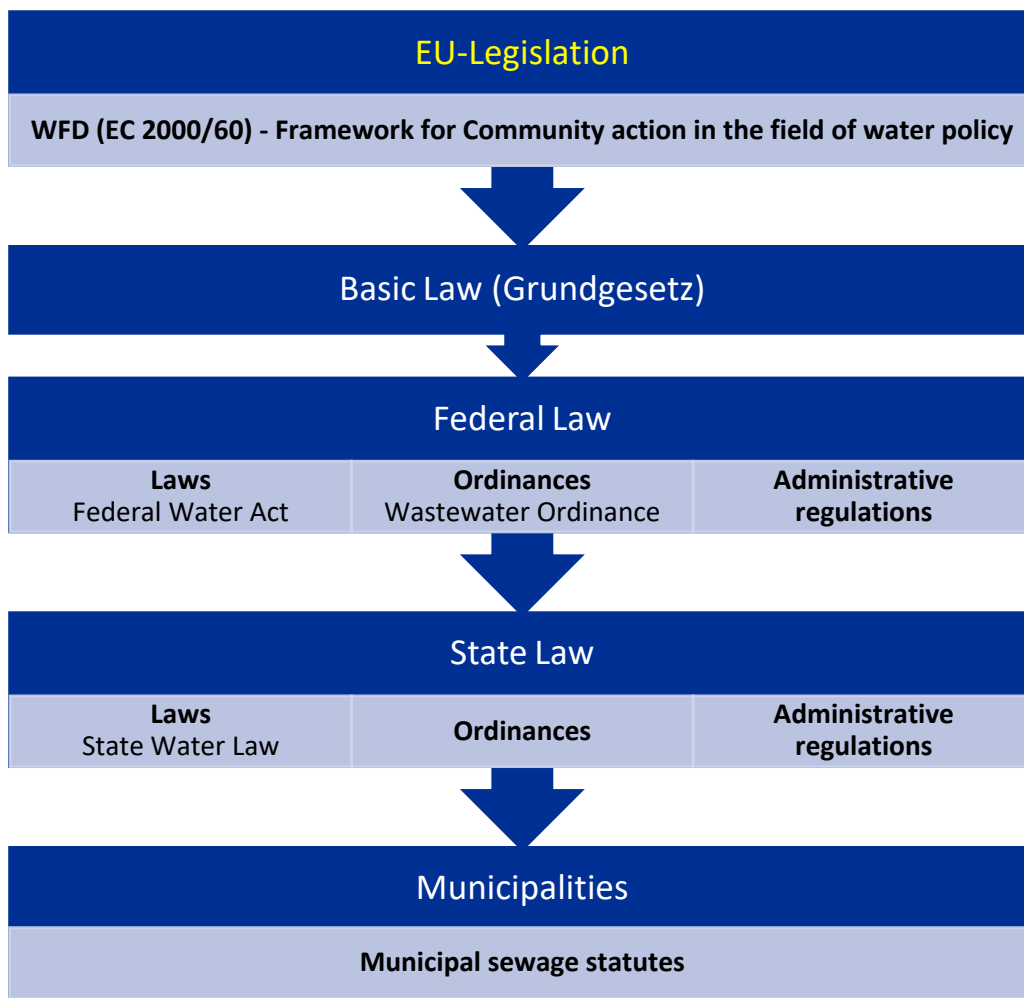


Figure 11 Hierarchy of norms related to water in Germany

The most important law in the water sector is the Federal Water Act in March 2010. It regulates the protection and use of surface- and groundwater, the development of water bodies and water management as well as the flood protection. The Federal Water Act implements the water Framework Directive (Directive 2000/60/EC - Framework for Community action in the field of water policy) in Germany.

The execution of the federal and state law lies in the responsibility of the several German federal states. Except for small states and city states, the administration is according to the general structure¹³:

- Supreme authority: (Environmental) Ministry with water management division (tasks: control and higher-level administrative procedures)
- Middle instance: District governments, district presidents, state offices (tasks: regional water management planning, significant water law procedures, administrative procedures)
- Lower instance: Lower water authority in the district or independent city, technical authority (tasks: water law procedures and expert advice, monitoring of water bodies and discharges)

To coordinate the water related policies, the administrative implementation and the concerning legislation, the federal government and the federal states have founded a working group in 1956 called "LAWA". Topics of this working groups are water legislation, hydrology, inland waters and sea conservation, ecology, flood prevention, coastal protection, groundwater, water supply, municipal and industrial sewage, handling with water polluting substances and climate change related issues¹⁴.

According to the Federal Water Act, the discharge of wastewater may only be permitted if the pollutant load is kept as low as technically and economically possible according to the state of the art. Since the polluted waters sources alter significantly, the discharge requirements are emission related. The requirements for those various wastewater sources are further elaborated in sector-specific annexes to the Wastewater Ordinance. Until now, there are 57 annexes for the different sectors for example annex 1 for domestic and municipal wastewater, annex 22 for wastewater from the chemical industry or annex 38 for the textile industry.

Commercial and industrial wastewater discharge is distinguished in direct and indirect discharge. In the case of direct discharge, the wastewater is treated on site and must meet the conditions from the respective annex of the Wastewater Ordinance. Indirect discharge means the discharge of un- or pre-treated wastewater (if needed according to the Wastewater Ordinance annexes) into the sewerage system. The water is then finally treated in a municipal wastewater treatment plant. To discharge wastewater indirectly a permit is required, and the requirements of the respective drainage statutes of the cities and municipalities have to be met¹⁵.

Furthermore, several professional associations in Germany maintain, develop and expand a broad set of rules in the field of urban water management. These include the following and further associations and institutes¹⁶:

- German Association for Water, Wastewater and Waste (DWA)

¹³ <https://www.bmu.de/themen/wasser-ressourcen-abfall/binnengewasser/gewaesserschutzpolitik/deutschland>

¹⁴ <https://www.lawa.de/Startseite-358.html>

¹⁵ <https://www.umwelt.nrw.de/umwelt/umwelt-und-wasser/abwasser/industrielle-abwasserbeseitigung>

¹⁶ <https://www.sieker.de/fachinformationen/rechtliche-grundlagen/article/technische-regeln-96.html>

- Association of Engineers for Water Management, Waste Management and Land Improvement (BWK)
- German Institute for Standardization e.V. (DIN)

Besides the development of set of rules, they create instruction sheets, working reports as well as handbooks in (waste-)water related topics.

3.5.2 Legal framework in Italy

In Italy, the legal framework governing the use and management of water resources in industrial settings is based on national legislation, as well as EU directives and regulations. Here are some of the key laws and regulations that apply to industrial water management in Italy:

- Water Framework Directive (WFD): The WFD is an EU directive that establishes a framework for the protection of water resources and the sustainable use of water in Europe. It requires member states to develop water management plans, including measures to prevent and reduce water pollution, and to ensure that water use is sustainable.
- Legislative Decree No. 152/2006: This is the main law regulating environmental protection in Italy. It covers a wide range of environmental issues, including water management, waste management, and air pollution control. The decree establishes a permitting system for activities that have an impact on the environment, including industrial water use and discharge.
- Ministerial Decree No. 260/2010: This decree establishes technical regulations for the discharge of industrial wastewater into the sewer system. It sets out parameters for water quality, as well as requirements for monitoring and reporting.
- Legislative Decree No. 31/2001: This law sets out the framework for the prevention and control of water pollution caused by hazardous substances. It requires companies to identify and manage the risks associated with the use of hazardous substances, and to take measures to prevent accidental releases.
- Legislative Decree No. 59/2013: This law establishes a national system for the allocation of water resources. It sets out the criteria for the allocation of water rights and establishes a system of water charges to promote efficient and sustainable water use.

These laws and regulations, along with other regional and local regulations, establish a comprehensive legal framework for the use and management of water resources in industrial settings in Italy. Companies operating in this sector must comply with these regulations to ensure the protection of water resources and the environment.

In addition to the national laws and regulations that apply to industrial water management in Italy, there are also regional and local regulations that may apply, particularly in Northern Italy

where the industrial sector is more developed. Here are some examples of regional and local regulations in Northern Italy that may be relevant to industrial water management:

- Lombardy Regional Regulation No. 14/2012: This regulation establishes the criteria for the classification of surface water bodies and the quality objectives for water use in Lombardy. It also sets out the requirements for the discharge of wastewater into the environment.
- Veneto Regional Law No. 9/2010: This law establishes a framework for the management of water resources in Veneto. It includes measures to promote sustainable water use and protect water resources from pollution.
- Piedmont Regional Law No. 15/1999: This law establishes a permitting system for activities that have an impact on the environment, including industrial water use and discharge. It also includes measures to prevent and control water pollution.
- Emilia-Romagna Regional Law No. 33/2013: This law establishes a regional water management plan, which includes measures to ensure the sustainable use of water resources and protect water quality.
- Municipal regulations: Municipalities may also have their own regulations that apply to industrial water management, particularly in relation to the discharge of wastewater into the local sewer system.

These regional and local regulations may vary in their scope and requirements, depending on the specific characteristics of the region or municipality. Companies operating in Northern Italy must comply with these regulations, as well as national regulations, to ensure that their activities do not have a negative impact on the environment or public health.

There are also several professional associations in Italy that contribute at developing rules and best practices in the field of urban water management:

- Italian Association of Environmental Engineering and Science (IAERE): is a professional association that promotes research and education in the field of environmental engineering and science, providing guidelines and best practices for the management of water resources, including urban water management.
- National Association of Water Companies (ANCI): ANCI is an association that represents Italian water companies at the national level, providing guidance on water management practices, including the management of urban water systems.
- The Interregional Agency for the Po River (AIPo, the Italian acronym), is a public body that provides engineering and environmental services across the full spectrum of operations in support of interests of the Italian regions crossed by the Po River: Piemonte, Lombardia, Emilia – Romagna and Veneto. AIPo mission is to provide flood protection and flood damage reduction. The projects range from small local ones (levees or non-structural flood damage reduction measures) to major civil engineering works (dams, flood control storage areas, etc) and are the result of a close cooperation with national and local governments, academic institutions, and other concerned groups.

- IAHR Italy – Italy Young Professionals Network, is a worldwide independent organisation of water specialists, working in fields related to the hydro-environmental sciences and their practical application. It promotes research and education in the field of hydraulic engineering and technical hydraulics, offering guidance on the management of water resources, including urban water management. Activities range from river and maritime hydraulics to water resources development and eco-hydraulics, hydro-informatics and CVT
- ARPA stands for Agenzia Regionale per la Protezione dell'Ambiente (Regional Agency for Environmental Protection) and is a public agency in Italy responsible for monitoring and protecting the environment at the regional level. ARPA operates in each of Italy's 20 regions, with each regional agency responsible for the environmental monitoring and protection within its jurisdiction.

Some of the key functions of ARPA include:

- Environmental monitoring: ARPA is responsible for monitoring air and water quality, soil pollution, and other environmental parameters. This includes collecting and analyzing data on environmental conditions, identifying pollution sources, and assessing the impact of human activities on the environment.
- Environmental protection: ARPA works to protect the environment by enforcing environmental laws and regulations, conducting inspections and audits, and responding to environmental emergencies such as spills and accidents.
- Scientific research: ARPA conducts scientific research on environmental issues, including climate change, pollution, and environmental health. This research informs policy and regulatory decisions related to environmental protection.
- Public awareness and education: ARPA is responsible for educating the public about environmental issues and promoting sustainable and environmentally responsible practices.

3.5.3 Political initiatives on EU Level

The new industrial strategy for Europe and the European Green Deal are two key policies that aim to promote sustainability and address environmental challenges in Europe. Both of these policies recognize the important role of education and training, particularly adult education, in achieving their goals.

The new industrial strategy for Europe was adopted by the European Commission in 2020, and it aims to support the transition to a more sustainable and digital economy. The strategy includes measures to promote sustainable production and consumption, reduce greenhouse gas emissions, and protect natural resources. One of the key objectives of the strategy is to ensure that the workforce has the necessary skills and competences to work in a sustainable and digital economy. This includes investing in education and training programs that address the skills gaps and prepare workers for the jobs of the future.

The European Green Deal is another key policy initiative adopted by the European Commission in 2019, which aims to make Europe climate-neutral by 2050. The policy includes a range of measures to reduce greenhouse gas emissions, promote sustainable energy use, and protect biodiversity. The Green Deal recognizes the importance of education and training in achieving these objectives and emphasizes the need to invest in adult education and upskilling programs to prepare the workforce for the transition to a more sustainable economy.

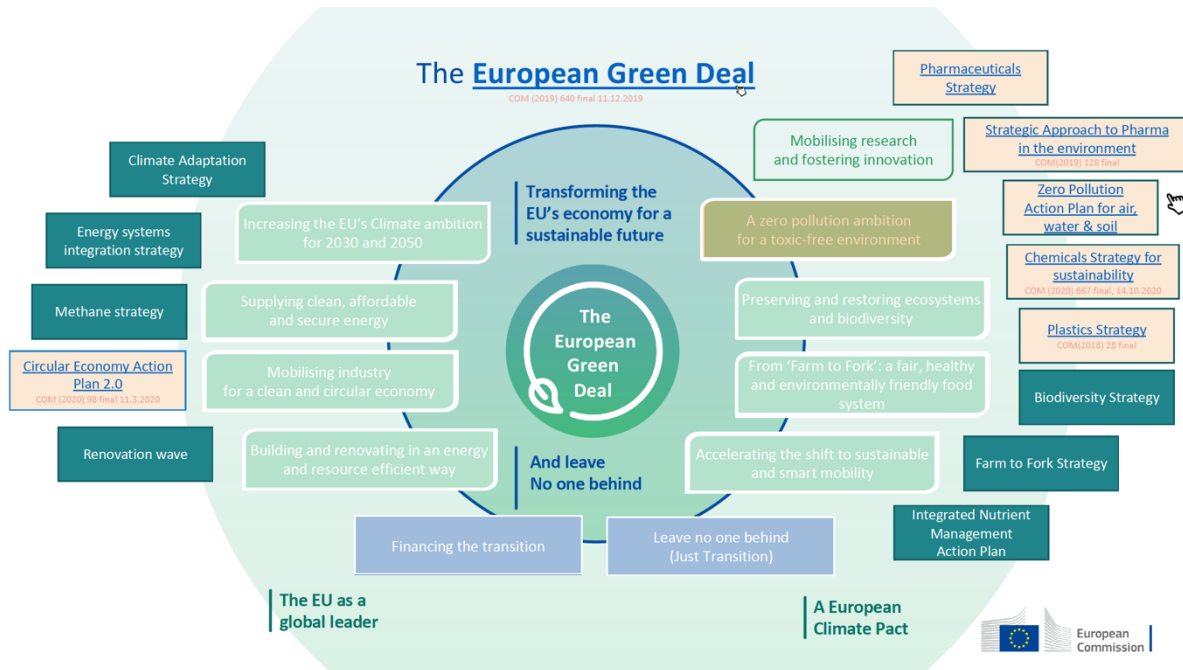


Figure 12 The European Green Deal and related strategies (EC 2022)

Overall, both the new industrial strategy for Europe and the European Green Deal highlight the importance of adult education and sustainability in achieving their objectives. By investing in education and training programs that address the skills gaps and prepare workers for the jobs of the future, Europe can build a more sustainable and resilient economy that benefits both people and the planet. Here are some ways in which these policies can impact adult education in this sector:

Increased focus on sustainability: Both policies emphasize the need to transition to a more sustainable economy. This means that adult education programs in industrial water treatment and management may need to focus more on sustainability topics, such as eco-friendly technologies, water conservation, and pollution prevention.

New skills and competences required: The transition to a more sustainable economy may require new skills and competences from workers in the industrial water treatment and management sector. Adult education programs may need to adapt to provide training and education on these new skills, such as digital literacy, data analysis, and sustainability management.

Investment in adult education: Both policies recognize the importance of investing in education and training programs to support the transition to a more sustainable economy. This could mean increased funding for adult education programs in industrial water treatment and management, as well as new initiatives to support adult learners, such as apprenticeships, internships, and career development programs.

Overall, the new industrial strategy for Europe and the European Green Deal can have a positive impact on adult education in the industrial water treatment and management sector, by promoting sustainability, new skills and competences, increased investment, and collaboration with industry stakeholders.

Empowering people through education in green skills requires a flexible and adaptable approach that recognizes the diversity of individuals and their learning needs. This approach should focus on providing learners with the knowledge and skills they need to understand and contribute to sustainability, while also allowing them to develop their own unique perspectives and approaches. There are some specific ways in which people can be empowered through education in green skills, without relying on standardization:

- **Personalized learning:** Education providers can use personalized learning approaches, such as competency-based education, to allow learners to progress at their own pace and focus on the skills and knowledge that are most relevant to their individual needs.
- **Active learning:** Active learning approaches, such as project-based learning, problem-based learning, and experiential learning, can help learners develop their critical thinking and problem-solving skills, while also allowing them to apply their knowledge in real-world contexts.
- **Interdisciplinary learning:** Green skills education should be interdisciplinary, drawing on a range of disciplines, such as science, engineering, economics, and social sciences. This can help learners develop a more holistic understanding of sustainability and the complex challenges it poses.
- **Inclusion and diversity:** Education providers should ensure that their programs are inclusive and accessible to learners from diverse backgrounds, including those from marginalized and underrepresented communities. This can involve adapting teaching methods and materials to accommodate different learning styles and needs.
- **Collaboration and networking:** Education providers can encourage collaboration and networking among learners, allowing them to share ideas and perspectives, and build connections with other professionals in the field.

Overall, empowering people through education in green skills requires an approach that is flexible, adaptive, and learner-centred. This can help learners develop the skills and knowledge they need to contribute to sustainability, while also allowing them to develop their own unique perspectives and approaches.

4 Trends in the water sector and education

4.1 Trends in the water sector

4.1.1 Climate change

Vulnerabilities in Europe

Water availability in the Mediterranean is highly sensitive to changes in climate conditions. In the last century the Mediterranean basin has experienced up to 20% reduction in precipitation. Such a trend is expected to worsen with increasing demand for water and reduction in rainfall in the region. Future projection of this trend will reduce drastically water supplies in these areas, affecting considerably the population and economy of the Mediterranean countries.

In southeastern Europe annual rainfall and river discharge have already begun to decrease in the past few decades.

Water stress will increase over central and southern Europe. The percentage area under high water stress is likely to increase from 19% today to 35% by the 2070s, and the additional number of people affected by the 2070s is expected to be between 16 million and 44 millions. The most affected regions are southern Europe and some parts of central and eastern Europe, where summer flows may be reduced by up to 80%. The hydropower potential of Europe is expected to decline on average by 6% but by 20 to 50% around the Mediterranean by the 2070s.

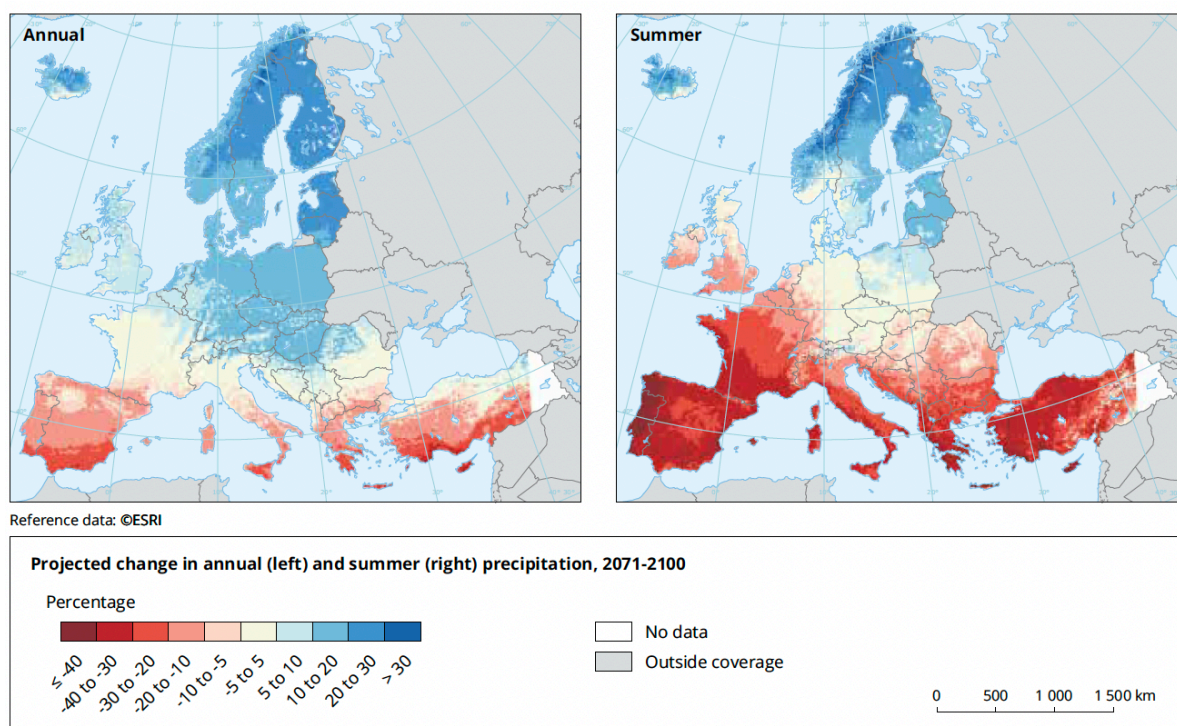
Annual average runoff in southern Europe (south of 47°N) decreases by 0 to 23% up to the 2020s and by 6 to 36% up to the 2070s, for the SRES A2 and B2 scenarios and climate scenarios from two different climate models. Summer low flow may decrease by up to 80% in some rivers in southern Europe. Other studies indicate a decrease in annual average runoff of 20–30% by the 2050s and of 40–50% by the 2075s in southeastern Europe.

Climate change must be seen in the context of multidecadal variability, which will lead to different amounts of water being available over different time periods even in the absence of climate change. The average standard deviation in 30-year average annual runoff is typically under 6% of the mean, but up to 15% in dry regions. Temperature rise and changing precipitation patterns may also lead to a reduction of groundwater recharge and hence groundwater level. This would be most evident in southeastern Europe. Higher water temperature and low level of runoff, particularly in the summer, could lead to deterioration in water quality. Inland waters in southern Europe are likely to have lower volume and increased salinisation. Figure 14 shows the projected change in annual and summer precipitation in Europe.

Most studies on water supply and demand conclude that annual water availability would generally increase in northern and northwestern Europe and decrease in southern and southeastern Europe. In the agricultural sector, irrigation water requirements would increase mainly in southern and southeastern Europe. The risk of drought increases mainly in southern

Europe. For southern and eastern Europe the increasing risk from climate change would be amplified by an increase in water withdrawals.

Water shortages due to extended droughts will also affect tourism flows, especially in southeast Mediterranean where the maximum demand coincides with the minimum availability of water resources.



Source: EEA (2017d).

Figure 13 Projected change in annual (left) and summer (right) precipitation across Europe for the period 2071-2100 (versus 1971-2000 average)

Adaptation strategies

According to the EU, policy orientations for the way forward are:

- Putting the right price tag on water,
- Allocating water and water-related funding more efficiently: Improving land-use planning, and Financing water efficiency,
- Improving drought risk management: Developing drought risk management plans, developing an observatory and an early warning system on droughts, and further optimising the use of the EU Solidarity Fund and European Mechanism for Civil Protection,
- Considering additional water supply infrastructures,
- Fostering water efficient technologies and practices,
- Fostering the emergence of a water-saving culture in Europe,

- Improve knowledge and data collection: A water scarcity and drought information system throughout Europe, and Research and technological development opportunities.

Adaptation strategies in Southern Europe

In southern Europe, to compensate for increased climate related risks (lowering of the water table, salinisation, eutrophication, species loss), a lessening of the overall human burden on water resources is needed. This would involve stimulating water saving in agriculture, relocating intensive farming to less environmentally sensitive areas and reducing diffuse pollution, increasing the recycling of water, increasing the efficiency of water allocation among different users, favouring the recharge of aquifers and restoring riparian vegetation, among others.

Managed aquifer recharge

Comprehensive management approaches to water resources that integrate ground water and surface water may greatly reduce human vulnerability to climate extremes and change and promote global water and food security. Conjunctive uses of ground water and surface water that use surface water for irrigation and water supply during wet periods, and ground water during drought, are likely to prove essential. Managed aquifer recharge wherein excess surface water, desalinated water and treated wastewater are stored in depleted aquifers could also supplement groundwater storage for use during droughts. Indeed, the use of aquifers as natural storage reservoirs avoids many of the problems of evaporative losses and ecosystem impacts associated with large, constructed surface water reservoirs.

4.1.2 Other trends affecting the water sector

The efficiency driven water sector

While appropriate asset management for water infrastructure has been neglected for quite some time, it is recognized that more investments are required to keep up the current level of service and adapt to current and future challenges arising from water pollution, water scarcity, and population dynamics. Water companies and governments, however, are facing a dilemma. In various developed countries huge infrastructure investments are needed, due to ageing or lacking infrastructure and population dynamics, but there is often little room to cover the increasing cost for required investment. Water companies in EU countries are also required to comply with stricter legislation and lower thresholds for contaminants. For example, the update of the UWWTD will require removal of micropollutants and the implementation of the WFD is already lacking behind the planned schedule.

Since the late 1990s, cost savings through automation in operation and monitoring have been increasingly realized making it difficult to use traditional solutions for cost reduction.

Besides direct price pressure, there is also increasing conflict between stakeholders for limited water resources, particularly in water scarce regions or during drought periods in otherwise water rich environments. Many regions in Europe prioritize water use for agriculture and

domestic use leading to an increasing pressure on the manufacturing industry to adapt to reduced water availability. To safeguard water security for the economically important industrial sector, expensive and technically more challenging solutions are increasingly implemented.

On a global scale we are observing a competition between regions where the abundance of water as well as other economic factors such as cost of labour, level of skills, and environmental legislation and their enforcement play an important role for long-term investment decisions. Particularly Europe is under pressure competing with Asia and America. In many cases private investments are seen as potential solution to bring funds to the water sector from outside and reduce the pressure on the government to provide the funds for optimum boundary conditions for innovation and healthy / sustainable industrial production.

Finally, the price rise in energy costs and ever tighter regulation in many aspects related to manufacturing threaten industrial production in many traditional industrial zones in Europe such as Germany and Northern Italy.

Digitalisation and new technologies

The fourth industrial revolution, also known as Industry 4.0, is a term that has been coined to describe the current trend of automation and data exchange in manufacturing and other industries. This trend is illustrated by the boosted interconnectivity of systems, smart automation, and the use of digital technologies such as the Internet of Things (IoT) and artificial intelligence (AI) to improve the efficiency and productivity of businesses.

This trend is also observed in the water sector with digital solutions to manage water supply and treatment being increasingly applied. While digitalisation may improve efficiency and effectiveness of water management, high upfront investment cost and the need of adequate security measures against cyber threats and other potential security risks might limit the use of new tools and approaches.



Figure 14 Green transition, digital transformation and the European Green Deal (Hedberg and Šipka, 2020)

Nevertheless, digitalisation ranging from simple upgrades of the Information and communication technologies (ICT) (i.e., hardware, software and networks) to the advanced methods such as Internet of Things (IoT), smart metering, GIS, Building Information Modelling (BIM) and Digital Twins (DT) will gain increasing importance and require more skilled personal in all water related employment.

Privatization, concentration, and monopolization

As a response to the increasing cost pressure and rising skills requirement in the water industry, privatization in its full form or as public-private partnership has gained importance across many EU member states. Large players are coming for example from France, Spain, and the US and encompass Suez, Veolia, Acciona, GE, DuPont to name a few of the large corporates. Although there is a huge potential for further involvement of the private sector in the water industry, political sensitivity has increased and the quality of services in private or public-private partnership partnerships have not always met the expectations but led to price rises and lack of long-term investments.

In addition to the already long-lasting discussion of the pros and cons of privatization, a trend in further concentration of the water industry can be witnessed. DuPont has purchased DOW Chemical and expanded its water related technology portfolio through several acquisitions of innovative SMEs or profit centres from other large corporates. Veolia has acquired Suez SA in 2022 becoming the leading global provider of water related solutions from technology supply to financing and operation. Furthermore, several European companies moved to Asia including India, Singapore and China where the economies are thriving and large investments in water infrastructure are ongoing and will probably continue in the coming decades.

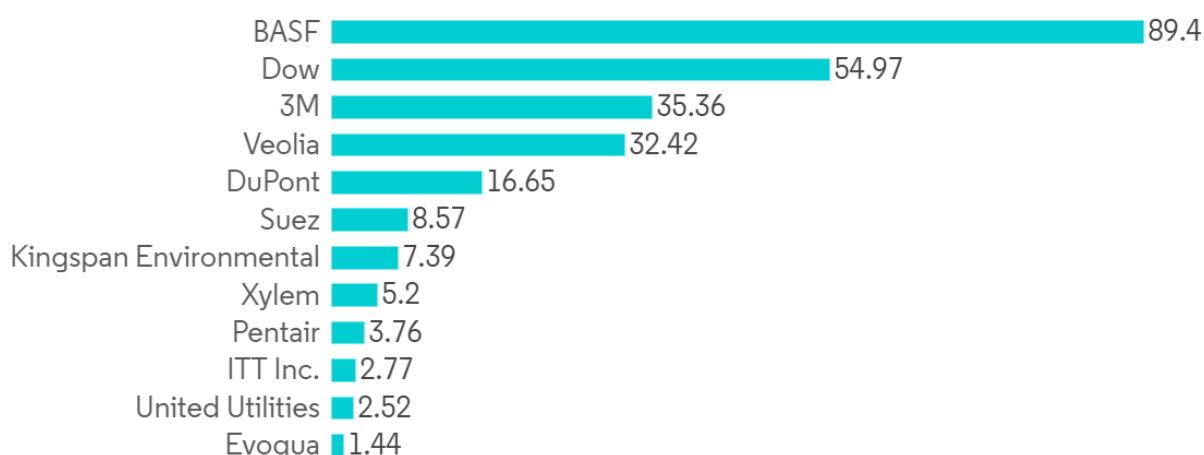


Figure 15 Revenue of selected global companies active in water and wastewater treatment in 2021 (in billion U.S. dollars; Source: United Utilities, Kingspan Environmental)

4.2 Trends in education

4.2.1 Water sector education

4.2.1.1 Professional education and vocational training

To ensure comparability of the different National Qualification Frameworks (NQF) within the EU, the European Qualification Framework (EQF) was introduced cover the different levels and pathways of education. The competence raises with the level which is ranging from 1 to 8 where 1 is the lowest and 8 the highest. Figure 16 depicts the different EQF levels linked to the general educational qualification. It also shows that the academic level starts at EQF level 6.

EQF LEVEL 8	ACADEMIC LEVEL	DOCTORATE
EQF LEVEL 7		MASTER
EQF LEVEL 6	POST UPPER SECONDARY LEVEL	BACHELOR
EQF LEVEL 5		HIGHER NATIONAL DIPLOMA
EQF LEVEL 4	UPPER SECONDARY LEVEL	HIGHER NATIONAL CERTIFICATE, UPPER SECONDARY DIPLOMA
EQF LEVEL 3	SECONDARY LEVEL	SECONDARY DIPLOMA OR VOCATIONAL DIPLOMA
EQF LEVEL 2	PRIMARY LEVEL	SECONDARY SCHOOL WITH NO DIPLOMA
EQF LEVEL 1		PRIMARY SCHOOL

Figure 16 EQF levels linked to the general education qualifications (Hladík et al., 2012)

The alignment of the NQF to the EQF is the responsibility of the countries. For the assignment of the NQF to the EQF, each country must prepare a detailed assignment report based on the ten EQF mapping criteria, which is reviewed and approved by the EQF Advisory Group.

Figure 17 shows the Vocational Education and Training system of Italy. Italy offers 3-4 year and up to 5-year programmes in technical and vocational trainings leading to EQF 3 to 4.

However, Italy is among the countries with the largest population reaching only EGF 0-2 (around 40%) compared to Germany (20%) (cf. Fig. 18). Also, in life-long learning Italy is lacking behind the other EU member states with slightly increasing share in the last decade (cf. Fig. 19)

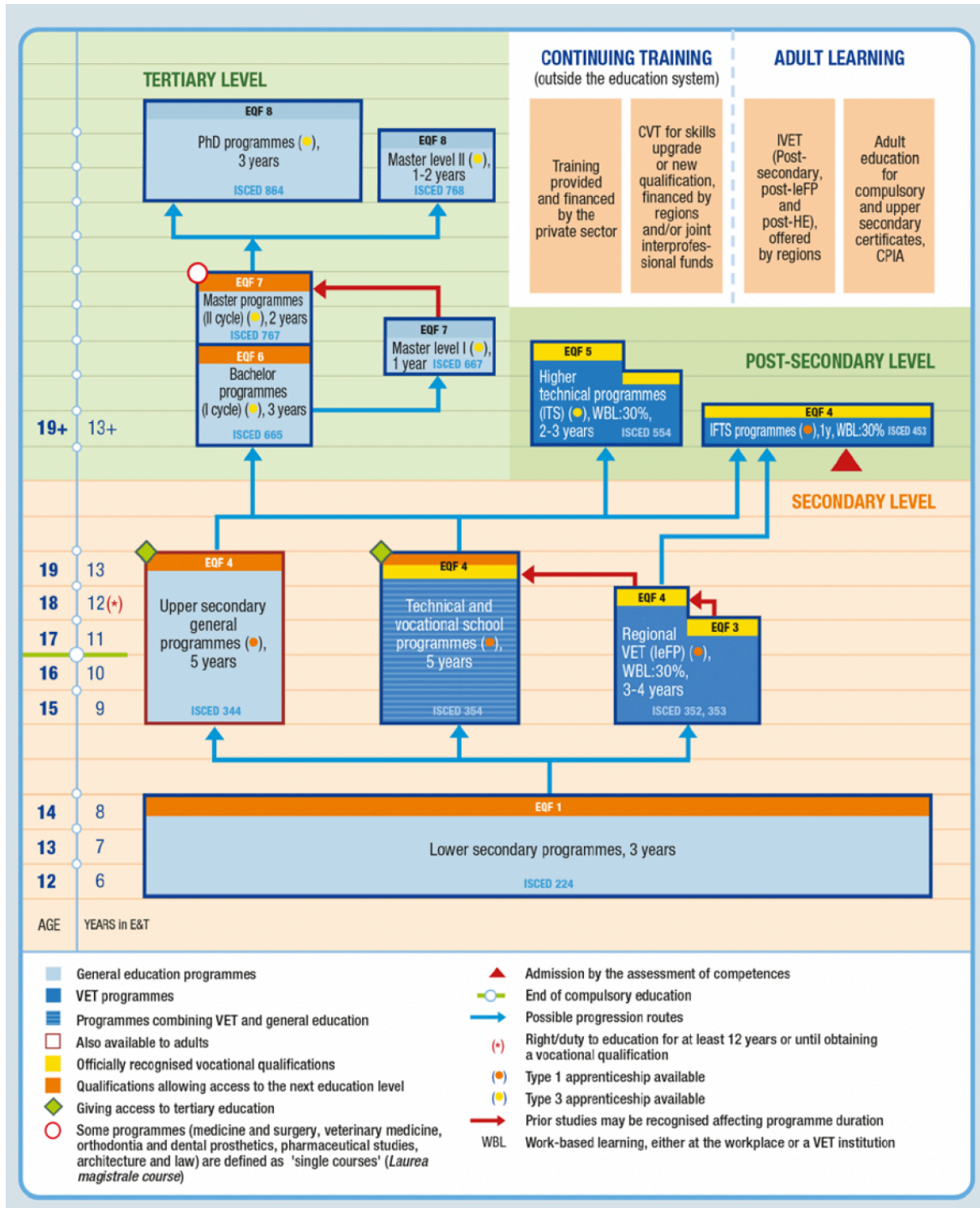
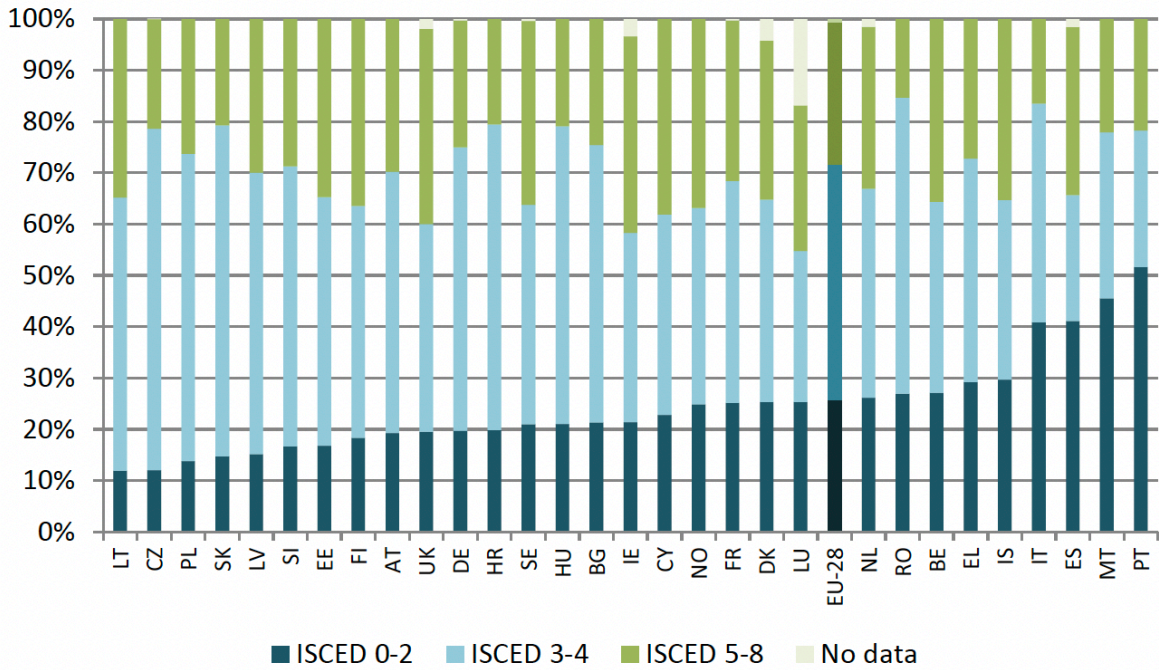
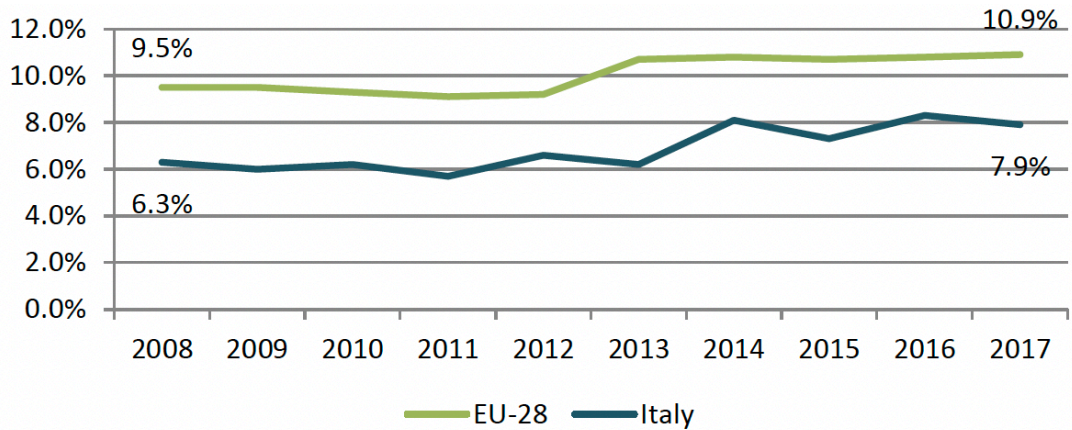


Figure 17 Vocational Education and Training in the Italian education and training system in 2018 (Angotti 2019)



NB: Data based on ISCED 2011
 ISCED 0-2 = less than primary, primary and lower secondary education
 ISCED 3-4 = upper secondary and post-secondary non-tertiary education
 ISCED 5-8 = tertiary education
 Source: Eurostat, lfsa_pgaed [extracted on 7.11.2018]

Figure 18 Population (aged 15 to 64) by highest education level attained in 2017 (Angotti 2019)



NB: Share of adult population aged 25 to 64 participating in education and training. Source: Eurostat, trng_lfse_01 [extracted 12.11.2018]

Figure 19 Participation in lifelong learning in 2008-17 (Angotti 2019)

4.2.1.2 Technical education and vocational training

In Germany, the EQF is implemented through the German Qualification Framework (GQF). According to the GQF, the educational system in Germany starts with the vocational preparation at level 2. Within this level, several basic and advanced courses are offered and reach up to EQF level 4. These courses are designed to create and build upon a solid knowledge base. They include, but are not limited to, the following: laboratory-, sewer-, microscopy-, and electrical-related topics. Reaching from level 2 to level 5, specialised courses for e.g. sewer inspection/cleaning, (Oil)-separators or specialised Electricians expand this education and training offer. Covering the EQF levels 3 and 4, the vocational training offers in the water sector in Germany are: 1. Specialist for wastewater technology, 2. Water management specialist, 3. Specialist for pipe, sewer and industrial service and 4. Hydraulic engineer (DWA, 2018). These vocational training options are offered in a dual system, where the training is divided into a practical part, which is carried out at the employer and a block of school-based instruction.

Possible further training includes master hydraulic engineer, technician, or shift supervisor in lock operations. Given the appropriate school qualification, a degree in civil engineering, environmental protection or municipal hydraulic engineering can follow.

4.2.1.3 Academic education from universities

The academic level of education includes EQF level 6 for Bachelor's degrees, 7 for Master's degrees and 8 for the doctorate. Students in the water sector usually obtain the academic degree Bachelor/Master of Science or Bachelor/Master of Engineering. Classic degree programmes in the water sector are civil and environmental engineering/science. These are usually broadly based and allow for in-depth study in the water sector through compulsory electives. Since environmental topics and thus also topics around water treatment and wastewater treatment are increasingly coming into focus, more and more degree programmes are now being offered that specialise in water topics. These include, for example, Water Science and Engineering, Water Sciences or Urban Water Management. Graduates from universities are responsible, for example, for the conception and planning of filter systems for the design of water treatment plants or the determination of groundwater courses for drinking water production. Here you can work in engineering offices or public administration, for example in the application, monitoring and approval of facilities that fall within the water sector. This includes wastewater treatment plants, water treatment plants, water lifting stations, etc. As water law is very complex and not uniform, legal tasks are also a possible area of activity. Environmental and water management are other topics that fall within the remit of university graduates.

4.2.1.4 Non- and informal education

Most learning takes place outside the formal sector in everyday life and non-formal learning environments. These environments can be biosphere reserves, adult education centres, environmental education centres, social associations, sports clubs, family, circle of friends etc. Compared to the formal education it is more motivation driven because it is based on personal

interests. Non-formal education or extracurricular education refers to any form of education planned outside the formal curriculum and educational opportunities for personal and social education that serve to improve certain skills and competences. It takes place in a systematic and planned manner but without the directly aiming of getting a degree or certificate. Examples are in-company education, private language learning courses, political continuing education, or continuing education in the hobby sector. It is specifically used in youth work and by many youth organizations and groups. Informal education in comparison is completely unstructured, has no institutional organization, and is not pedagogically supported or accompanied. It occurs in everyday life/work has an action or problem solving as its goal, not learning itself. Thus, is directed and controlled by the learner him/herself and is based on experience learning and it is a conscious or intentional process which is often integrated into a social context.

In Italy, most workers enter the water sector without formal training and have only non- or informal education with a training on the job approach. This leads to a strong dependence on their employer, as they lack officially recognized qualifications and certificates. This further results in reduced opportunities and mobility as they do not have the possibility to change jobs. Blending the German vocational education offers with the existing non- and informal education would make the water sector more attractive for employees and thus counteract the shortage of skilled workforce.

4.2.1.5 Coursework for non-formal training

In Germany, the German Association for Water, Wastewater and Waste (DWA) and the Training Centre for the Supply and Disposal Industry gGmbH (BEW) are offering a broad variation of courses in the water sector which can serve as an example for other countries. These courses are designed for various target groups, such as employees of water and soil associations, agencies and authorities, water supply companies, engineering offices and other companies. The lecturers come from practice, academia, or official authorities. On offer are certificate courses, qualification courses and short updates. The seminars are mostly offered in presence, but there are also online-only seminars and hybrid events. Topics are broadly diversified and reach from water bodies protection to supply of drinking water and water reuse topics as well as legal affairs and sampling courses. Furthermore, technical, and electrical courses as well as occupational safety courses part of the seminars offered.

4.2.2 Trends in education

In education digitalization represents also one of the mega trends. Digitalization in education may play a vital role in providing high-quality education and equal opportunities to learners across all qualification levels. The potential as well as limitations have become widely visible during the last 3 years with over 1.5 billion students having switched to online education.

While traditionally digital tools were mostly used in the form of portable hardware and certain exchange and learning platforms such as Moodle used in universities. Digitalization, however, goes far beyond traditional learning approaches where hardcopy-based learning materials such as books, lecture notes or exercises have been converted to digital formats as e-books and online lecture materials (slides, scripts, etc.).

The European Commission promotes digital education and has released the *Digital Education Action Plan (DEAP, 2021-2027)*¹⁷ “that sets out a common vision of high-quality, inclusive and accessible digital education in Europe, and aims to support the adaptation of the education and training systems of Member States to the digital age” (EC 2022). The DEAP sets two priorities:

1. **Fostering the development of a high-performing digital education ecosystem**
2. **Enhancing digital skills and competences for the digital transformation**

On the one hand, digital education allows for flexible and learner-centred education independent of time and location. Thus, students can access the provided information 24/7 and particularly in remote locations students can now access high-quality education previously not available. Also travel time to commute between homes and the learning institutions can be saved. Teaching videos and online lecturing allow for asynchronous learning and adaptation of the teaching speed to the learning progress of the single student.

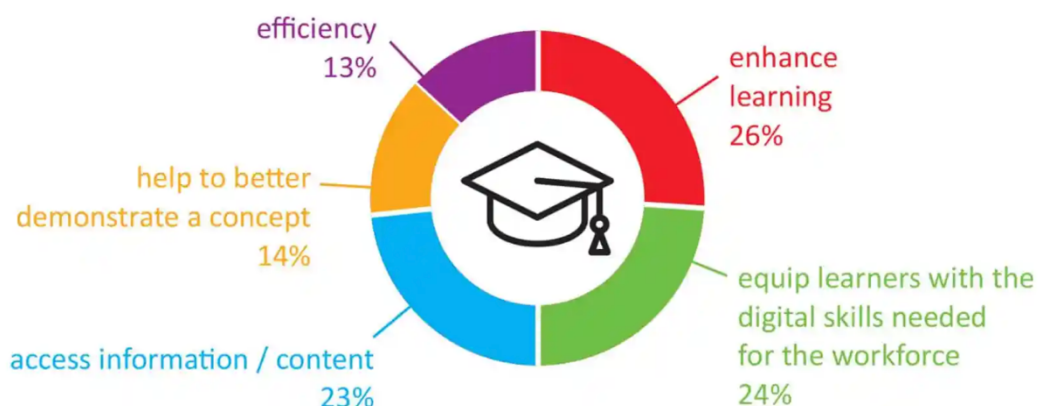


Figure 20 Main benefits of digital education (McNulty Consulting 2022)

¹⁷ <https://education.ec.europa.eu/focus-topics/digital-education/action-plan>

On the other hand, during and after the pandemic it became also evident that successful learning requires not only the provision of information in different formats but also proper interaction between the teacher and learner as well as between the learners for the students' motivation, understanding the needs of the students and development of social competence and other soft skills typically acquired in collaborative learning. Also practice and hands-on training are often difficult to provide in digital formats.

One of the key insights from the pandemic is that hybrid formats and blended learning combining online educational methods and opportunities for interaction online with traditional physical place-based classroom methods are superior to pure online teaching.

Adult and continuing professional education are also increasingly moving in the direction of digital education. However, in contrast to students in schools and universities, adult learners and practice learners may not avail of expensive hardware, software, and broad band connection to the internet. Also, in rural settings bandwidths are still significantly lower than in urban areas making it difficult to follow lectures, videos, or other online formats.

Finally, the digitalization with increased usage of more recent developments as the broad roll-out of AI based internet tools such as ChatGPT and similar tools pose a large risk at traditional learning and teaching methods and may, at the end point, completely question the rationale of individual qualifications and certificates. As an immediate reaction many teaching institutes have now switched back to examination methods which allow for direct proof of the acquired knowledge, e.g. in oral exams, colloquiums in presence and other formats which exclude the learner from tapping into the internet related knowledge base. Depending on the programming AI may further introduce a bias with less neutral or balanced opinions promoting certain products, opinions or agendas. At the end of the day AI threatens individuality and human relationships as well as meaningful professional careers across many sectors, particularly those that are knowledge driven.

5 Needs of the labour market and employees in the water sector

The labour market in the water sector is constantly evolving due to changes in technology, environmental regulations, and other factors. Some of the current needs of the labour market and employees in the water sector could be as follows:

- **Digital skills:** The water sector is becoming increasingly digitalized, with the use of IoT sensors, big data analytics, and other technologies. Workers in the sector need to have the skills to work with these technologies and understand how to analyze and interpret data to improve water treatment and management practices.
- **Sustainability knowledge:** The water sector is under increasing pressure to adopt sustainable practices to reduce the environmental impact of water use and protect natural resources. Workers in the sector need to have a strong understanding of sustainability issues and how to integrate sustainability principles into water management practices.
- **Soft skills:** The water sector requires workers with strong communication, teamwork, and problem-solving skills. These soft skills are important for effective collaboration with colleagues and stakeholders, as well as for resolving complex water management issues.
- **Regulatory compliance:** The water sector is subject to a range of environmental regulations at the national and international level. Workers in the sector need to be familiar with these regulations and have the skills to ensure compliance.
- **Practical experience:** The water sector is highly practical, and workers in the sector need to have hands-on experience with water treatment and management technologies and practices. Practical training and experience, such as apprenticeships and internships, are important for building the skills and knowledge needed for success in the sector.

By meeting these needs of employees in the industrial water sector, education and training programs can help ensure that workers have the skills and knowledge needed to succeed in this important field. The Italian education system provides a range of programs and training opportunities related to water management and treatment, including for the industrial water sector. In general, the Italian education system has been criticized in the past for not being adequately connected with the needs of the labour market, leading to a mismatch between the skills and qualifications of graduates and the needs of employers. However, there have been recent efforts to improve the alignment between education and training programs and the labour market, including through partnerships between educational institutions and industry stakeholders.

Overall, while the Italian education system provides some opportunities for education and training in the water sector, it is important to ensure that these programs are aligned with the current needs of the labour market. This requires ongoing collaboration and dialogue between education providers, industry stakeholders, and government policymakers to identify and

address skills gaps and ensure that graduates have the skills and knowledge needed to succeed in the water sector. There are also some initiatives in Italy specifically aimed at providing education and training for the water sector, such as the Water Campus in Venice and the Water Academy in Bologna. These institutions provide specialized training and education in water management and treatment, including for the industrial water sector.

The Water Campus is a partnership between the University of Venice and a range of public and private organizations involved in water management and treatment. The campus provides education and training programs at the undergraduate and graduate level, as well as professional development courses and research opportunities. The Water Campus focuses on interdisciplinary approaches to water management and treatment, including the integration of engineering, science, economics, and social sciences. The campus also promotes collaboration between educational institutions, industry stakeholders, and public authorities to address the challenges of sustainable water management.

The Water Academy is a training and research institution established by Hera Group, a leading Italian multi-utility company in the water sector. The Academy provides training and education programs for professionals in the water sector, including for the industrial water sector. The programs offered by the Academy focus on technical skills and knowledge related to water management and treatment, as well as soft skills such as communication and leadership. The Academy also provides research and development activities, including the development of new technologies and approaches for water management and treatment.

6 Conclusions

6.1 Summary

The Italian water sector sustains a large and still very successful industrial sector. Nevertheless, education levels of the staff employed in industrial water management and treatment are insufficient to cope with future challenges arising from globalization, tightening legislation, digitalization, and other megatrends such as climate change.

One of the key factors that contributes to future risks of the Italian industrial water sector is insufficient investment in water infrastructure and funds to operate and maintain the infrastructure at industries and municipalities.

Life-long learning and professional development are less common in Italy than in countries with comparable importance of the manufacturing industries such as in Germany. Italy also has very few professional sector organisations such as the German DWA, DVGW and education organisations such as the BEW in North-Rhine Westphalia which offer a broad range of formal and informal education programmes for professionals in all levels of education.

Specialized trainings such as the EQF Level 3 and 4 degrees in Germany have improved the quality of the education and the competence of the staff working in the water sector.

New opportunities arise from digitalisation of the education and the water sectors allowing to access employees in remote locations and optimizing operation and maintenance of water and wastewater systems. The recent developments based on artificial intelligence can further support the growth of efficient and targeted management and operation of water infrastructure but can also lead to massive job losses across a range of knowledge-driven sectors.

6.2 Recommendations

The following short-term actions are recommended:

- Develop qualifying formal adult education and high-quality non-formal and informal education,
- Provide high-quality learning opportunities for adults with a focus on environment/wastewater and digital sector,
- Adapt and develop tailored curricula at universities and training centres for environmental and water management in industries,
- Collect best-practice examples from EU and abroad to enhance the quality of non-formal and ongoing education in the water sector of Italy and countries with similar boundary conditions,
- Increase cooperation between industries and between the industry and other stakeholders to increase the robustness and resilience of the manufacturing sector.

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