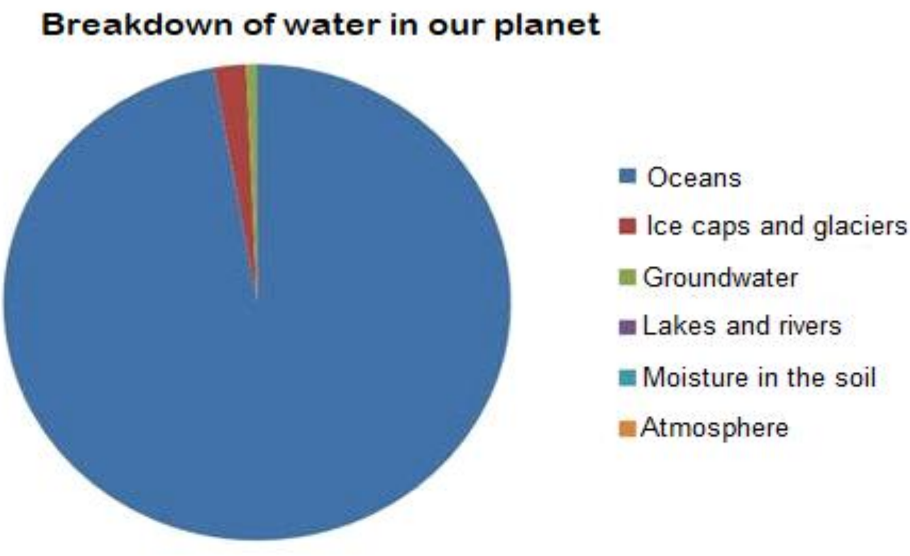
Presentation of desalination plants

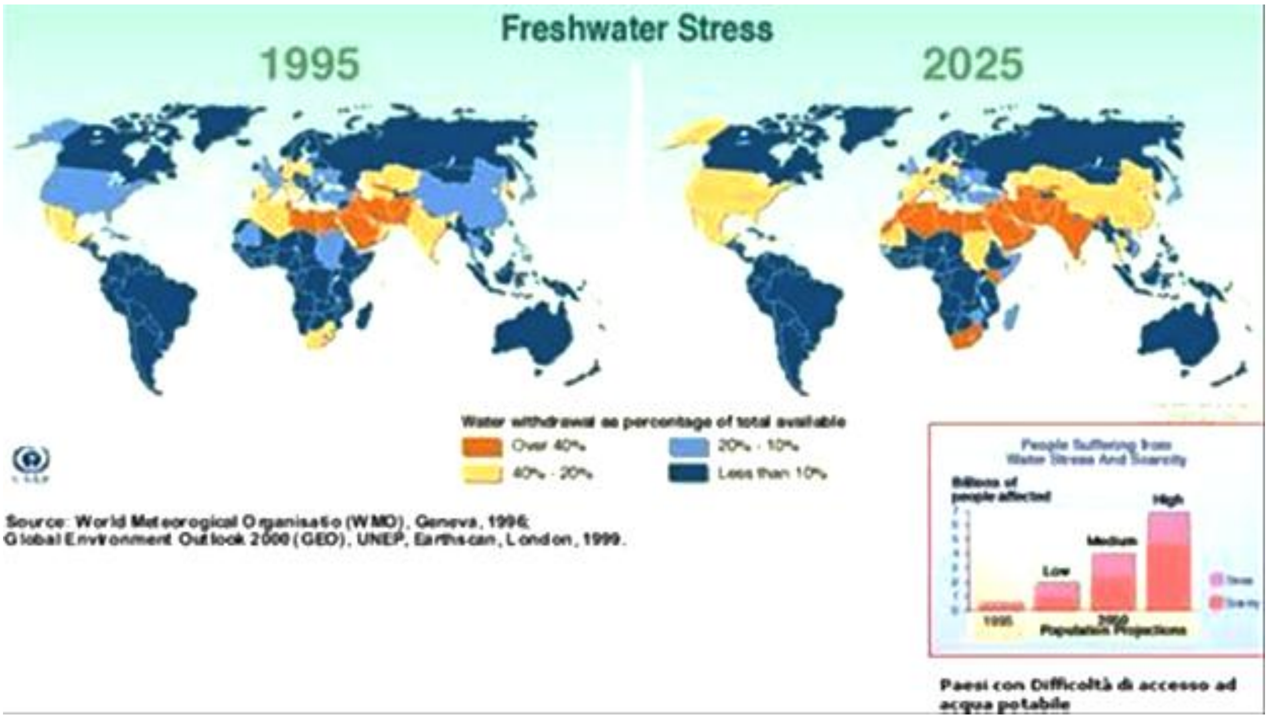
In this crazy modern world, the world is shaken by the fear of the end of traditional energy resources, peoples, engineers, scientists are all concerned with how to save the planet from the lack of oil and gas, indispensable for running the most industrialized nations and the race for the transformation of energy means and resources is now done.

Let's be clear, I have been dealing with renewable energy for 18 years, so I can only be happy about it, but in this currency very few worry about another type of gold, if oil is black gold, drinking water is blue gold .

Our planet is made up of about 71% of water, the remaining part of land, but of this 71% of water that is on our planet only 2.5% is drinkable and access to this resource is very different from area to area, we ourselves are made up of about 80% water and for us water is life as it is for the plants and animals that populate our world.



Between droughts, natural disasters the great distribution of humidity is threatened by climate change, the need for new sources of drinking water grows with each passing day. Every year the world population is believed to be about 85 million people, the demand for fresh water grows at double the growth rate of the population, doubling every 20 years or so. Worldwide, our rarest and most important resource is under stress and not all nations have the same access to fresh water or the ability to access it



So why not convert sea water into fresh water?

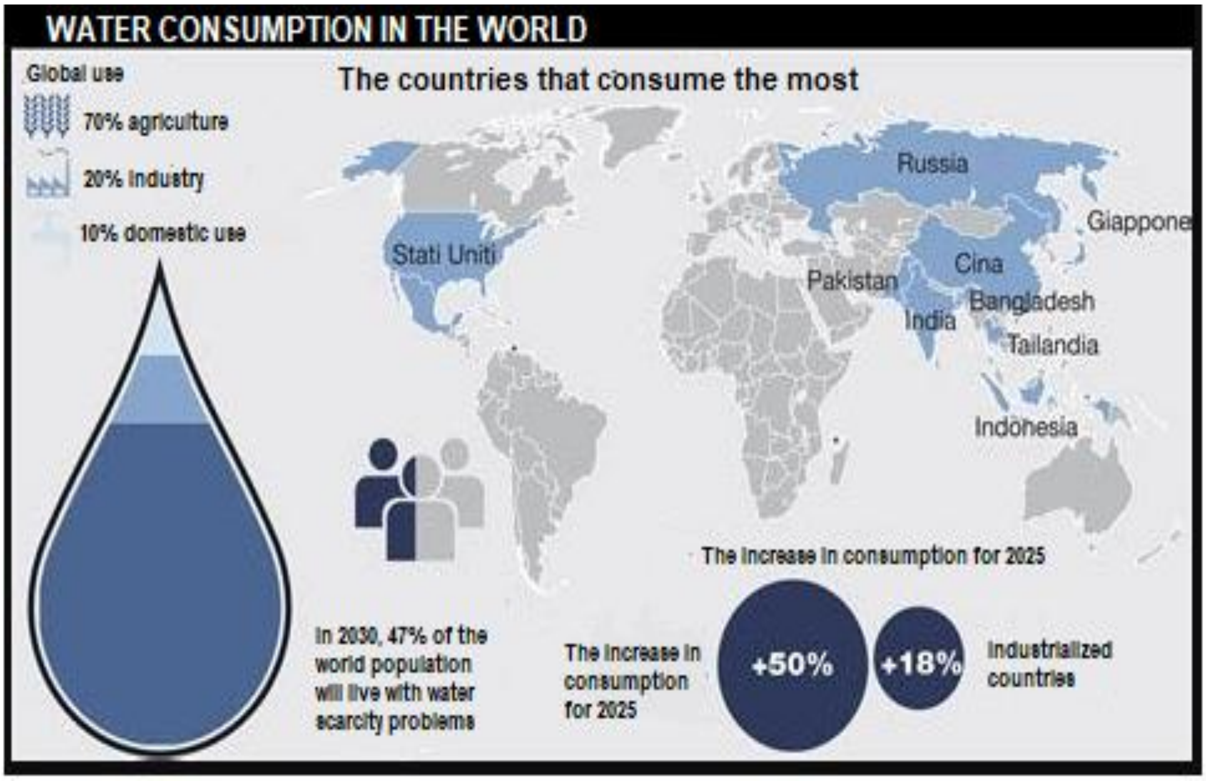
In reality this is possible and we can and must do it, people have been doing it since the time of the ancient Greeks and the basic procedure has remained the same ..

The idea of desalinators, to desalinate sea water or variously brackish water and make it available for human activities, is not new and today seems more and more a concrete and realistic solution to satisfy at least part of humanity's thirst for fresh water and there are strong interests (not only social and humanitarian) in optimizing desalination technologies and in reducing their costs for large-scale use, costs that are still too high for many of the countries that would need them most. The approximately 16,000 desalination plants scattered around the world are in fact mostly concentrated in the Middle East and North Africa, in economically developed and rich contexts.
A recent study (December 2018) commissioned by the UN reveals that the production capacity of more or less soft water of the desalination plants is approximately 95 million cubic meters per day, or approximately 95 billion liters per day.
In Italy the average per capita consumption is about 200 liters, on average a family of 5 people uses and consumes and often wastes about 1 cubic meter of water.
There are 628,000 liters of water a year for every single person on Earth engaged in producing food (about 70%), for every type of industrial or manufacturing production (about 20%), for all domestic, city, social and recreational activities. (about 10%).
This gives the idea of how much water the whole world can serve and why fresh water is in fact blue gold.
So how can we convert and which are the countries where this technology is most developed?
As mentioned, desalination was already known in the times of the Greeks when people boiled and collected the steam in the sponges to then store it, still today this principle is used in part, the water is heated and becomes

water vapor leaving the salts and other impurities , then condenses as it cools and falls in the form of fresh water.

Improved distillation plants accelerate this process by artificially heating and cooling the steam but this method requires large amounts of energy.

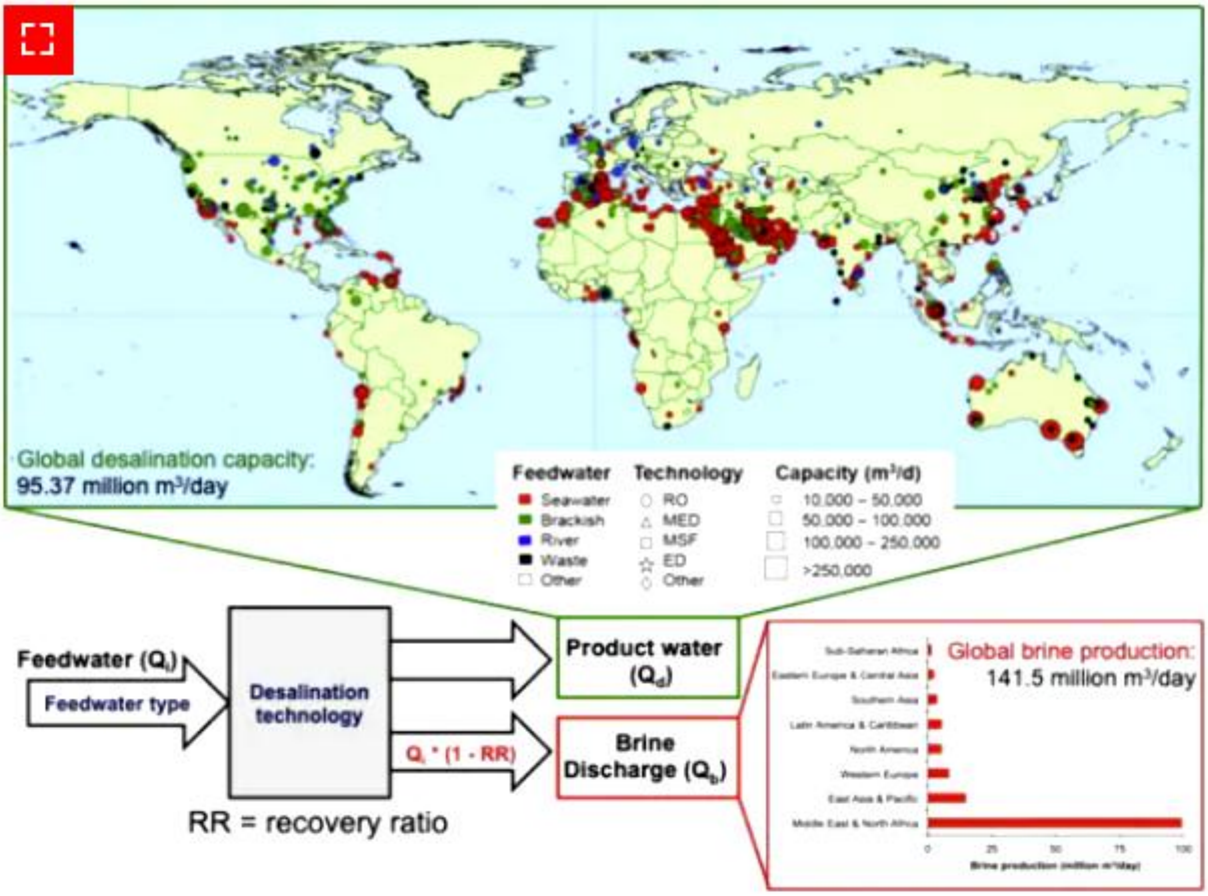
Currently the most widely used method is that of Reverse Osmosis (RO), this system uses pressure to force sea water through filters, separating the substances at the molecular level.
Developed in 1960, the process became feasible on a commercial scale ten years later and is the one most used today because it requires less energy to remove salt and other seawater compounds, producing water that is safe to drink (500ppm, while the limit in Italy is 1500 ppm) far higher than the standards relating to drinking water.



But which are the countries that make more use of desalination plants?

essentially everyone, including Italy, even if for obvious reasons the Arab countries are the ones that make the most of it, but also North Africa, Australia and New Zealand, the coastal part of China and the USA.

The following table will better clarify the words where they are used



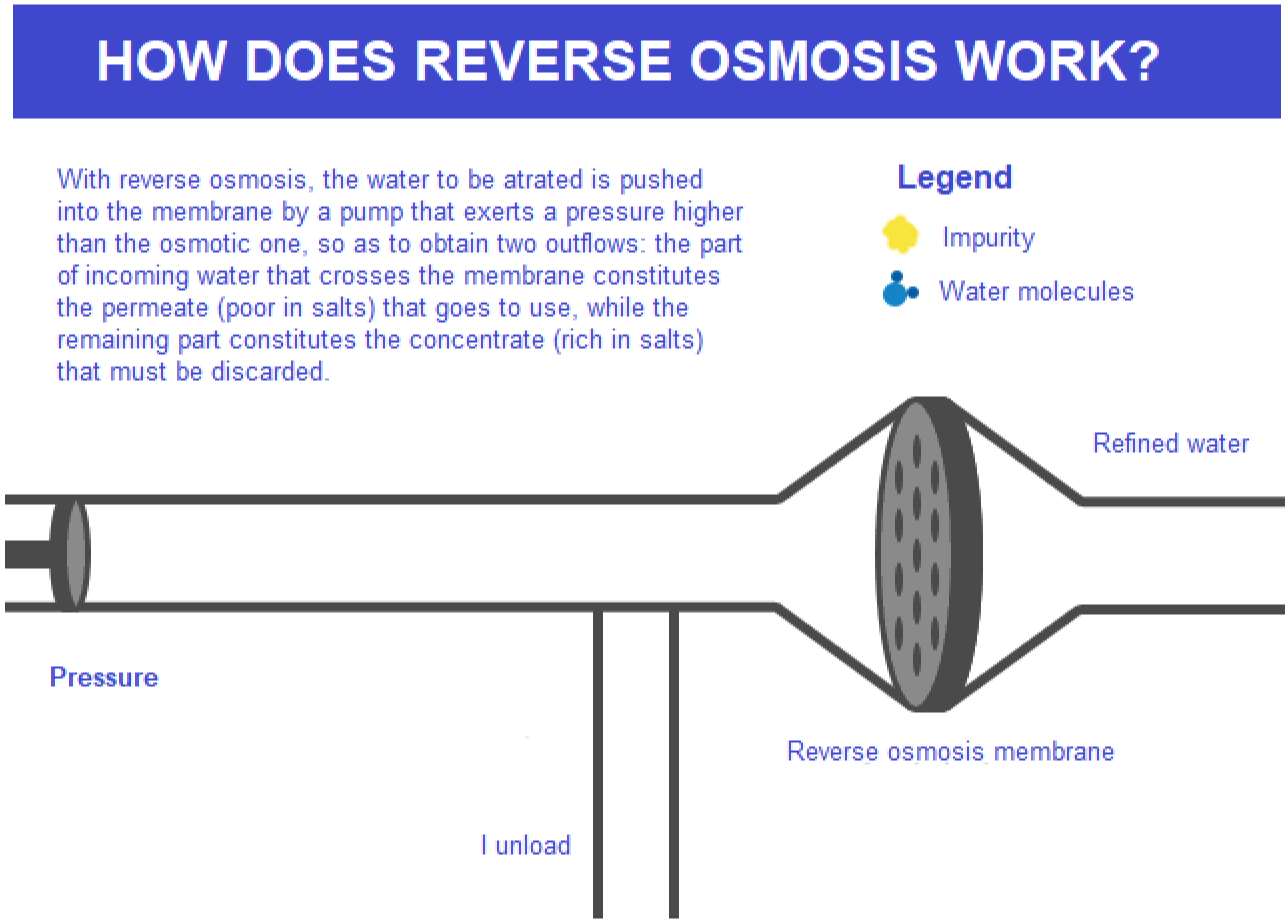
Desalinators, an overview: at the top, the distribution of desalination plants worldwide, for a total of 95 million cubic meters per day (end of 2018).
In this part of the graph the colors correspond to the primary water supply sources: sea water (red), brackish water (green), rivers (blue), recycling (black). Below the simplified flow of the process that currently ends with the brine, 140 million cubic meters per day.

But how does a water desalination plant work?

Osmosis is a natural phenomenon, of vital importance for animals and plants, which allows the cell pressure to be maintained and regulated thanks to the membrane that constitutes it, which is semipermeable, i.e. permeable to water but not to certain solutes such as dissolved salts, sugars and proteins.
So osmosis is a chemical-physical process that occurs whenever two aqueous solutions containing different saline concentrations are separated by a semipermeable membrane, in this situation the spontaneous passage of water from the most diluted solution to the most concentrated one takes place until the of the same salinity.
The pressure that is generated is the so-called "osmotic pressure": the greater the difference between the starting saline concentrations, the higher the osmotic pressure value.
What is reverse osmosis?
By exerting a counterpressure, higher than the osmotic one, the process can be reversed.

The operating pressures required to achieve reverse osmosis can be considerable: if it is sea water, the pressure that must be exerted is several tens of atmospheres, while for mains or weakly brackish water the osmotic pressure values are they hover around 10 bars.
This is the principle on which reverse osmosis is based: the passage of water through a semi-permeable membrane in the opposite direction to the natural one, with the generation of two solutions: one with a high salt concentration and the other very diluted.
Modern technologies offer the market a wide range of compact and very efficient reverse osmosis systems, which can be used to purify water with a high concentration of salts and pollutants, or to improve the quality of common mains water.
Undeniable advantages are offered by the reverse osmosis technology when the mains water, although drinkable, does not have excellent characteristics, such as some groundwater characterized by a high concentration of nitrates, herbicides or pesticides, or other pollutants that are difficult to remove with other technologies; vice versa, this technology offers an overabundant treatment for a large part of the mains water, which often only requires a refinement of the organoleptic characteristics.

How reverse osmosis works



Reverse osmosis is a membrane process, which allows you to remove almost all of the substances present in it, both suspended and dissolved, from the water.
The action of an osmotic membrane is not only mechanical, separation occurs thanks to diffusion and dissolution mechanisms, which intervene to varying degrees and allow it to act up to the ionic level.

An osmotic membrane consists of a central core around which a semi-permeable synthetic material (eg polysulfone) is wound in a spiral.
Membranes are generally classified according to dimensions according to standards generally expressed in inches (e.g. a 4040 membrane corresponds to a module 40 inches long and 4.0 wide), but also depending on the production capacity, generally indicated in GPD (gallons per day).
The water to be treated is pushed into the membrane by a pump, which exerts a pressure higher than the osmotic one, so as to obtain two outflows: the part of incoming water that crosses the membrane constitutes the permeate (poor in salts) that goes use, while the remaining part comes out with a high salt concentration, due to the accumulation of all the salts that have not crossed the membrane, it is the concentrate (rich in salts) that must be discarded.
The salt content of a water, also called Fixed Residue or TDS (Total Dissolved Solid), is measured in mg / L (or ppm). An osmotic membrane produces an average of 20% of permeate compared to the incoming flow, but for larger systems, which require the use of several membranes in series, this value can exceed 75%.
The rejection of a membrane, or the ability to remove the solute present in the water, is influenced by various parameters such as the characteristics of the water itself, the operating pressure and temperature; in any case, the removal values for the vast amount of substances present in the water generally exceed 95%.
To date, a good reverse osmosis system is able to treat large quantities of sea water and transform them into fresh water with 500ppm (Italian legislation allows 1500ppm), obviously, as in all mechanical machines, maintenance is essential.
The machines are delivered in containers and can be powered by renewable sources such as photovoltaic, wind or biomass modules and cogeneration also supported with energy storage systems and the only works they need are the connection to the water network, a concrete base. on which to place the container and finally the pipe from which to suck sea water necessary for the transformation and in environments where conditions are extreme, so either very hot or very cold, maybe put the system under a canopy ..
and the water is served!