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Blue Funds: a defensive asset class?

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Introduction

The aim of this thesis is to provide an analytical framework and an empirical analysis based on the use of the Phyton programme to show the vitality of water as a resource and as an investment opportunity. The aim is to discuss the relevance of this commodity from the perspective of climate change and sustainable investments, trying to provide a picture of the best financial products in the market willing to exploit its potential. Furthermore, through the analysis of the time series of a sample of financial products related to water (Investment Funds and ETFs) and the analysis of several US macroeconomic variables we will be provide a first attempt to evaluate the correlation between the overall business cycle and this specific asset class. In particular, our ultimate goal is to investigate how macroeconomic variables impact this asset class.

More specifically, in Chapter 1 we present water as natural resource with its chemical features for the human purpose, as well as a commodity and financial instrument with the problem of ethic. Moreover, we talk about the impact of climate change with the resulting risks for investors and about sustainable finance with the integration of ESG Criteria into the investment process.

In Chapter 2, we focus on investing in water. We first introduce what Mutual Funds, Sicavs and Exchange Traded Funds are, then we explain the difference between financial instruments that invest in water future contracts, in water utilities and industrials, in water equipment and materials analysing different thematic funds currently existing in the market.

In Chapter 3, we propose a brief introduction to Fintech, that might be simply defined as the technology applied to financial landscape. Then, we focus on Machine Learning, and its implementation in finance, in order to build the methodological basis for the empirical part of the analysis. In the empirical part we employ a Linear Regression Model and a Decision Tree Regression to compute and analyse from a statistical point of view, under both linear and a non-linear models, the correlations between a dataset containing the major US macroeconomic variables and a generic American stock index (specifically MSCI USA Index) as well as a sample of Funds and ETFs investing in water stocks as described and discussed in chapter 2. We use Python programming language to carry out

the analysis since we want to apply ML techniques with its specific language to analyse the economic problem.

Overall, our results show that the ability of US macroeconomic variables to predict the performance of water-related assets is lower than their ability to predict the performance of a more traditional stock index. This underscores the potential of water to be less correlated with the economic cycle, paving the way for the view that water is a resilient asset against economic downturn and a good investment opportunity for retail investors, with limited economic capacity, to be protected from fluctuations.

Water is life, it is energy, it is an essential resource of inestimable value to man and all living things on Earth. Without water there is no life. Without water there is no economic activity. That is why water is the subject of a business whose importance is growing day by day: water is a commodity like oil, iron, gas, whose scarcity creates investment opportunities. Investing in water, the so-called 'blue gold', today makes more sense than ever.

Water is one of those investments that can be defined as related to a megatrend, meaning those powerful trends that globally direct the actions of governments and international organisations towards a common goal, move large public and private investments, activate research and development efforts, and influence university education.

Ten years ago, after having successfully completed his famous subprime short, Micheal Burry, the businessman who inspired the film 'The big short', decided to invest in water**.**

Now, in all stock exchanges you can find so-called '*water* stocks', shares of companies that operate in water-related activities: there are utilities that deal with water distribution, companies that act in irrigation, but '*water stocks*' are also companies that work in water treatment and purification, industries that produce components or equipment for water systems such as pumps, valves and desalination plants.

Water may soon influence the commodity market segments of financial marketplaces.

Its use will have to be rationalised to avoid distortions that could jeopardise the ESG strategies of listed companies and their suppliers. Shareholders, rating agencies, observers and consumers will always be likely to demand more attention.

Blue gold moves business in terms of billions and growing. We know perfectly well that the intersection of economy, society and environment is a complex matter. Industry professionals must encourage access to the capital market by sustainability-oriented

investors and companies and foster efficient compliance processes of market participants with respect to new regulatory obligations and supervisory processes by the authorities. All this not to cry over spilt water.

Chapter 1

What is water? The relationship between its scarcity and value.

1.1 Water as a natural resource.

From a pragmatic and technical point of view, water is the most abundant chemical compound on earth, it is found in all environments and is an integral part of all living organisms.

The amount present on earth is immense, estimated at around 1200 billion tonnes. Our planet is, in fact, about 70 per cent occupied by water while only 30 per cent is occupied by land.

Most of it, 97.2%, is sea water or brackish water, unusable for drinking, but used for work, irrigation and most industrial uses. Fresh water is also present on the planet in very large quantities (40 million billion tonnes) but is mostly retained by ice caps and glaciers (2.15%); only the remaining 0.65% is divided between lakes, rivers, groundwater and the atmosphere[1].

In its pure form, water is a chemical compound, given by the union of two different elements: oxygen and hydrogen. As shown in the figure, its chemical structure thus consists of two hydrogen atoms bonded to an oxygen atom with a polar covalent bond[2] . Two positively charged hydrogen atoms join an oxygen atom with two negative charges, forming the H_2O molecule. A teaspoon of water contains millions of these molecules. This is the only substance found in nature in the three states of aggregation: solid, liquid and gas. Its versatility enables many chemical reactions, which are indispensable for life on our planet.

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[1] Conoscere l'acqua – acda.it.

[2] The covalent bond (symbolised in structural formulae by a hyphen between the atom symbols) is a bond established between two atoms that share one or more electron pairs of the outermost electron shell. A pure covalent bond (non-polar) occurs when the atoms have identical electronegativity; examples are H_2, O_2, Cl_2. Instead, a polar covalent bond occurs when the electron doublets shared between atoms are not equally shared. In this case, the bonding electrons are closer to the more electronegative atom, which thus acquires a partial negative charge, while the other atom acquires a partial positive charge.
legame covalente (zanichelli.it).

Figure 1.1, 1. The composition of water molecules.

(Reference: Conoscere l'acqua – acda.it)

It is in constant motion through the 'water cycle', which even today mankind tries to regulate and control for its own needs.

The water cycle is often taught as a simple circular cycle of evaporation, condensation, and precipitation. It shows the continuous movement of water within the Earth and atmosphere. It is a complex system that includes many different processes. Liquid water evaporates into water vapor, condenses to form clouds, and precipitates back to earth in the form of rain and snow. Water in different phases moves through the atmosphere (transportation). Liquid water flows across land (runoff), into the ground (infiltration and percolation), and through the ground (groundwater). Groundwater moves into plants (plant uptake) and evaporates from plants into the atmosphere (transpiration). Solid ice and snow can turn directly into gas (sublimation). The opposite can also take place when water vapor becomes solid (deposition).

It consists of numerous mineral nutrients classified into three groups:

- macro-nutrients, present in the human body in discrete quantities, such as calcium, phosphorus, magnesium, sodium, potassium, chlorine and sulphur;
- microelements or trace elements, which the body needs in small quantities, such as iron, copper, zinc, fluorine, selenium, cobalt, iodine, manganese and molybdenum;
- trace minerals, whose requirements are very low, e.g. silicon (useful for bone health).

Water can be hard or light. Hard water contains calcium, magnesium and other dissolved metals. These substances can change the properties of water, such as the salts in seawater

that lower the freezing point of the oceans. However, the water we drink is usually potable, i.e., made drinkable (drinkable) through a process that rids it of all substances that would make it unpalatable or harmful.

Most of our body is composed of water. It is the main ingredient in our blood, our cells and accounts for about 65% of our body weight. Water is necessary for our health: drinking water helps keep our organs healthy and replaces the fluids we lose through breathing, sweating and digestion.

Elements which make up our organism, in order to be able to interact each other, it is necessary to allow them to swim in an environment in which the random but high probably contact of different molecules is preferred, with the ability to exchange different components. This environment must consist of a liquid substance which is able to support molecules that contained in without disturbing them in the process of chemical reaction. If necessary, to cooperate in some other reaction by giving up part on its structural atoms. Water satisfies all of these characteristics.

Water belongs to the category of raw materials, i.e., it is part of all those materials that we derive from the exploitation of natural resources and that are subsequently used for the production of a wide range of goods through manufacturing and industrial processes. Raw materials are of agricultural (e.g. wood, natural fibres, vegetable oils) and mining origin (e.g. iron, sulphur, copper, lead, coal, oil, fuel gas). In addition, they can be distinguished according to use, food or industrial, or according to production, and can therefore be divided into renewable and non-renewable.

1.2 Water as a commodity and a financial instrument (with ethics problems).

Water is a resource and a raw material. From an economic point of view, water can be defined as an essential natural resource with an intrinsic economic value. This value derives from its relative scarcity and its importance in various economic sectors. It is considered an economic source because it is based on supply and demand, that can be traded and influences the allocation of resources.

In the financial context, water can also represent an investment opportunity. There are various forms of water-related investments, such as water utilities, water treatment technologies, water infrastructure and water markets, so-called water futures contracts.

Investors can bet on the fact that the growing demand for drinking water and its efficient and sustainable management offer opportunities for financial returns. Considered the oil of the new millennium, water is strongly threatened by climate change, pollution and population growth. The latest alarm in this regard came from the UN, which pointed out that the shortage of water sources is worsening rapidly even in developed countries[3]. While the risk of global drought is certainly a cause for concern, it can only catalyse investors' interest in a sector that is increasingly perceived as defensive and with enormous potential for long-term growth.

However, it is important to note that water is also a common resource and a fundamental human right that, however, remains without legal recognition and therefore left to the interpretations of social economics and declarations of intent by states. Water has not been recognised as a public common good by the founding treaties of the European Union. Access to water is not provided for as a human right in the Charter of Fundamental Human Rights (2007). EU directives on water quality constitute the obligations that member states are bound to comply with, starting with Directive 2000/60/EC, which in fact constitutes EU policy and classifies water as "a commodity, but not like any other". The service of access to water for human use is a service of economic importance subject

[3]Focus Risparmio *Acqua, i fondi azionari che hanno inziato meglio il 2023*, 30 marzo 2023, Giulio Zangrandi.
INTERMONTE: Tema di Investimento - aprile 2022 - BNP Paribas.

to the rules of the market and competition, and governance as a public good is left to the sovereignty of member states.

This ambiguity on the legal nature of water - common good or commodity? - has unfortunately not been overcome by the Drinking Water Directive, in force since 2021, and in fact critical issues are nurtured. Specifically, the European governance model of management makes it possible to transform not only surface water but also rainwater, which feeds groundwater for human use, into a storable product that can be sold for both productive and human uses. Furthermore, the adoption by several states to classify environmental goods as natural capital, to assign a monetary valuation to ecosystems, and to activate systematic accounting, in fact create the conditions for removing common goods from the sovereignty of member states. This is because environmental goods are equated with products of economic value and the protection of services entrusted, in the absence of public resources, to financial instruments of ethical value.

Its management must balance economic interests with environmental sustainability, and fair and universal access to clean water must be ensured. Over-privatisation and commercialisation can raise equity concerns, leading to limited access for disadvantaged communities and potential negative impacts on the environment. Consequently, the responsible management of water resources is crucial to ensure economic sustainability and the protection of human rights.

Nevertheless, the pricing of this commodity presents risks. Compared to the different 'values' attributable to water such as cultural, religious, social, legal, etc., the increasingly dominant approach of establishing an 'economic value' and conditioning access to drinking water on the payment of a 'price', as envisaged in Goal 6 of the 2030 Agenda, is worrying.

The 2030 Agenda is a global action plan adopted by the United Nations in September 2015. Its full name is 'Transforming our world: the 2030 Agenda for Sustainable Development'. It was developed and drafted through a consultative and negotiated process between UN member countries (currently 193), civil society and other stakeholders. Its main goal is to achieve global sustainable development by 2030. Sustainable development is based on three fundamental dimensions: the economy, society and the environment. The 2030 Agenda includes 17 Sustainable Development Goals, the so-called SDGs, which comprise a set of 169 specific and measurable targets. The Sustainable Development Goals cover a wide range of global challenges, including poverty, hunger,

health, education, gender equality, access to clean water, sustainable energy, climate action, environmental conservation, peace and justice[4] . The 2030 Agenda recognises the interconnectedness of these challenges and the importance of taking an integrated approach to address them.

Figure 1.2, 2. The SDGs Goals of Agenda 2030.

(Reference: getupandgoals.it)

In particular, Target n.6 of Agenda 2030 has the objective 'to ensure the availability and sustainable management of water and sanitation for all'. Our planet has enough drinking water to achieve this goal. However, due to poor infrastructure or economic mismanagement, every year millions of people, most of them children, die from diseases due to inadequate water supply, sanitation and hygiene levels. Water shortages and poor water quality, together with inadequate sanitation systems, have a negative impact on food security, livelihood choices and educational opportunities for poor families around the world. Droughts affect some of the poorest countries on the planet, exacerbating hunger and malnutrition.

[4] The 17 Sustainable Development Goals refer to a set of important development issues that take into account the three dimensions of sustainable development - economic, social and ecological - in a balanced manner and aim to end poverty, fight inequality, tackle climate change and build peaceful societies that respect human rights. We talk about: eradicating poverty, hunger, promoting health and wellbeing, quality education, gender equality, clean water and sanitation, clean and affordable energy, decent work and economic growth, business, innovation and infrastructure, reducing inequalities, promoting sustainable cities and communities, raising awareness of responsible consumption and production, combating climate change, supporting life under water and on land, promoting peace, justice and through strong institutions creating a partnership for the goals.

According to the 2020 UN Water Development Report, facts and figures emerge that highlight inequities in the use of this precious resource. Since 1990, 2.6 billion more people have had access to improved drinking water resources, but still 663 million people lack it. It is estimated that at least 1.8 billion people globally use drinking water sources contaminated by excreta; between 1990 and 2015, the proportion of the world's population using improved drinking water sources rose from 76% to 91%. However, water scarcity affects more than 40% of the global population, a percentage that is expected to increase. More than 1.7 billion people live in river basins where water use exceeds its regeneration; 2.4 billion people do not have access to basic sanitation services such as toilets or latrines; and more than 80 per cent of wastewater produced by human activities is discharged into rivers or seas without purification systems. This analysis also shows that every day, about 1,000 children die from preventable diarrhoeal diseases related to water and sanitation. Water power remains the most important and most widely used source of renewable energy, so much so that in 2011, it accounted for 16% of the world's total electricity production. About 70% of the water extracted from rivers, lakes and aqueducts is used for irrigation. Floods and other water-related disasters are responsible for 70% of deaths due to natural disasters.

The goal of this Agenda and Goal 6 is to achieve universal, safe, affordable and equitable access to safe drinking water by 2030. The creation of adequate sanitation services, improving water quality by reducing pollution and optimising efficiency in its use. The maintenance and protection of ecosystems related to this resource by also supporting the development of adequate infrastructure in developing countries.

The launch of the first 'futures' fund, listed on the Californian Stock Exchange - in December 2020 - is based on precisely this 'economic' vision; it heralds the birth of the 'world's first water market', but constitutes a threat to the human right enshrined by the UN. After the announcement made by the Chicago Mercatile Exchange (CME), one of the most important financial centres for derivative instruments, the first water futures[5] came on the market on 7 December 2020. Contracts linked to the Nasdaq Veles California Water index, which measures the price of water rights in California, began trading under the ticker NQH2O. Following this, the CME claims that the futures contract can

[5] A futures contract is a financial derivative that represents an agreement between two parties to buy or sell an asset at a prearranged price on a specific future date. It is a standardized contract traded on CME, allowing participants to speculate on the price movement of underlying assets, like commodities, currencies, equity indices, precious and rare metals.

immediately serve as a risk management tool to help municipalities, farms and industries protect themselves from the economic risks associated with water shortages. Until now, buying and selling water rights was done only in the spot market, where the exchange of traded commodities takes place with immediate settlement; this meant that in drought years, when more water was required to grow crops and supply homes, buyers faced high prices and a lot of uncertainty. Now, instead, they will be able to bet on futures contracts to offset higher figures they might have to pay in a normal transaction. Over time, the CME hopes that water futures will become a benchmark index, that is, a yardstick that can signal the level of global water alert. This inevitably produces a moral dilemma. While futures are intended to achieve price transparency in the market, they could, like all commodities, be the object of financial speculation. The United Nations General Assembly, which in 2010 included access to clean water and sanitation among the 'universal and fundamental human rights' and the market's attempt to cap prices, prompts ethical reflection.

The dilemma has been taking shape since 2000 when the water war in Cochabamba[6] caused by a multinational company's appropriation of water sources in Bolivia, allowed its recognition as a right by the UN. In 2020, in order to overcome the risk of lack of access to water in California, the multinationals of the agricultural world turned to speculative finance, calling for the launch of the first speculative guarantee fund for access to it. Hence, the first 'Water Future' as a global contract.

In the case of the Nasdaq Veles California Water Index Futures, the underlying is not water as a commodity, but an index. It represents on a weekly basis the reference price of water rights in California, which allow those who hold them to exploit water from rivers,

[6] Since 1985, under pressure from the Bretton Woods institutions (International Monetary Fund, World Bank) and as a consequence of the adoption of the neo-liberal New Economic Policy (NPE), the Bolivian government privatised the public services sector, which led to social movements and clashes in the country. This privatisation led to tensions and conflicts, with the municipal company Semapa in Cochabamba being sold to an international consortium called Aguas del Tunari. The latter increased water tariffs significantly, up to 300%, and obtained the right to charge for water to citizens who took it from sources not connected to the water network.

In 2000, the 'Guerra del agua' broke out in Cochabamba, with the creation of a social movement called 'Coordinadora de Defensa del Agua y de la Vida', which organised strikes and demonstrations to defend water as a common good and denounce its commercial exploitation. The government responded with repression, resulting in the death of five people and numerous injuries. The war only ended when Semapa returned under public management.

Currently, water wars are still a source of concern in Bolivia. Underground mining and large-scale farmers, particularly in the production of soya and sugar cane, use large amounts of water and contribute to deforestation. Environmental activists accuse large farms of appropriating water as a private resource. Furthermore, the then Bolivian president, Evo Morales was criticised by environmentalists for his management of public water and the drying up of Lake Poopó in 2016.

lakes or underground sources. The index is based on the weighted average of the transaction prices of these rights in the state's five largest water resource basins. It is a market of about $1.1 billion. The fact that the first water futures developed in California is no coincidence. High temperatures, repeated fires and climate change are increasingly threatening local agriculture. By purchasing these financial instruments, local and governmental authorities, farmers and traders are able to hedge against future increases in the price of water. Repeated water emergencies on a global scale lead to speculation that futures similar to the Nasdaq Veles California Water Index Futures will be traded on other derivatives exchanges, rather than remaining the exclusive preserve of the Chicago Mercantile Exchange. However, the debate on these instruments is quite heated, as alongside those who use these instruments to hedge against price increases, there are those who might use them, like any other futures, as a financial instrument to speculate and enrich themselves on one of the world's most precious commodities.

1.3 The impact of climate change.

As mentioned before one of the factors that can contribute to increasing water scarcity by altering the entire eco-system is climate change. To define this phenomenon, we can cite the 1992 United Nations framework convention on climate change (UNFCCC).

"*Climate change means a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods of time*".[7]

Climate change is defined by the United Nations as any alteration of the global atmosphere that is directly or indirectly caused by human action. Humans exert an increasing influence on the earth's climate and temperature through the use of fossil fuels, deforestation, the use of nitrogen fertilisers and fluorinated gases, and intensive livestock farming. These activities add enormous quantities of greenhouse gases to those naturally present in the atmosphere:

- Combustion of fossil fuels: Combustion of coal, oil and gas releases carbon dioxide (CO_2) and nitrogen oxide (NO_x), which are greenhouse gases that trap heat in the atmosphere.
- Deforestation: thus the felling of forests contributes to the increase in CO_2 emissions. Trees absorb CO_2 during chlorophyll photosynthesis[8] , but when they are felled, the stored carbon is released into the atmosphere.
- Livestock farming: Livestock, such as cattle and sheep, produce methane during digestion. Methane is a potent greenhouse gas that contributes to the greenhouse effect.

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[7] United Nations Framework Convention on Climate Change (unfccc.int).

[8] Chlorophyll photosynthesis is the most important biological reduction process that takes place on the earth's surface, whereby photosynthetic plants absorb light energy, which they convert into chemical potential energy and, starting from simple inorganic compounds (carbon dioxide and water), form organic substances (carbohydrates etc.), which form the compounds of living matter, both plant and animal. The unfolding of the f. is usually represented by the overall reaction:

$$6CO_2 + 6H_2O + h\nu \rightarrow C_6H_{12}O_6 + 6O_2$$

where $C_6 H_{12} O_6$ represents a sugar and $h\nu$ a photon. This reaction is strongly endothermic.
fotosintesi clorofilliana nell'Enciclopedia Treccani.

- Use of nitrogenous fertilisers: Nitrogen-containing fertilisers can generate emissions of nitrogen oxide (NO_x), a greenhouse gas.
- Fluorinated gases: Appliances and products using fluorinated gases emit very potent greenhouse gases, such as sulphur hexafluoride (SF_6), which has a very high global warming potential compared to CO_2.

These act like the glass in a greenhouse: they capture the sun's heat and prevent it from returning to space, causing global warming.

Many of these gases occur naturally, but human activity increases the concentrations of some of them in the atmosphere, in particular: carbon dioxide (CO_2), methane (CH_3OH), nitrous oxide (NO) and fluorinated gases. CO_2 produced by human activities is the main factor in global warming. In 2020, the concentration in the atmosphere exceeded the pre-industrial level (before 1750) by 48%. Other greenhouse gases are emitted by human activity in smaller quantities. Methane is a gas with a more powerful greenhouse effect than CCO_2 (Capillary Oxygen Content), but it has a shorter atmospheric lifetime. Nitrous oxide, like CO_2, is a long-lived greenhouse gas that accumulates in the atmosphere for decades and even centuries. Natural causes, such as changes in solar radiation or volcanic activity, are estimated to have contributed less than 0.1ºC to the total warming between 1890 and 2010.

We can say that this phenomenon is having serious consequences for the environment and human health. For example, the period 2011-2020 was the hottest decade on record, with global average temperatures 1.1ºC higher than pre-industrial levels[9].

Rising global average temperatures are associated with negative impacts such as extreme climate change, rising sea levels and threats to biodiversity. All this is also manifested through extremely adverse and sudden atmospheric events such as water bombs: violent rainfall that in a very short time leaves a quantity of water on the ground that would normally have occurred over days, weeks, months. Abnormal heat waves in autumn and winter periods, thus a gradual alteration of the temperate climate.

The Intergovernmental Panel on Climate Change (IPCC) is a scientific organisation, established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP), which assesses the risks of human-induced climate change and suggests solutions to mitigate them. IPCC reports provide a scientific basis for policy decisions on climate change. The IPCC's Fifth Assessment Report (also

[9] Le cause dei cambiamenti climatici (europa.eu).

the mainstay of the most recent reports), published in 2013, considers new evidence of climate change on the basis of numerous independent scientific analyses: from observations of the climate system, paleoclimate archives, theoretical studies of climate processes, and climate model simulations. This Report provides a fundamentally important basis for information on climate change-event extremes in recent years. All observations made, with reference to the climate system, are based on direct measurements and remote sensing from satellites and/or other platforms. Observations on a global scale of temperature and other variables began in the mid-19th century, with comprehensive observations particularly for the period from 1950 onwards. Palaeoclimatic reconstructions allow the reconstruction of climate data up to hundreds of millions of years ago. Taken together, these data therefore provide a complete and comprehensive overview of long-term climate variability and state changes in the atmosphere, ocean, cryosphere and land surface. According to the IPCC, the warming of the climate system is undeniable and, since the 1950s, many of the observed changes, on time scales ranging from decades to millennia, are unprecedented. The atmosphere and oceans have warmed, snow and ice amounts have decreased, sea levels have risen and greenhouse gas concentrations have increased. Ergo, there are changes in the atmosphere, oceans, cryosphere, sea level, carbon cycle and biogeochemistry.

The international community has pledged to limit the global average temperature increase to below 2ºC compared to pre-industrial levels and to pursue efforts to limit it to 1.5ºC to avoid catastrophic environmental impacts.

Climate variations, as well as other stress factors, such as changes in land use, could lead to pressure on European ecosystems and protected areas in terms of threats to terrestrial and marine biodiversity. Many animal and plant species are progressively undergoing changes in their life cycles, many animals migrating northwards or to higher altitudes; other species, on the other hand, have invaded certain territories and extended their area of influence. With reference also to the migration of particular species, there will be important consequences from the point of view of agriculture and fishing, which in turn will also affect the food chain.

The effects of climate change on health, according to the scientific literature, highlight diseases caused by climate-sensitive pathogens and changing environmental and social conditions. In recent years, flooding of rivers and coastal areas has led to infections and exposure to chemical hazards; heat waves have led to premature deaths and the spread of

ticks and mosquitoes, developing the spread of new diseases. Land mismanagement is also pointed out, with a particular focus on vegetation adjacent to urban and industrial areas.

If no preventive or corrective measures are taken, these events will increase and intensify. The economic costs of climate change can often be very high. Since 1980, extreme weather events in the member countries of the European Environment Agency have resulted in economic losses in excess of 400 billion euros. Obviously, it is difficult to make a forecast for the future, either for Europe or for the entire planet.

The main international agreement on climate action and climate change is the United Nations Framework Convention on Climate Change (UNFCCC), one of three conventions adopted at the 1992 Earth Summit in Rio de Janeiro. To date, it has been ratified by 195 countries. Initially, it was an instrument to enable collaboration in order to limit the rise in global average temperature and climate change and to address their consequences. Specifically, the United Nations Framework Convention on Climate Change (UNFCCC), also known as the Rio Accords, is an international environmental treaty produced by the United Nations Conference on Environment and Development (UNCED), (also known as the 'Earth Summit'). On 12 June 1992, 154 nations signed the UNFCCC, which, upon ratification, obliged governments to pursue a 'non-binding goal' to reduce atmospheric concentrations of greenhouse gases, with the intention of 'preventing dangerous anthropogenic interference with the Earth's climate system'. These actions were primarily directed at industrialised countries, with the intention of stabilising greenhouse gas emissions at 1990 levels. The nations that signed the Convention recognised 'common but differentiated responsibilities', highlighting greater responsibilities in reducing greenhouse gas emissions in the short term for developed countries (Annex 1 I - Industrialised countries: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Russian Federation, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, United Kingdom, Sweden, Switzerland, Turkey, Ukraine, United States of America). Compliance with what has been established to curb global warming is therefore the treaty's priority objective.

It is important to emphasise that the original stipulation did not impose mandatory limits on greenhouse gas emissions on individual countries but was based on the possibility for

signatory parties to adopt additional acts (protocols) at special conferences, which set precise limits. The UNFCCC came into force on 21 March 1994, and since then, every year the parties meet at the 'Conference of the Parties' (COP) to review progress and take stock of the situation.

Below is a list of the COPs that have taken place so far:

- COP1, Berlin Mandate, 1995;
- COP2, Geneva, Switzerland, 1996;
- COP3, Kyoto Protocol, 1997;
- COP4, Buenos Aires, Argentina 1998;
- COP5, Bonn, Germany, 1999;
- COP6, The Hague, The Netherlands, 2000;
- COP6 'BIS', Bonn, Germany, 2001;
- COP7, Marrakesh, Morocco, 2002;
- COP9, Milan, 2003;
- COP10, Buenos Aires, Argentina, 2004;
- COP11, Montreal, Canada, 2005;
- COP12, Nairobi, Kenya, 2006;
- COP13, Bali, Indonesia, 2007;
- COP14, Poznan, Poland, 2008;
- COP15, Copenhagen, Denmark, 2009;
- COP16, Cancun, Mexico, 2010;
- COP17, Durban, South Africa, 2011;
- COP18, Doha, Qatar, 2012;
- COP19, Warsaw, Poland, 2013;
- COP20, Lima, Peru, 2014;
- COP21, Paris Agreement, France, 2015;
- COP22, Marrakech, Morocco, 2016. One of the main Protocols, adopted by the parties to the Convention, was the Kyoto Protocol in 1997, and one of the most significant agreements was the Paris Agreement of 2015.
- COP23, Bonn, Germany, 2017;
- COP24, Katowise, Poland, 2018;
- COP25, Madrid, Spain, 2019;

- COP26, Glasgow, UK, 2021.
- COP27, Sharm el-Sheikh, Egypt, 2022

As highlighted at COP26 and COP27, the loss of natural resources and climate change are intrinsically linked: a failure in one sphere cascades to the other, and to achieve Net Zero it is necessary to address both.

Net Zero means reducing greenhouse gas emissions to as close to zero as possible, with the remaining emissions being absorbed from the atmosphere, oceans and forests.

1.4 Risks for Investors.

We have only one planet, one water and one health. It is imperative to change the dominant economic model, veering decisively towards sustainable development.

Why not trying to reverse the trend by investing in companies that put water at the centre of their business?

Doing so entails a set of risks, relevant for companies and institutions and, consequently, for investors. We can identify five main types of risks: physical, technological, legal, reputational and social.

If not managed effectively, they can lead to significant financial damage for investors, who should therefore take this into account for reasons that are not only environmental and ethical but also economic-financial.

1. Physical risk: these are the actual, material impacts of climate change highlighted by the above-mentioned scientific studies. These can result in significant damage to economic activities and, consequently, to investors, such as: destruction or deterioration of infrastructure and tangible assets, reduced productivity of agricultural land, difficulty or impossibility of finding certain raw materials and consequent interruption of the supply chain.
2. Technological risk: related to the speed of progress and investment in the development of technologies that can support the transition to a low-carbon economy. Important factors are the speed, the level of diffusion and success of low-carbon technologies, with the degree of transformation and the reconsideration of current production sectors.
3. Legal risk: refers to the ability of investors to anticipate possible developments in the international and national regulatory framework, which could lead to the introduction of measures to reduce the impact of human activities on climate change. More binding legal measures in terms of resource consumption and pollution may apply to all sectors.

   We can mention policies on the price of coal, enforceable through taxation or regulation. If the price of coal rises sharply, companies and public bodies may be encouraged to manage their energy resources more efficiently, to reduce emissions and to invest in projects that can provide alternatives to this fuel. If we

consider the case of stranded assets[10] , it has been calculated that 60-80% of the coal, oil and gas reserves of publicly traded companies cannot be burned, otherwise the emission limit necessary to keep the temperature rise below 2°C will not be met, and this share increases to more than 90% if a target of 1.5°C is considered. Consequently, stocks of fossil energy companies may lose a large part of their value if the goal of keeping global temperatures below 1.5°C is confirmed by concrete commitments and obligations, including at the regulatory level.

It should be emphasised that among the factors driving a stranded asset *is* first and foremost its incompatibility with a low-carbon economy, as sustainability regulations such as the SFDR[11] or the European Taxonomy and the market become more stringent. But decreasing costs of clean technologies (e.g. solar PV) and changes in consumer behaviour demanding better environmental performance (e.g. certification schemes) also contribute to asset stranding.

More generally, investments in climate-damaging activities are not only threatened by the introduction of stricter climate protection regulations, but also by economic factors, such as falling oil prices, and innovations in the field of energy, particularly when linked to energy efficiency measures and/or advances in renewable energy storage techniques.

4. Reputational risk: with reference to some scandals, it has been shown how insufficient attention to the environment can cause serious reputational and image damage, direct to the companies themselves as well as indirectly to their investors. We can cite the British Petroleum (BP) case related to the environmental disaster of the Deepwater Horizon oil rig, with the massive oil spill in the waters of the Gulf of Mexico in 2010. In 2009, the company had designed a new logo focusing

[10] In 2014, the then Governor of the Bank of England Mark Carney gave a speech at the World Bank that brought a little-known topic to the attention of investors: *stranded assets*. The point of the talk was to emphasise the importance of managing carbon-related assets within portfolios: a crucial insight now, in an economy slowly moving towards clean energy. It is argued that within 15 years or so, the international economy will in fact be shaken by a new financial earthquake, this time related to the 'carbon bubble' of too much money invested in fossil fuels. According to this prediction, by 2035 the world will burst a huge *carbon bubble that will* wipe out between one trillion and four trillion dollars. All of this money refers to investments that, because of their natural connection to the fossil world, are bound to lose value in the coming years.

[11] Sustainable Finance Disclosure Regulation is a regulation on sustainability disclosure in the financial services sector that is part of the EU Action Plan for Sustainable Finance. This plan comprises a set of interconnected rules designed to promote sustainable investments and is one of its key pillars. It entered into force on 10 March 2021. It helps investors by requiring greater transparency in indicating the extent to which financial products take environmental and/or social characteristics into account, constitute sustainable investments or have sustainable objectives.

on environmental issues and a slogan ('Beyond Petroleum') with the aim of improving the negative reputation generally associated with oil companies. These initiatives failed due to a lack of concrete and feasible environmental policies. The case ended with a USD 4.5 billion fine for the environmental disaster caused.

Another case in point is the recent 'Dieselgate' scandal of 2015 where, in just one year, the sales of the car manufacturer Volkswagen fell significantly and its reputation was severely damaged. In fact, the company dropped from 14th to 100th place in the Reputation Institute's ranking[12] . Stocks on the stock exchange also fell to the point that several institutional investors (including Californian Calpers and CalSTRS) filed claims for compensation for losses suffered as a result of the scandal. The affair led to the arrest of several Volkswagen Group executives in the US and Germany who had falsified declarations and emission data for Euro 6 turbo diesel engines.

A final example illustrating the relevance of the reputational risk associated with environmental issues refers to the Dutch pension fund PGGM. In February 2016, the fund supported the proposal of a number of shareholders who challenged the US investment company Franklin Templeton Investments (FTI) on the discrepancy between its statements about considering climate change as a financial risk and the investment strategy of FTI funds. Climate risk is in fact completely ignored in the votes in which the company participates in the shareholders' meetings of invested companies[13] .

5. The social risk is caused by involuntary migration and crises related to water scarcity triggered by global warming, increased rainfall and disasters due to extreme events. So-called environmental refugees, i.e. those people forced to leave their homeland due to natural disasters such as droughts, floods and hurricanes, are added to those triggered by wars and poverty, thus further increasing the number of refugees. Other social risks are linked to the impact on the health of citizens of all forms of pollution. This, in turn, leads to an increase in social and health costs that put traditional welfare systems at risk.

[12] The Reputation Institute is the world's most authoritative body on the subject of reputation, and every year it draws up a ranking of the world's leading companies known as the 'Global Rep Trak': 2023 Global RepTrak® 100 | RepTrak.

[13] Wagner, Jan 2016, 'PGGM backs shareholder proposal to hold Franklin Templeton accountable on climate change', Responsible Investor, 19 February 2016.

Climate change is one of the three ESG (Environmental, Social and Governance) fundaments, as well as the factor of greatest general interest, because it is most closely considered by governments and therefore subject to legislation that can alter its dynamics with related economic consequences. I believe it is the most at risk of the three, with a tendency to worsen over time, unlike the other two factors (economic, social and corporate governance sustainability), which historically, albeit with ups and downs, have been improving.

1.5 History of Ethical and Sustainable Finance.

Before talking about sustainable finance and socially responsible investments, it is worth mentioning the ethics that guide every individual towards conscious moral choices and decisions that are reflected in investments and thus in the allocation of resources.

Ethics (from ancient Greek, èthos) is a branch of philosophy that studies the fundamental elements that allow human behaviour to be assigned a deontological status, i.e. to distinguish right from wrong behaviour. Economics, from the Greek Oikos (home) and Nomos (law), refers who take care of the household, in the sense of management, so it represents the way in which resources are managed[14].

Financial activity is part of the economic system and is the production as well as the provision of financial services through financial instruments. These are contracts that incorporate patrimonial/economic rights (credit, ownership, commitment to future trading) and may also incorporate non-patrimonial rights such as, for example, administrative powers attached to shares. Financial instruments are an easier form of representation of real wealth to hold and transfer, which is fundamental to the modern economy.

It is easier to organise and sell financial instruments than real wealth because there is the possibility of estimating the unit amount of an investment to a small amount, accessible even for modest investments. The place where financial instruments are traded is the financial market.

Talking about ethical finance means linking two terms that are in stark contrast to each other, according to common perception. While the concept of finance immediately evokes the idea of profit maximisation as the sole objective, the concept of ethics refers to values that move away from the view of maximum profit, in the pursuit of morality in an absolute sense and at the same time through the assumption of commitments of social relevance[15].

The philosopher Aristotle believed that the goal of human action should be to achieve what is good for man and his community without be limited to the exclusively personal. When we speak about ethical finance, we mean that area of finance within which, in addition to traditional valuation methods, we determine how and where to use resources based above all on ethical and moral evaluations, which do not take purely technical

[14] ETIMOLOGIA: ECONOMIA (etimoitaliano.it)

[15] Banca Etica, *Finanza Etica e Finanza Sostenibile due modelli a confronto*, Febbraio 2021.

factors into account. An attempt is made to combine financial economic performance and positive socio-environmental impact.

The ethical investor is precisely the one who consciously uses, not only the usual economic-financial criteria (risk-weighted return), but also other variables based on ethical, social and environmental principles in his investment choices. Ethical finance does not renounce profitability, but simply pursues the objective of returning this discipline to its original function, i.e. the fair use of resources in time and space to support the development of the real economy in the interest of the community.

This concept emerged from the 1970s, when citizens began to question whether the behaviour of financial institutions, whose sole purpose was to achieve maximum profit, took into account the consequences that the impact of such choices could have on the environment and on society. Subsequently, thanks to the strict regulation of markets, of exchanges of financial instruments and services, bearing in mind that the market by definition is inefficient, the channel of trust was established that allowed mankind to have confidence in financial institutions and in all those intermediaries that bridge the information gap (the so-called information asymmetries that make the market inefficient) and act as a glue between the givers of funds and the takers of funds.

Linked to the concept of ethical finance is the idea of socially responsible finance, in the original definition Socially Responsible Investment (SRI), which refers to all Socially Responsible Investments. The latter focuses on the selection of securities of the companies that fulfil certain criteria of responsibility: enhancement of human capital, promotion of the environment and so on.

The recent European Regulation 2019/2088[16] (so-called. *Sustainable Finance Disclosure Regulation - SFDR*) in paragraph 17, provides the definition of sustainable investment: *"investment in an economic activity that contributes to an environmental objective, as*

[16] The regulation came into force in March 2021 and provides for a 1-level disclosure on processes and a 2-level disclosure on products. At product level it requires a distinction according to 3 articles: Art. 6: non-ESG investment fund, Art. 8: generic ESG investment fund, Art.9: investment fund with specific ESG objective (thematic funds). The regulation is attentive to greenwashing in that it seeks to prevent a manager from passing off a fund as Art. 8 when in fact it is Art. 6. Therefore, the SFDR must talk to the Taxonomy for the census of funds. The SFDR is a European regulation and does not apply to non-European products marketed in Europe (in the US there is no such regulation and this opens up opportunities for regulatory arbitrage even though the US with the SEC would like to do ESG regulation). 57% of the funds in Europe are still Art. 6, around 40% are Art. 8 and a marginal portion are Art. 9. Each intermediary is assessed at both product and process level; therefore, it must state how it makes the selection in terms of assets and how it assesses the product in terms of underlying composition. Furthermore, each management company must measure how much sustainability risk impacts product performance and how much a given product impacts sustainability in general.

measured, for example, by key resource efficiency indicators concerning energy use, use of renewable energy, use of raw materials and water resources and land use, waste generation, greenhouse gas emissions as well as impact on biodiversity and the circular economy or an investment in an economic activity that contributes to a social objective, in particular an investment that contributes to the fight against inequality or which promotes social cohesion, social inclusion and industrial relations, or an investment in human capital or economically or socially disadvantaged communities provided that such investment does not significantly harm any of these objectives and that the enterprises benefiting from such investment comply with good governance practices, in particular regarding sound management structures, employee relations, staff remuneration and compliance with tax obligations[17]".

Basically, it aims to create value for the investor and for society as a whole through a medium- to long-term oriented investment strategy that integrates financial analysis with environmental, social and good governance analysis when assessing companies and institutions.

Responsible investing differs from classic investing in the fact that, while the latter aims to achieve short-term gains, responsible investing has a medium- to long-term profit horizon.

In 2006, the United Nations launched the Principles for Responsible Investment (or PRI), with the intention of encouraging the spread of sustainable and responsible investment among institutional investors. These principles highlight a very interesting currents aspect, namely ESG, Environmental, Social and finally Governance (stewardship) approach. The aims is to incorporate environmental, social and governance parameters into financial analysis and decision-making processes. Today, this concept has been given considerable note mainly due to the UN's desire to remedy climate change by 2030.

In general, ethical finance focuses primarily on conformity to specific moral values and principles. Ethical investors seek to avoid sectors or companies that contradict their personal values, such as armaments, tobacco, nuclear energy, gambling, genetic engineering, pesticide production, and financial speculation. Its main objective is the alignment of investments with individual ethical standards. More precisely, to provide economic resources to those whose business projects respect the environment and human

[17] EUR-Lex - 32019R2088 - EN - EUR-Lex (europa.eu)
SFDR (Sustainable Finance Disclosure Regulation) - Banca Etica

rights and promote inclusion, while also setting social and environmental goals to be achieved. The realisation of profits is pursued as an indicator of efficiency and a socially shared goal within the expected economic return on investment[18].

Sustainable finance has a broader approach that integrates both ethical considerations and environmental, social and governance (ESG) factors. Sustainable investors seek to identify and support companies that adopt sustainable practices, manage their environmental and social impacts responsibly, and demonstrate sound governance. The target is to promote greater sustainability in the economy and society as a whole, to have a profit return, to emphasize share value and dividends, without harming the environment too much.

The transition to more sustainable types of economic activities requires substantial financial resources. The mitigation of the effects on the environment can only be achieved through technological innovation, which can compensate for qualitative and quantitative inefficiencies in energy production and use, even if it is expensive for companies.

How does the term ESG take shape, and where do these values begin to evolve?

From ancient time, finance has occupied the thoughts of philosophers and theologians about the moral permissibility of receiving a return for lending money. Aristotle supported the immorality of any kind of remuneration connected to the activity of lending money, differently from physical or intellectual labour.

In the late Middle Ages, there was a clear condemnation of all forms of interest-bearing loans. Usury, regulated by Roman law, was considered a sin by Christian moral theology and was banned for a long time by several church councils and the legislation of secular powers.

St. Thomas Aquinas, regarding usury, argued that it was immoral because it was obtained from idle capital that could only be conceived as a simple means of exchange and not as a source of unlimited accumulation. Only when remuneration was justified by a participation in risks and created by economic activities that did not conflict with religious values, it could be considered in conformity with the law.

The first idea of sustainability in relation to the economy was born in the mid-1800s, by an official of the Bavarian government. Finding himself dealing with the need for timber and the protection of the forest as a natural habitat, he posed the problem of how to balance both.

[18] Banca Etica, *Finanza Etica e Finanza Sostenibile due modelli a confronto*, Febbraio 2021.

In 1928, the Pioneer Fund was founded and it was the first ethical fund. It attracted Protestants' investments, it made a clear distinction between sin stocks[19] from other assets. Tobacco, gambling and alcohol were considered non-investable sectors.

In actual fact, it was only in the 1960s-1970s that true sustainable finance found its foundation in the USA. The protests of the time, based on the defence of civil rights, against the racial discrimination that affected Afro-Americans and the rebellions against Vietnam war, judged imperialist, brought important social issues to the fore.

The dynamism of religious funds and American university foundations that choose not to invest in arms-producing activities is stimulated. It is also an opportunity for secular society to participate in ethical finance and it is detected that this type of investment must be made engaging.

From this logic, in 1971 the Pax World Index was introduced, created by two Methodist fathers, which excluded companies involved in arms and other morally doubtful activities, and which had anti-union and discriminatory conduct. There is an emerging awareness among ethical investors in the USA that corporations must be supervised and this is not enough. It is not sufficient to establish exclusion criteria, but it is essential that operators participate as shareholders in investable companies. This allows to check accountability and fairness in economic operations.

Hence, start a focus of the finance on the 'S' component of the ESG paradigm. In 1971, the Episcopal Church in the USA showed a resolution to General Motors because of the withdraw of its operations from South Africa due to the racial segregation regime in the country[20] . A few years later, Father Sullivan drafted the Sullivan Principles while he was a member of the committee within the company. These principles were a code of conduct that defined corporate social responsibility principles. Specifically, they referred to the equal treatment of workers without distinction on the basis of skin colour, in the employment contract, in access to public and non-public places, in tasks and remuneration. The improvement of the quality of life for black workers is pursued. This led to the divestment of General Motors from South Africa and hundreds of other American corporations did the same. This document considered social factors such as:

[19] This term refers to all those sectors which, precisely because of their controversial impact on society, tend to be excluded from investment choices. The best known are the tobacco and arms industries, but also pornography, gambling and, with increasing attention, the fossil fuel industry.

[20] This resolution is the first active shareholder initiative that lays the foundation for the foundation of the Interfaith Centre on Corporate Responsibility, the world's largest network for the promotion of active share ownership on social and environmental issues.

Human Capital, Availability of the product, Stakeholder Opposition and Social Opportunities[21].

The 'E' was added in the 1980s when the European Commission in 1987 gave to Prime Minister of Norway, Brundtland, the task of drafting a report (Our Common Future) specifying how to keep the economic and socio-environmental system on its feet in a balanced way. At that time, the first reports of the Intergovernmental Panel for Climate Change were beginning to be produced, which were studying global temperature anomalies that could be attributed to CO_2 emissions. The Oil & Gas companies, of course, disputed the reports, presenting other accounts to support the fact that these events were only transient. Climate change and the association between the phenomena and human behaviour were ignored for a long time. But then it was realised that the connection is there, and it is very strong: with the industrial revolution, mankind suddenly dumped millions of tonnes of CO2 and other greenhouse gases into the atmosphere. The amount in the atmosphere has doubled from the minimum levels of the last 800,000 years.

The letter E refers to the environmental aspect, which encompasses factors such as: Climate Change, Natural Resources, Pollution and Waste, Environmental opportunities.

The letter 'G' stands for the concept of governance, therefore, it encompasses Corporate Governance and Company Conduct. It is important to emphasise that G is the factor on which rating agencies have the lowest correlation because quantifying and qualifying good corporate governance has no quantitative parameters to latch onto, as is the case for the other two factors, which can reduce the heterogeneity of judgement.

In 1987 the acronym ESG was born, and later in 1990 the first 'SRI in the Rockies' conference was held (today the SRI Conference is held annually). In 1997 the first Italian ethical fund is Sanpaolo Azionario Internazionale Etico. Two years later in 1999 the first global SRI stock index is the Dow Jones Sustainability Index. In 2001 the first European sustainability stock index is the FTSE 4Good and at the same time the Forum for Sustainable Finance in Italy is born. In 2006 we have the Principles for Responsible Investments and in 2015, the United Nations elaborates the SDGs.

Communities and countries are beginning to see the importance of the climate change problem, but agreements, compliances between countries will probably never be reached. As was the case at COP26, some agreement will be reached but never finalised because

[21] Alfonso Del Giudice *La finanza sostenibile. Strategie, mercato e investitori istituzionali*. Giappichelli Editore, 2019.

it is difficult to convince countries that are lagging behind in terms of industrialisation to abandon certain practices that have been used for years by other countries and through which wealth and well-being has come. It is difficult for states to converge on assumptions of CO_2 reduction by 2050, but the window of opportunity has opened, the market has started and private capital is being directed towards investments that create benefits, in the knowledge that they will improve the quality of life and the future. The role of public governance is also emphasised.

Sustainable finance also stems from the impetus of regulatory changes that have enriched the set of available information, requiring listed companies to publish documents containing data and information of a non-financial nature.

1.6 The development of ESG Rating.

The ESG rating is a synthetic judgement that certifies the creditworthiness of an issuer of a security or fund from the point of view of environmental, social and governance commitment.

The financial system uses this modality to quantify this new information available into a score that complements traditional techniques for composing and managing securities portfolios[22]. Agencies that assess the non-financial performance of companies are a key player in shaping the market for SRI finance, as they make it possible to verify the sustainability performance of listed companies both over time and in relation to peers. Agencies working to produce ESG scores offer investors a numerical figure that can be integrated into securities portfolio management systems, either in total or on a pillar-by-pillar basis. SRI strategies that use non-financial ratings as a basis for identifying securities to invest in are more efficient in mitigating overall portfolio risk. Non-financial data and information published by companies are processed by some players to provide the market with synthetic indicators.

There are three categories of operators:

1. International not-for-profit operators, which define which frameworks to quantify sustainability in rating (IR, PRI, SDGs); which are the key issues and measurements to be made. Some of them investigate by submitting questionnaires.
2. Operators that passively analyse data provided by companies on sustainability and integrate it with public information on that company in order to form an ESG rating (e.g. MSCI, Vigeo Eiris, Sustainanalytics, S&P Global, Bloomberg).
3. Those who buy data and rankings from others to make rankings (e.g. Fortune 100 Best Companies to work for, Global100)

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[22] A financial portfolio is not only the set of financial instruments that an investor, a financial institution or an asset management company, holds. It is the result of an appropriate investment strategy that aims to ensure the most suitable and profitable return based on the risk profile. The instruments that make up a portfolio can be different: equities, bonds, government securities, ETFs, investment funds, commodities, derivative instruments. It is necessary to consider the objective function, which establishes a criterion for defining the higher return required to remunerate the greater risk (the so-called risk premium). From a mathematical point of view, the objective function can be expressed through an indifference curve that brings together all the points that, at that time and in that space, are equivalent for the investor. The return of the portfolio is regarded as the expression of the economic result of its management. It is expressed in % basis and on an annual basis.
Luciano Munari, *Strumenti finanziari e creditizi, dai bisogni alle soluzioni*, 3° edizione, Mc Graw Hill, 2015.
Bodie, Kane, Marcus. *Investments*. 12th Edition, McGrawHill, 2021.

The main ESG rating agencies are MSCI, VIGEO-EIRIS, Thomson Refinitiv, ISS-Oekom and Sustainalytics and are the result of merger operations that have changed the face of the industry in recent years[23].

- Vigeo-Eiris was bought by Moody's, which holds 51%. In turn, Vigeo-Eiris is a merger between Vigeo and Eiris. It offers coverage of approximately 4500 listed companies worldwide.
- MSCI (Morgan Stanley Capital International) is one of the most widely used ESG providers covering 13500 listed companies and own institutional investors as shareholders.
- Thomson Refinitiv: covers 7000 listed companies.
- ISS-oekom: the result of a merger between two agencies specialising in governance (ISS) and non-financial analysis (Oekom) respectively. Since 2018 it has been taken over by Oekom Research and covers 4700 listed companies.
- Sustainalytics: has consolidated a significant number of ESG agencies through successive acquisitions. It is 40% owned by Morningstar, which provides it with ESG data.

Each agency follows its own method for analysing the ESG content of covered companies. What they have in common is the materiality of the rating: more precisely the identification of the non-financial information that has a real impact in the assessment of the business being analysed. Materiality relates to all the relevant non-financial information necessary for the investor to have a complete information set, to determine his voting rights and in making investment decisions. Environmental, social and governance issues are to be investigated and quantified in scores that determine the risk exposure of companies.

The agencies acquire the data 1/3 from the non-financial statement of the listed company under investigation; 2/3 from public information, which may be scandals reported in newspapers, legal disputes and so on.

It is difficult to determine whether there is transparency and objectivity behind this conduct. Logically, a sustainability rating is realised in stages:

1. The first is the Scope, what is observed, therefore what is the key issue (for example, hypothesis: CO_2 emission).

[23] Alfonso Del Giudice *La finanza sostenibile. Strategie, mercato e investitori istituzionali*. Giappichelli Editore, 2019.

2. The second is Measurement: basically, measurement of what has been observed in relation to a benchmark.
3. The third are Weights: weighting, i.e. defining the importance of what was observed on the total score. Specifically, the CO_2 emission in an insurance company has less weight than the anti-corruption protection guarantees.

ESG phenomenon has had positive impacts in recent years, but it remains a belief among some investors that integrating ESG factors into the investment process will hurt performance.

A well-known scholar and economist Adamo Rosa, in La Finanza Etica - Principi strumenti e finalità, stated that the ESG rating '*borrows the principles and assumptions from traditional rating system methodologies, ultimately expressing a synthetic judgement based on ethical criteria, i.e. on an assessment based on information not only of a financial nature but also social, environmental and cultural; from this perspective, the aim is to assess the ability to create value not only for the shareholder, but for all stakeholders*'[24].

This new type of rating has developed a lot of interest around it, but there is the opposite side of the matter, in which there are responses from sceptics regarding this topic. Sceptics have argued that ESG ratings are not always able to provide a classification of which companies are socially responsible and their ratings can be misleading. The issuance of an ESG evaluation is considered by two parties: the market and the company itself. Assessments are made from a qualitative point of view, which may give rise to different results depending on the analysis carried out by the agency issuing the assessment. The variables that go into determining the ethical and sustainable rating are multiple, subjective and therefore not always easy to measure. They are linked to the preferences of the evaluator and investors. As a consequence, the socially responsible meaning attributed can have a purely preferential and personal nuance. For example, investors inspired by a religious morality might attach great importance to the fulfilment of certain criteria that might instead be of little significance to an environmentalist investor[25].

[24] Adamo Rosa, *La Finanza Etica - Principi strumenti e finalità.* Edizioni Scientifiche Italiane, 2009.
[25] Stefania Funari, *I vincitori in etica: valutazione multicriteriale di fondi socialemente responsabili*, Università Ca' Foscari Venezia, Novembre 2011.

1.7 The impact of Sustainability in firms.

Sustainable finance takes place in the middle area of expertise between traditional finance that aims for the highest risk-adjusted return and philanthropy that has no return objective and pursues the promotion of a positive collective social-environmental impact.

Studies suggest that companies with sound ESG practices have shown a lower cost of capital, lower volatility, and fewer instances of corruption and fraud over certain time periods. In contrast, studies have shown that companies with poor ESG performance have had a higher cost of capital, higher volatility due to litigation and other incidences such as strikes, fraud and irregularities in accounting and other forms of governance.[26] It is therefore not surprising that numerous studies conducted by MSCI in recent years have found historically lower risk and even outperformance in the medium to long term for portfolios that integrate ESG factors alongside rigorous financial analysis. In a recent study entitled 'Foundations of ESG Investing: How ESG Affects Equity Valuation, Risk, and Performance'[27], MSCI researchers focused on understanding how ESG characteristics led to financially significant effects. This study examined how ESG information included in equities is transmitted to the stock market. In this analysis, three 'transmission channels' are created within a standard discounted cash flow (DCF) model. These channels are called the cash flow channel, the idiosyncratic risk channel and the valuation channel. They are three essential elements that, thanks to the introduction of ESG factors, have a high weight in the evaluation of the companies considered.

In particular, it highlights:

1. Cash-flow channel. Companies with high ESG ratings were more competitive and generated abnormal returns, often leading to higher profitability and dividends, especially compared to companies with low ESG ratings.
2. Idiosyncratic risk channel. Companies with high ESG ratings had a lower frequency of idiosyncratic risk incidents. Conversely, companies with low ESG ratings were more likely to experience serious incidents.
3. Evaluation channel. Companies with high ESG ratings tended to have lower systematic risk exposure, evidenced by less volatile earnings and lower systematic

[26] ESG and Performance - MSCI

[27] Guido Giese, Linda-Eling Lee, Dimitris Melas, Zoltan Nagy and Laura Nishikawa, *Foundations of ESG Investing: how ESG Affects Equity Valuation, Risk and Performance*, the Journal of Portfolio Management, July 2019, jpm.iprjournals.com.
03d6faef-2394-44e9-a119-4ca130909226 (msci.com)

volatility. Compared to low ESG-rated companies, they also experienced lower betas and lower costs of capital.

Addressing ESG issues has become a point of interest as a risk management concern for investors, shareholders and companies, which in recent years have incorporated ESG elements into their business strategies in contrast to the early 1990s, when most companies were not interested in these issues. The predominant number of ESG rating agencies have started to operate at a national level (Vigeo started by focusing on the French market) contributing to the fact that local investors could rely on a solid rating agency. Over the past few years, on the one hand, the market has seen consolidation among exclusively ESG rating agencies; on the other hand, some large data providers and asset managers - such as MSCI, Bloomberg and Robeco - have shown increasing interest in entering the ESG rating field. This latter start offering their clients specific views on ESG performance, either by acquiring or merging with ESG rating agencies, which develop in-house CSR rating products (e.g. Bloomberg). This has undoubtedly affected competition and prices, as the intermediary can offer clients full-service research with competitive prices.

Chapter 2

Investing in water? An overview of Mutual Funds and Exchange Traded Funds related to water stocks.

2.1 Mutual funds, Sicavs, and Exchange Traded Funds.

Since the mid-1990s, the financial system has been characterised by intense innovative activity involving institutional models, the organisational structures of intermediaries, and the types of financial and credit instruments. Especially with reference to traded instruments, this innovative process shows no sign of abating, and the landscape of contract offerings is enriched with new products every day[28].

The investment process of asset management presents several elements of complexity, linked both to the characteristics of financial instruments and markets. Generally, the investor wishes to keep the investment risk below a certain threshold of acceptability, which is highly subjective. Certain people are inclined to take high risks to obtain a higher return in case of a positive investment outcome. Others, on the contrary, have a low propensity for risk and are willing to bear a rather low level of risk in exchange for a less uncertain, although a lower remuneration. In addition to risk and return, investment decisions are made according to the time horizon over which the capital is invested. The risk/return ratio thus determines the allocation of savings across the different types of financial instruments (shares, bonds, money market instruments, etc.), and their choice depends on what the investor desires and on the basis of his or her personal propensity for the above-mentioned ratio and time horizon. Stock picking and market timing become two fundamental variables in determining the exact moment to make the investment or disinvestment and obtain the maximum benefit from the market price movements of financial assets.

Assets may be managed by an individual or collective basis. For individual management, the individual's asset is managed by the intermediary separately from the assets of other investors. With the service of collective management, on the other hand, savers entrust

[28] Luciano Munari, *Strumenti finanziari e creditizi, dai bisogni alle soluzioni*, 3° edizione, Mc Graw Hill, 2015.

their assets to an authorised intermediary, which manages the total funds collected as a unit. Each investor take part in the asset managed by the intermediary for a share proportional to the resources paid in.

2.1.1 Characteristics and classification.

Examples of collective management are mutual funds and SICAVs. Through this type of management (upstream) it is easier to diversify, because the assets collected can be used to purchase a wider range of financial assets. At the individual level, on the other hand, an adequate degree of diversification can only be achieved if the investor's asset is sufficiently large to carry out an appropriate portfolio strategy. It is important to point out that in individual management, the saver can give instructions how to manage the assets and the instruments or markets in which to carry out transactions. In collective management, the choice of the modalities and type of operations are entirely entrusted to the manager.

Collective asset management is the management of OICRs (collective investment undertakings) and their related risks. The "Testo Unico della Finanza (TUF)"[29] , in Article 1, identifies which Italian OICRs are:

- Mutual funds, so OICRs constituted in the form of autonomous assets and divided into units, established and managed by a manager, which may be an asset management company (SGR in Italian) or a company incorporated in an EU member state.
- The SICAV, Variable Capital Investment Company.
- The SICAF, Fixed Capital Investment Company.

Article "32 quarter" of the TUF specifically states that collective asset management services are reserved for SGRs, SICAVs and SICAFs under Italian law, for managers of

[29] The Testo Unico Sulla Finanza (TUF) is the single text of the provisions on financial intermediation, issued by Legislative Decree 58/1998, which is the main regulatory source of financial market law in the Italian legal system. This legislation, which came into force on 1 July 1998, was drafted at the instigation of the Community Law for 1994 (Law 52/1996), which delegated to the government the issuance of a single text that would coordinate in an organic corpus the various laws regulating specific areas of financial market law at the beginning of the 1990s. This reform work was led by a commission of experts led by M. Draghi, then Director General of the Treasury (which is why the TUF is also informally known as the 'Draghi Law'). Since its entry into force, the TUF has been amended several times after the interventions of the European legislator in financial matters (such as, for example, Directive 2004/39/EC, known as MiFID, Directive 2003/6/EC on market abuse and Directive 2003/71/EC on prospectuses).

Italian collective asset products authorised in other countries as EU management companies and for specialised EU and non-EU managers of alternative investment funds (AIFs). Individual management services, on the other hand, can be provided by investment firms, banks and SGRs themselves (the latter may also provide collective management services).

Mutual funds are set up by SGRs, which can set up one or more funds, each one with specific characteristics regarding the range of financial instruments in which the assets are invested (long/short equity, corporate or government bond or high yield, thematic, natural resources, etc.). Each fund, or each sub-fund of a fund, constitutes an autonomous and distinct asset from the assets of the SGR, from the assets of the individual participants and from any other assets managed by the same company (Article 36 TUF).

From a legal point of view, the fund is the owner of the financial assets acquired with the savings collected. Each fund has a management regulation (art.37 TUF) that defines its characteristics and regulates its operation, listing the custodian, the management company (also different from the SGR that set up the fund), the investment advisor and other key information that define the product's identity card.

The NAV - Net Asset Value, indicates the difference between the investments constituting the fund's assets calculated at market value and eventually debts incurred by the fund. Considering that it is divided into units of equal unit value, each of which gives the holders equal rights, their value is obtained from the ratio between the NAV and the number of outstanding shares.

$$\text{Net Asset Value} = \frac{\text{Fund Assets} - \text{Funds Liabilities}}{\text{Total number of Outstanding Shares}} \tag{2.1.1, 1}$$

A saver who decides to invest in a mutual fund subscribes a certain number of units, the unit value of which depends on the fund's net assets at the time of subscription. Each investor owns a fraction of the fund corresponding to the number of units subscribed. The amount paid for the subscription of the units goes into the mutual fund and added with the amount contributed by other savers; then, it is used by the SGR to buy and sell financial instruments. The value of the net assets varies because the assets in which the fund invests vary.

Basically, it represents the price that an investor would have to pay to subscribe new units or the price he would have to collect from the redemption of units he owns. In the case of open-ended mutual funds, the NAV is calculated daily and communicated through major national newspapers; in contrast, in the case of closed-end funds, the NAV is calculated less frequently (usually monthly) because of the nature of the assets being invested in.

The classification of mutual funds is first divided into five macro-categories:

- Equities
- Balanced
- Bonds
- Liquidity
- Flexible

Each macro-category is distinguished by its minimum and maximum percentage of equity investment, i.e. it identifies the parameters for the basic (equity-bond) asset allocation. In particular, the macro categories can be placed in ascending order with respect to the proportion of equities that can be held in the portfolio:

- liquidity funds cannot invest in shares;
- Bond funds may not invest in equities (with the exception of mixed bond funds, which may invest from 0% to 20% of the portfolio in equities);
- Balanced funds invest in shares in amounts ranging from 10% to 90% of the portfolio;
- equity funds invest at least 70 per cent of their portfolio in equities;
- Flexible funds have no equity asset allocation constraints (0%-100%).

Investment funds can be classified according to the composition of investments, the weighting of different financial assets within the portfolio.

For the sake of simplicity, below there is a table listing the classification proposed by Assogestioni[30]. Although the classes are subject to change, this chart is useful to identify the criteria for defining the categories.

[30] Assogestioni is the Italian association of asset managers.
Founded in 1984 by the first management companies, it now represents over 290 associates, including most of the Italian SGRs and foreign investment management companies operating in Italy, several banks and insurance companies operating in the area of individual management and supplementary pensions. The association assists its members by offering advice and technical support on legal, tax and operational issues and promotes an ongoing dialogue with industry operators and institutions on investment, asset protection, corporate governance and regulatory and operational innovation in the industry. Internationally, Assogestioni is a member of EFAMA (European Funds and Asset Management Association), with which it collaborates on the development of EU regulations and effective self-regulation of the European asset management sector.

Figure 1.1.1, 3. Classification of Mutual Funds.

Macro-categories	% of portfolio invested in shares	Categories	Criteria for definining individual categories
Equity	>70%	Italian Equities	Issuer jurisdiction and sector specialisation
		Euro Area Equities	
		European Equities	
		American Equities	
		Pacific Equities	
		Emerging Markets Equities	
		Country Equities	
		International Equities	
		Energy and Commodity Equities	
		Industrial Equities	
		Consumer Goods Equities	
		Healthcare Equities	
		Finance Equities	
		IT Equities	
		Equities Telecommunications Services	
		Equity Utilities	
		Equities Other Sectors	
		Equities Other Specializations	
Balanced	10% - 90%	Equity Balanced	Proportion of the share component
		Balanced	
		Bond Balanced	
Bond	0% (except mixed bonds that invest from 0% to 20% of the shares in the portfolio)	Italian Bonds	Market risk (currency denomination and duration of the portfolio) and credit risk
		Short-term Euro Government Bonds	
		Medium/long-term Euro Government Bonds	
		Euro Corporate Investment Grade Bonds	
		Euro high-yield bonds	
		International Government Bonds	
		International Investment Grade Corporate	
		International high-yield bonds	
		Yen bonds	
		Emerging Markets bonds	
		Bonds - other specialisations	
		Mixed Bonds	
		Flexible Bonds	
Money Market (Liquidity Funds)	0%	Euro Area Money Market Funds	Currency of denomination, issuer creditworthiness and portfolio duration
		Dollar Area Money Market Funds	
		Yen Area Money Market Funds	
		Money Market Funds Other Currencies	
Flexible	0% - 100%	\	No common risk factors

(Reference: www.assogestioni.it)

Investors can approach the desired risk-return combination by selecting the fund according to the category it belongs to, i.e. the financial instruments in which it invests. Units in mutual funds are represented by registered or bearer certificates, as provided for in the fund rules. However, units of funds traded on regulated markets are subject to dematerialisation. Instead of being represented by certificates, they are represented by entries in a special centralised management account. For the subscription of units, the investor may turn to the parties responsible for placement or, increasingly, may subscribe units directly using online services.

The dynamics of subscriptions and redemptions depend on the fund's form of establishment. Open-ended funds are characterised by the possibility of subscription and redemption at any time. The sums paid through subscription increase the fund's assets, while the sums received by the investor upon redemption reduce the fund's assets. In principle, the fund can meet the redemption of units using available cash, or by selling the financial assets held. The fund's assets are therefore variable and depend on subscription and redemption transactions. Open-ended funds take the form of mutual funds that invest in easily liquid assets, typically listed securities.

In the case of closed-end funds, the investment subsequent to the fund's constitution can only take place by subscribing to units at subsequent issues (if provided) aimed at collecting the assets defined at the time of constitution, or by purchasing units from savers wishing to disinvest. Unlike open-ended funds, therefore, units are issued not at the request of the subscriber, but exclusively on the fund's formation or on predetermined dates. Consequently, the units are redeemed only at predetermined dates, or at the fund's maturity. The only alternative for the investor wishing to disinvest on a date other than the scheduled dates is to find a buyer to whom the units can be sold. If the closed-end fund is admitted to trading on regulated markets, the investor can more easily find a counterparty to whom he can sell his units; in this case, it is clear that the sale does not imply the redemption of the units, but simply their transfer to another party (the fund's assets remain unchanged). In any case, if the fund rules provide that the assets may also be raised through issues subsequent to the first, early redemptions take place with the same frequency and coincide with new issues. The assets of closed-end funds generally consist of assets that are not easily liquidated, e.g. unlisted securities or real estate assets.

It is worth noting that, for both open-ended and closed-end funds, redemption may be requested for all or only some of the units held and that the redemption value of units depends on the value of the fund at the time of the request.

Funds are subject to specific rules aimed at ensuring the containment and spreading of risk. In general, these rules prohibit the fund from engaging in particularly risky transactions (e.g. short selling of financial instruments), prohibit the fund from concentrating investments in instruments issued by the same issuer or by issuers belonging to the same group, and impose limits on investments in certain financial instruments (e.g. derivatives) and on recourse to debt (Article 6 of the Consolidated Law on Finance). The fund's financial instruments and liquid assets are entrusted to a

depositary, which may be a bank authorised in Italy, an Italian branch of an EU bank, a SIM (Italian securities brokerage firm) or an Italian branch of investment firms (Art. 47 TUF). The custodian has the task, among others, of ascertaining the legitimacy of issuance and redemption transactions of the fund's units, of ascertaining the allocation of the fund's income, of verifying the correctness of the calculation of the value of the units (or of proceeding with the calculation, if entrusted by the SGR).

With the same number of units in circulation, the value of the fund's assets changes over time due to both changes in the prices of the assets in which the fund is invested and the charges levied and income received by the fund. Increases or decreases in the value of the assets result in increases or decreases in the value of the units.

The change in value of the units expresses the return realised by the fund. However the return realised by the investor may differ from that obtained by the fund, since the economic profile for the investor consists of several elements. For the investor, the gain, i.e. the return, derives first and foremost from the increase in value of the unit, since the remuneration arises from the difference between the sum received at the time of disinvestment and the sum paid at the time of subscription. The loss, on the other hand, derives from the decrease in value of the share.

The return for the investor also depends on the amount of income periodically distributed by the fund. We can in fact distinguish:

- Income-distributing funds, where dividends, interest and other financial income are periodically distributed in full (or in part) to investors;
- Income accumulation funds, where dividends, interest and other financial income are reinvested in the fund, adding to the assets. The saver collects the proceeds upon disinvestment in the form of the increased value of the unit.

SICAVs collectively manage the savings collected through the offer of their own shares, which have no nominal value[31] . The fundamental difference from a mutual fund is that the investor does not own a share but is a shareholder in the company. Compared to a mutual fund, where the investor buys the shares, in order to participate in a SICAV the saver subscribes to the shares of the company, which are specially issued. The total assets collected by the SICAV through the shares are then managed in a unified manner, exactly as in mutual funds. The shares are either registered or bearer shares, as determined by the

[31] According to Article 1 of the TUF, a SICAV is an open-ended OICR constituted in the form of a joint-stock company with variable capital with its registered office and management in Italy having as its exclusive object the collective investment of assets raised through the public offering of its shares.

articles of incorporation. By assuming the position of shareholder, the investor enjoys voting rights although, unlike in ordinary Ltd.'s, each shareholder is entitled to only one vote, regardless of the number of shares held. In general, however, the investor rarely actually exercises this right. At the time of disinvestment, the subscriber requests redemption of the shares, which consequently become extinct. The shares, therefore, come into existence at the time of investment and cease to exist at the time of disinvestment. The company's capital is variable, as it depends on subscriptions and redemptions requested by investors and is always equal to net assets. A single SICAV may therefore have several investment sub-funds (equity, bond, balanced, etc.), each of which constitutes autonomous assets, separate for all purposes from the assets of the other sub-funds. Like mutual funds, investment in SICAVs also entails the payment of subscription, redemption and switch fees.

There are particular categories of funds. In our analysis, we will focus on ETFs (Exchange Traded Funds). These are index-linked open-ended funds (or Sicavs), which faithfully replicate the performance of a reference index (benchmark), of which they therefore also replicate the return. The capital raised is in fact systematically invested in a portfolio of securities with the same composition as the benchmark. They are traded on the stock exchange (on the Italian Mercato Telematico dei Fondi segment of the Mercato Telematico Azionario) through the buying and selling mechanisms typical of shares. They can be purchased with the intervention of intermediaries authorised to operate on the stock exchange's telematic market and the purchase is subject to the same commissions envisaged for the purchase of shares. They therefore do not have entry, exit or performance fees, but only the commissions due for trading. They may have management fees, which are usually extremely low. The value of ETFs (which takes the form of a NAV) is calculated continuously throughout the day and therefore fluctuates on the basis of the market prices of the assets in which the assets are invested. ETFs are characterised by a high degree of liquidity, guaranteed by the presence on the market of specialised

operators (specialists and market makers[32]) who propose continuous offers to buy and sell[33].

2.1.2 Costs and Fees.

While analysing an investment fund, it is also very important to assess the costs that the activity generates. In particular, the TER, Total Expense Ratio, or average expense ratio, represents the ratio between the total charges borne by the fund and its average assets. It is an effective indicator of the costs borne by the fund, excluding, therefore, subscription and redemption costs, which are paid directly by the subscriber. The figure, which includes all charges except tax and part of the trading charges, is expressed as a percentage of the fund's average annual assets and makes it easy for the investor to determine how much of his or her investment has been absorbed by costs. Besides management fees, the other major component is performance fees. The TER must be indicated in the second part of the prospectus and can be used to compare several funds.
Further information on costs such as, for example, subscription, redemption, switch and performance fees are given in the prospectus, but also in the KIID (Key Investor Information Document)[34] , which is nothing more than a fund's summary sheet, summarising key features such as volume, past performance, costs, risk, investment strategy, principal positions and financial metrics. The prospectus is often too technical and complex for the financial culture of retail investors. The EU UCITIS IV directive has improved the quality of disclosure and the transparency of the information to be made available to the public. The documentation, therefore, has been enriched with the KIID,

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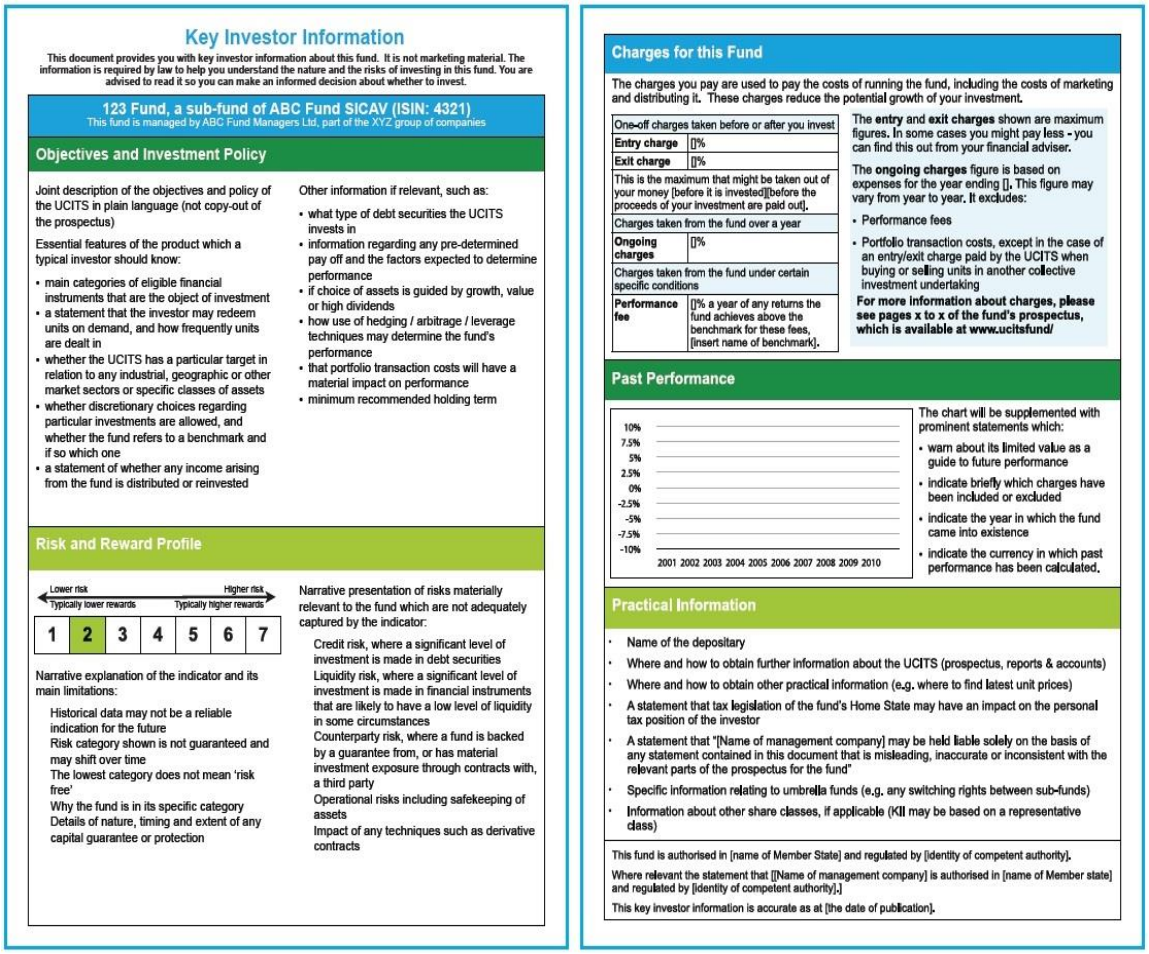
[32] The *Market Maker* or *Delaer* takes his own position. In markets with this type of intermediary, he quotes a buy and sell price for the security, thus, pricing is called *Quoten Driven*. In auction markets, on the other hand, buy and sell order flows are crossed and placed in a trading book on the basis of price and time priorities. The pricing here is called *Orden Driven*, i.e. prices go up if buy orders prevail and vice versa go down. In some cases, if the security is illiquid, i.e. there is a large difference between bid and ask price, an intermediary acting as a counterparty is involved to increase liquidity and make the price more meaningful: the *specialist*.
In the United States, the market maker and the specialist are regulated by the Securities and Exchange Commission (SEC) and the Financial Industry Regulatory Authority (FINRA); whereas in Europe, regulation and guidelines are expressed by MiFID II (Markets in Financial Instruments Directive).
[33] Forestieri Giancarlo, Mottura Paolo *Il sistema finanziario* Egea, 2017.

[34] The prospectus is prepared in accordance with the principles laid down in Article 17 of the Consob Issuers' Regulation. This regulates the obligations to inform investors by means of official documents such as the prospectus and the KIID.

which is a concise document, standardised both in format and content, that reports in simple and comprehensible language only the key information related to a given investment product. We find in the KIID the identification of the fund (issuer, ISIN code, website link), details on objectives and investment policy, type of management whether active or passive and declared benchmark, risk/return profile, costs, performance and sustainability classification (SFDR Classification).

Figure 2.1.2, 4. KIID Template.



Key Investor Information

This document provides you with key investor information about this fund. It is not marketing material. The information is required by law to help you understand the nature and the risks of investing in this fund. You are advised to read it so you can make an informed decision about whether to invest.

123 Fund, a sub-fund of ABC Fund SICAV (ISIN: 4321)
This fund is managed by ABC Fund Managers Ltd, part of the XYZ group of companies

Objectives and Investment Policy

Joint description of the objectives and policy of the UCITS in plain language (not copy-out of the prospectus)

Essential features of the product which a typical investor should know:

- main categories of eligible financial instruments that are the object of investment
- a statement that the investor may redeem units on demand, and how frequently units are dealt in
- whether the UCITS has a particular target in relation to any industrial, geographic or other market sectors or specific classes of assets
- whether discretionary choices regarding particular investments are allowed, and whether the fund refers to a benchmark and if so which one
- a statement of whether any income arising from the fund is distributed or reinvested

Other information if relevant, such as:

- what type of debt securities the UCITS invests in
- information regarding any pre-determined pay off and the factors expected to determine performance
- if choice of assets is guided by growth, value or high dividends
- how use of hedging / arbitrage / leverage techniques may determine the fund's performance
- that portfolio transaction costs will have a material impact on performance
- minimum recommended holding term

Risk and Reward Profile

Lower risk — Higher risk
Typically lower rewards — Typically higher rewards

1	2	3	4	5	6	7

Narrative explanation of the indicator and its main limitations:

Historical data may not be a reliable indication for the future
Risk category shown is not guaranteed and may shift over time
The lowest category does not mean 'risk free'
Why the fund is in its specific category
Details of nature, timing and extent of any capital guarantee or protection

Narrative presentation of risks materially relevant to the fund which are not adequately captured by the indicator:

Credit risk, where a significant level of investment is made in debt securities
Liquidity risk, where a significant level of investment is made in financial instruments that are likely to have a low level of liquidity in some circumstances
Counterparty risk, where a fund is backed by a guarantee from, or has material investment exposure through contracts with, a third party
Operational risks including safekeeping of assets
Impact of any techniques such as derivative contracts

Charges for this Fund

The charges you pay are used to pay the costs of running the fund, including the costs of marketing and distributing it. These charges reduce the potential growth of your investment.

One-off charges taken before or after you invest	
Entry charge	[]%
Exit charge	[]%
This is the maximum that might be taken out of your money [before it is invested][before the proceeds of your investment are paid out].	
Charges taken from the fund over a year	
Ongoing charges	[]%
Charges taken from the fund under certain specific conditions	
Performance fee	[]% a year of any returns the fund achieves above the benchmark for these fees, [insert name of benchmark].

The **entry** and **exit charges** shown are maximum figures. In some cases you might pay less - you can find this out from your financial adviser.

The **ongoing charges** figure is based on expenses for the year ending []. This figure may vary from year to year. It excludes:

- Performance fees
- Portfolio transaction costs, except in the case of an entry/exit charge paid by the UCITS when buying or selling units in another collective investment undertaking

For more information about charges, please see pages x to x of the fund's prospectus, which is available at www.ucitsfund/

Past Performance

10% 7.5% 5% 2.5% 0% -2.5% -5% -7.5% -10%
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

The chart will be supplemented with prominent statements which:

- warn about its limited value as a guide to future performance
- indicate briefly which charges have been included or excluded
- indicate the year in which the fund came into existence
- indicate the currency in which past performance has been calculated.

Practical Information

- Name of the depositary
- Where and how to obtain further information about the UCITS (prospectus, reports & accounts)
- Where and how to obtain other practical information (e.g. where to find latest unit prices)
- A statement that tax legislation of the fund's Home State may have an impact on the personal tax position of the investor
- A statement that "[Name of management company] may be held liable solely on the basis of any statement contained in this document that is misleading, inaccurate or inconsistent with the relevant parts of the prospectus for the fund"
- Specific information relating to umbrella funds (e.g. any switching rights between sub-funds)
- Information about other share classes, if applicable (KII may be based on a representative class)

This fund is authorised in [name of Member State] and regulated by [identity of competent authority].

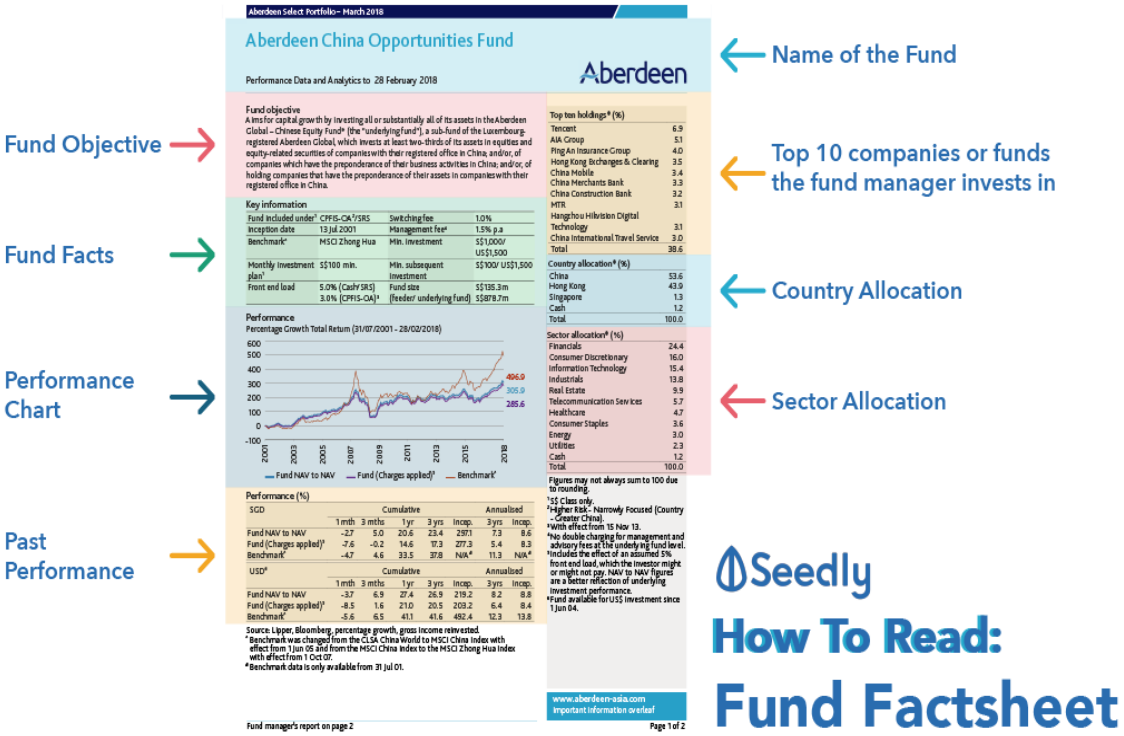
Where relevant the statement that [[Name of management company] is authorised in [name of Member state] and regulated by [identity of competent authority].]

This key investor information is accurate as at [the date of publication].

(Reference: Cos'è un KIID? - FIDA LIVE fidaonline.com)

The Factsheet is another important document that summarises the main characteristics of the fund and summarises the volume, past performance, costs, risk and lists the main positions with portfolio asset-allocation, geographical breakdown and all key financial metrics. It summarizes also the fund objective, the benchmark declared and we find the name of the fund with address and contacts. Depending on the manager's discretion, this report may be monthly or quarterl

Figure 2.1.2, 5. Factsheet example.



(Reference: How To Read A Fund Factsheet? seedly.sg)

To elaborate, we can specify that investing in funds generates costs for the subscriber, which are paid in the form of fees and can be expected:

- subscription (or entry) fees, payable when the unit is subscribed. They may be of a fixed amount or as a percentage of the amount invested. In this case they are generally decreasing as the paid-up capital increases. Funds with no entry fees are called no-load funds;
- redemption (or exit) fees, payable on disinvestment. They may be a fixed amount or a percentage (constant or variable) of the disinvestment value;
- switch fees, payable if the investor decides to transfer savings from one fund to another of the same management company;
- management fees, payable to the manager for the asset management activity. Unlike the former, which are charged to the individual investor, management fees are charged directly to the fund's assets; thus, the value of the unit is expressed net;

- incentive (or performance) fees, payable according to the fund's performance. When applicable, they are payable to the manager only if the performance achieved reaches or exceeds a pre-determined threshold.

2.1.3 Benchmark and Performance.

In order to assess the appropriateness of fund investment results, a benchmark is needed. The returns of the fund are compared with the returns obtained by the benchmark. The benchmark is a hypothetical portfolio whose composition reflects the composition of the investments implemented by the fund. The weight of the individual financial asset classes making up the benchmark reflects the weight of the same asset classes within the fund's portfolio. The benchmark can be a single market index, or a composition of indices, appropriately weighted to reflect the fund's investment strategies. This is composed of all securities belonging to a given asset class and is thus a perfectly diversified portfolio that is not affected by all risk components. Comparing the performance of the fund with the performance of the benchmark, therefore, means checking how close the manager is able to get to the best hypothetically achievable return. When the manager manages to outperform the benchmark, the manager is said to have 'beaten the market'.

The manager may adopt two management styles. He may decide to replicate the composition, hence the trend, of the benchmark (passive management); or he may decide to deviate from the benchmark to a certain extent in order to seize market opportunities (active management) and attempt to obtain a higher return than the benchmark index.

When comparing the performance of the benchmark and the performance of the fund, however, it must be pointed out that the fund is burdened with management fees and taxes, whereas market indices are not. In addition, unlike the benchmark, the fund maintains a portion of its assets invested in cash, which has an extremely low return and depresses the overall return of the portfolio.

The investment-related risk/return is based on the indicator SRRI (Synthetic Risk and Reward Indicator). It is based on the historical volatility of the fund's weekly or monthly returns measured on an annual basis. Once the indicator value has been calculated, based on a priori defined volatility ranges, each fund is placed within an increasing scale of riskiness, between 1 and 7, identifying its specific risk/return class.

Thanks to the divisibility of the investment, guaranteed by the quota mechanism, they are suitable for both medium-large and small assets, allowing the investor to achieve a level of diversification otherwise unattainable. They also allow savings to be invested gradually. In fact, depending on the subscription method, one can have:

- Capital Investment Plans, in Italian "PIC (Piani di Investimento del Capitale)".
- Capital Accumulation Plans, in Italian "PAC (Piano di Accumulo del Capitale)".

In the case of PIC, the investment in the fund is made through a single payment, the amount of which depends on the saver's liquid assets at the time of the investment. PAC is an investment method in which the saver initially determines the total amount to be invested and the duration of the plan by making periodic payments into the fund, with the possibility of suspending them or redeeming part of the shares in advance. This has the advantages of promoting the accumulation of savings, offering flexibility in payouts and mitigating the negative effects of any timing errors. In addition, it allows the investor to adapt the pay-in amounts to his or her financial means and to purchase fund shares when their value is lower.

After this in-depth overview of the technical and structural characteristics of Investment Funds, as well as how to invest in them, a number of top-performing water-related thematic funds will be presented. These are several funds that invest in so-called water stocks, i.e. companies related to the water sector. We also analyse raw materials used to generate renewable energy and energy in general. We specifically focus on the sectors where such companies operate as the top ten within the portfolio. The main water ETFs are also included considering that four are actually the best in terms of return.

2.2 Highlights on thematic funds: Water and Natural Resources.

The purpose of this in-depth study is to provide an analytical and comprehensive overview of the main financial products related to the water sector. It starts from an analysis carried out by FIDA (Finanza Dati Analisi) for the FocusRisparmio editorial on 30 March 2023, which reviewed the products specialised in water and natural resources and authorised to be sold to retail customers in Italy. In this paragraph, we will present in detail the different types studied.

FIDA is an Italian company that, thanks to its long-standing experience in financial research, develops software applications for wealth managers, private bankers, financial advisors, consultants and asset managers, with Europe-wide service coverage[35].

The aim of the analysis starts from the fact that water, considered the crude oil of the new millennium, is strongly threatened by climate change, pollution and population growth. The latest alarm in this regard came from the UN, which pointed out that the shortage of water sources is worsening rapidly even in developed countries. While the risk of global drought is certainly cause for concern, it can only catalyse investors' interest in a sector that is increasingly perceived as defensive and with enormous potential for long-term growth. This is why FIDA presents the best equity products in this category trying to identify recurring patterns and useful pointers for dealing with the new investment environment. Of course, not without developing a focus on other natural resources as well.

Before proceeding, some questions need to be asked; why do we do a data analysis in this context? Why is it important to talk about this sector? What kind of macroeconomic situation are we experiencing?

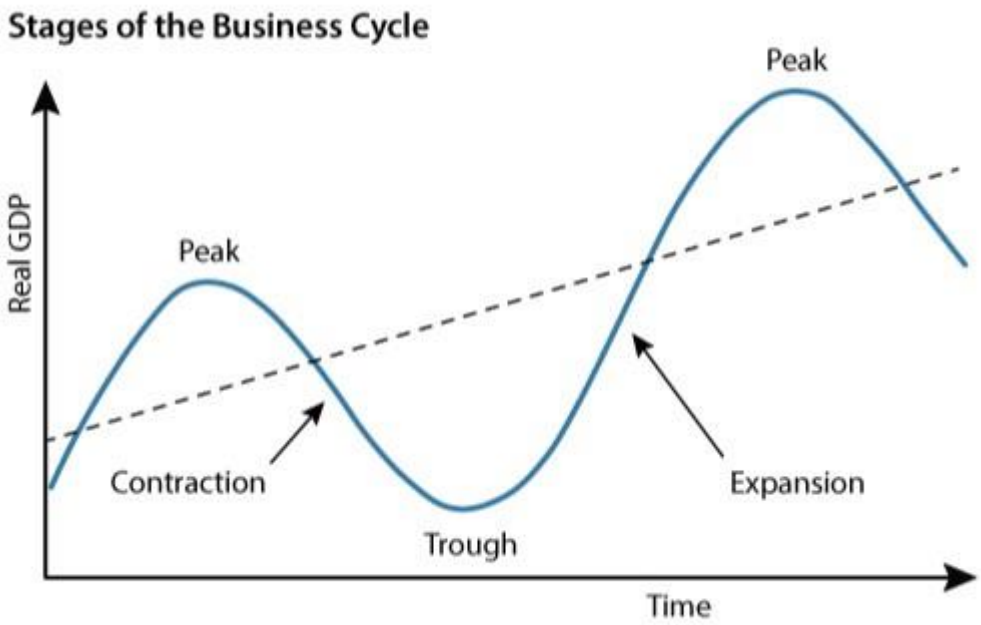
First of all, a distinction between cyclical and non-cyclic (defensive) sectors is necessary. Investing in cyclical and defensive sectors is a choice some investors make to try to make the most of the opportunities of the favourable business cycle, while limiting the difficulties during the less positive phases. This is because different sectors react differently to business cycle trends. Some sectors amplify gains and losses, while others are more stable.

Industrialised countries over the centuries have experienced extraordinary economic growth that has transformed economies and improved living standards for their citizens.

[35] FIDA Finanza Dati Analisi (fidaonline.com).

Yet periodically the expansions have been interrupted by episodes of marked unemployment, sharp declines in production, income and consumption, pandemics, wars and inflationary shocks. This sequence of expansions and declines in economic activity is known as the business cycle. The definition of the business cycle refers to the pioneering work of Burns and Mitchell in the 1940s. According to the two economists, "*business cycles are the kind of fluctuations that occur at the aggregate level in market-based economic systems. A cycle consists of expansions occurring almost simultaneously in many sectors of the economy, followed by equally generalised contractions, until the expansion phase of the next cycle. This sequence of changes is recurrent but not periodic; in terms of duration, business cycles vary from one to ten or twelve years*'.[36] Business cycles are fluctuations that involve aggregate economic activity and therefore affect not just one variable such as GDP, but simultaneously the main economic variables such as employment, prices of goods and services, investment, the velocity of circulation of money, productivity, consumption, so we speak of co-movements.

Figure 2.2, 6 The Business Cycle.



(Reference: All About the Business Cycle: Where Do Recessions Come From? | St. Louis Fed stlouisfed.org.).

[36] Ciclo economico - Urbrick.

The figure illustrates a typical business cycle. On the X-axis we find time, on the Y-axis we find real GDP, which measures the level of the economy at a given time. The dashed line describes the growth trend of aggregate economic activity, while the continuous function highlights expansions and contractions of economic activity. When economic activity is decreasing, we are facing a contraction or recession. If the recession is particularly strong then it is called a depression. When economic activity increases it is called an expansion that reaches a peak, the largest value the function takes. When contraction begins, which then becomes recession, it reaches its lowest point which is called a minimum and is the smallest value the function takes on. The entire sequence of expansion, contraction, recession and recovery constitutes the business cycle. Basically, it is characterised by a vicious cycle that characterises the economy by its recurring but not periodic fluctuations. The highs and lows repeat but we are not sure when.

An economic recession is a phase in which there is a general decline in economic activity. It occurs when there is a widespread drop in demand, which can be triggered by various events: a financial crisis, a decline in foreign trade, a sharp drop in supply, the bursting of an economic bubble, or a natural disaster of global significance, such as a pandemic[37]. Inflation plays a special role in this situation. Although inflation and recession are very different but closely related economic phenomena, they usually do not occur at the same time, but follow each other. High inflation rates can indicate an impending recession as companies react to high costs by reducing production and increasing prices. It should also be pointed out that Central Banks, to fight inflation, increase interest rates through monetary policy[38] ; thus, increasing the cost of money investment slow down, borrowing becomes more expensive, companies do not invest and consequently the economy does not grow.

Linked therefore to the business cycle are cyclical and non-cyclic or defensive sectors. A sector or a specific security is defined as cyclical when it is strongly influenced by the

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[37] Jack Reardon, Maria Alejandra Caporale Madi, Molly Scott Cato. *Introducing a New Economics: Pluralist, Sustainable and Progressive* Pluto Press, 2018.

[38] Monetary policy (together with fiscal policy) is part of economic policy. It is carried out by the central banks, whose ultimate objectives are employment and income growth, price stability and a balanced balance of payments. Monetary policy is summarised in the regulation of the money supply and the level of interest rates. Relevant is the objective of maintaining the stability of the financial system, which is a transmission channel for monetary policy.

Pietro Alessandrini, *Economia e politica della moneta. Nel labirinto della finanza*. 3° Edizione, Il Mulino, 2021.

Nadotti L., Porzio C., Previati D. *Economia degli intermediari finanziari* McGraw-Hill, quarta edizione, 2022.

business cycle, for example by movements in GDP or industrial production. When the economy accelerates, the performance of cyclical companies tends to improve, whereas when the economy loses or goes into recession, a cyclical company tends to suffer more than others. Major cyclical sectors include financials, mining (metals and steels), automotive, luxury goods, textiles, industrial goods and services, technology, construction, distribution, semiconductors, hotels, restaurants and tourism.

Defensive sectors and/or stocks have little correlation with the economic cycle and are less affected by any growth slowdowns or recessions. These are typically goods or services that are considered necessary, and therefore not given up even in times of economic constraints. Think of foodstuffs, healthcare and pharmaceuticals, utilities (water, gas, electricity) or oil companies. Precisely because they are not affected by fluctuations in the business cycle, these sectors tend to be more resilient than cyclical sectors, but at the same time they can be less attractive during economic upturns. While optimism and increased disposable income may prompt us to buy a piece of jewellery or a car that we would have given up in times of crisis, our consumption of medicines or groceries is likely to remain unchanged. By their nature, cyclical stocks tend to incorporate higher market risk and greater variability of earnings and dividends. Defensive stocks, on the other hand, usually expose us to less risk and produce more regular company results over time[39].

Considering the current times, high inflation, the ongoing war between Russia and Ukraine, investing in a defensive sector like water could be a good alternative. One of the characteristics of this investment is that it combines potential return and sustainability. The availability of fresh water (for agriculture, industry, food industry and healthcare sector) is proving to be an inverse function of population growth and the deficit is worsening due to climate change. Investing in water therefore helps combat drought and the risk of desertification. Although water covers about 70% of the planet (97%, however, is salt water), the availability of fresh water is decreasing. According to the World Bank definition, a country is under water stress if water availability is less than 1,700 cubic metres per year per capita. In Europe and the United States, for example, this figure is around 3,000 and 8,000 cubic metres per year per capita, respectively. While several countries in Africa and the Near and Middle East region have already been affected by water stress for some time, freshwater scarcity is gradually spreading to areas such as the

[39] Settori ciclici vs settori difensivi (familybanker.it).

West Coast of the United States, the Mediterranean, some Central Asian countries, and Australia[40].

The typical profile of someone who invests in this asset class is that of an investor:

- Environmentally aware
- Socially active
- Seeking niche opportunities
- Long-term

Currently, betting on water is possible through four more or less speculative and risky ways:

1. Shares in specialised companies
2. Investment Funds
3. ETF
4. Water futures

The following is a list of sectoral equity funds related to water, energy and commodities, and the main water ETFs:

Figure 2.2, 7. Isin Codes and Instrument Classification.

Mutual Funds				
Funds Name	CLASS	ISIN CODE	Equity Sector - Water Resources	Equity Sector - Natural Resources (Energy and Commodity)
JSS Sustainable Equity Water	C	LU0950593250	X	\
BNP Paribas Aqua K EUR	K	LU2200547300	X	\
Arca Blue Leaders	n.a	IT0005494569	X	\
FAM Series Fid. Sust. Water and Waste L Cap EUR	L	IE00BLKQFT85	X	\
RobecoSAM Sustainable Water Equities D Cap $	D	LU2146191130	X	\
KBI Water H EUR	H	IE00B64V3N43	X	\
NAT Thematics Water R Cap $	R	LU1923621640	X	\
Allianz Global Water AT3 Cap $	AT3	LU2229751404	X	\
EurizonAM Sicav Clean Water U Cap Eur	U	LU1973565028	X	\
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	BT	LU0999463937	X	\
Pictet-Timber-R EUR	R	LU0340559805	\	X
Allianz Global Water AT Cap $	AT	LU2089279066	X	\
Janus Hend. Hor. Responsible Resouces A2 Cap $	A2	LU1120392870	\	X
SISF Commodity B Cap $	B	LU2274224166	\	X
Franklin Natural Resources A EUR	A	LU0300741732	\	X
Aberd.Stadn.I World Resources Eq. A Cap EUR	A	LU0505663822	\	X

[40] L'acqua, una risorsa per la vita - ESG News.

Exchange Traded Funds				
ETF Name	CLASS	ISIN CODE	Equity Sector - Water Resources	Equity Sector - Natural Resources (Energy and Commodity)
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	Dist	FR0010527275	X	\
L&G Clean Water UCITIS ETF	Acc	IE00BK5BC891	X	\
iShares Global Water UCITIS ETF USD (Dist)	Dist	IE00B1TXK627	X	\
Invesco Materials S&P US Sel. Sector UCITIS ETF Acc	Acc	IE00B3XM3R14	\	X

(Reference: Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar).

11 of the above funds belong to the Equity Sector – Water Resources, with the exception of five funds such as, Pictet-Timber, Janus Hendersen Horizon, SISF Commodity, Franklin Natural Resources and Aberdeen Standard World Resources which are classified as Equity Sector - Natural Resources (Energy and Commodity). As far as ETFs are concerned, we have four Equity Sector - Water Resources products and one ETF related to Energy and Commodities. The data were collected from Morningstar and from each financial report, KIID and Prospectus. These are updated to the most recent date on which the relevant documents were published.

It should be noted that some of the funds were launched recently, so since they do not have 1, 3, 5-year performance for each, the financial metrics used for a uniform evaluation were Year To Date, Dividend Yield, Price/Earnings Ratio, Volatility, Sharpe Index, Beta and Alpha[41].

- The Year To Date (YTD) is a time indicator that describes the time between the start of the calendar year and today's date. It basically expresses the percentage return of the instrument from the beginning of the year to the last available value.

- The Dividend Yield (DY) is both an indicator of immediate return and one of the multiples used to value companies. In particular, it is given by the ratio between the unit dividend paid by a given share and the share price itself. This indicator, as well as all major multiples, is particularly used in benchmarking where the objective is to assess the positioning of a company in relation to another company or a group of potential competitors. The higher it is, the better the judgement is made about the company's ability to remunerate invested capital. However, the

[41] Bodie, Kane, Marcus. *Investments*. 12th Edition, McGrawHill, 2021.

Dividend Yield is a static measure of return and does not take business risk into account.

- Price/Earnings is the ratio of a company's share price (market price) to earnings per share. It is also expressed as the ratio of the issuer's market capitalisation to its earnings. It indicates how often the share price incorporates expected earnings and thus how often a company's earnings are contained in the value that the market assigns to it. The higher the P/E, the higher the investors' expectations of the company's growth. In fact, a high P/E value indicates that the market is willing to pay a lot to have the level of earnings in the denominator, as it believes in the company's ability to grow further.

- Volatility measures the uncertainty about future price movements of an asset or a financial asset. As volatility increases, the probability that performance will be very high or very low increases, i.e. the probability that price movements will be very large, either increasing or decreasing. It is measured as the standard deviation of the rate of return of the asset or financial asset.

- Sharpe index is the ratio of the difference between the portfolio return and the Risk Free return, with Volatility in the denominator. It measures the ratio of a fund's return to the return of a risk-free financial product and its volatility. The higher the index, the higher the return in a given period is obtained with less risk. The higher the index, the greater the manager's ability to optimise the risk-return ratio.

$$SR = \frac{Rp - Rf}{\sigma ER}$$

(2.2, 2)

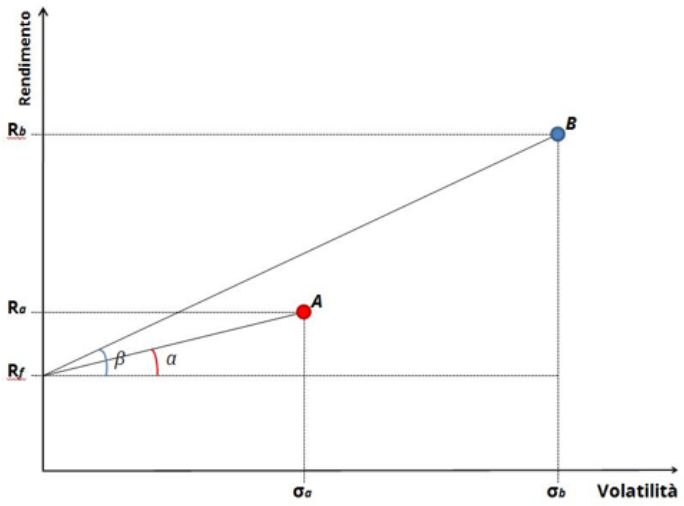
- ✓ Rp is Return of portfolio;
- ✓ Rf is the Risk Free rate;
- ✓ σ^{ER} is the Standard Deviation of portfolio excess return.

To better understand, let's take a small example: Fund A with a return of 12% and volatility of 19%, Fund B with a return of 10% and volatility of 12%. The risk-free return is by hypothesis 1%.

a) Fund A: (12%-1%) /19 = 0.58
b) Fund B (10%-1%) /12 = 0.75

Fund B manages to generate an additional 0.75% return on top of what is considered risk-free (1%) every time volatility increases by 1%, whereas investment A only gets an extra 0.58% return under the same conditions. Therefore, investment B is said to have a better risk-return ratio and is therefore to be preferred.

Figure 2.2, 8. Graphical representation of Sharpe Ratio.



(Reference: Gli indici di Sharpe e Sortino - FIDA LIVE fidaonline.com)

On the horizontal axis we have the volatility and on the vertical axis we have the return.

Given a risk-return scenario, the Sharpe index is the angular coefficient of the straight line joining the points representing the fund and the risk-free asset. From a graphical point of view, a financial instrument (in this case fund B) with the largest slope is therefore to be preferred.

- Beta (β) measures the sensitivity of a fund to market fluctuations, it determines how much the fund varies with the market as a result of market movements. It is referred to as systemic risk, attributable to macroeconomic, political and factors

beyond investors' control. This indicator can be used to assess the fund's behaviour by indicating its riskiness, it measures the tendency to amplify changes in the reference benchmark. We can have:

- ✓ Beta > 0 (Concordance): if there is a positive shock the fund has a positive shock;
- ✓ Beta < 0 (Discordance): viceversa;
- ✓ Beta = 0 (Independence): the fund is independent of changes in the benchmark.

By definition, the market beta (benchmark) is equal to 1.

- The Alpha indicator (α) expresses a fund's ability to change value independently of market trends (specific risk). A positive Alpha indicator indicates that the security is able to grow more than its reference market, while a negative value indicates the possibility of the security suffering losses regardless of the general market trend. Jensen's Alpha (named after the economist who introduced this performance measure) is the incremental return (or extra-return) of a portfolio or mutual fund relative to the return that such a portfolio should have produced based on its level of systematic risk as measured by Beta. In conclusion, it represents the measure of the variation (greater or lesser) of a fund's performance with respect to its expected value, calculated on the basis of the risk assumed by the fund, referred to as Beta. Consequently, an alpha value greater than zero indicates the higher return of the managed portfolio compared to the equilibrium return (as constructed by the Capital Asset Pricing Model, CAPM) of an unmanaged (market) portfolio with the same beta. It is thus an indicator of the manager's skill in stock picking and thus of his ability to add value.

$$\alpha = Rp - (\beta * Rm)$$

(2.2, 3)

Rp represents the return net of the free-risk return realised by the managed portfolio; Rm represents the return net of the free-risk return realised by the market (or benchmark).

Having concluded this overview of the financial metrics used, Table 2.2 number 9 synthesizes our analysis, carried out between April and May 2023, and shows that the total assets, i.e. the total Assets Under Management, managed by all these 16 instruments is approximately 13,850.06 million[42].

However, it is difficult to say which fund has performed better than another when taking into account all the financial metrics mentioned above. The tables show the available data collected by Morningstar and the factsheets published by each management company. Some items have not been reported due to unavailability (they were not published) and the recent launch date of the sub-fund. In the products analysed, the SRRI (Synetic Risk and Reward Indicator) corresponds to a medium risk level (4/7 and 5/7) for all funds, except for Arca Blue Leaders (6/7), Janus Henderson Horizon Responsible Resources (7/7) and Franklin Natural Resources (6/7), which correspond to the riskiest instruments.

Figure 2.2, 9. Data related to March/April 2023.

Funds Name	ESG	SFDR	AUM	YTD	1 year	3 year	5 year
JSS Sustainable Equity Water	Yes	article 9	358,30	6,09%	0,48%	18,01%	8,77%
BNP Paribas Aqua K EUR	Yes	article 9	3600,14	6,24%	-1,33%	\	\
Arca Blue Leaders	Yes	article 8	22,6	6,04%	0,00%	0,00%	0,00%
FAM Series Fid. Sust. Water and Waste L Cap EUR	Yes	article 8	354,64	7,80%	-9,90%	\	\
RobecoSAM Sustainable Water Equities D Cap $	Yes	article 9	3680,207	7,52%	-6,40%	16,97%	7,42%
KBI Water H EUR	Yes	article 8	1173,75	4,06%	11,50%	18,18%	9,39%
NAT Thematics Water R Cap $	Yes	article 9	393,8	4,30%	4,17%	11,49%	\
Allianz Global Water AT3 Cap $	Yes	article 8	967,14	2,68%	6,72%	\	\
EurizonAM Sicav Clean Water U Cap Eur	Yes	article 8	161,66	2,16%	0,63%	9,97%	\
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	Yes	article 9	390,91	2,20%	2,88%	11,37%	9,27%
Pictet-Timber-R EUR	Yes	article 9	1199	-0,08%	-16,47%	13,50%	3,26%
Allianz Global Water AT Cap $	Yes	article 8	975,29	3,16%	5,91%	8,82%	\
Janus Hend. Hor. Responsible Resouces A2 Cap $	Yes	article 8	15,92	-2,71%	-17,42%	13,87%	2,63%
SISF Commodity B Cap $	No	article 6	96,27	-7,30%	-21,30%	\	\
Franklin Natural Resources A EUR	No	article 6	351,98	-8,13%	-8,31%	24,38%	1,37%
Aberd.Stadn.I World Resources Eq. A Cap EUR	No	article 6	108,45	-3,47%	-7,50%	15,84%	5,57%
TOT			13850,06				

Funds Name	DY	P/E	Volatility	Sharpe	Beta	Alfa	TER	Inception
JSS Sustainable Equity Water	1,73%	19,10	17,27%	1,05	1,09	1,17	1,64%	23/12/2013
BNP Paribas Aqua K EUR	1,92%	20,02	19,11%	0,39	1,16	-2,47	2,98%	03/07/2015
Arca Blue Leaders	3,78%	14,29	12,50%	0	0	0	2,07%	20/06/2022
FAM Series Fid. Sust. Water and Waste L Cap EUR	2,06%	18,20	18,12%	Neg	\	\	1,69%	13/11/2020
RobecoSAM Sustainable Water Equities D Cap $	1,53%	19,75	16,75%	0,81	0,96	-0,41	1,71%	29/10/2020
KBI Water H EUR	2,44%	17,47	13,53%	1,19	0,90	3,86	0,76%	09/03/2012
NAT Thematics Water R Cap $	1,77%	19,82	15,73%	0,83	0,90	-0,20	2,05%	20/12/2018
Allianz Global Water AT3 Cap $	1,72%	20,11	\	\	\	\	1,55%	10/01/2020
EurizonAM Sicav Clean Water U Cap Eur	2,19%	22,15	15,91%	0,67	0,94	-3,07	2,21%	18/11/2019
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	1,42%	21,88	15,84%	0,82	0,91	-0,41	1,12%	18/09/2007
Pictet-Timber-R EUR	3,17%	12,27	18,23%	0,74	0,98	2,18	2,70%	29/09/2008
Allianz Global Water AT Cap $	1,94%	19,69	16,61%	0,52	0,89	-4,51	2,10%	18/12/2019
Janus Hend. Hor. Responsible Resouces A2 Cap $	1,67%	14,18	25,09%	0,50	1,05	-4,78	1,94%	02/07/2014
SISF Commodity B Cap $	0,45%	23,60	\	\	\	\	2,54%	22/02/2021
Franklin Natural Resources A EUR	5,64%	10,75	25,06%	1,02	0,83	2,27	1,82%	12/07/2017
Aberd.Stadn.I World Resources Eq. A Cap EUR	4,90%	11,91	16,12%	1,00	0,87	-0,44	1,69%	26/07/2010

(Reference: Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar and each Factsheet).

[42] The total Asset Under Management is the result of the calculation of each AUM data related to each fund thought Excel. We applied the same procedure for calculate the total AUM of several ETFs.

At first glance we can say, looking only at the YTD, that among the best ones we find the Fidelity Sustainable Water and Waste of Fineco Asset Management. Although it was launched on November 13, 2020, it recorded a performance of 7.80%, maintains a rather high volatility at 18.12% and offers a Dividend Yield of 2.06% and a P/E of 18.20. However, we note that the fund has a negative Sharpe Ratio, which means that it optimises the risk/return ratio less than other funds. Next, we mention BNP Paribas Aqua K EUR of BNP Paripas Management, launched on July 3rd, 2015, performed 6.24%, has a higher volatility of 19.11%, a Dividend Yield of 1.92% but a P/E of 20.02 and a Sharpe Ratio of 0.39. The P/E shows that the companies in which this fund invests have greater growth potential than those in which Fidelty Sustainable Water invests. The Alpha index of this fund, on the other hand, is negative, -2.47%, which means that it has a higher probability of incurring losses and a lower stock picking ability of the manager. Remember that both funds invest in the industrial sector. Below we discuss the JSS Sustainable Equity Water fund managed by JSS Investment Fund SICAV. This one achieved a YTD of 6.09%, a Dividend Yield of 1.73% and a good P/E Ratio of 19.10. This product compared to the other two above has a lower volatility 17.27%, a higher Sharpe Ratio 1.05 and better Beta and Alpha indicators, 1.09 and 1.17 respectively.

Among the worst performers there was the Frankling Natural Resources fund which had a negative YTD of -8.13% while maintaining a Dividend Yield of 5.64% and a P/E of 10.75. The Sharpe Ratio was 1.02, the Beta 0.83 while we point out that among the worst performers it had the best Alpha 2.27. This fund invests mainly in energy-related companies.

After mentioning the best and worst three funds in terms of purely performance, it is useful to underline that all the equity funds that invest in water-related companies showed both positive and negative performances in relative terms. In contrast, the worst performing funds were those linked to the energy and commodities sector. This is probably linked to the current macroeconomic situation, i.e. high inflation, the Russian-Ukrainian conflict and the subsequent increase in energy and commodity prices. This leads to the conclusion that water is indeed a megatrend and that the thematic funds shown in the table are actually benefiting from this investment asset. We are talking about investment funds dedicated to a sector that transcends the business cycle and are therefore driven to continuous future development regardless of the economic and social situation of the country of reference.

As far as ETFs are concerned, we can mention the four main instruments related to the sector under consideration and reported in Table 2.2 number 10:

Figure 2.2, 10. Data Related to March/April 2023.

ETF Name	ESG	SFDR	AUM	YTD	1 year	3 year	5 year
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	Yes	article 8	1265,04	10,61	9,14%	11,28%	10,72%
L&G Clean Water UCITIS ETF	Yes	article 9	425,4	7,66	7,70%	12,97%	\
iShares Global Water UCITIS ETF USD (Dist)	Yes	article 8	1975	5,77	6,54%	11,46%	11,35%
Invesco Materials S&P US Sel. Sector UCITIS ETF Acc	No	article 6	8,11	1,52	-7,49%	13,71%	9,75%
TOT			3673,55				

ETF Name	DY	P/E	Volatility	Sharpe Ratio	Beta	Alfa	TER	Inception Date
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	2,04%	21,30	16,59%	0,78	0,88	0,04	0,60%	09/10/2007
L&G Clean Water UCITIS ETF	1,92%	18,93	17,24%	0,87	0,87	2,33	0,49%	02/07/2019
iShares Global Water UCITIS ETF USD (Dist)	2,18%	21,00	17,14%	0,76	0,94	-0,23	0,65%	16/03/2007
Invesco Materials S&P US Sel. Sector UCITIS ETF Acc	n.a	n.a	17,10%	0,81	0,89	2,05	0,14%	16/12/2009

(Reference: Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar and each Factsheet).

Total AUM under management amounts to EUR 3674.55 million. First of all, we note that the management costs, the TER, are significantly lower than in the above-mentioned funds. All these ETFs have achieved good returns and all have similar volatility. The first ETF, the Lyxor MSCI Water has a better P/E than all of them 21.30%, while the iShares Global Water, offers a higher dividend yield 2.18%. We highlight the Invesco Materials S&P US Sector, which has very small assets under management of, about EUR 8.11 million, replicates the US commodities sector and does not take ESG criteria into account. The other three products are respectively related to the global water sector, clean water industry and the iShares Global Water replicates the 50 largest and most liquid equities worldwide that are engaged in the water economy. All the three financial instruments take ESG criteria into account.

In the following paragraph, we will go deeper the detail of each product and technically analyse the different portfolio positions and the degrees of investment concentration of the various instruments.

2.3 Differences between mutual funds investing in water futures contracts, water utilities and industrials, water equipment and materials.

First, it is important to point out that the funds under review all belong to the Retail investment class and are authorised for sale in Italy. Retail investors are savers, including businesses, companies or other entities, who can not be qualified as professional clients. They are, in essence, ordinary savers who turn to the intermediary to make their investments. According to the MIFID (Market in Financial Instruments Directive), investors are not all equal and their subdivision into classes determines different levels of protection and rules of conduct to which intermediaries must adhere[43].

We therefore have:

- Retail customers represent the basis of investor classification and must be the most protected class as they lack the experience, knowledge and skills of professional clients and eligible counterparties. Models of protection for retail clients find centrality in the obligation of intermediaries to provide clients with useful information, also in a standardised format, so that they can understand the nature of investment services and the specific type of financial instruments and related risks, with the aim of making informed choices.
- Professional clients, on the other hand, are those who are deemed to possess the experience, knowledge and skills necessary to make independent and informed investment decisions after a careful risk assessment. Professional clients therefore require a lower level of protection than retail clients. Professional clients in turn are divided into professional clients by right and professional clients on demand.
    1) Professional clients as of right. They fall into this category:
        - ✓ Entities that are required to be authorised or regulated to operate in financial markets, whether Italian or foreign (e.g. credit institutions, investment companies, insurance companies, collective investment undertakings and management companies of such undertakings).
        - ✓ Large companies that meet at least two of the following size requirements at individual company level: balance sheet total of EUR 20 million or

[43] Forestieri Giancarlo, Mottura Paolo *Il sistema finanziario* Egea, 2017.

more, net turnover of EUR 40 million or more, own funds of EUR 2 million or more.

- ✓ Institutional investors whose main activity is investing in financial instruments, including entities engaged in asset securitisation or other financial transactions. Similarly, national governments, public bodies in charge of managing public debt, central banks, international and supranational institutions, such as the World Bank, the International Monetary Fund and the European Central Bank, are to be considered as professional clients in their own right.

2) Professional clients on request. That is, people (retail clients) who, while not meeting the requirements of professional clients, expressly request to be considered as professional clients by virtue of their expertise and experience in the financial field.

- Qualified counterparties. They are the class of clientele that possesses the highest level of knowledge, experience and expertise in investment matters, and conversely, they are the category of investors that has the least protection and at the same time the greatest freedom of action. But this class only becomes relevant when the intermediary provides the services of order reception and transmission, proprietary trading or order execution. We are talking about Banks, SIMs, OICRs, SGRs, Pension Funds, Electronic Money Institutions, National Governments, Central Banks and supranational organisations of a public nature.

The table below summarises the sectors in which the funds invest, the geographical areas in which they are most concentrated and the stated benchmark. The sectors in which capital flows are concentrated are the industrial sector, the utility sector, the life sciences services and tools sector, timber, metals and their extraction, energy and commodities.

The GICS (Global Industry Classification Standard) was introduced in 1999, and has since been updated, by MSCI in collaboration with Standard & Poor's to establish a globally accepted criterion for the sectoral classification of industries. The final goal is to give greater comparability to research and analysis carried out in different parts of the world[44]. The rationale of the GICS is that each company is classified into a sector according to its core business (as measured by revenue accounting items). The sectors thus identified are:

[44] GICS® - Global Industry Classification Standard - MSCI.

- Energy Sector companies;
- Materials Sector (companies belonging to the manufacturing sector);
- Industrials Sector;
- Consumer Discretionary Sector (companies that are more sensitive to economic cycles);
- Consumer Staples Sector (companies less sensitive to economic cycles);
- Health Care Sector (pharmaceutical and biotechnology companies);
- Financials Sector;
- Information Technology sector (hardware, software and semiconductor companies);
- Telecommunications Services Sector;
- Utilities Sector (companies belonging to the public goods sector such as gas, electricity, water, etc.);
- Real Estate Sector (companies belonging to the real estate sector).

Basically, it is a method of assigning each public company to the economic sector and industry group that best defines its business. It is one of two rival systems used by investors, analysts and economists to compare and contrast competing companies. The GICS classification competes with the Industry Classification Benchmark (ICB) system, operated by Dow Jones and the FTSE Group in London. In practice, most of the same sector and industry designations exist in both standards. This classification was launched in 2005 and enhanced in 2019 with the integration of the Russel Global Sectors (RGS) classification. The ICB system allocates each company to the subsector that most closely describes the nature of its business. When a company conducts two or more types of business that differ substantially, the predominant sector is determined by a review of the audited accounts and the directors' report. The classification is made according to the immediate or the end use of the product, or the industrial process used. The allocation is made through four different levels: Industry (like Energy, Finance, Technology, Healthcare and Utility), Supersector (such as Oil &Gas, Banking segment, IT, Pharmaceutical and Telecommunications), Sector and Subsector. The greatest difference lies in how consumer businesses are classified at the sector level[45].

[45] Industry Classification Benchmark (ICB) | FTSE Russell.

With the ICB, companies doing business with consumers are divided into providers of goods and providers of services. With the GICS, companies are labelled as cyclical or non-cyclical, or between discretionary spending and staples.

All funds considered invest in the Industrial sector, except for five funds. These are classified as Services and tools for life sciences, Woodlands, Metals and Mining, Commodity, Energy and Materials. More precisely they do not invest in water stocks.

In particular, RobecoSAM Sustainable Water, which has in its portfolio companies that offer products and services related to the water value chain. Their business model is based on thematic investments that contribute to the promotion of the SDG Agenda, i.e. they offer life science services and tools. The other four funds do not invest in water and more precisely are related to other industrial sectors. The Pictet-Timber-R fund invests in companies involved in the financing, planting and management of forests and forest regions, in the processing, production and distribution of timber and other timber-based products and services. Janus Hendersen Horizon Responsible Resources focuses on the mining, energy and agricultural sectors in every country in North America. It invests in companies related to these sectors that benefit from the continued demand for natural resources throughout the supply chain. The SISF commodity invests in commodities such as gold, oil, silver, natural gas, wheat, coffee, sugar, aluminium and soybeans and is geographically located in Canda. Franklin Natural Resources is active in oil & gas, exploration and production technologies, energy services, chemicals, agriculture and industrial products by investing in both public and private companies. The Aberdeen Standard World fund has companies in its portfolio that are active in the mining, manufacturing, construction materials processing, chemical, paper and energy industries.

Figure 2.3, 11. Sector, Geographic Area and weights assigned in the portfolio.

Funds Name	Sector	% Portfolio Weight	Geographic Area	% Portfolio Weight
JSS Sustainable Equity Water	Industrials	47,55%	USA	49,35%
BNP Paribas Aqua K EUR	Industrials	53,11%	USA	49,08%
Arca Blue Leaders	Industrials	30,40%	USA	25%
FAM Series Fid. Sust. Water and Waste L Cap EUR	Industrials	48,28%	North America	45,51%
RobecoSAM Sustainable Water Equities D Cap $	Services and tools for life sciences	22,80%	America	64,40%
KBI Water H EUR	Industrials	39,45%	USA	52,36%
NAT Thematics Water R Cap $	Industrials	43,30%	Americas	62,10%
Allianz Global Water AT3 Cap $	Industrials	32,90%	USA	58,20%
EurizonAM Sicav Clean Water U Cap Eur	Industrials	46,20%	USA	48,50%
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	Industrials	51,05%	USA	61,79%
Pictet-Timber-R EUR	Woodlands	22,90%	USA	51,82%
Allianz Global Water AT Cap $	Industrials	72,18%	USA	60,06%
Janus Hend. Hor. Responsible Resouces A2 Cap $	Metals and Mining	41,17%	North America	62,41%
SISF Commodity B Cap $	Commodity	100%	Canada	99,81%
Franklin Natural Resources A EUR	Energy	100%	USA	67,28%
Aberd.Stadn.I World Resources Eq. A Cap EUR	Materials	65,10%	USA	32,10%

(Reference: Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar and each Factsheet).

All the other funds we have not mentioned focus on investing in companies that use water efficiently and sustainably and are involved in the management, purification, desalination

for industrial purposes and recycling of water, industrial tools such as pumps, valves and general equipment, and waste management. All have a strong impact in choosing companies that demonstrate effective ESG management. Geographically, all funds invest in the US with some minor exceptions in North America, Canada, the Americas in general and Europe.

Here below we can see the sectors, geographical investment concentrations with the portfolio percentage of the following ETFs.

Figure 2.3, 12. Sector, Geographic Area and weights assigned in the portfolio.

ETF Name	Sector	% Portfolio Weight	Geographic Area	% Portfolio Weight
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	Industrials	67,17%	USA	66,90%
L&G Clean Water UCITIS ETF	Industrials	54,50%	USA	60,20%
iShares Global Water UCITIS ETF USD (Dist)	Industrials	51,61%	USA	55,93%
Invesco Materials S&P US Sel. Sector UCITIS ETF Acc	Materials	100%	USA	78,28%

(Reference: Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar and each Factsheet).

What they all have in common is that they all invest only in the US and are Industrials, except for the Invesco Materials S&P which invests in commodities. It is an accumulation ETF so the dividends distributed by the ETF's underlying holdings are reinvested by the fund manager without additional expenses and as a result, its value increases.

In detail, the iSharere Global Water plots the S&P Global Water 50 index from which it takes its name. The index groups together the 50 stocks of the most liquid companies in the sector. More than 45 per cent of the companies operate in the US, 16 per cent in Western Europe and 12 per cent in the UK. Investors receive dividends semi-annually and pay fees of 0.65% per annum (see TER Figure 2.2 number 10).

The Lyxor MSCI Water ESG Filtered replicates the MSCI ACWI IMI Water ESG Filtered index. This Benchmark replicates the global water sector and is designed to represent the performance of securities whose activities are related to the water sector, such as water distribution and public services and equipment supply and water treatment, excluding companies that lag in environmental, social and ESG governance terms, in relation to the thematic range, based on an ESG assessment. The equities included are filtered according to these criteria. It is a weighted index with a maximum holding of 10%

per share, in fact, the index is rebalanced every 6 months. The management costs are 0.60% per year (see TER Figure 2.2 number 10).

The L&G Clean Water UCITS ETF is the youngest of the mentioned ones, in fact it has only been active since 2019. It replicates the Solactive Clean Water index, which groups companies internationally involved in clean water. Each of the stocks is represented with a very small share, in fact, the top 10 companies account for only 20.7% of the total. Solactive Clean Water is also a weighted index, in fact the weight of each security cannot exceed 15% and the rebalancing of the index takes place every month because the fund is Accumulation.

However, the analysis shows that no product invests in water futures. As mentioned in Chapter 1, the first futures contract with underlying water was the one contracted from December 2020 at the CME Group with ticker H2O 'Nasdaq Veles California Water Index'. So, what does it means water future? How many amounts of money moves this kind of contract?

First of all, a futures contract is a Derivative contract where two contracting parties undertake to buy or sell in the future, financial assets, or real assets and/or commodities, at a price set today. This type of contract is traded on official markets, has standard characteristics and therefore cannot be customised[46]. Each contract had a value of 3.26 million gallons of water. The purpose of the contract was to hedge California farmers, utility companies and municipalities against price risk in an approximately $1.1 billion water market. California is the largest agricultural producer in the US and suffers from increasingly acute droughts[47]. The futures contract can also be used as a speculative tool and not just to hedge price risk.

A retail investor who wants to trade this contract must be warned of the risks typical of leveraged derivative instruments. Regardless of whether the underlying of the future is, for example, oil, gold or water, it is, by its nature, useful for a short-term speculative strategy by trading in leverage, which is highly risky and, the fluctuations in the case of water, will depend on the drought risk. It would be good to have a good understanding of California's climatological model, which is not easy.

To invest in water with medium and long-term horizons, it is preferable to use other instruments such as those mentioned above, which are affordable from the point of view

[46] J.C. Hull, *Options, Futures and Other Derivatives* Pearson, Prentice Hall, Upper Saddle River, 2011.

[47] Focus Risparmio, *Acqua come il petrolio? ETF, azioni e fondi per investire nell'oro blu*, 23 febbraio 2021, Sofia Fraschini.

of management costs, do not require a minimum initial deposit or sometimes a very low one, and above all are products authorised for sale to this type of clientele.

On the next paragraph we focus on the benchmark of each financial product describing the composition and the metrics used to compare the performance and the ability of the fund manager.

2.4 Benchmark of Funds and ETFs investing in water.

The choice of a benchmark plays a crucial role both in active and passive management and for the selection of financial products to include in the portfolio. Information Ratio index (IR) is a financial metric that tell us how much the product is faithful to the benchmark. Differently from Sharpe Ratio, that we mentioned and explained before, Information Ratio measures the risk-adjusted return in relation to a benchmark, the consistency of an investment's performance. In fact, this index measures the ability of the asset manager to consistently outperform the benchmark, it provides an indication to achieve a positive differential return relative to the benchmark per unit of risk assumed differing from it.[48] From an analytical point of view, it is defined as a ratio between the outperformance achieved by the asset manager relative to the benchmark and the Tracking Error Volatility (TEV).

$$IR = \frac{R - Rb}{TEV}$$

(2.4, 4)

- ✓ R = average portfolio or securities return.
- ✓ Rb = average performance of the benchmark over time period considered.
- ✓ TEV = Tracking Error Volatility.

The numerator expresses the outperformance, and its function is to measure how much the results achieved by active management deviate from what could be achieved by passive management. In the denominator the TEV is the mean square deviation of the fund's extra returns from the benchmark over the period considered. It is calculated as the square root of the average of the differences between extra returns called a_i and their average value $\bar{a}$.

$$TEV = \sqrt[2]{\sum_{i=0}^{N} \frac{(ai - \bar{a})^2}{N}}$$

(2.4, 5)

- ✓ N is the time period considered.
- ✓ a_i is the outperform of i-th period.

[48] Bodie, Kane, Marcus. *Investments*. 12th Edition, McGrawHill, 2021.

- ✓ $\bar{a}$ is the average of extra returns over the time horizon considered.

Tracking Error Volatility identifies risk with the volatility of extra-returns, highlighting the manager's ability to realise outperformance while maintaining a high correlation with the performance of the benchmark. In conclusion, we can say that higher is the Information Ratio, the greater is manager's ability to achieve higher returns than its benchmark. At the same time the manager's ability is to limit relative volatility while achieving consistency better performances.

The table proposed show the Information Ratio of funds and ETFs investing in water and their declared benchmarks.

Figure 2.4, 13. Financial product investing in water with Benchmark declared and Information Ratio metrics.

Funds Investing in Water Stocks	Declared Fund Benchmark	Information Ratio	Inception Date
JSS Sustainable Equity Water	MSCI ACWI NR USD	0,38	23/12/2013
BNP Paribas Aqua K EUR	MSCI World (EUR) NR	0,94	03/07/2015
Arca Blue Leaders	MSCI AC World ESG Leaders NR	n.a.	20/06/2022
FAM Series Fid. Sust. Water and Waste L Cap EUR	MSCI ACWI Index	0,51	13/11/2020
RobecoSAM Sustainable Water Equities D Cap $	MSCI World NR EUR	0,35	29/10/2020
KBI Water H EUR	MSCI ACWI Index	0,77	09/03/2012
NAT Thematics Water R Cap $	MSCI ACWI NR	0,09	20/12/2018
Allianz Global Water AT3 Cap $	MSCI ACWI NR EUR	1,00	10/01/2020
EurizonAM Sicav Clean Water U Cap Eur	90% S&P Global Water 10% ICE BofAML Euro Treasury Bill Index	0,28	18/11/2019
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	MSCI World NR EUR	-0,06	18/09/2007
Allianz Global Water AT Cap $	MSCI ACWI NR EUR	0,17	18/12/2019

ETF investing in Water Stocks	Declared ETF Benchmark	Information Ratio	Inception Date
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	MSCI ACWI IMI WATER ESG FILTERED INDEX	0,53	09/10/2007
L&G Clean Water UCITIS ETF	Solactive Clean Water Index NTR	0,59	02/07/2019
iShares Global Water UCITIS ETF USD (Dist)	S&P Global Water 50 Index	0,53	16/03/2007

(Reference: Quantalys and Factsheets of each product).

This metric answer two important questions for an active manager. First, did the manager outperform the passive benchmark? Second, was the manager able to outperform the benchmark consistently? Generally, an Information Ratio of 0.50 is considered good while a ratio of 0.75 is very good and 1.00 or higher is exceptional.

In the case analysed in figure 2.4 number 13, FAM series Fidelity Sustainable Water and Waste fund has a good level about 0.51. Then we have a ratio of KBI Water fund that is 0.77, we can underline BNP Paribas Aqua K fund with a very good level about 0.94, so we have two good ratios than the previous mentioned. Finally, Allianz Global Water AT3 with an exceptional level of 1.00 is the best. However, we highlight Swisscanto Equity Fund Sustainable Global Water that have a negative value and it is the worst in terms of ability of asset manager. It means that -0.06 represents the value of the return lost by a non-optimal management by the asset manager. About Arca Blue Leaders fund we do not have the data available due its recent launch. Those who remain that are not mentioned have positive ratios but lower than 0.50.

In the case of ETFs we can say that all the product proposed have a good Information Ratio about 0.53 for Lyxor MSCI Water ESG Filtered and iShares Global Water and 0.59 for L&G Clean Water.

The currency of each benchmark can be Euro or American Dollar. In particular, RobecoSam Sustainable Water fund, Nat thematic, Allianz AT3 and AT have USD as currency. Lyxor ETF is in Euro while L&G Clean Water and iShares Global Water are in USD.

The cross-section of financial instrument proposed in figure 2.4 number 13 emerge specific benchmarks declared in their Factsheets and KIIDs. About funds we are talking about MSCI ACWI NR (USD or EUR), MSCI World (EUR) NR, MSCI AC world ESG Leaders NR, S&P Global Water Index, ICE BofAML EURO Treasury Bill Index. For simplicity, since we are talking about global and American indexes, it is proposed the chart and data in USD[49].

In recent decades, investment in global markets has become an increasingly popular practice for investors looking for opportunities for growth and portfolio diversification. In this context, MSCI Indices have established themselves as key tool for monitoring and measuring the performance of a wide range of financial markets throughout the world. MSCI is an acronym for Morgan Stanley Capital International. It is an investment research firm that provides stock indexes, portfolio risk and performance analytics and governance tools for investors. They are primarily designed to provide information on the trend of the financial markets. The index represents the market as a whole[50]. The MSCI

[49] Real time index data search - MSCI.

[50] Indici MSCI: storia, performance e come investire in essi | Rankia: Comunità finanziaria and MSCI: What Does It Stand For and Its Importance (investopedia.com).

indices were the first global indices to be created for markets other than the United States. Originally, the indices were created by Capital International (starting in 1968). In 1986, Morgan Stanley acquired the rights to Capital International and changed the name into Morgan Stanley Capital International (MSCI). Morgan Stanley began the largest shareholder of MSCI. In 2004, MSCI acquired Barra, a risk management and portfolio analytics firm. The merger of both entities resulted in a new firm, MSCI Barra, which was spun off in an Initial Public Offering (IPO) in 2007 and began trading on the New York Stock Exchange (NYSE) under the stock ticker MSCI. Finally, in 2009 MSCI became an independent company based in New York and actually It is responsible for the creation of these indices and other investment instruments. MSCI Indices are public so it means that everyone, every kind of investor can use it. They cover approximately 85% of the global investment opportunity set and they are calculated as weighted averages of the prices of the securities included in them. Shares considered are weighted with different weights: the weighting according to market capitalisation (price multiplied by the number of shares outstanding) means that shares with a higher market capitalisation have a greater impact on the index. This reflects the fact that large-cap companies have a bigger impact on an economy than mid- or small-cap companies. A percent change in the price of the large-cap stocks in an MSCI index will lead to a bigger movement in the index than a change in the price of a small-cap company. Each index in the MSCI family is reviewed quarterly and rebalanced twice a year. Stocks are added or removed from an index by analysts within MSCI to ensure that the index still acts as an effective equity benchmark for the market that it represents[51].

The main indices of MSCI are:

- MSCI ACWI NR: ACWI means All Country World Index and this index captures large and mid-cap representation across 23 Developed Markets (DM) and 24 Emerging Markets (EM) countries. It also includes the equity markets of emerging countries such as China, Brazil, India, South Korea, South Africa and many others. With 2,934 constituents, the index covers approximately 85% of the global investable equity opportunity set. NR caption refers to Net Return and it means that the index reflects movements in share price over a period and dividends

[51] MSCI: What Does It Stand For and Its Importance (investopedia.com) and Powering better investment decisions - MSCI.

reinvested on a net basis (without any associated tax credit) in shares on the payment date. The currency is US Dollar but we may have also Euro.

We summarize in a table the countries that compose the index with their weight:

Table 2.4, 1. Countries and weights in the portfolio.

Countries	**Weights**
USA	61.95%
Japan	5.46%
United Kingdom	3.60%
China	3.30%
France	3.00%
Others	22.69%

(Reference: MSCI ACWI Index Factsheet).

We have several sectors that compose the index:

Table 2.4, 2. Sectors and weights in the portfolio.

Sectors	**Weights**
Information Technology	21.90%
Financials	15.61%
Health Care	11.58%
Consumer Discretionary	11.39%
Industrials	10.47%
Communication Services	7.48%
Consumer Staples	7.16%
Energy	4.73%
Materials	4.63%
Utilities	2.72%
Real Estate	2.34%

(Reference: MSCI ACWI Index Factsheet).

The next chart (from the MSCI Factsheet) shows the performance and the comparison between the major MSCI indices. We notice that there is the MSCI Emerging Market that is another sub-index, but we do not discuss. The chart summarizes performances (Net Return) in terms of 1 months, 3 months, 1 year, YTD, 3 years, 5 years, 10 years and since inception annualized. We use the same metrics for all indexes.

In terms of annual performance, we underline the negative performance in 2022 of all sub-indexes of MSCI due to Post Pandemic scenario, the conflict between Russia and Ukraine and the rise of Inflation. We also propose the pie chart with the weights assigned to sectors and countries.

Figure 2.4, 14. Graph and table of performance.

CUMULATIVE INDEX PERFORMANCE – NET RETURNS (USD) (JUL 2008 – JUL 2023)

ANNUAL PERFORMANCE (%)

Year	MSCI ACWI	MSCI World	MSCI Emerging Markets
2022	-18.36	-18.14	-20.09
2021	18.54	21.82	-2.54
2020	16.25	15.90	18.31
2019	26.60	27.67	18.42
2018	-9.41	-8.71	-14.57
2017	23.97	22.40	37.28
2016	7.86	7.51	11.19
2015	-2.36	-0.87	-14.92
2014	4.16	4.94	-2.19
2013	22.80	26.68	-2.60
2012	16.13	15.83	18.22
2011	-7.35	-5.54	-18.42
2010	12.67	11.76	18.88
2009	34.63	29.99	78.51

INDEX PERFORMANCE – NET RETURNS (%) (JUL 31, 2023)

					ANNUALIZED							
	1 Mo	3 Mo	1 Yr	YTD	3 Yr	5 Yr	10 Yr	Since Dec 29, 2000	Div Yld (%)	P/E	P/E Fwd	P/BV
MSCI ACWI	3.66	8.50	12.91	18.11	10.41	8.24	8.64	6.02	2.08	19.75	16.80	2.82
MSCI World	3.36	8.52	13.48	18.95	11.67	9.12	9.30	6.11	1.96	20.75	17.51	3.07
MSCI Emerging Markets	6.23	8.41	8.35	11.42	1.46	1.71	3.47	7.76	3.09	14.13	12.51	1.69

FUNDAMENTALS (JUL 31, 2023)

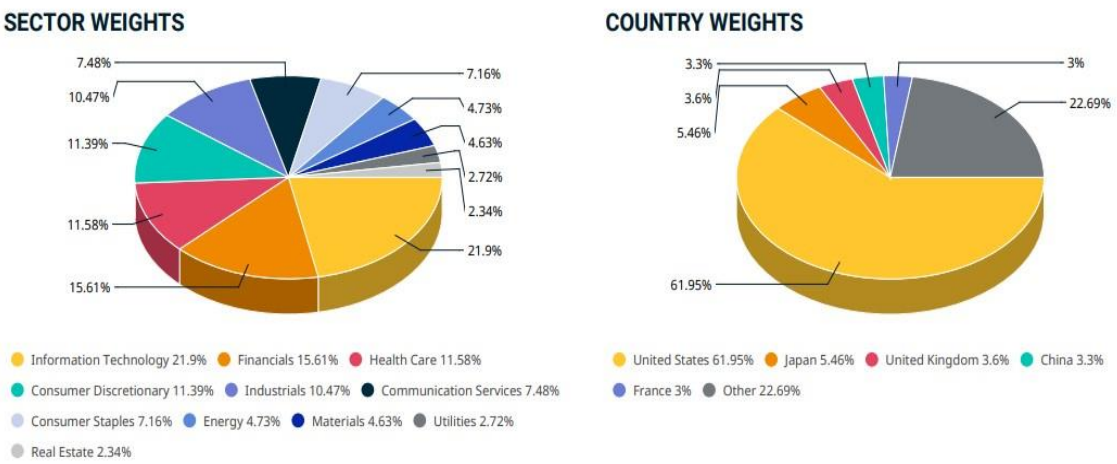
INDEX RISK AND RETURN CHARACTERISTICS (JUL 31, 2023)

		ANNUALIZED STD DEV (%) [2]			SHARPE RATIO [2,3]				MAXIMUM DRAWDOWN	
	Turnover (%) [1]	3 Yr	5 Yr	10 Yr	3 Yr	5 Yr	10 Yr	Since Dec 29, 2000	(%)	Period YYYY-MM-DD
MSCI ACWI	2.37	17.16	17.92	14.47	0.58	0.44	0.57	0.34	58.38	2007-10-31–2009-03-09
MSCI World	2.15	17.78	18.29	14.64	0.63	0.48	0.61	0.35	57.82	2007-10-31–2009-03-09
MSCI Emerging Markets	5.04	17.52	19.03	17.01	0.08	0.10	0.22	0.38	65.25	2007-10-29–2008-10-27

[1] Last 12 months [2] Based on monthly net returns data [3] Based on NY FED Overnight SOFR from Sep 1 2021 & on ICE LIBOR 1M prior that date

(Reference: MSCI ACWI Index Factsheet).

Figure 2.4, 15. Components and Weights (Pie Chart).



(Reference: MSCI ACWI Index Factsheet).

- The MSCI World Index NR captures large and mid-cap representation across 23 Developed Markets (DM) countries. With 1,512 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

  The countries with the highest weight, after the US, are Japan, the UK and France. However, the weight of each of them does not exceed 10%. Composed of 100% equities from 23 developed countries in 3 regions of the world (Americas, Europe and Middle East and Pacific). Each economic region is weighted differently in the index. In particular we summarize countries and sectors components in the following tables:

Table 2.4, 3. Countries and weights in the portfolio.

Countries	**Weights**
USA	69.42%
Japan	6.12%
United Kingdom	4.04%
France	3.36%
Canada	3.20%
Others	13.86%

(Reference: MSCI World Index Factsheet).

Table 2.4, 4. Sectors and weights in the portfolio

Sectors	**Weights**
Information Technology	22.09%
Financials	14.89%
Health Care	12.52%
Consumer Discretionary	11.05%
Industrials	10.96%
Consumer Staples	7.27%
Communication Services	7.19%
Energy	4.69%
Materials	4.19%
Utilities	2.74%
Real Estate	2.41%

(Reference: MSCI World Index Factsheet).

Figure 2.4, 16. Graph and table of performance.

CUMULATIVE INDEX PERFORMANCE — NET RETURNS (USD)
(JUL 2008 – JUL 2023)

ANNUAL PERFORMANCE (%)

Year	MSCI World	MSCI Emerging Markets	MSCI ACWI
2022	-18.14	-20.09	-18.36
2021	21.82	-2.54	18.54
2020	15.90	18.31	16.25
2019	27.67	18.42	26.60
2018	-8.71	-14.57	-9.41
2017	22.40	37.28	23.97
2016	7.51	11.19	7.86
2015	-0.87	-14.92	-2.36
2014	4.94	-2.19	4.16
2013	26.68	-2.60	22.80
2012	15.83	18.22	16.13
2011	-5.54	-18.42	-7.35
2010	11.76	18.88	12.67
2009	29.99	78.51	34.63

INDEX PERFORMANCE — NET RETURNS (%) (JUL 31, 2023)

					ANNUALIZED							
	1 Mo	3 Mo	1 Yr	YTD	3 Yr	5 Yr	10 Yr	Since Dec 29, 2000	Div Yld (%)	P/E	P/E Fwd	P/BV
MSCI World	3.36	8.52	13.48	18.95	11.67	9.12	9.30	6.11	1.96	20.75	17.51	3.07
MSCI Emerging Markets	6.23	8.41	8.35	11.42	1.46	1.71	3.47	7.76	3.09	14.13	12.51	1.69
MSCI ACWI	3.66	8.50	12.91	18.11	10.41	8.24	8.64	6.02	2.08	19.75	16.80	2.82

FUNDAMENTALS (JUL 31, 2023)

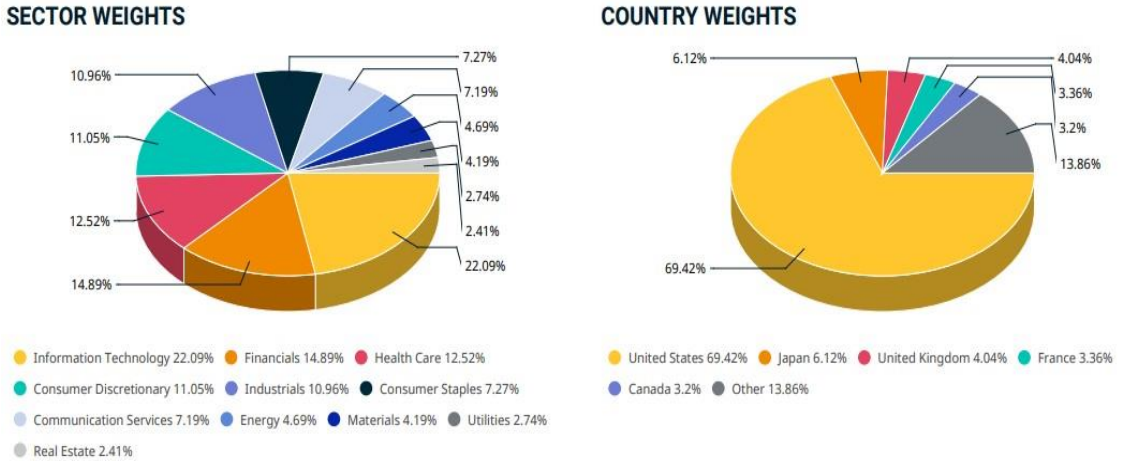
INDEX RISK AND RETURN CHARACTERISTICS (JUL 31, 2023)

		ANNUALIZED STD DEV (%) [2]			SHARPE RATIO [2,3]				MAXIMUM DRAWDOWN	
	Turnover (%) [1]	3 Yr	5 Yr	10 Yr	3 Yr	5 Yr	10 Yr	Since Dec 29, 2000	(%)	Period YYYY-MM-DD
MSCI World	2.15	17.78	18.29	14.64	0.63	0.48	0.61	0.35	57.82	2007-10-31—2009-03-09
MSCI Emerging Markets	5.04	17.52	19.03	17.01	0.08	0.10	0.22	0.38	65.25	2007-10-29—2008-10-27
MSCI ACWI	2.37	17.16	17.92	14.47	0.58	0.44	0.57	0.34	58.38	2007-10-31—2009-03-09

[1] Last 12 months [2] Based on monthly net returns data [3] Based on NY FED Overnight SOFR from Sep 1 2021 & on ICE LIBOR 1M prior that date

(Reference: MSCI World Index Factsheet).

Figure 2.4, 17. Components and Weights (Pie Chart).



(Reference: MSCI World Index Factsheet).

The main differences between these two indices are the different weights that assign to sector in which they invest, the first index invest in China while the second invest in Canada. We have a different geographic allocation, the MSCI World is concentrated in developed market while the MSCI ACWI extends its investment in emerging market, basically it offers a higher degree of diversification and a grater exposition to stock market worldwide.

- The MSCI World ESG Leaders Index is a free float-adjusted market capitalization weighted index designed to represent the performance of companies that are selected from the MSCI World Index based on ESG criteria. It is related to Arca Blue Leaders fund. This index consists of Large and Mid-cap companies in 23 Developed Markets Countries. The Index construction targets 50% free float-adjusted market capitalization coverage of each Global Industry Classification Standard (GICS) sector by selecting constituents primarily based on criteria including the ESG rating, the trend in that rating and the company's industry adjusted ESG score. Basically, this index derives from MSCI World Index discussed above. The chart proposed present the Net Return about the performance of the index. Gross Return refers to the total return on an investment before accounting for any expenses, fees, or taxes. It includes both the capital appreciation (or depreciation) of the investment and any income generated by the investment, such as dividends or interest. In other words, the gross return measures the overall performance of an investment without considering any tax

or expense deductions. On the contrary the net return takes into account all expenses, fees and taxes associated with the investment and represent the actual profit or loss that an investor realizes.[52] We have the same country and sector allocation compared to MSCI World Index, but the only difference is in terms of weights assigned:

Table 2.4, 5. Countries and weights in the portfolio.

Countries	**Weights**
USA	69.90%
Japan	6.58%
United Kingdom	3.89%
France	3.75%
Canada	3.34%
Others	12.84%

(Reference: MSCI World ESG Leaders Index).

Table 1.4, 6. Sectors and weights in the portfolio.

Sectors	**Weights**
Information Technology	22.45%
Financials	14.77%
Health Care	12.41%
Consumer Discretionary	11.62%
Industrials	11.39%
Communication services	8.42%
Consumer Staples	7.17%
Materials	4.35%
Energy	3.05%
Real Estate	2.47%
Utilities	1.89%

(Reference: MSCI World ESG Leaders Index).

[52] Gross Rate of Return: Definition, Formula, Vs. Net Return (investopedia.com).

Figure 2.4, 18. Graph and table of Performance.

CUMULATIVE INDEX PERFORMANCE – NET RETURNS (USD) (JUL 2008 – JUL 2023)

ANNUAL PERFORMANCE (%)

Year	MSCI World ESG Leaders	MSCI World
2022	-19.57	-18.14
2021	24.70	21.82
2020	15.30	15.90
2019	28.15	27.67
2018	-7.77	-8.71
2017	20.98	22.40
2016	7.25	7.51
2015	-1.11	-0.87
2014	4.88	4.94
2013	27.56	26.68
2012	14.48	15.83
2011	-5.42	-5.54
2010	10.67	11.76
2009	32.42	29.99

INDEX PERFORMANCE – NET RETURNS (%) (JUL 31, 2023)

					ANNUALIZED							
	1 Mo	3 Mo	1 Yr	YTD	3 Yr	5 Yr	10 Yr	Since Sep 28, 2007	Div Yld (%)	P/E	P/E Fwd	P/BV
MSCI World ESG Leaders	3.28	8.58	13.42	19.52	11.83	9.59	9.27	6.16	1.90	22.22	18.66	3.60
MSCI World	3.36	8.52	13.48	18.95	11.67	9.12	9.30	6.10	1.96	20.75	17.51	3.07

FUNDAMENTALS (JUL 31, 2023)

INDEX RISK AND RETURN CHARACTERISTICS (SEP 28, 2007 – JUL 31, 2023)

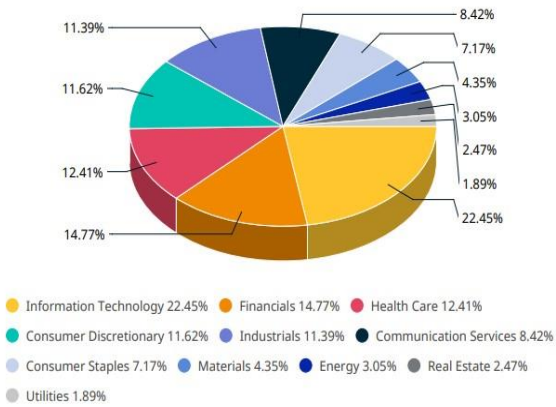
				ANNUALIZED STD DEV (%) [2]			SHARPE RATIO [2,3]				MAXIMUM DRAWDOWN	
	Beta	Tracking Error (%)	Turnover (%) [1]	3 Yr	5 Yr	10 Yr	3 Yr	5 Yr	10 Yr	Since Sep 28, 2007	(%)	Period YYYY-MM-DD
MSCI World ESG Leaders	0.99	1.29	12.91	18.00	18.08	14.47	0.63	0.51	0.61	0.38	58.14	2007-10-31–2009-03-09
MSCI World	1.00	0.00	2.15	17.78	18.29	14.64	0.63	0.48	0.61	0.38	57.82	2007-10-31–2009-03-09

[1] Last 12 months [2] Based on monthly net returns data [3] Based on NY FED Overnight SOFR from Sep 1 2021 & on ICE LIBOR 1M prior that date

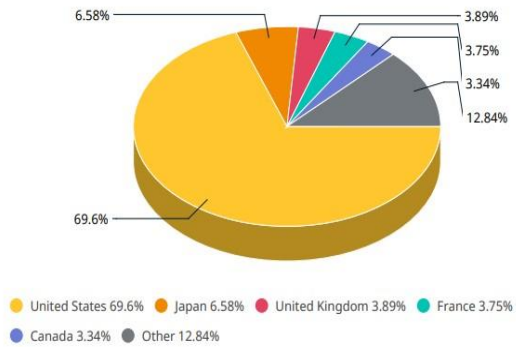
(Reference: MSCI World ESG Leaders Index Factsheet).

Figure 2.4, 19. Components and Weights (Pie Chart).

SECTOR WEIGHTS



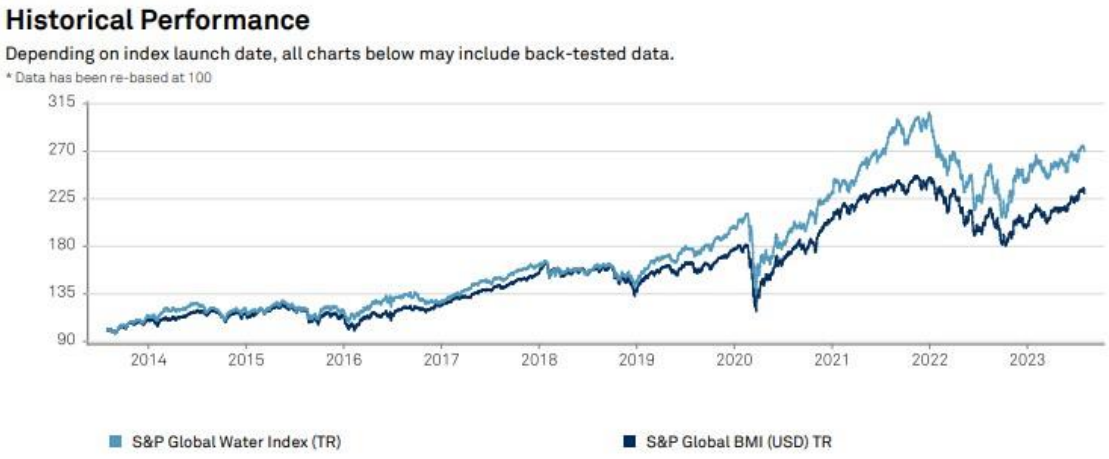
COUNTRY WEIGHTS



(Reference: MSCI World ESG Leaders Index Factsheet).

- S&P Global Water Index: This index is managed by the S&P Dow Jones Indices and is designed to represent the performance of several companies operating in the water sector. The index includes companies involved in activities such as drinking water supply, wastewater treatment, water engineering and water resource management. All stocks in the investment universe are divided into Water Equipment Instruments & Materials or Water Utilities & Infrastructure. The companies in the index must have a market cap of USD 300 million and a float-adjusted market cap of USD 100 million. It was launched on February 22, 2007. The number of constituents in the index is 43: twenty-three for USA, three for United Kingdom, four for Switzerland, three for Japan, one for France, Brazil, Canada, Italy, Netherlands, Austria, Australia, South Korea and two for China. It consists of 48.4% Industrials, 43% Utilities, 4.8% Materials, 2.6% Information Technology, 0.7% Energy and 0.5% Consumer Discretionary.

Figure 2.4, 20. Historical Performance of S&P Global Water and S&P global BMI.



(Reference: S&P Global Water Index Factsheet).

Figure 2.4. 21. Table of S&P Global Water performance.

Performance

INDEX LEVEL	RETURNS			ANNUALIZED RETURNS			
	1 MO	3 MOS	YTD	1 YR	3 YRS	5 YRS	10 YRS
Total Return							
10,271.69	3.01%	6.67%	13.74%	10.77%	12.36%	11.05%	10.62%
Price Return							
5,926.65	2.93%	5.68%	12.17%	8.43%	10.17%	8.72%	8.13%
Net Total Return							
9,296.97	3.01%	6.53%	13.44%	10.33%	11.94%	10.59%	10.13%
BENCHMARK* Total Return							
608.62	3.86%	8.69%	17.75%	12.94%	10.71%	8.15%	8.92%
BENCHMARK* Price Return							
344.27	3.72%	7.98%	16.08%	10.37%	8.44%	5.8%	6.45%
BENCHMARK* Net Total Return							
472.85	3.83%	8.54%	17.37%	12.37%	10.21%	7.63%	8.38%

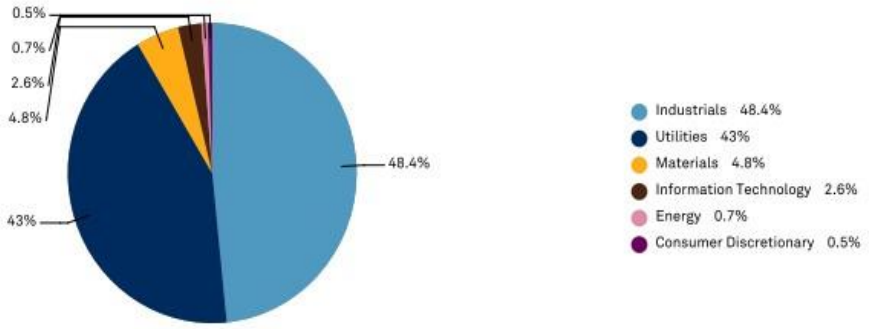
* The index benchmark is the S&P Global BMI (USD)

(Reference: S&P Global Water Index Factsheet).

The figures above show the performance of the S&P Global Water Index relative to the S&P Global Broad Market Index. The second is managed also by Dow Jones and it provide a broad representation of companies from various regions worldwide and its aims is to cover a significant portion of the global equity market.

Figure 2.4, 22 Sector Breakdown pie chart.

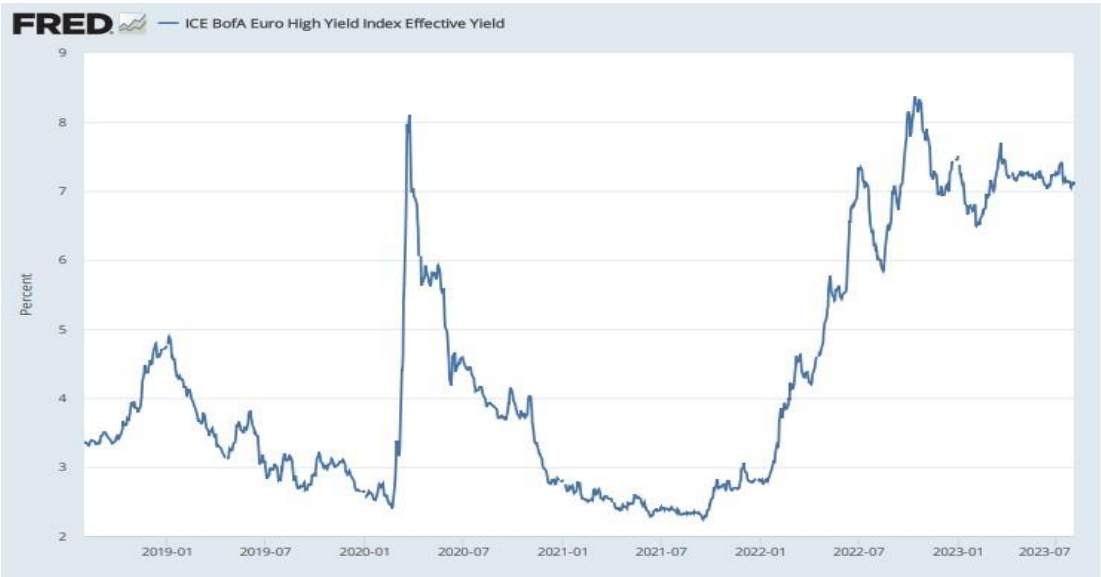
Sector* Breakdown



(Reference: S&P Global Water Index Factsheet).

- ICE BofAML EURO Treasury Bill Index represents the performance of Euro denominated below investment grade corporate debt publicly issued in the euro domestic or Eurobond markets. Qualifying securities must have a below investment grade rating (based on an average of Moody's, S&P, and Fitch). Qualifying securities must have at least one-year remaining term to maturity, a fixed coupon schedule, and a minimum amount outstanding of Euro 100 million. Original issue zero coupon bonds, "global" securities (debt issued simultaneously in the Eurobond and euro domestic markets), 144a securities[53] and pay-in-kind securities, including toggle notes, qualify for inclusion in the Index. Callable perpetual securities qualify provided they are at least one year from the first call date. Fixed-to-floating rate securities also qualify provided they are callable within the fixed rate period and are at least one year from the last call prior to the date the bond transitions from a fixed to a floating rate security. Defaulted, warrant-bearing and euro legacy currency securities are excluded from the Index.

Figure 2.4, 23. Effective Yield of the index.



(Reference: ICE BofA Euro High Yield Index Effective Yield (BAMLHE00EHYIEY) | FRED | St. Louis Fed stlouisfed.org).

[53] The Securities Act Rule 144 is law that provides an exemption and permits the public resale of restricted or control securities if a number of conditions are met, including how long the securities are held, the way in which they are sold, and the amount that can be sold at any one time. But even if you've met the conditions of the rule, you can't sell your restricted securities to the public until you've gotten a transfer agent to remove the legend.
Securities Act Rule 144 | Investor.gov.

The chart represents the effective yield of the index. Index constituents are capitalization-weighted based on their current amount outstanding. With the exception of U.S. mortgage pass-throughs and U.S. structured products (Asset Backed Securities, Commercial Mortgage Backed Securities and Collateralized Mortgage Obligations), accrued interest is calculated assuming next-day settlement. Accrued interest for U.S. mortgage pass-through and U.S. structured products is calculated assuming same-day settlement.

S&P Global Water Index and ICE BofAML EURO Treasury Bill Index are two benchmarks declared by Eurizon Clean Water U fund. They represent the 90% the first and 10% the second. From the fund Factsheet we notice that it is actively managed by investing at least 70% of its net assets in equity securities of companies operating in the water sector without any geographic or currency restrictions. In particular, the Sub-Fund favours companies that are active in the management of water resources and that offer products, technologies, solutions and services to improve the use, efficiency and quality of water. The Sub-Fund may directly invest up to 30% of its net assets in equity securities with no limits in terms of sector, currency and geographic area. The Sub-Fund may invest up to 15% of its net assets in bond market instruments (including, up to 10% of its net assets, debt securities rated "sub-investment grade" or unrated) and/or money market instruments and/or bank deposits.
About ETFs investing in water, we can highlight MSCI ACWI IMI Water ESG Filtered Index, and Solactive Clean Water Index. ishares Global Water Index replicates S&P Global Water Index; in particular, it selects a basket of 50 stocks companies that are the most liquid in the water sector. We discussed about it in paragraph 2.3 above.

- MSCI ACWI IMI Water ESG Filtered Index captures large, mid and small-cap securities across 23 Developed Markets (DM) and 10 Emerging Markets (EM) countries. The index aims to represent the performance of a set of companies associated with water related businesses such as water supply, water utilities, water treatment and water related equipment while excluding those involved in certain controversial businesses, misaligned on SDG Product Alignment or with relatively low ESG Controversies and Ratings scores. The index was launched in 2015 and it is managed by MSCI. It is compared with the MSCI ACWI IMI Index

that captures large, mid and small cap representation across 23 Developed Markets (DM) and 24 Emerging Markets (EM) countries. With 9,168 constituents, the index is comprehensive, covering approximately 99% of the global equity investment opportunity set. We propose the chart of performances. In 2022, the MSCI ACWI IMI Water ESG Filtered registered a negative performance and it is focused on Industrial sector about 75.06%, Utilities about 21.33%, Information Technology is 2.1% and Materials 1.52%. If we look at countries concentration the USA is about 71.76%, United Kingdom is 8.44%, Switzerland is 7.21%, Japan is 4.64%, Brazil 2.09% and Others 5.87%. Percentages reported are weights assigned to each sector and country.

Figure 2.4, 24. Graph, table of performance and pie chart of sector and country portfolio components.

CUMULATIVE INDEX PERFORMANCE — NET RETURNS (USD)
(NOV 2015 – JUL 2023)

ANNUAL PERFORMANCE (%)

Year	MSCI ACWI IMI Water ESG Filtered	MSCI ACWI IMI
2022	-21.65	-18.40
2021	31.77	18.22
2020	12.58	16.25
2019	35.05	26.35
2018	-12.16	-10.08
2017	24.58	23.95
2016	9.29	8.36

INDEX PERFORMANCE — NET RETURNS (%) (JUL 31, 2023)

	1 Mo	3 Mo	1 Yr	YTD	ANNUALIZED 3 Yr	5 Yr	10 Yr	Since Nov 24, 2015
MSCI ACWI IMI Water ESG Filtered	1.93	7.86	13.96	17.90	13.49	9.75	na	10.75
MSCI ACWI IMI	3.82	8.55	12.54	17.58	10.48	7.87	na	9.22

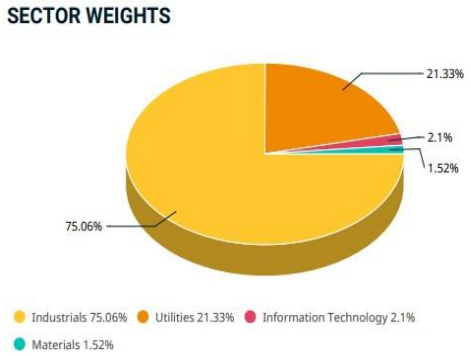
FUNDAMENTALS (JUL 31, 2023)

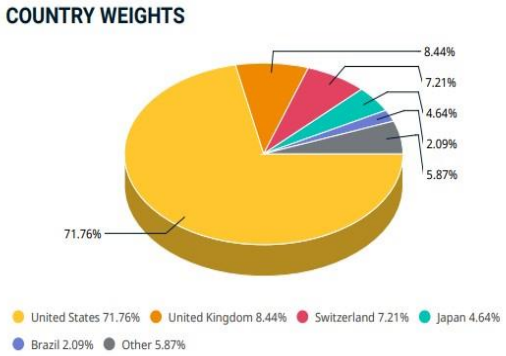
	Div Yld (%)	P/E	P/E Fwd	P/BV
MSCI ACWI IMI Water ESG Filtered	1.85	24.40	21.62	3.70
MSCI ACWI IMI	2.10	19.81	16.67	2.63

INDEX RISK AND RETURN CHARACTERISTICS (NOV 24, 2015 – JUL 31, 2023)

	Beta	Tracking Error (%)	Turnover (%) [1]	ANNUALIZED STD DEV (%) [2] 3 Yr	5 Yr	10 Yr	SHARPE RATIO [2,3] 3 Yr	5 Yr	10 Yr	Since Nov 24, 2015	MAXIMUM DRAWDOWN (%)	Period YYYY-MM-DD
MSCI ACWI IMI Water ESG Filtered	0.98	6.23	5.85	19.17	19.69	na	0.68	0.49	na	0.61	36.07	2020-02-19—2020-03-23
MSCI ACWI IMI	1.00	0.00	2.29	17.26	18.26	na	0.58	0.42	na	0.56	34.52	2020-02-12—2020-03-23

[1] Last 12 months [2] Based on monthly net returns data [3] Based on NY FED Overnight SOFR from Sep 1 2021 & on ICE LIBOR 1M prior that date





(Reference: MSCI ACWI IMI Water ESG Filtered Index Factsheet).

- The Solactive Clean Water is an international index that aims to track the performance of a basket of stocks of companies actively engaged in the international clean water industry through the provision of technology, digital, engineering, utility and/or other services. It is provided by Solactive which is a Germany based index provider operating globally. Since 2007, they have been developing tailor-made and multi-asset class index solutions for ETFs and other index-linked investment products. The index is a Net Total Return, dividends are reinvested, and it is calculated in US Dollars. There are 52 components. It was launched on March 15, 2013.

Figure 2.4, 25. Historical performance, statistics, and composition by countries

HISTORICAL PERFORMANCE

STATISTICS

USD	30D	90D	180D	360D	YTD	Since Inception
Performance	0.78%	3.94%	1.57%	11.68%	13.00%	215.34%
Performance (p.a.)						11.69%
Volatility (p.a.)	11.27%	12.53%	12.87%	18.02%	13.45%	16.43%
High	323.75	323.75	323.75	323.75	323.75	344.45
Low	305.30	295.08	284.06	241.58	279.07	93.49
Sharpe Ratio*	0.41	0.93	-0.16	0.36	1.31	0.39
Max. Drawdown	-2.60%	-3.44%	-8.51%	-17.11%	-9.09%	-36.00%
VaR 95 \ 99				-26.9% \ -41.5%		-23.1% \ -44.7%
CVaR 95 \ 99				-35.3% \ -44.0%		-38.5% \ -69.7%

COMPOSITION BY COUNTRIES

(Reference: Solactive Clean Water Index Factsheet as of July 2023).

We can summarize the main financial metrics and the characteristics of benchmarks in the following table:

Figure 2.4, 26. Characteristics of benchmark indexes

Products	Benchmark	Number of constituents	Dividend Yield	2022 Performance	YTD	Since Inception Annualized	Inception date
Investment Funds	MSCI ACWI NR (USD)	2934	2,08%	-18,36%	18,11%	6,02%	29/12/2000
	MSCI ACWI NR (EUR)	2934	2,08%	-13,01%	14,32%	5,27%	29/12/2000
	MSCI World Index NR (USD)	1512	1,96%	-18,14%	18,95%	6,11%	29/12/2000
	MSCI World Index NR (EUR)	1512	1,96%	-12,78%	15,15%	5,36%	29/12/2000
	MSCI WORLD ESG Leaders Index (USD)	724	1,90%	-19,57%	19,52%	6,16%	28/09/2007
	MSCI WORLD ESG Leaders Index (EUR)	724	1,90%	-14,30%	18,69%	7,88%	28/09/2007
ETFs	S&P Global Water Index (USD only)	43	2,12%	-21,48%	13,74%	n.a	22/02/2007
	MSCI ACWI IMI Water ESG Filtered Index (USD only)	37	1,85%	-21,65%	17,90%	10,75%	24/11/2015
	Solactive Clean Water Index (USD only)	52	n.a.	n.a.	13,00%	11,69%	05/03/2013
Average Performance drop in 2022		-17,41%					

(Reference: Data from Factsheets of each index).

In term of performance, looking at YTD the benchmark with ESG integration gained more. We talk about MSCI World ESG Leaders in both currencies, Euro and US Dollar, and the MSCI ACWI IMI Water ESG Filtered that performed respectively 19.52% (USD currency), 18.69% (Euro currency) and 17.90% (USD currency).

In 2022 every index lost about -17.41% on average[54]. Looking at Dividend Yield the indexes that offer higher value are S&P Global Water Index with 2.12%, MSCI ACWI NR with 2.08%, MSCI World Index NR offers a DY about 1.90%. The lowest DY belongs to the index who dropped more in terms of performance in 2022, the MSCI ACWI IMI Water ESG Filtered. Probably the lowest DY is related to the fact that this index is the smallest in terms of number of constituents, 37. The biggest indexes in terms of composition are the MSCI ACWI and the MSCI World. Looking at since inception performance annualized, we can say that the best index is the Solactive Clean Water with a value of 11.69% and it means that it gained more than other instruments since the inception date. The second is MSCI ACWI IMI ESG Filtered with a value of 10.75% and the worst is MSCI ACWI NR, in Euro currency, with an annualized performance about 5.27%. This data is not available for the S&P Global Water Index.

After explaining how to compare and evaluate the performance of a benchmark with the Information Ratio, in the next paragraph we will talk about how the sample proposed is classified under the SFDR Regulation, what is its impact and the breakdown of the portfolios.

[54] We calculated the average of all performance drop in 2022 through Excel program.

2.5 The impact of SFDR Classification in investment Funds and ETFs.

After explaining the analysis of the instruments analysed, the financial metrics used, the type of clientele they are aimed at, which indices this precious commodity is listed in, the benchmarks of the financial instruments proposed, we will look in detail at the SFDR classification and the ESG impact of the products examined.

A Morningstar report dated May 4, 2023, (SFDR Article 8 and Article 9 Funds: Q1 2023 in Review)[55] points out that, just over two years after the SFDR Regulation came into force, the universe of funds classified as slightly green (Article 8) or deeply green (Article 9) continues to evolve due to lingering concerns about greenwashing and regulatory uncertainty. The first quarter of 2023 was marked by the implementation of the SFDR's Level 2 regulatory technical standards, which require asset managers to disclose more information about their funds' environmental, social and governance approaches, sustainability risks and impacts in pre-contract documents and periodic reports. Prior to this updated disclosure regime and as a result of the new regulatory guidelines, asset managers reassessed the classification of their funds and declassified more than 300 products from Article 9 to Article 8.

Morningstar's report provides an update on the Article 8 and Article 9 fund landscape at the end of March 2023, examining aspects such as flows, assets, product launches, fund reclassifications, sustainable investment objectives and other data from the European ESG Model, or EET[56] .

The key words highlighted by the report tell us that Article 8 funds raised more than EUR 25 billion in new flows in the first quarter of 2023: double the previous quarter's flows, despite persistent macroeconomic pressures. Article 9 funds recorded the lowest inflows ever, at EUR 4 billion, mainly due to the latest wave of declassifications. Assets in Article 8 and Article 9 funds increased by more than 3% in the first quarter to EUR 4.9 trillion, bringing their combined market share to a record 57%. As a result, new product development slowed down, partly due to the challenging macroeconomic environment, but also due to regulatory uncertainty and fears of greenwashing allegations.

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[55] SFDR_Article_8_and_Article_9_Funds_Q1_2023_FINAL_(002).pdf (contentstack.io).

[56] The European ESG Template is a format that contains a large amount of data, there are more than 600 fields that will have to be filled in, at the moment products that refer to Article Six of the SFDR and all other 'non-sustainable' products will not have to fill in all fields, while Article Eight and Article Nine products will have to be very, very precise, so that there is no greenwashing in any way. It was developed by FinDatEx, the working group consisting of representatives of the European six financial services industry, i.e. banks, insurance companies, SGRs and placement agents.

In the report, it is noted that, since January, almost 300 products have changed their SFDR classification, including more than 260 funds that moved from Article 6 to Article 8 and only a dozen that moved from Article 9 to Article 8.

In addition, it is argued that the wave of declassification of Article 9 funds, which began in the third quarter of 2022, may come to an end if not reversed following a clarification by the European Commission that there will be no minimum requirements for sustainable investments.

At present, almost all Article 9 funds aim for at least 70 per cent sustainable investments, with the rest of the assets representing cash and hedging instruments.

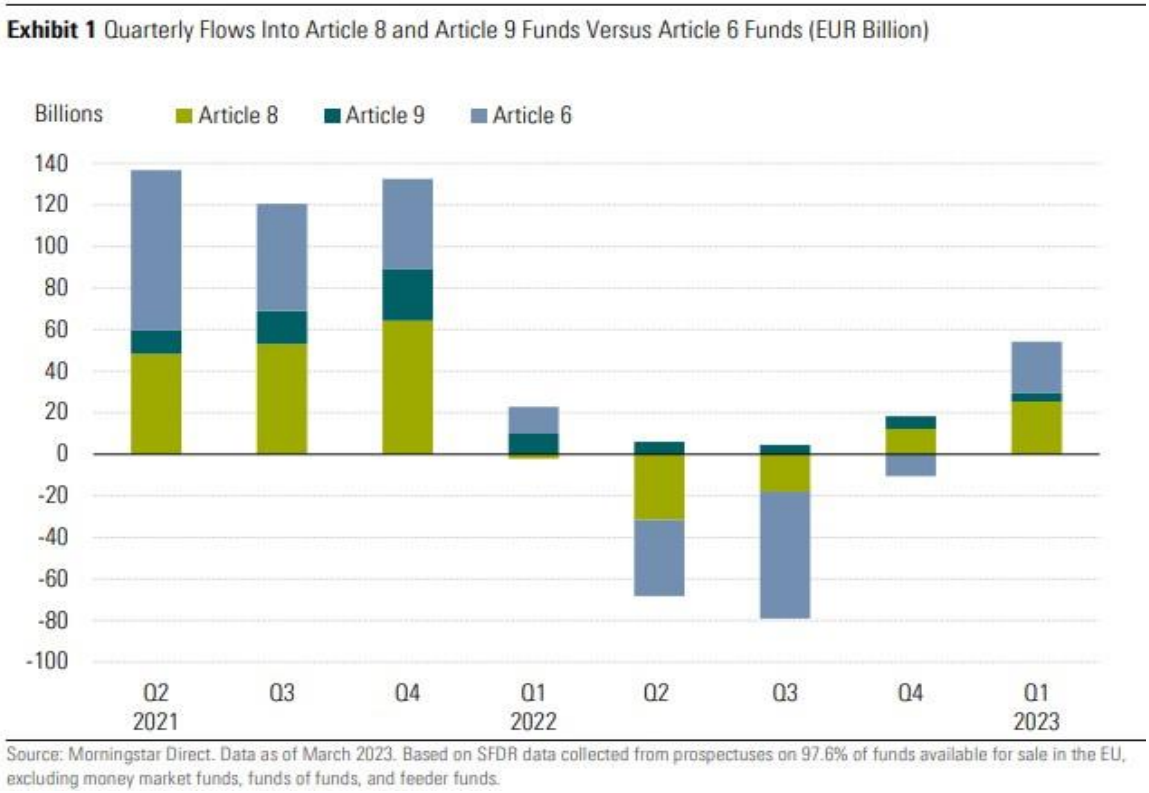
The upswing for Article 8 funds extended into the first quarter of 2023, during which they collected EUR 25.4 billion in net new flows, despite persistent macroeconomic pressures, including rising interest rates, persistent inflation and the imminence of a recession. This is more than double the EUR 12.2 billion net flows of the previous quarter.

Meanwhile, Article 9 funds attracted only EUR 4 billion of new capital in the first quarter: a third less than the revised EUR 6.2 billion in the last quarter of 2022 and the lowest flows recorded for Article 9 funds since the introduction of the SFDR in March 2021. This significant decrease in flows is largely attributed to the large number of funds that switched from the Article 9 classification to the Article 8 classification following ESMA's (European Securities and Markets Authority) clarification following the European Commission's June 2021 debate. The clarification specified that funds making Article 9 disclosures must only hold sustainable investments, with the exception of cash and assets used for hedging purposes.

The year started with a net inflow of EUR 24.8 billion for Article 6 products, ending three consecutive quarters of outflows.

The figure proposes the quarterly flows into Article 8 and Article 9 funds versus Article 6 funds. Based on SFDR data collected from prospectuses this study tells that on 97.6% of funds available for sale in European Union, excluding money market funds, funds of funds and feeder funds.

Figure 2.5, 27 Chart of quarterly flows into SFDR Articles.



(Reference: SFDR_Article_8_and_Article_9_Funds_Q1_2023_FINAL_(002).pdf contentstack.io).

During the quarter 2023, Article 8 funds grew organically by 0.6 per cent, Article 9 by 1.4 per cent and Article 6 by 0.7 per cent.

In the last months of 2022, many companies revised the classification of their sustainable funds in view of the regulatory crunch. According to data released by Morningstar for the last quarter of 2022, some 420 products have changed their SFDR classification since September, including 307 products that have moved from Article 9 to Article 8. The reflection of this reclassification in terms of assets amounted to EUR 175 billion: 40% of the assets of Article 9 funds. Moreover, as a result of these downgrades, the share of Article 9 funds in the total EU fund market fell to 3.3% at the end of December from 5.2% three months earlier, while the share of Article 8 funds rose to 52.2% from 48.3%.

It is useful to point out that the entry into force of the Level 2 regulation for some fund managers has not raised any concerns as management companies have internal qualitative and quantitative processes that analyse the investment process, the management philosophy and the ESG approach adopted, seeking to verify the consistency between the manager's stated approach and the securities held in the portfolio. Each fund selector adopts a wide discretion in assessing the characteristics of the products under

management. According to another perspective, however, with the introduction of the SFDR regulation, many managers thought they could categorise many funds as Article 8 or Article 9, because the definition given by the regulator seemed rather broad, but the technical standards, introduced later on, turned out to be more stringent. Therefore, during 2022, many management companies took a more cautious approach and downgraded or revised the category of some funds to avoid the risk of being accused of greenwashing.

As regulations are still evolving, opinions among fund managers in classifying products are fragmented. At present, these articles only give us a general overview of the assessment of the relevance and value that management companies place on sustainability issues in their investments.

In the sample proposed we can summarize the ESG and SFDR Classification in the following picture.

Figure 2.5, 28. SFDR Classification of sample considered.

Funds Name	ESG	SFDR
JSS Sustainable Equity Water	Yes	article 9
BNP Paribas Aqua K EUR	Yes	article 9
Arca Blue Leaders	Yes	article 8
FAM Series Fid. Sust. Water and Waste L Cap EUR	Yes	article 8
RobecoSAM Sustainable Water Equities D Cap $	Yes	article 9
KBI Water H EUR	Yes	article 8
NAT Thematics Water R Cap $	Yes	article 9
Allianz Global Water AT3 Cap $	Yes	article 8
EurizonAM Sicav Clean Water U Cap Eur	Yes	article 8
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	Yes	article 9
Pictet-Timber-R EUR	Yes	article 9
Allianz Global Water AT Cap $	Yes	article 8
Janus Hend. Hor. Responsible Resouces A2 Cap $	Yes	article 8
SISF Commodity B Cap $	No	article 6
Franklin Natural Resources A EUR	No	article 6
Aberd.Stadn.I World Resources Eq. A Cap EUR	No	article 6

ETF Name	ESG	SFDR
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	Yes	article 8
L&G Clean Water UCITIS ETF	Yes	article 9
iShares Global Water UCITIS ETF USD (Dist)	Yes	article 8
Invesco Materials S&P US Sel. Sector UCITIS ETF Acc	No	article 6

(Reference: Factsheet, KIID and Prospectus of each financial instrument).

The figure 2.5 number 28, show the different classifications of the analysed products, according to the articles of the SFDR (Sustainable Finance Disclosure Regulation). In addition to meeting clients' expectations, management companies are now obliged to comply with the European Union's guidelines on sustainable investments. This regulation aims to fight phenomena such as *greenwashing*[57] by introducing mandatory disclosure of the ESG characteristics of investment products and how they impact management processes.

According to the proposed analysis, the different products, Funds and ETFs, are classified on the basis of Articles 6, 8 or 9 of the SFDR.

The regulation came into force in March 2021 and provides for: a first-level disclosure on processes; and a second-level disclosure on products that can be classified according to the articles mentioned above. Investment products are divided into three groups whose name recalls the number of SFDR articles discussing each type of financial instruments:

1) Article 9 relates to that funds have a sustainable investment objective with a strong ESG focus;
2) Article 8, on the other hand, discusses fund portfolios that should promote environmental or social characteristics, or a combination of such characteristics, provided that the companies in which the investments are made comply with good governance practices;
3) Article 6 encompasses funds that do not fall under the characteristics defined in Articles 8 or 9 and are therefore without an ESG focus.

From the analysis carried out, it emerges that only three funds and one ETF reflect the requirements of Article 6 and these are generic instruments related to the energy and commodities sector. Being thematic products, the other instruments, select the companies to invest in, based on their compliance with ESG criteria. In the figure 2.5 number 28, in our cross-section of sixteen funds, sixth products are classified as Article 9, seven as

[57] Greenwashing is a neologism indicating the communication strategy of certain companies, organisations or political institutions aimed at building a deceptively positive self-image in terms of environmental impact, in order to divert public attention from the negative environmental effects caused by their activities or products. This is a communication strategy adopted by companies, organisations or political institutions that communicate a commitment and attachment to environmental policies that does not actually exist. They do this because in this way their image improves, becomes positive in terms of environmental impact and attracts the eco-sensitive consumer who thus identifies with the philosophy, in reality fake and non-existent, of these realities.
Sara Fornasiero, Silvio de Girolamo, Laura Oliva, *Sostenibilità per scettici, come integrare pratiche efficaci nella vita aziendale.* Mondadori, 2022.

Article 8 and three funds are Article 6. About the sample of four ETFs, we can say that one product is Article 9 while two ETFs are article 8 and one is Article 6. We can notice that the management companies give a high importance to the integration of ESG Criteria in their investment decision and this is declared in the prospectus and Factsheets of each funds. In addition, we can say that there is an increasing focus on sustainability among retail customers. This recent increasing, thanks to a new model of doing business where the pursuit of profit is combined with an equally important focus on environmental and social sustainability, can open new scenarios and lead to a broadening of a market[58].

There are many asset managers who claim to follow strategies aimed at selecting companies that are future-oriented, innovative, active in sustainable water practices, and attentive to social and environmental sustainability issues. From what is stated in the factsheets of each product that invest in water stocks, a high ecological vocation emerges.

Figure 2.5, 29. Portfolio Breakdown

Funds Investing in Water Stocks	American Waters Works	Veolia Environment	Severn Trent	Pentair PLC	Stantec INC
JSS Sustainable Equity Water	2,80%	3,10%	\	\	\
BNP Paribas Aqua K EUR	4,58%	4,40%	2,81%	3,37%	
Arca Blue Leaders	\	\	\	1,43%	1,42%
FAM Series Fid. Sust. Water and Waste L Cap EUR	4,81%	\	4,84%	\	\
RobecoSAM Sustainable Water Equities D Cap $	\	3,81%	\	4,30%	\
KBI Water H EUR	3,39%	6,35%	3,31%	2,98%	\
NAT Thematics Water R Cap $	2,76%	4,03%	\	\	2,66%
Allianz Global Water AT3 Cap $	5,85%	4,72%	3,47%	3,54%	\
EurizonAM Sicav Clean Water U Cap Eur	7,00%	4,38%	5,27%	3,64%	3,68%
Swisscanto (LU) Eq. Fybd Gl. Water Inv. BT EUR	3,39%	\	\	\	4,42%
Allianz Global Water AT Cap $	5,85%	4,72%	3,47%	3,54%	\

ETF investing in Water Stocks	American Waters Works	Veolia Environment	Severn Trent	Pentair PLC	Stantec INC
Lyxor MSCI Water ESG Filtered (DR) Ucitis ETF D GBX	6,47%	\	4,22%	\	\
L&G Clean Water UCITIS ETF	2,35%	\	2,43%	\	\
iShares Global Water UCITIS ETF USD (Dist)	7,25%	4,26%	6,58%	\	\

(Reference: Factsheet of each Product and Borsa, Quotazioni Azioni, Fondi, ETF, Fondi Pensione | Morningstar).

In the table 2.5 number 29, the breakdown of the portfolios of the funds analysed show a certain concentration on developed countries and large caps. More precisely, eleven funds

[58] ESG, non solo investitori istituzionali: risparmiatori italiani e cambiamento climatico (itinerariprevidenziali.it).

and three ETFs invest in companies related to water sector. We can mention company like American Waters Works, Veolia Environment, Severn Trent, Pentair Plc and Stantec Inc that are the most valued by managers. In the portfolio top ten positions, we find these companies. This is the same about ETFs, in fact, we can say that management companies invest in the same Water Stocks but with different percentages in portfolios. American Water Works is a New Jersey-based company that provides water and wastewater services in the United States. In addition to serving residential and commercial customers, the company has long-term contracts with the US government to operate at many military installations. In 2021, it generated $4 billion in revenue. Veolia Environment is a multinational company headquartered in Aubervillies, in France, active in the utilities sector through three main areas: water, waste and energy services. The company resonates internationally, although Europe is the region where its business is most concentrated. In 2021, the company realised EUR 28 billion in revenues and EUR 4 billion in profits. Severn Trent Plc is a publicly traded water utility company based in the United Kingdom. It operates as a part of the water industry, providing essential water and wastewater services to millions of people in the UK. The company's roots trace back to the formation of the Trent Water Authority in 1974, and it was later privatized and renamed Severn Trent Water in 1989. In 1998, it became Severn Trent Plc, a holding company overseeing several subsidiaries within the water and waste services sector. Its key business areas are water supply, wastewater management and water infrastructure management. We highlight the Minneapolis-based American company Pentair Plc, which carries out a range of activities from wastewater treatment to the production of valves, pipes and filtration systems. The company is present in more than 150 countries and employs 11,000 people. In 2021, Pentair generated approximately $3.8 billion in revenue. Finally, we can mention Stantec Inc. which is a global engineering and consulting firm that provides several ranges of professional services to clients across various industries. Founded in 1954 and headquartered in Edmonton, Alberta region, Canada, Stantec has global presence with operations across North America, Europe, Asia, and other regions. In the water sector the company produces water pump stations, water treatment plant, pipe water systems and wastewater treatment plant.

All the companies mentioned have a focus on ESG integration in their business. They have a global presence in the developed countries, including for example USA, United Kingdom, Canada, France, and Germany.

In conclusion we can say that from the sample observed emerge that the majority of funds and ETFs are classified as Article 8. We are not able to say if they downgraded from Article 9 to 8, but the tendency is to have prudent approach from funds selector, providing a specific SFDR classification. This is only the beginning because investor's awareness of sustainable finance is growing continuously and this trend as indicated in a Morningstar Report dated May 4, 2023, is generally consistent with the analysis carried out on the products considered. Government's directives to support the Green Economy, both through public investments and tax incentives, are essentials.

Chapter 3

An overview of water financial market and market analysis through Python.

3.1 Why Machine Learning is useful.

In this chapter, we will discuss about the usefulness of Machine Learning and its possible applications starting with Fintech. We will try to provide answers to questions that arise spontaneously: why Machine Learning is useful in the analysis and management of the water sector? Are there already previous works in the literature? If so, what are the differences between these works?

Next, it will be obvious to discuss about Python, how to use the software and its applications to this science for data analysis.

The specific analysis performed to test water as a defensive asset class will be subsequently presented, with the construction of two models, one is a Linear Regression model and the other one is a non-linear model called Decision Tree Regressor.

Fintech refers to finance technology or technology, in general, applied to finance. It is an expression that might generically designate all the digital components existing in the financial system, including the banking and insurance segments, which concur in the production of a financial service or relationship, and that is characterised by different power of its technological dimension.[59] More precisely it refers to all tools that help an operator to realize a service, the modality of its access, the forms of establishing the financial relationship and its subject or documentation.

We can mention home banking services as an alternative form of banking service delivery compared to the physical bank teller, or the electronic documentation of financial instruments led into a centralised management systems in dematerialised form. Other tech component can be, for example, the incorporation into paper securities and their centralised safekeeping for electronic trading of insurance services by companies and forms of transmission of digital statements.

[59] Marco Cian Claudia sandei, *Diritto del Fintech*, Cedam, pp. 137-147, pp. 149-159, 2020.

The impact that new technologies have on the financial system goes beyond the simple enhancement of traditional canonical forms. Virtual connectivity, Artificial Intelligence (AI), applications and algorithms that are constantly being developed and processed, make it possible to generate services and products that are intrinsically innovative. This can open up entirely new channels through which financial resources and financial relationships can circulate facilitating also the entry of several players other than investors into the market. This increases the opportunities for raising the resources of deficit units and optimising the allocation of these resources.

Fintech includes, in a narrower sense, an articulated ecosystem in which new forms of wealth such as cryptocurrencies[60] or new manifestations of traditional wealth like e-money enter. New services are proposed or innovative processes such as automated consulting with Robo-Advisors[61] are activated, algorithmic trading[62],electronic payments that introduce formulas like, smart contracts and blockchain[63], that allow the circulation of wealth and services.

In describing the new technological-financial landscape, we might also mention the construction of new financing models such as crowdfunding, which consists of fundraising by Internet through small sums from a very large group of people sharing a common interest or a common project; Peer-to-Peer lending (P2P Lending) which is a loan between private individuals more specifically a personal loan provided by a private citizen to other private citizen through business sites or social lending institutions, without using the traditional channels represented by authorised financial intermediaries.

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[60] According to the definition of the Bank of Italy, it is a type of unregulated digital currency, issued and controlled based on computer algorithms, which can be accepted on a voluntary basis by the parties to a transaction as a means of payment. This currency presents many risks regarding consumer protection.
Cripto-attività | L'economia per tutti (bancaditalia.it).

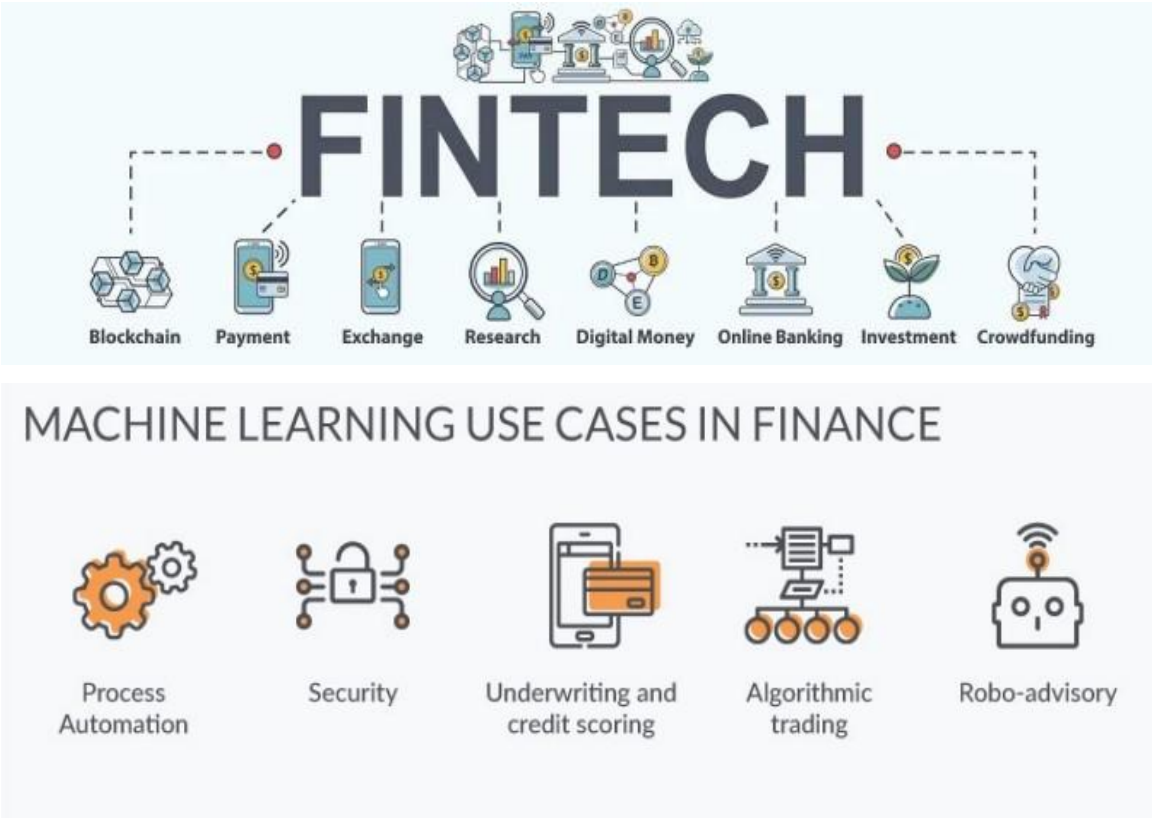
[61]The Robo-Advisor is an online platform that, based upon risk management and asset allocation algorithms, offers savers pre-constituted investment solutions, recommending the construction of customised portfolios according to savers' needs, for a defined, low-cost fee.
https://www.pwc.com/it/it/industries/asset-management/assets/docs/robo-advisory.pdf.

[62]Algorithmic trading uses computer codes (including Phyton) and chart analysis to open and close positions, based on predefined parameters such as the price movements of the underlying asset. When specific conditions in a market meet pre-defined criteria, trading algorithms execute a buy or sell order on behalf of the trader, avoiding the need to manually monitor markets and allowing to save time.
Marcos Lopez de Prado, *Advances in Financial Machine Learning* Wiley, New Jersey, 2018.

[63] Blockchain means that time-ordered events are recorded and transactions are grouped into blocks. This system supports the creation between two or more parties of a smart contract that is executed according to blockchain logic.
Marco Cian, Claudia Sandei, *Diritto del Fintech*, Cedam, pp. 137-147, pp. 149-159, 2020.

From the point of view of the actors involved in this ecosystem, new players are emerging who run exchange platforms, manage e-wallets, enriching the wide range of services provided by traditional intermediaries.

Figure 3.1, 30. Fintech and the use of Machine Learning in Finance.



(References: Fintech: quali scenari per il web marketing | Web Agency Roma (aircommunication.it) , Machine learning in finance: Why, what & how | by Konstantin Didur | Towards Data Science).

Machine Learning is making continuous progress towards an ever closer relationship between data, the physical world and predictive capabilities.

There is a close relationship between data, analysis capabilities, Machine Learning and Artificial Intelligence. Technology is a tool that can be applied in different areas for different targets. One of the most compelling is the protection of the environment and the achievement of the 2030 Agenda.

Teaching machines how the physical world works in fact helps to predict what might happen in the coming years, thus supporting the best choices. Machine Learning (ML) is a segment of artificial intelligence that feeds on data, processes it and, thanks to

algorithms, triggers or suggests actions. It may have many different applications, including the management of water resources.

For example, during the International Conference on Data Mining 2021, a group of researchers from the University of Minnesota, the University of Pittsburgh and the US Geological Survey presented a study on the ability to predict flow and temperature in river networks[64]. The work allows for predictions even when the available data, as often the case for rivers and streams, are scarce. The study focuses on stream temperature because it represents a central variable in habitat balance, evaporation rates, and thermoelectric power generation. It was applied to the Delaware River Basin to better manage the distribution of drinking water to 15 million people and to guarantee a favourable temperature for river species habitats. This has allowed the accurate prediction of water temperature and flow rate. In turn, this can support the decisions of managers of these water resources by determining, for example, when and how much water to release from reservoirs to downstream rivers.

Another AI supported study was carried out by researchers of the "Laboratorio di Termofluidodinamica" of Libera Università di Bolzano[65] who built a system for detecting water consumption and leaks in aqueduct systems based on the use of deep learning. The algorithm created makes it possible to discover any type of leak or anomaly based on the flow and pressure sensors located in the system. In addition to discovering leaks in the network, the algorithm created can be trained to estimate water consumption and demand: a feature that enables operators to optimise the pumping of water into the network for hydroelectric power generation.

On the matter of AI for clean water, a Swiss company, GratzUp[66], developed a project for a system (G-Plant) that makes large quantities of contaminated water (from 250 to 3,000 litres per day) pure and drinkable, inspired by the high-temperature sterilisation process. The technology used, similar to working principle of induction hobs, brings non-potable water to 138.5 °C and with a pressure of 3.5 bar, neutralise the load of viruses and bacteria contained in it within two minutes, leaving its organoleptic properties unaltered. By means of a microchip inserted in the caps of each water container, certain parameters, including quantity, temperature level reached and viral load, are detected and

[64] Il machine learning può predire il futuro del pianeta - Pictet per Te (am.pictet).
[65] Siccità e perdite nei sistemi idrici. A Bolzano si studia una soluzione con l'Intelligenza Artificiale / Libera Università di Bolzano (unibz.it).
[66] GratzUp: la startup che porta l'acqua potabile in Africa - ilSole24ORE.

communicated to the central server. A system equipped with a machine learning algorithm then analyses this data, identifying anomalies and errors in the entire process.
The seawater desalination system (RemixWater), on the other hand, is Japanese. Within this system, the AI performs very specific tasks, i.e. verifying that certain indices for the management of the system are respected, detect the high pressure levels reached by the water during treatment, and signal the presence of scale within the water system. RemixWater was founded by the New Energy and Industrial Technology Development Organisation (NEDO).
In India, where AI is used for the management of clean water, a water conservation platform (ConserWater) has been developed using AI techniques and public data provided by NASA satellites, to support farmers (especially poorer farmers who lack monitoring devices and the skills to use them) in achieving a timely and efficient distribution of their water resources among different types of crops. More specifically, the platform employs historical meteorological data and geospatial deep learning techniques in order to make predictions about the correct water requirements of the land[67].
Another area of participation of artificial intelligence for clean water, is that of predicting possible future conflicts related to drought and the consequent impossibility for some local populations to access drinking water. This is often the case of several African countries. The Water, Peace and Security Partnership project works in this direction[68], by the Institute for Water Education in Delft, in the Netherlands, which involves the use of an artificial intelligence system that crosses data from NASA satellites and the European Space Agency with socio-economic and demographic data relating to the risk of specific territories, in order to make predictions about potential conflict dynamics that could occur within them as a result of a lack of water. The testing phase of the AI system led to the prediction of a number of local wars in Africa, which then occurred in 2017 in the Niger River area of Mali over the supply of water resources in the area. But having foreseen them meant the timely activation of dialogue, by the institutions, between the different actors involved. And this is precisely the value of the project, i.e. being able to intervene 'before' or, in the case of sudden guerrilla warfare, to already have a clear strategy to adopt at the socio-political level.

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67 https://www.cnr.it/sites/default/files/public/media/attivita/editoria/VOLUME%20FULL%2014%20digital%20LIGHT.pdf.

68 Intelligenza artificiale per l'acqua pulita: focus sul Goal 6 ONU (tech4future.info).

Finally, we might also talk about the Water Resilient project of the end of 2021[69], from the "Agenzia Regionale di Protezione Ambientale Emilia-Romagna", Hera Group and University of Bologna.

Its objectives include the climatic analysis of past rainfall, the prediction of future rainfall (with a focus on possible new droughts), the monitoring of surface and subterranean water resources in the territory using sensors, and the analysis of water availability (including wells, for example) that can be exploited in case of need. The use of predictive Artificial Intelligence algorithms takes over, in particular, about the latter objective, with a snapshot of the current situation and forecasts on the future evolution of the aquifers taken into consideration. This analysis should then lead to an intervention strategy and investment planning, as well as the development of guidelines to be adopted in the event of future critical moments.

After providing an overview of various projects in the field of water management and how the literature is moving to exploit these algorithms and computer tools to highlight potentials and risks in relation to the 17 goals of the 2030 Agenda, many countries have already drafted and published their own AI development and application strategy.

AI, Machine Learning, and the use of data are today considered extremely powerful technologies that will have major impacts on our lives, economy, work, democracy, but also on the entire planet such as climate change and biodiversity. Its application is also found in the field of finance, in which AI, by specific software and programming languages, may support market analysis (data collection) and forecasting.

[69] Acqua, presentato il progetto "Resilient water" — Arpae Emilia-Romagna.

3.2 What is Python? An introduction to Machine Learning.

Machine Learning (ML) is the branch of computer focused on developing programs that can self-teach and adapt. It allows developers to create algorithms that improve themselves by identifying patterns in existing data, without human guidance. The effectiveness of Machine Learning depends on the quantity of data available, so more are data available and more efficient ML is.

Automatic decision systems, based on AI and ML, extract meaningful patterns from extensive datasets. Their efficiency relies on recent advancements in computing and efficient algorithms for processing large amounts of data. [70]. AI and ML find applications in several areas of Fintech, such as including fraud preventions, customer service, marketing, algorithmic trading, risk management, investment predictions, document interpretation, process automations.

They refer to two different areas of Computer Science, one more general, one more specific. More precisely, AI studies the development of computer system constituted by intelligent agents, that gather information from their environment to achieve goals[71]. This encompasses a large number of subareas such as knowledge representation, automatic reasoning, robotics and automatic planning. These subareas are extremely heterogeneous and differ in several aspects, including: the type of problems they may aim at solving the computational methods that they employ; the type of applications in which their use is appropriate. AI was defined by John McCarthy[72] in 1956 as "*the science and engineering of making intelligent machines*".

ML is considered a subset of AI and it focuses on the problem of learning patterns from data. It addresses the challenge of quantitatively describing the relationship between information and the desired prediction. It relies on automatic techniques to learn this relationship from historical data, such as customer behaviour. The goal is to identify patterns, or models, within large datasets. These models vary depending on specific scenarios and are derived from collections of information known as features.

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[70] Financial Stability Board, *Artificial intelligence and machine learning in financial services Market developments and financial stability implications*, November 1st, 2017.

[71] Stuart J. Russel, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Pearson, 2021.

[72] John McCarthy was an American computer scientist and cognitive scientist. He was one of the founders of the discipline of artificial intelligence. He co-authored the document that coined the term "artificial intelligence" (AI), developed the programming language family Lisp, significantly influenced the design of the language ALGOL, popularized time-sharing, and invented garbage collection. He spent most of his career at Stanford University.

Both AI and ML depend on algorithms to solve computational problems and achieve tasks. Algorithm is a well-defined sequence of operations that processes some data given in input in order to obtain a desired output. The operations performed by algorithms are usually defined in terms of simple, primitive, operations which are combined to perform more complex operations and tasks. The objective of ML systems is to recognize valuable patterns through the analysis of extensive data. The process of finding these patterns, or models, varies based on the specific context in which they are applied. The data consists of numerous samples, or instances, each containing a set of information or measurements known as features.

We can summarize below the use case of ML in finance[73]:

- ML for customer experience in financial services: it helps organizations and financial institution to improve customer experience, services, and optimize budgets. It enables a process automation that replaces routine manual work, automates tasks, and makes their realization more productive. For example, we can mention the use of call centres, chatbots and automation of paperwork. We can mention US banks Well Fargo that uses this system.
- Customer onboarding is a crucial process for banks and Fintech companies. ML, through the analysis of user behaviour patterns, helps to optimize the onboarding experience, influencing the customer's relationship with the organization. Let's think about the German online bank N26 which is fully digitalised and enables customers to manager their personal finance directly from their smartphone.[74]
- Fraud detection and prevention: as long as the number of transactions, real clients, and integrations grows, security become very important. Banking organizations can use ML algorithms to monitor a considerable number of transactional parameters at once for every account in real time. These algorithms analyse historical payment data and user actions to efficiently detect suspicious behaviour.
- Portfolio management is an online wealth management service that uses statistical points of the issue as well as automated algorithms to optimize the performance of clients' assets. Customers fill in their financial goals, for example, to save some amount of money during a certain period of time. Customers set financial goals, and a robot advisor allocates assets based on investment opportunities and risk

[73] https://fayrix.com/blog/machine-learning-in-finance.
[74] The Forbes recognized digital bank - N26

tolerance. We can mention Aladdin system developed by Blackrock Investment Company.[75]

- Assessment and management of credit risks: credit risk is the economic loss that emanates from a counterparty's failure to fulfil its contractual obligations or the increased risk of default during the transaction term. The increased complexity of assessing credit risks has opened the door to deep learning in finance. This is evident in the growing credit default swap market, where there are many uncertain elements, involving determining both the likelihood of an event of credit default and estimating the cost if a default occurs. Feedzai, a data science company, developed and offers a software that use ML and big data analysis to prevent fraud.[76]
- The so-called credit scoring system is a numerical statistical method that assesses an individual's creditworthiness based on various factors. This technology is commonly used for fast lending, where a scoring system automatically approves or declines loan applications based on the risk assessment. This is the case for Equifax that use algorithms of ML relate to credit decisioning.[77]
- Asset management for digital assets or distributed industrial assets are applications where the automation through AI is applied in managing voluminous data related to assets. This is relevant in asset and wealth management firms seeking to improve investment decisions using historical data.
- Predictions of stock market and technical analysis are often underestimated in the trading sector and even considered pseudoscientific. Some old school traders still think so, too, and study tons of stock charts with Japanese candlesticks every day. However, modern businesses leverage current and historical data to make informed forecasts. Technical analysis, which examines past price movements, helps predict stock direction. Additionally, advanced techniques involving artificial neural networks and algorithms play a significant role.
- Financial machine learning helps to solve tasks with the winning trading decisions in the algorithmic trading sphere. It involves employing mathematical models to monitor real-time market updates and trade outcomes. Special algorithms are

[75] Introduzione ad Aladdin | BlackRock
[76] Feedzai: Fraud Prevention Powered by Machine Learning (fintastico.com)
[77] Q&A: Machine Learning and Explainable AI in Credit Risk (equifax.com)

designed to identify patterns influencing stock price dynamics, allowing for proactive actions like selling, holding, or buying stocks based on forecasted data. These algorithms have the capacity to analyse a large amounts of data sources and market conditions simultaneously, surpassing the capabilities of human traders.

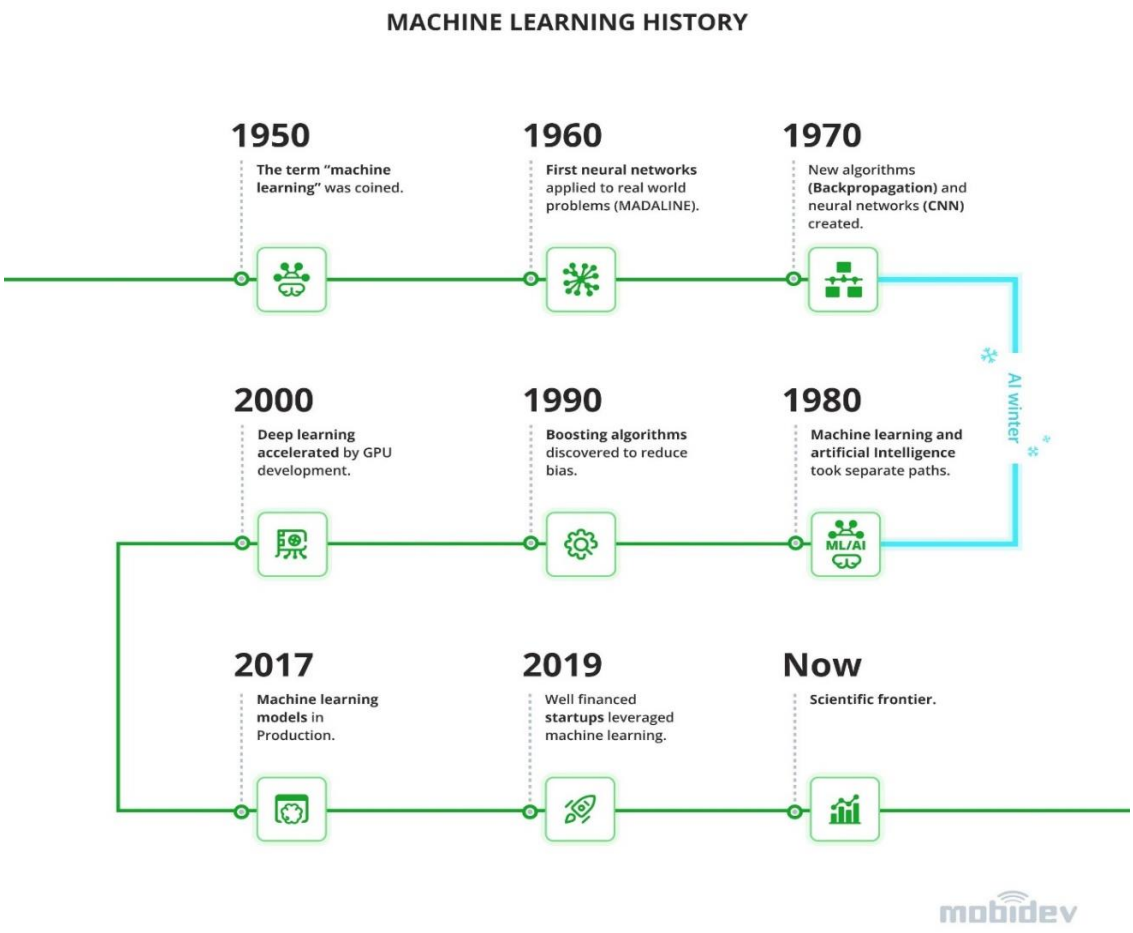
- Customer churn forecasting is one of the most popular big data use cases in business. This method is utilized across various channels, from sales funnels in marketing emails to tailoring loyalty programs, showcasing its significant impact on customer retention strategies. This system is adopted by Netflix, a giant of video streaming, which exploit ML to increase the appeal of specific movies and the numbers of subscribers of the platform.[78]

ML technology has been in existence since 1952. It has evolved drastically over the last decade and saw several transitions periods in the mid-90s. The data-driven approach to ML come into existence during the 1990s. From 1995 to 2005, there was a lot of focus on natural language, search, and information retrieval. In those days, ML tools were more straightforward that the tools being used currently.

A short history of ML is reported in figure 3.2 number 31.

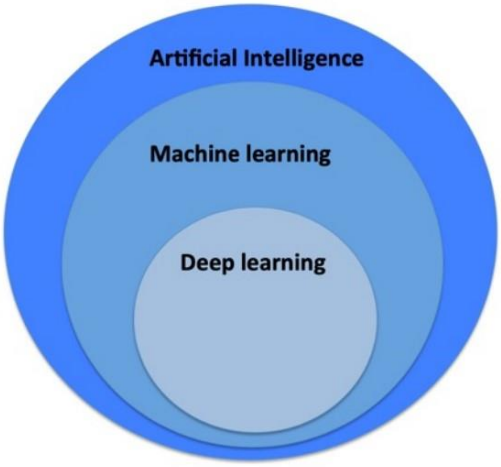
[78] Netflix Recommendations: How Netflix Uses AI, Data Science, And ML | Simplilearn

Figure 3.2, 31 The Evolution of Machine Learning.



(Reference: TOP 9 Machine Learning Technology Trends To Impact Business in 2023 mobidev.biz)

Figure 3.2, 32 A scheme of the interconnection between Artificial Intelligence, Machine Learning and Deep Learning



(Reference: drawing up a personal scheme).

As reported in figure 3.2 number 32, ML is a category of research and algorithms focused on finding patterns in data and using those patterns to make predictions. ML falls within the AI umbrella, which in turn intersects with the broader field of knowledge, discovery and data mining.

ML techniques fall into three major categories:

- Supervised Learning: given the desired outputs $t_1, t_2, t_3, \ldots, t_N$ learn to produce the correct output given a new set of input.
- Unsupervised Learning: exploit regularities in D to build a representation to be used for reasoning or prediction.
- Reinforcement Learning:[79] producing actions $a_1, a_2, a_3, \ldots, a_N$ which affect the environment and receiving rewards $r_1, r_2, r_3, \ldots, r_N$ learn to act in order to maximize rewards in the long term.

Supervised problems are further subdivided depending on the type of values that the target assumes. If the target assumes one of a fixed number of possible values or labels, the problem is called classification. When instead the target is quantity, such as a positive number, the problem is called regression. For example, this is used if the target is to predict the number of sponsored contents where the customer clicks on. Unsupervised

[79] Richard S. Sutton, Andrew. G. Barto, *Reinforcement Learning: An Introduction*. Bradford Books, 2018.

techniques are designed for situations where a target feature is not explicitly defined, or not measured and one is interested in finding interesting structures and relations among the instances and/or the features. A commonly used unsupervised technique is clustering, where one partitions the instances into groups with the goal of having similar instances within each group and different instances in different groups. It is used to identify for example groups of customers with similar characteristics, to devise different marketing strategies for each group. Reinforcement technique studies problems and techniques related with improving the performance of an agent on a specific task as feedback on past actions is provided to the agent. This is useful for automatic stock trading[80].

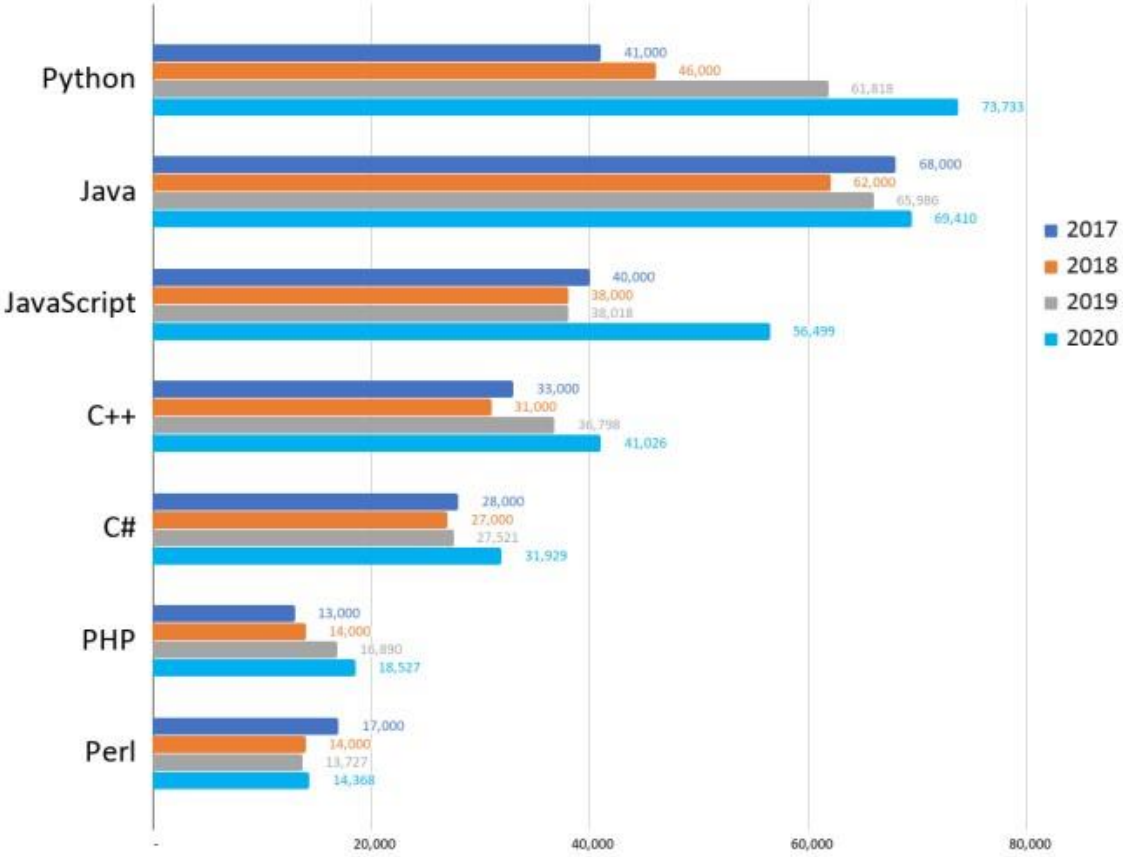
In order to carry out our analysis a Phyton program language was used to implement ML models. Python is a "higher-level" programming language than most other languages, object-oriented (but not as hard-core as, say, Java), suitable for, among other uses, developing distributed applications, scripting, numerical computation, and system testing.

Python is one of the most used programming languages. It is free, multi-paradigm with procedurals, objects, and functions. It is composed by several libraries like NumPy, Pandas, Matplotlib in order to analyse the dataset that we want to import and the plot the results of the analysis.

The figure 3.2 number 33 show the use of Python in comparison with other tools used as programming languages. We notice that since 2020 Python is the most used.

[80] Shai Shalev-Shwartz, Shai Ben-David, *Understanding Machine Learning: From theory to algorithms*, Cambridge University Press, 2014.

Figure 3.2, 33 The evolution of the use of programming languages.



(Reference: Quando Scala è una scelta migliore, Java o Python? - Quora)

In the next paragraph, we will carry out the analysis of two datasets: one is related to macroeconomic US variables called Dataset USA (X, independent variable), in relation to the time series of MSCI USA $ Index net return Dataset (y, dependent variable), and another one is related to the same macroeconomic US variable (X, independent variable) in relation to the sample of Fund and ETF proposed (y, independent variable), discussed in the previous chapters.

3.3 Datasets and purpose of the analysis.

The purpose of the analysis is to understand whether macroeconomic variables have an impact on the proposed sample of Funds and ETFs that invest in water stocks. The main assumption is: can water be considered a defensive asset class? What is the relationship between the economic cycle and water investment?

In general, we can observe that a vast literature focuses on the predictability of U.S. and international stock returns using macroeconomic variables, such as the short government interest rate or the yield spread between defaultable and government bonds. We can mention several studies in order to understand how this work took place. Ferson and Harvey (1993)[81] find that returns on international stock indexes are predictable using macroeconomic indicators as condition variables. Another study carried out by Ferson and Harvey (1999)[82] finds that broad economic variables explain the cross-sectional variation in US individual stock return better that the Fama and French (1993)[83] empirical factors. These papers, as well as numerous others in the academic literature, indicate that substantial gains in portfolio choice can be obtained from the use of macroeconomic information.

In our case, we focus on US because all the sample of Funds and ETFs proposed has a breakdown portfolio concentrated in the US market, therefore, we will use macroeconomic variables such as Consumer Price Index (Inflation Rate), Interest Rate, Exchange rate, VIX Index, Industrial Production Index, Consumer Confidence Index and Business Confidence Index referred to this specific country.

Parameters considered are discussed below:

- Consumer Price Index: The Consumer Price Index (CPI) is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. Indexes are available for the U.S. and various geographic areas. Average price data for select utility, automotive fuel, and food items are also available. It is a statistical measure that help to have an overview of the rate of inflation. The Bureau of Labour Statistics calculates the

[81] Wayne E. Ferson, Campbell R. Harvey, *The risk and predictability of international equity returns*. The Review of Financial Studies Volume 6, pp. 527–566, 1993.
[82] Wayne E. Ferson, Campbell R. Harvey. *Conditioning variables and the cross section of stock returns*. Journal of Finance Volume 54, pp.1325–1360, 1999.
[83] Eugene F. Fama, Kenneth R. French. 1993. *Common risk factors in the returns on stocks and bonds.* Journal of Financial Economics Volume 33, 1993.

CPI as weighted average of prices for a basket of goods and services representative of the aggregate spending of US consumer. The CPI report employs a survey methodology, price sampling but with different weights compared to the Producer Price Index (PPI), which measures changes in production prices in the USA. The calculation is based approximately on 80.000 price quotes collected monthly from a sample of about 23.000 retail and service establishments, as well as 50.000 rental housing units. Rental housing costs are used to estimate the variation in rental costs including owner-occupied homes. Changes in rents in America count for approximately one-third of the overall CPI.[84]

- Interest Rate: The federal funds rate is the interest rate at which depository institutions trade federal funds (balances held at Federal Reserve Banks) with each other overnight. When a depository institution has surplus balances in its reserve account, it lends to other banks in need of larger balances. In simpler terms, a bank with excess cash, which is often referred to as liquidity, will lend to another bank that needs to quickly raise liquidity. The rate that the borrowing institution pays to the lending institution is determined between the two banks; the weighted average rate for all of these types of negotiations is called the effective federal funds rate. The effective federal funds rate is essentially determined by the market but is influenced by the Federal Reserve through open market operations to reach the federal funds rate target[85].
- Exchange Rate: it is defined as the price of one country's currency in relation to another country's currency. This indicator is measured in terms of national currency per US Dollar. It expresses the rate at which one currency will be exchanged for another currency and affects trade and movement of money between countries. In our analysis we consider US Dollar to Euro spot exchange rate which is the current rate at which one currency can be exchanged for another currency and it is based on the demand and supply of currencies.[86].
- VIX Index: the Chicago Board Option Exchange Volatility Index (VIX) is a real-time index that represents the market's expectations for the relative strength of near-term price changes of the S&P 500 Index. It is derived from the prices of

[84] U.S. Bureau of Labor Statistics (bls.gov)
[85] Federal Reserve Economic Data | FRED | St. Louis Fed (stlouisfed.org)
[86] Federal Reserve Board - Home

S&P 500 Index Options with near-term expiration dates, it generates a 30-day forward projection of volatility. This means how fast prices change and is often seen as a way to gauge the market sentiment, and in particular the degree of fear among market participants. It helps investors to understand the level of market fear or optimism and it can be observed as investors sentiment, so what they think about the market. In general, higher market volatility will lead to higher Option prices, the so called "premium". If the market is calm Option premium is lower and investors buy Call Options, on the contrary when volatility is higher investors buy Put Options. When the market is calm means that we have absent or a limited fear and more optimism for the market growth. For the Index calculation, the CBOE employs a formula aimed at tracking the change in Options prices with the same expiration date. It selects them for the index taking into account a range of Call and Put strikes with two successive expiration dates. Then it calculates the influence of each Option on the total variance. It computes the total variance for the first and second expiration dates. Finally, the 30-day variance is calculated by interpolating between the two variances with the standard deviation being the square root of the 30-day variance. In the end the CBOE multiplies this standard deviation by 100 to obtain the VIX. As a general overview of the result we can say that if it is less than 20, the market has a low volatility, so it is calm, and if is more than 30 the market has high volatility.[87]

- Industrial Production Index (IPI): it is an economic indicator measuring real output in the manufacturing, mining, electric and gas industries relative to a base year. More precisely, the calculation for the indicator reflects the industries included in the North American Industry Classification System (NAICS). It encompasses for example, manufacturing, utilities, mining, energy, books and periodical publishing. The time frequency calculation is monthly, and it is based on two types of source of data: production volume expressed in physical units and data on the inclusion materials on the production process. Data are provided by industry associations and government agencies. If it is not available production volume is calculated based on hours worked by employees in various sectors. The Federal Reserve use this index to assess inflation and the manufacturing sector of

[87] https://it.finance.yahoo.com/
Indice VIX: cos'è e come funziona l'indice di volatilità. E la VIX Curve? (borsainside.com)

the country. The value of the indicator can help also to predict the Gross Domestic Product (GDP) for the current period.[88]

- Consumer Confidence Index (CCI): it provides an indication of future developments of households' consumption and saving, based upon answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings. An indicator above 100 signals a boost in the consumers' confidence towards the future economic situation, as a consequence of which they are less prone to save, and more inclined to spend money on major purchases in the next 12 months. Values below 100 indicate a pessimistic attitude towards future developments in the economy, possibly resulting in a tendency to save more and consume less. It is calculated by the Conference Board through the survey called Consumer Confidence Survey (CCS) conducted on a sample of 5000 households. The selection of individuals is random but proportional to the American adult population in terms of age, gender, income and geographic area. The data is available segmented by these categories dividing the nation into 9 regions. The report provides detailed insights into consumer attitudes like intention to purchase goods (including durable goods), holiday plans and consumer expectations regarding inflation, stock prices and interest rates[89].
- Business Confidence Index (BCI): it provides information on future developments, based upon opinion surveys on developments in production, orders and stocks of finished goods in the industry sector. It can be used to monitor output growth and to anticipate turning points in economic activity. Numbers above 100 suggest an increased confidence in near future business performance, and numbers below 100 indicate pessimism towards future performance. For this index we have the same methodology of calculation for the CCI. The only difference is that this index has industry sector and companies as target of the analysis[90].

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[88] https://fred.stlouisfed.org/
Fed Industrial Production m/m - economic indicator from the United States (mql5.com)
[89] https://data.oecd.org/
US Consumer Confidence Index - Indice sulla Fiducia dei Consumatori USA - Finance Looting
[90] https://data.oecd.org/

On the other side we use the time series data of the returns of the sample proposed. In order to have an accurate model we use the average of all Funds and ETFs time series, calculated through Excel, and we consider them as a whole. Specifically, we calculated the monthly average return across the sample of Funds and ETFs. For simplicity, we will call it Average Sample of Funds and ETFs.

We use Python programme to create a Linear Regression Model considering the Dataset of US macroeconomic variables and the overall sample of Funds and ETF proposed. Then, we replicate the same analysis by taking into consideration the Dataset of US macroeconomic variables and the MSCI USA Index as a benchmark for the generic US stock market (more specifically large and mid cap segments of the US market[91]).

The final goal of the empirical analysis is to evaluate how macroeconomic variables impact on Funds and ETFs investing in water as compared to the impact on a generic stock index.

In the second analysis, we use the Decision Tree Regressor which is a machine learning algorithm used in the field of regression to predict a continuous numerical value. The decision trees is used to model the independent variable in our dataset on the basis of a set of independent variables.

We built two models: one with the original values of the series of the US macroeconomic variables and another one with the Year-on-Year variation of the same inputs to understand which model fits our data better for both MSCI USA Index and the water sample proposed.

To complete the description of the data used during our analysis, we propose an excerpt of the Dataset US containing macroeconomic variables, of the sample analysed containing the computation of monthly average return across the sample of Funds and ETFs investing in water, a snapshot of the MSCI Index that contains a table with data of the time series of the index.

The total of observations is 202 rows that start from September 2006 and end in May 2023. The frequency is monthly and for simplicity we propose the first three rows and the

[91] The index is composed of 628 constituents. It covers approximately 85% of the free float-adjusted market capitalization in the US. In terms of top 10 constituents, we find the following companies with index weight: Apple (7.44%), Microsoft Corp (5.80%), Amazon.com (3.19%), Nvidia (3.05%), Alphabet A (2.03%), Alphabet C (1.85%), Tesla (1.84%), Meta Platform A (1.64%), Berkshire Hathaway B (1.17%) and Exxon Mobile Corp (1.13%). Sectors that compose this index are: Information Technology for 28.31%, Healthcare is about 12.98%, Financials is 12.26%, Consumer Discretionary is 10.85%, Industrials are 8.82%, Communication Services are 8.75%, Consumer Staples are 6.32%, Energy is 4.4%, Real Estate is 2.49%, Materials are 2.48% and Utilities are 2.34%.

last three rows for the USA Dataset, for the sample proposed of Funds and ETFs investing in water and for the US stock market Index.

We specify that we used the same time period in any specification.

Table 3.3, 7 Macroeconomic Variables in the USA Dataset.

Time Frequency	IPI	BCI	CCI	CPI	FEDFUD Interest Rate	Exchange Rate	VIX Index
2006-09-01	99.2207	99.71144	100.1146	202.9	5.25	1.2722	11.980
2006-10-01	99.1253	99.51582	100.5409	201.8	5.25	1.2617	11.100
2006-11-01	99.0969	99.37728	100.7754	201.5	5.25	1.2888	10.910
…	…	…	…	…	…	…	…
2023-03-01	102.6426	98.90712	97.31009	301.83	4.65	1.0711	18.700
2023-04-01	103.1222	98.90242	97.19019	303.36	4.83	1.0962	15.780
2023-05-01	102.7421	98.88741	97.11353	304.12	5.06	1.0867	17.950

(Reference: OECD Data, US Bureau of Statistics, FED Website, FRED Economic Data, Yahoo Finance).

Table 3.3, 8 Average return of Funds and ETFs investing in water.

Time Frequency	Average of Funds and ETFs Samples investing in water.
2006-09-01	191.85
2006-10-01	199.87
2006-11-01	204.45
…	…
2023-03-01	531.34
2023-04-01	522.96
2023-05-01	515.37

(Reference: Refinitiv).

Table 3.3, 9 Time Series of MSCI USA Index

Time frequency	MSCI USA Index (USD) Net Return
2006-09-29	2935.675
2006-10-31	3035.092
2006-11-30	3093.057
…	…
2023-03-31	11473.674
2023-04-28	11616.058
2023-05-31	11685.39

(Reference: Refinitiv)

After the description of the type of data and the scope of the analysis, in the next paragraph we show the Linear Regression Model and the Decision Tree Regressor explaining what it is, the results of the analysis and the Python libraries that we used for run the script.

3.4 Linear Regression Model and Decision Tree Regressor.

First of all, the construction of a model arises from the need to represent reality in a simplified form. The real-world problem is translated into a statistical model which is formalized in mathematical terms in order to verify a general assumption.

A Linear Regression Model[92] is a statistical approach used to establish a linear relationship between a dependent variable denoted as Y and one or more independent variables denotes as X. This model is a basic and commonly used type of predictive analysis. The overall idea of regression is to examine two things: does a set of predictor variables do a good job in predicting an outcome (dependent) variable? Which variables in particular are significant predictors of the outcome variable, and in what way do they impact the outcome variable, as indicated by the magnitude and sign of the beta estimates? Broadly speaking we can use this statistical approach for determining the strength of predictors, forecasting an effect, and forecasting trends.

The general formula that theorizes this method can be expressed as:

$$Y = \beta 0 + \beta 1X + \varepsilon$$

(3.4, 6)

- ✓ Y represents the dependent variable
- ✓ X represents the independent variable
- ✓ β0 is the intercept (the value of Y when X is 0)
- ✓ β1 is the slope (the change in Y for a unit change in X)
- ✓ ε represents the error term, the difference between the observed and predicted Y values.

This is the case in which we have one independent variable, so for a simple linear regression.

For multiple linear regression, when we have more than one independent variable, the formula is extended:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + \varepsilon$$

(3.4, 7)

[92] Stock, James H. and Watson, Mark W. *Introduction to Econometrics* Pearson, Milan, 2019.

A Decision Tree is a classification model that assigns objects to one or more classes based on the training data and if-then rules. A decision tree is a non-linear model that creates meaningful subdivisions or subgroups of the classes in the dataset. A decision tree model makes predictions by traversing down the branches of the tree based on the features of the input data. When it reaches a leaf node, it assigns a predicted value associated with that leaf node.

In order to apply these functions in Python; and to build the model, we use pandas[93], scikit-learn (sklearn)[94], scipy[95] and matplotlib library[96]. Then we created the code to run functions, to compute data and to create the plots.

The hypothesis of our model is: can Blue Funds be considered a defensive asset class?

Can water be a defensive investment? How much macroeconomic variables impact on our model, on this kind of commodity?

In order to carry our analysis, we used Ordinary Least Squares (OLS) in Python to build the Linear Regression Model. We also computed the p-values of our regression to estimate the significance of the relationships between the independent variable (predictor) and the dependent variable (the response variable). This quantifies the evidence against the null hypothesis that there is no relationship between variables. The p-values of the coefficient of our regression are the result of a statistical test on the mean and variance. The Standard Error is a measure of the variability or dispersion of our sample, in relation to the true population parameter that the model estimates. It basically quantifies the precision of the estimation and more it is a small value and more precisely is our estimation.

The following figures propose tables that summarize the results of our analysis and plots:

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[93] pandas - Python Data Analysis Library (pydata.org).

[94] scikit-learn machine learning in Python — scikit-learn 1.3.0 documentation.

[95] SciPy.

[96] Matplotlib — Visualization with Python Stack; Overflow - Where Developers Learn, Share, & Build Careers;

Sebastian Raschka, Vahid Mirjalili, *Machine Learning con Python, costruire algoritmi per generare conoscenza*, Apogeo, 2020.

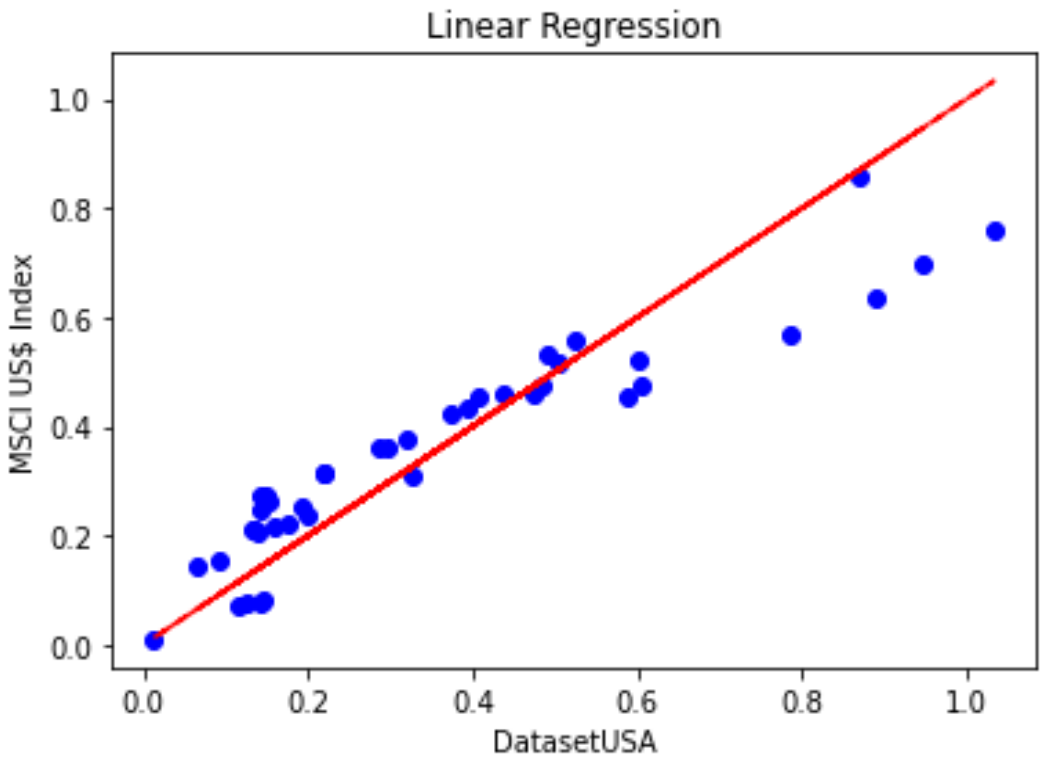
Figure 3.4, 34. Dataset US vs MSCI USA $ Index Linear Regression Model

X = Dataset US (macroeconomic variables)

y = MSCI USA $ Index

Mean Squared Error	0,0107
Mean Absolute Error	0,0800
R^2	0,8425

Variables	Coefficients Linear Regression (coeff)	Standard Error (Std. Err.)	p-values Linear Regression p > |t|	Coefficient Correlation	P-values Correlation
Consumer Price Index	0,9679	0,053	0	0,9374	0
FEDFUNDS Interest Rate	0,0715	0,027	0,008	0,0543	0,4434
Industrial Production Index	0,0527	0,039	0,175	0,4617	0
Consumer Confidence Index	0,0136	0,023	0,560	0,0210	0,7669
VIX Index	-0,0351	0,045	0,434	-0,0911	0,1981
Business Confidence Index	-0,0621	0,017	0	-0,1911	0,0065
Exchange Rate $ vs €	-0,0623	0,043	0,152	-0,7010	0



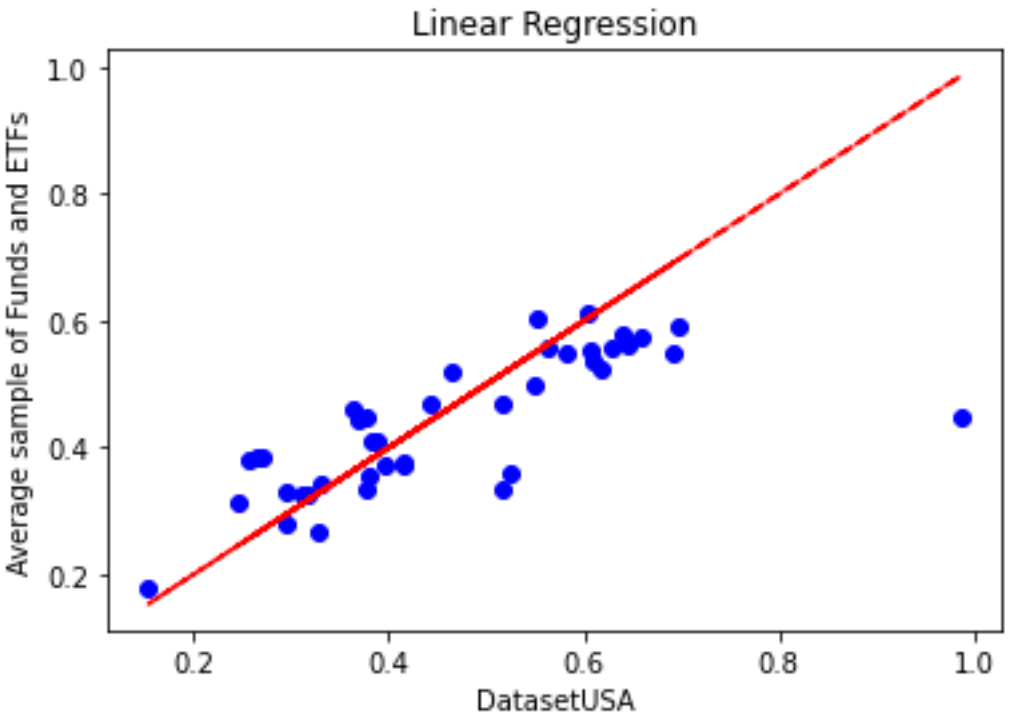
(Reference: computation results from OLS Model and Plot in Python).

Figure 3.4, 35. Dataset US vs Average sample of Funds and ETFs investing in water
Linear Regression Model

X= Dataset US (macroeconomic variables)
y = Average sample of Funds and ETFs investing in water

Mean Squared Error	0,0125
Mean Absolute Error	0,0731
R^2	0,5338

Variables	Coefficients Linear Regression (coeff)	Standard Error (Std. Err.)	p-values Linear Regression p > |t|	Coefficient Correlation	P-values Correlation
Consumer Price Index	0,5225	0,093	0	0,4638	0
FEDFUNDS Interest Rate	0,0134	0,046	0,772	0,2089	0,0029
Industrial Production Index	0,2558	0,067	0	0,4714	0
Consumer Confidence Index	-0,1421	0,040	0,001	-0,3578	0
VIX Index	0,0276	0,078	0,724	-0,2971	0
Business Confidence Index	-0,0236	0,029	0,422	-0,1415	0,0449
Exchange Rate $ vs €	0,3408	0,075	0	-0,4488	0



(Reference: computation results from OLS Model and Plot in Python).

According to the results we can say that macroeconomic variable impact more on traditional investments and less in Funds and ETFs investing in water.

Looking at figures 3.4 number 34 and 35, we can say that R^2 is higher for the MSCI Index dataset, 0.8425 versus 0.5338 for MSCI Index and for our sample of Funds and ETFs, respectively. This means that, for the first model, macroeconomic variables are more effective in explaining the series. Therefore, if we observe a lower correlation between traditional macroeconomic variables and our sample of water-related products, these financial products are likely to become more interesting for investors when the economic conditions deteriorate. However, this is not the only driving factor. Looking at single coefficients and comparing the two models, we notice that in the US MSCI Index model the variables with higher significance are Consumer Price Index, Interest Rate and Business confidence Index. For the case of Funds and ETFs investing in water, the most relevant variables are Consumer Price Index, Industrial Production Index, Consumer Confidence Index and Exchange Rate. In particular, if we look at the Consumer Confidence Index for the sample proposed we have a negative sign, -0.1421 and a p-value of 0.001 which is highly significant. This further reinforces the idea that when the confidence goes down (likely when the overall economic conditions are not very good), our Funds and ETFs grows up. It seems that this kind of investment is perceived as a safe-haven asset. When the confidence rises, the performance of the Funds and ETFs drops. In the other sample, we have a positive Consumer Confidence Index, 0.0136 but the p-value is higher 0.560 so the coefficient is not statistically significant. Looking at Consumer Price Index we see higher correlation with MSCI USA Index which is 0.9679 and lower correlation for the water-related sample proposed that is 0.5225. This leads us to conclude that traditional investments are affected more by inflation than Funds and ETFs investing in water stocks.

We also point out that in the sample of water Funds the exchange rate has a stronger correlation with the performance compared to the MSCI USA Index. The regression coefficient associated with the exchange rate is positive and equal to 0.3408. In the MSCI USA Index sample the regression coefficient is negative -0.0623, indicating a negative relationship; however, the coefficient does not reach the statistical threshold. Therefore, based on the coefficients and correlations, we can conclude that in the MSCI USA Index the exchange rate has a lower impact compared to the sample proposed.

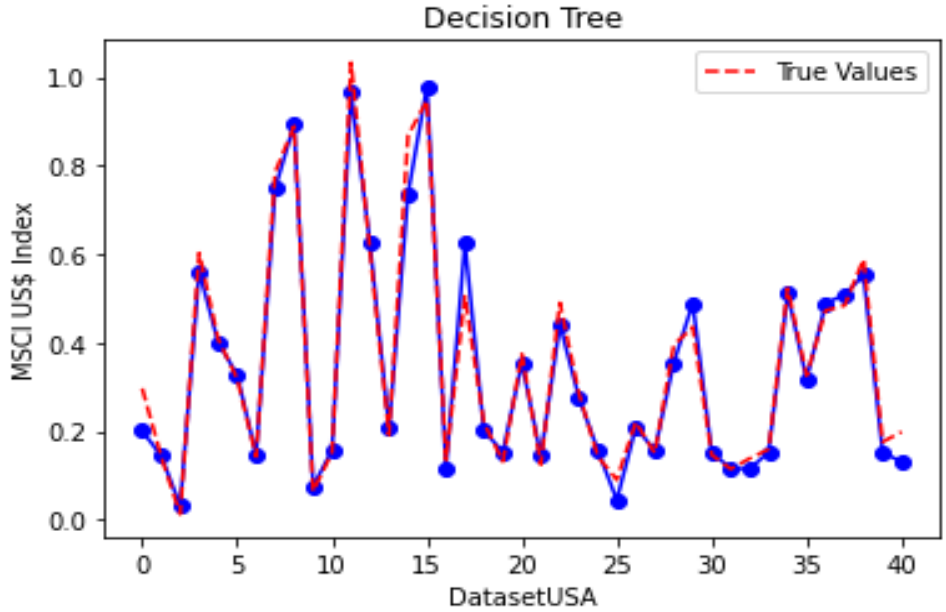
Interest Rate have a less statistically significant for the sample proposed, in fact we have a p-value of 0.772 and a regression coefficient of 0.0134, very low. For the MSCI USA Index we have a significant p-value of 0.008 and a regression coefficient of 0.0715. This means that interest rates have an higher impact on traditional investments.

After this model, we applied a Machine Learning technique, called Decision tree Regressor, to catch non-linear relations. We used the same statistical metrics, so Mean Squared Error and Mean Absolute Error and R^2 calculated for the Decision Tree Model. We used the same Dataset USA with the same macroeconomic variables in order to construct two models for each sample. One model is built with the original value of the time series for MSCI US Index. For the sample proposed, in order to consider them as a whole we computed the monthly average of the time series as it is for the Linear Regression Models. The other model is built with the Year-on-Year (YoY) variation for both datasets. Looking at R^2 the results are better than in the Linear Regression Model for each sample proposed. Respectively, we observe R^2 of 0.9746 for the MSCI USA Index and 0.8728 for the sample of Funds and ETFs. This suggests that the non-linear ML model is better able to describe these relationships. With YoY variation we have negative R^2 for both cases. Respectively we have -1.1000 for MSCI USA Index and -0.7050 for the sample of Funds and ETFs. The negative R^2 is a metric with a range from -∞ to 1. When it is 1, it means that the prediction of the model correlates well with the data. When it is negative the correlation is very bad.

In the next figures, we report the tables that summarize the result of the decision tree regressor and the plots. Blue values represent the true values and the red line is the prediction of the model.

Figure 3.4, 36. Decision Tree Regressor with Dataset USA and MSCI USA Index

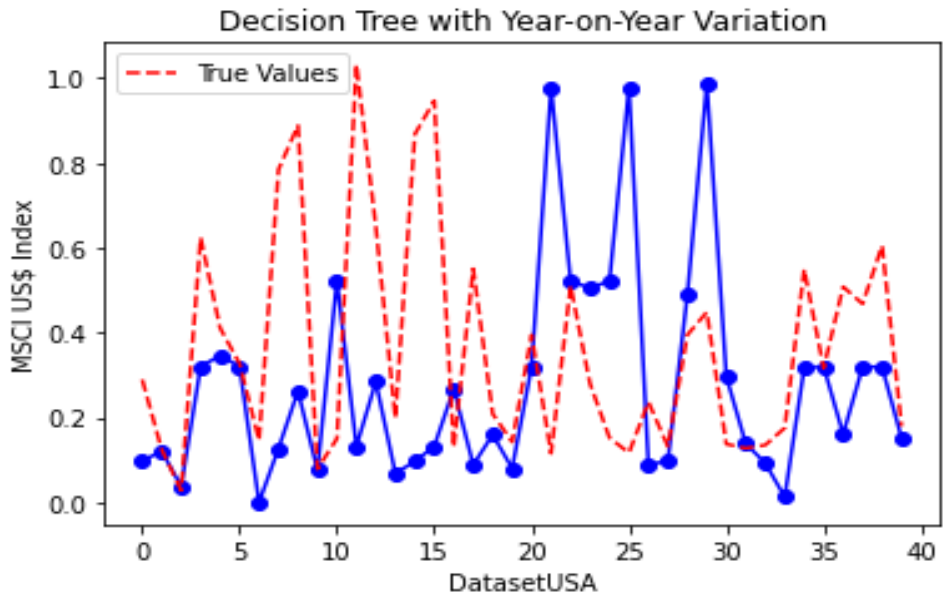
Tree Mean Squared Error	0,0017
Tree Mean Absolute Error	0,0286
Tree R^2	0,9746



(Reference: computation and Plot made with Python)

Figure 3.4, 37. Decision Tree Regressor with Dataset USA and MSCI USA Index

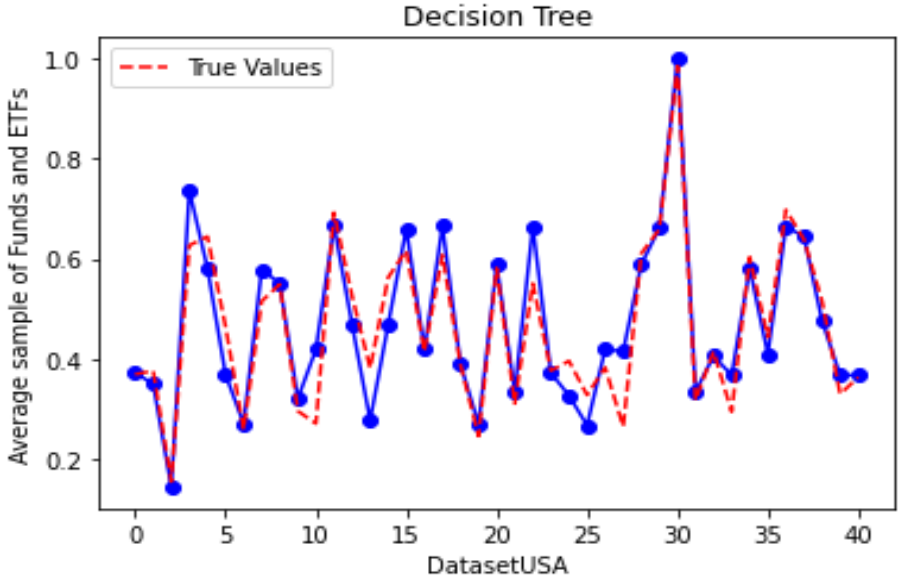
Tree Mean Squared Error	0,1478
Tree Mean Absolute Error	0,2680
Tree R^2	-1,1000



(Reference: computation and Plot made with Python)

Figure 3.4, 38. Decision Tree Regressor with Dataset USA and average sample of Funds and ETFs.

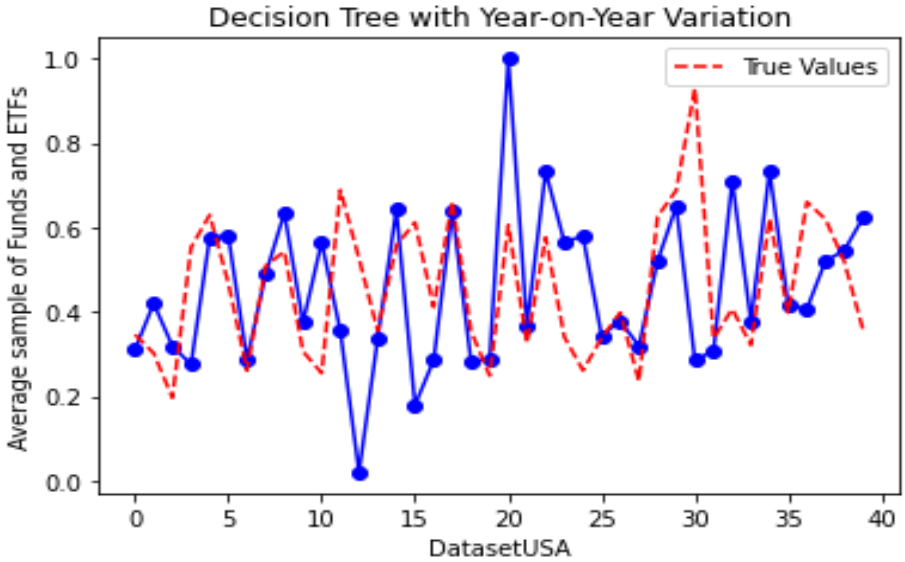
Tree Mean Squared Error	0,0034
Tree Mean Absolute Error	0,0426
Tree R^2	0,8728



(Reference: computation and Plot made with Python)

Figure 3.4, 39. Decision Tree Regressor with Dataset USA and average sample of Funds and ETFs.

Tree Mean Squared Error	0,0460
Tree Mean Absolute Error	0,1515
Tree R^2	-0,7050



(Reference: computation and Plot made with Python)

Overall, we can say that both models (linear and not linear) are useful to analyse the degree of correlations between the two financial datasets and the series of macroeconomic variables. To provide an answer to our hypothesis questions, specifically if Blue Funds and water-related products might be considered as a defensive asset class and how much macroeconomic variable impact in our model, we might say that we have some preliminary responses. First of all, if we look at the overall power of the models, it seems that the list of macroeconomic variables has more a role in explaining the time series of the generic stock index than the time series of the specific Funds and ETFs related to the water sector. Moreover, according to the data, the Decision Tree Model fits better the relationship between the datasets analysed.

We believe that our evidence is a first, although preliminary, evidence that water-related financial instruments might protect investors against negative economic conditions and might contribute to portfolio diversification as defensive asset, given the lower correlation they show with traditional proxies of the economic cycle.

Conclusions

The knowledge, for Aristotle, consists in deriving certain general explanatory principles from observations by logical procedures and deducing from them the phenomena that must be explained. Desires and inclinations are contingent upon intelligence and sensitivity.

Our analysis utilizing both Linear Regression and Decision Tree Regressor Models provides valuable insights into the relationships between macroeconomic variables, traditional investments, and a sample of Funds and ETFs investing in water-related assets. The results provide a first, preliminary evidence that water-related investments might serve as a defensive asset class, showing resilience during adverse economic conditions.

The Linear Regression Model highlights that traditional investments are more influenced by macroeconomic variables, with specific reference to indicators such as Consumer Price Index, Interest Rate and Business Confidence Index. On the other hand, water-related investments appear to be less correlated with our set of macroeconomic variables, suggesting their potential to be a stable option for investors seeking to mitigate risk. More specifically, we might say that holding this specific asset could mitigate the downside risk and contribute to the diversification.

The Decision Tree Regressor Models, particularly with the use of the original time series values for MSCI US Index and the monthly average values of Funds and ETFs, demonstrate improved predictive power compared to the Linear Regression Model. This indicates that non-linear relationships play a significant role in understanding the dynamics between the financial datasets and macroeconomic factors. On the contrary the Year-on-Year variation suggests that the correlation is very bad resulting in a failure of the second test.

However, it is important to acknowledge potential limitations in your analysis. One possible limitation could be the assumption of a linear relationship in the Linear Regression Model, which may not fully capture the complexity of all the possible interactions among variables. Additionally, the models are based on historical data and may not account for unforeseen events or shifts in market conditions beyond the dataset time frame. It is also important to consider potential multicollinearity among the independent variables, which could impact the accuracy of the regression coefficients.

Furthermore, the lack of data on fund management costs prevents from drawing final conclusions about the idea of using these products in investment portfolios addressing retail investors, with limited economic capacity, as a form of diversification with a focus on cost-effectiveness.

To sum up, our analysis provides a contribution to understand the dynamics between macroeconomic variables and different types of investments. Overall, we can say that thematic and sustainable investments seem to be more resilient to economic downturns. In particular, the sample of Funds and ETFs proposed show that financial products related to water sector have a weaker correlation to macroeconomic variable. Further research and validation with additional datasets or alternative models could enhance the robustness of these findings.

We are not able to say what will be the impact of this asset class in the future. But we are sure that, according to what is happening now, in terms of climate change, impact and importance that companies, investors and fund selectors give to sustainability, this asset class will attract more and more attention.

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