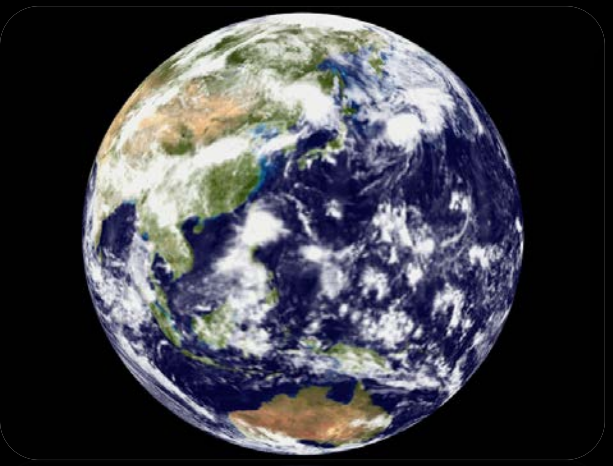
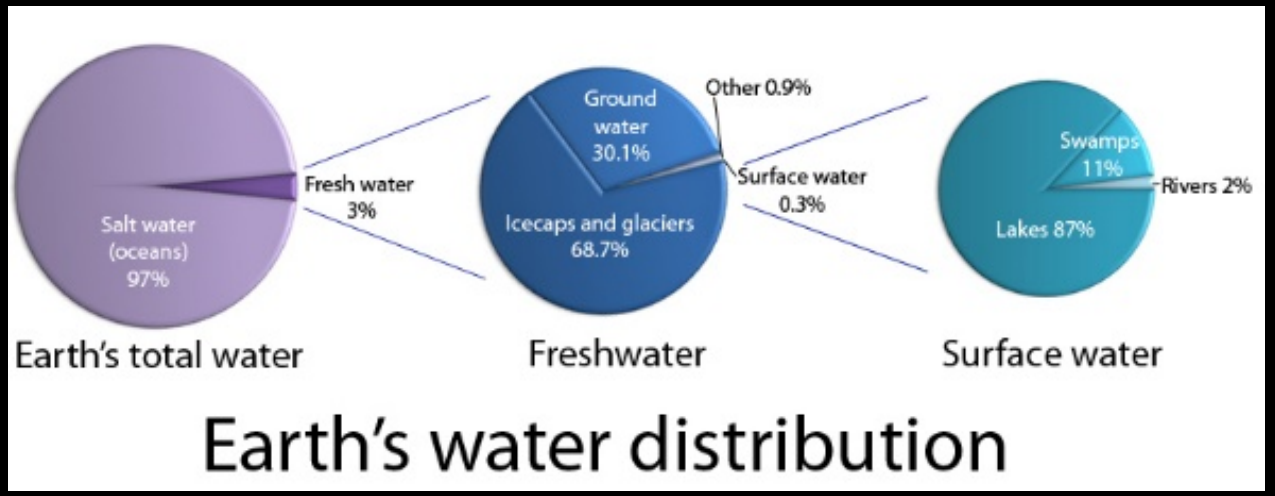
WATER RESOURCES





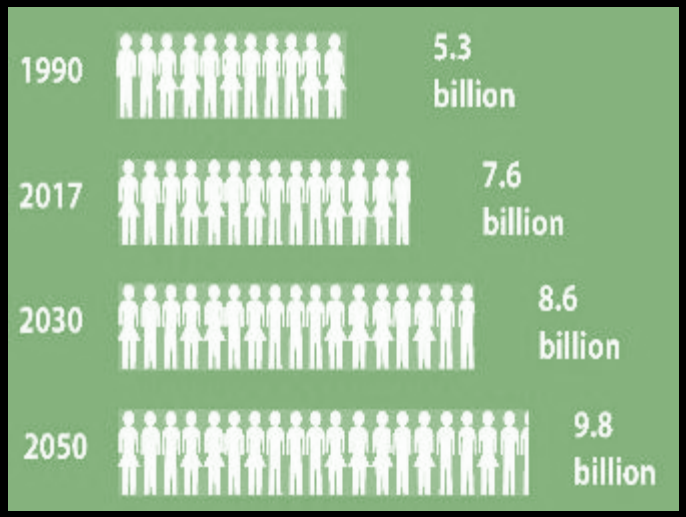
Swamp in Louisiana, USA

Icecaps and glaciers, Antarctica

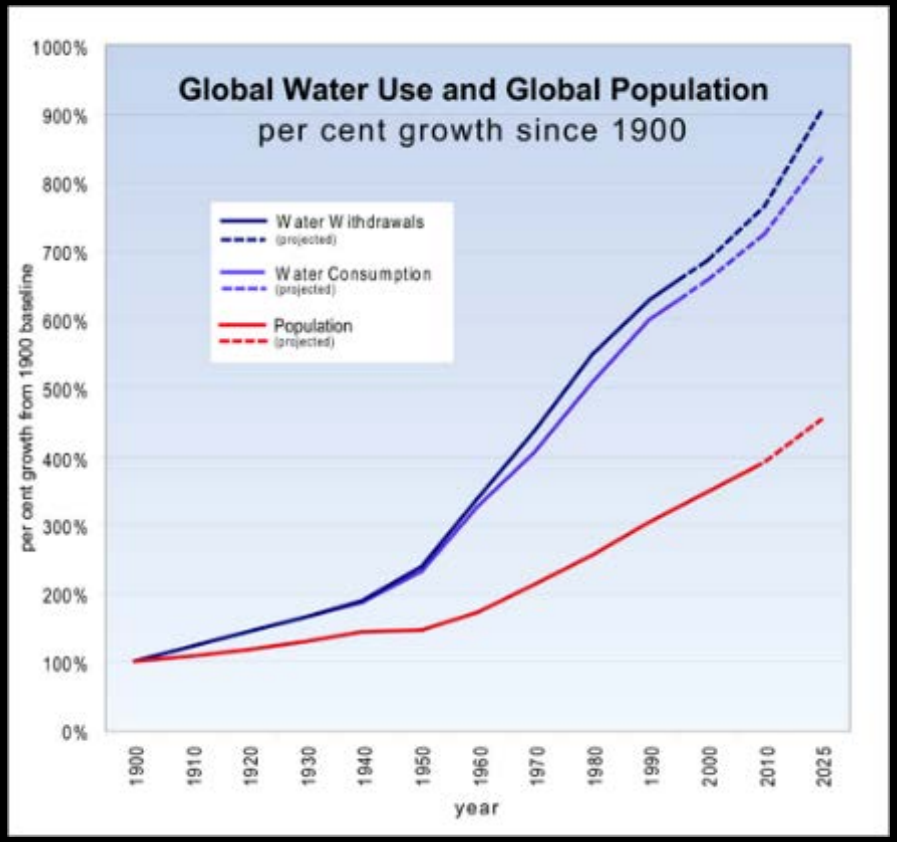
Lake Saimaa, Finland

Reference: https://www.sciencelearn.org.nz/images/802-earth-s-water-distribution

WORLD POPULATION GROWTH

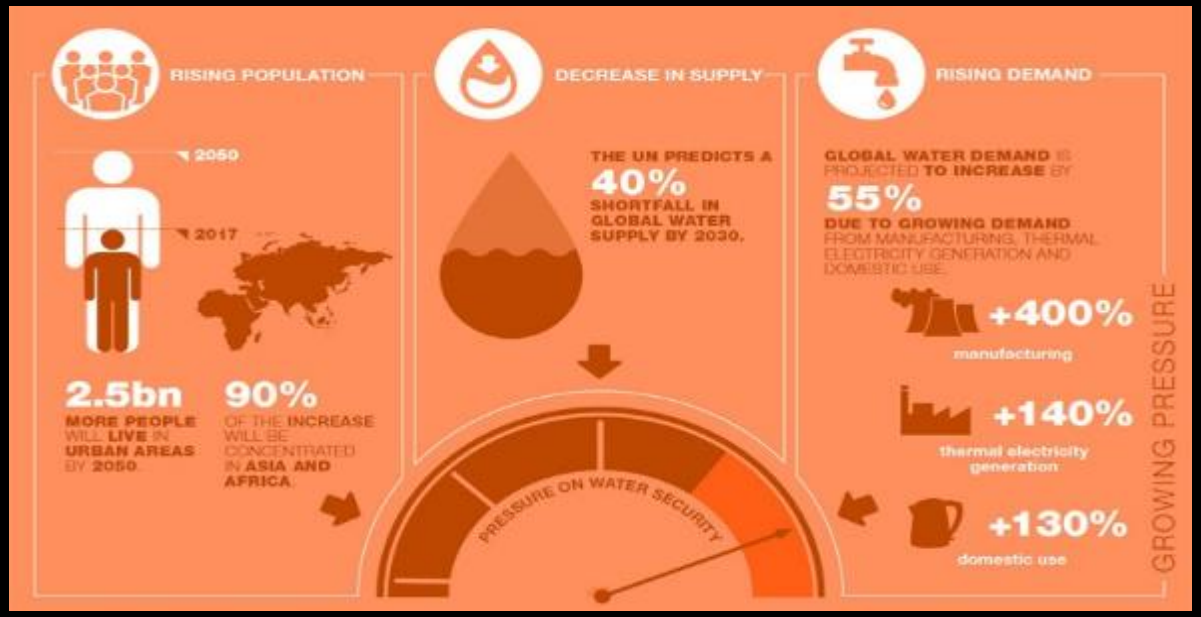


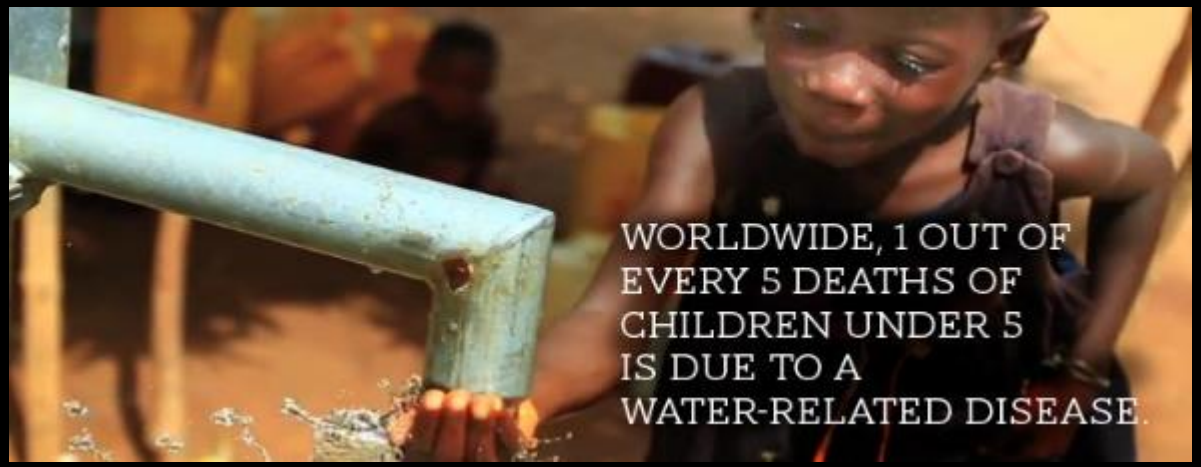
The **rate of growth in freshwater consumption** has been even **more rapid** than global **population growth**



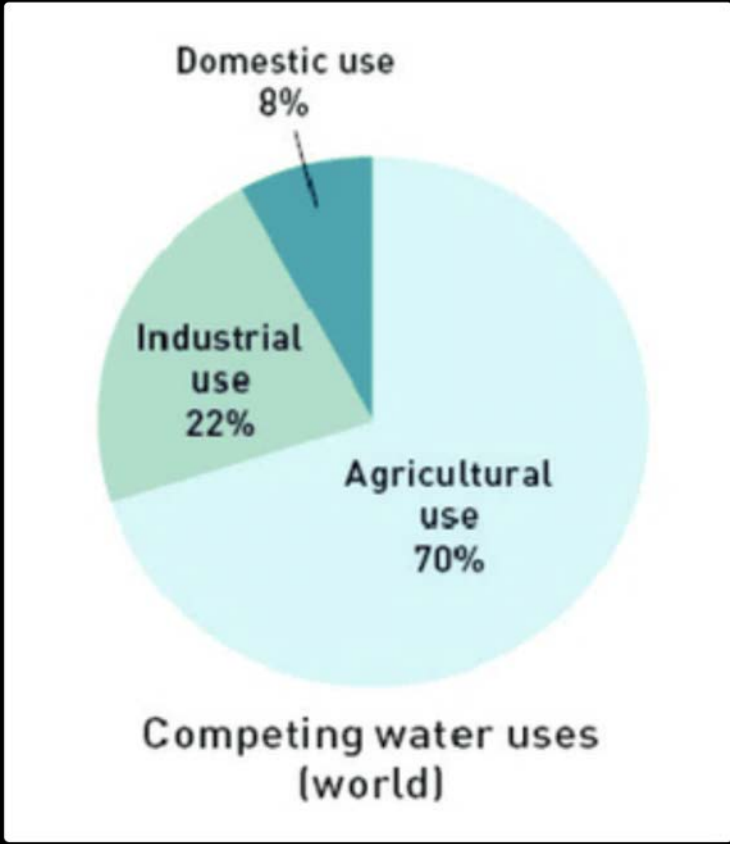
References:
1.United Nations Department of Information and social affair: Infographics, World Population.
2.Nurul Hassan. Ground Water Depletion Due To Water Mining– A Threat. Journal of Environmental Science, Computer Science and Engineering & Technology (JECET) Sec. A; 2016, Vol.5. No.2, 129-136

SOME FACTS ABOUT WATER





WATER USE AND WATER DEMAND

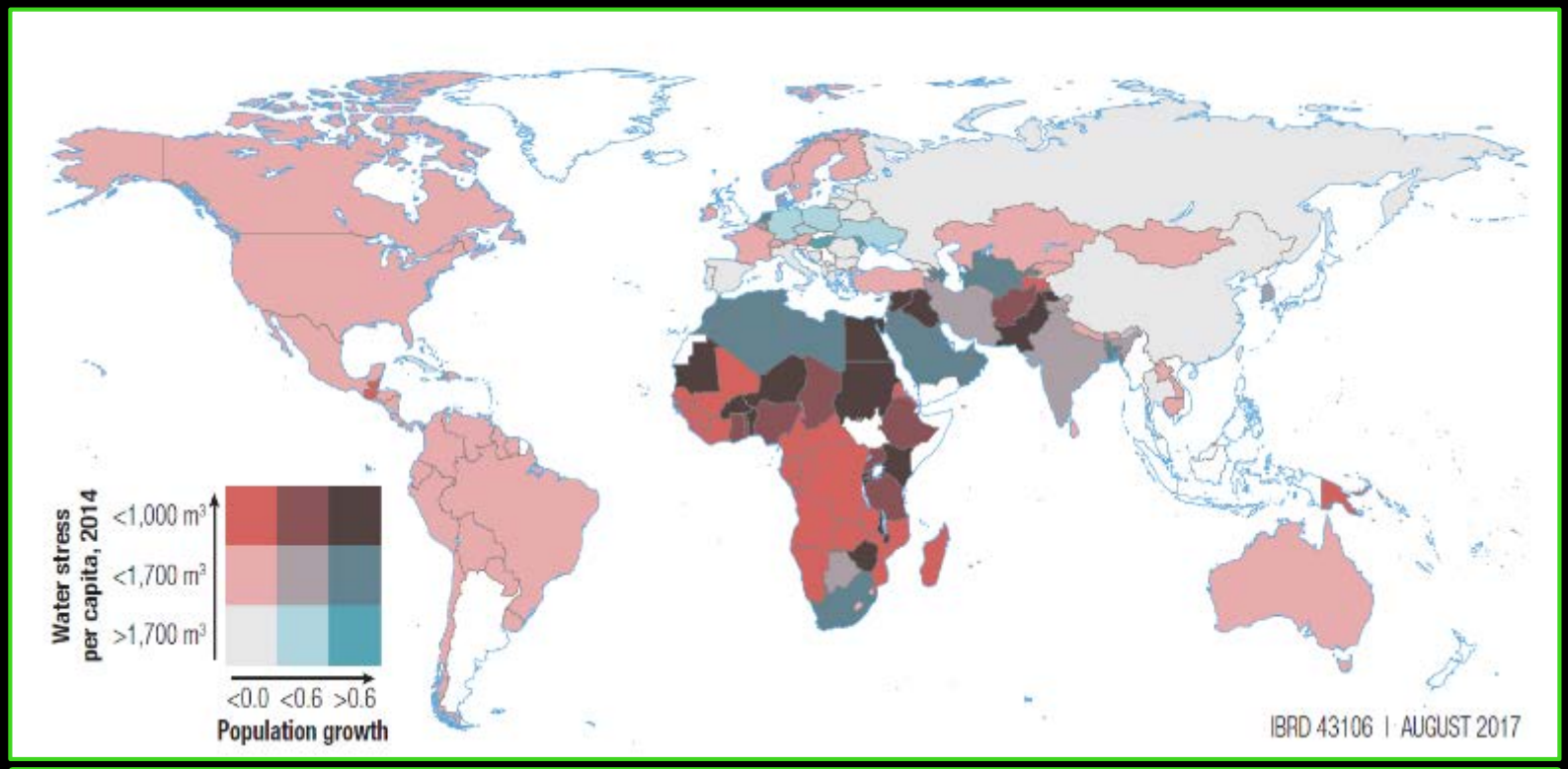


Water use has been increasing worldwide by about 1% per year since the 1980s.

Global water demand is expected to continue increasing at a similar rate until 2050.

References:
1. United States Educational Scientific and Cultural Organization. Competing water uses for main income groups of countries. Retrieved from http://www.unesco.org/water/wwap/facts_figures/water_industry.shtml on March 16,2011
2. Water Energy Nexus, Internaltional energy agency, OECD/IEA, 2016

Water Availability & Future Population Growth, 2050



About **4 billion people**, representing nearly two-thirds of the world population, **experience severe water scarcity** during at least **one month of the year**

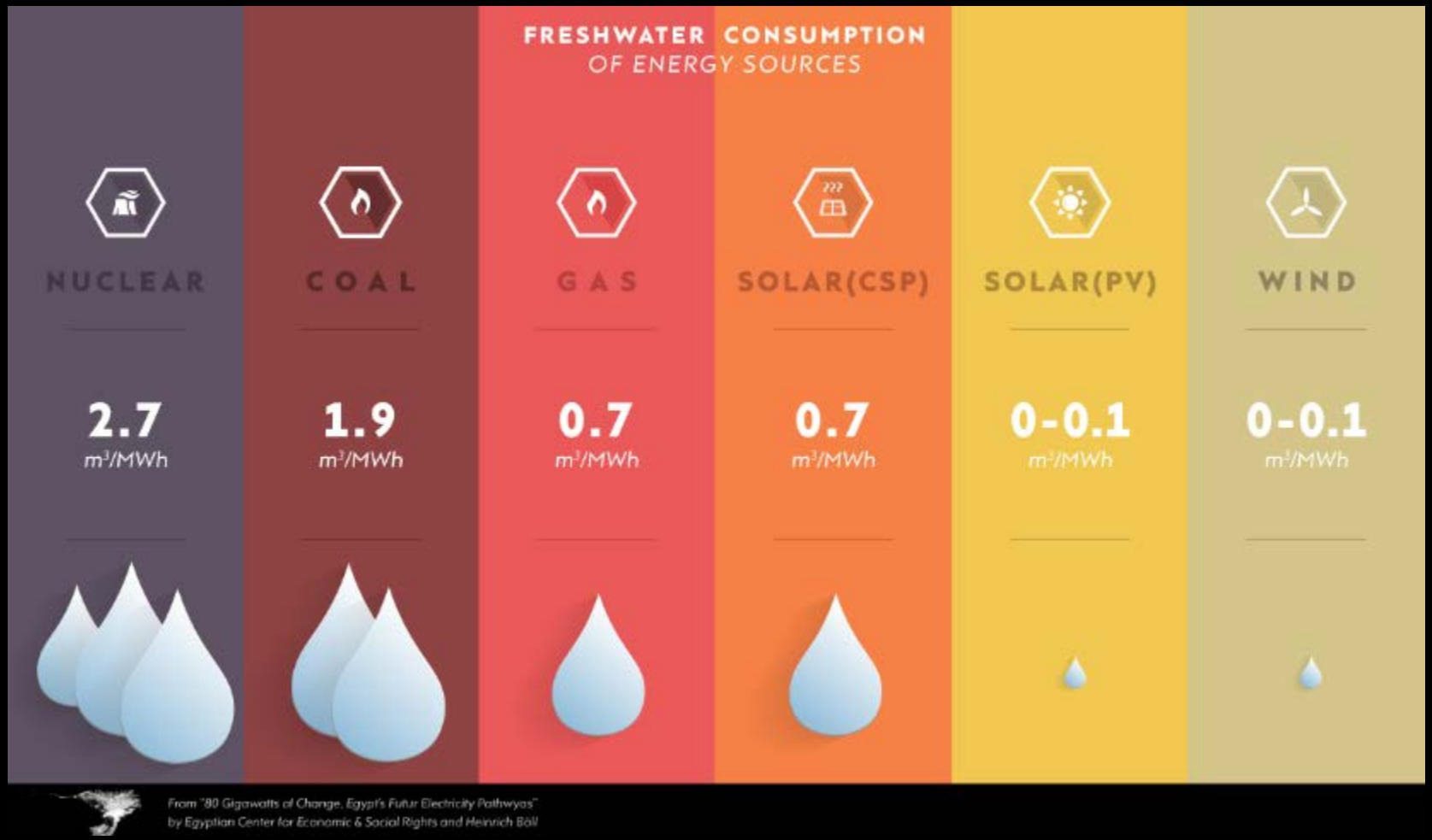
Sources: Freshwater availability data: FAO AQUASTAT database. Population growth estimates: United Nations Population Division, World Population Prospects, 2015 revision (moderate scenario), for the year 2050.

Water consumption for production processes

- ✓ 1 kilo of beef takes 15,500 liters of water,
- ✓ 1 cotton shirt takes 2,700 liters of water,
- ✓ 1 glass of wine takes 120 liters of water,
- ✓ 1 sheet of paper takes 10 liters of water.

Source: http://www.nerdgraph.com/look-done-water/

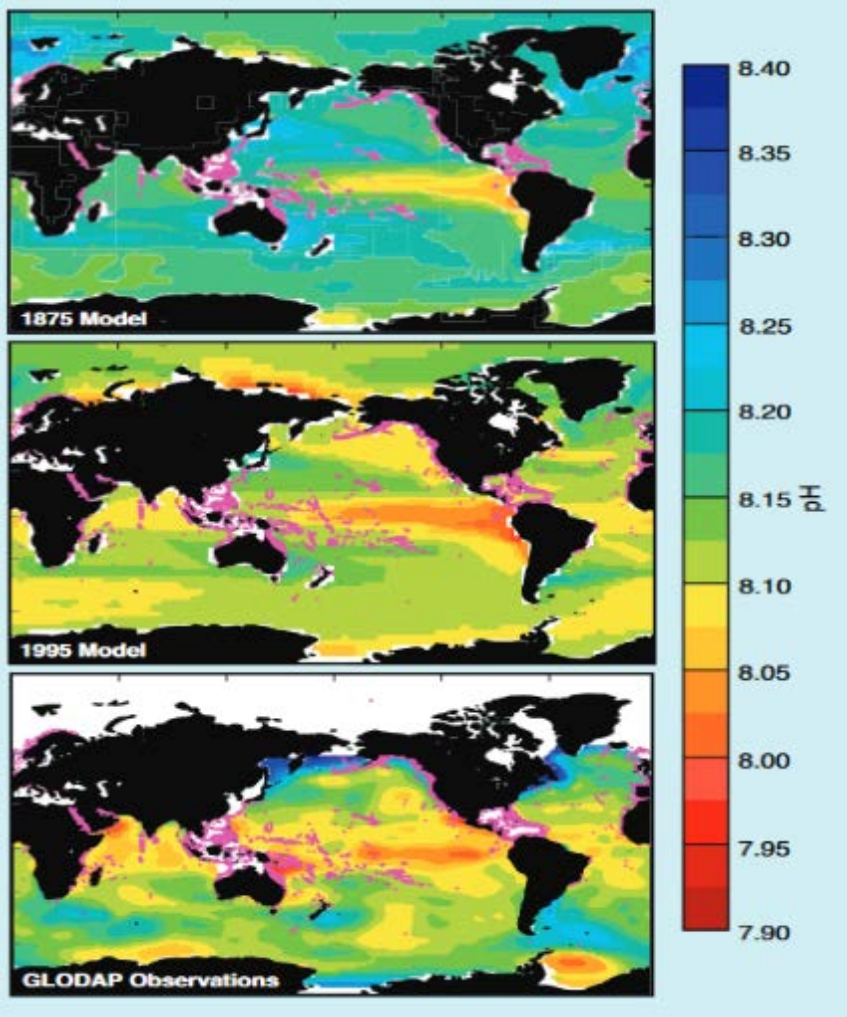
SOME FACTS ABOUT WATER



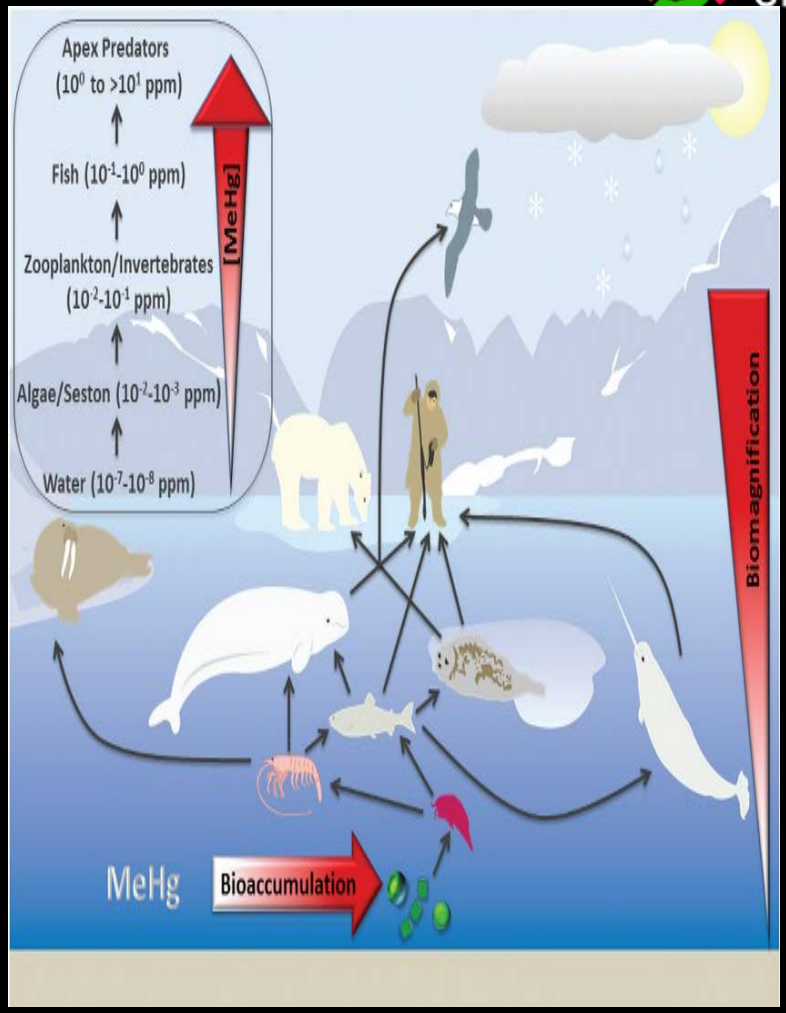
From "80 Gigawatts of Change. Egypt's Futur Electricity Pathways"
by Egyptian Center for Economic & Social Rights and Heinrich Böll

EFFECT OF CLIMATE CHANGE ON WATER QUALITY

Ocean acidification



Climate system model shows the increase in ocean acidification from 1875 to 1995 model.



Bioaccumulation and bio magnification of MeHg in oceans and it´s ultimate effect on whole ecosystem

Figure: National Center for Atmospheric Research Community Climate System Model
Source: IPCC

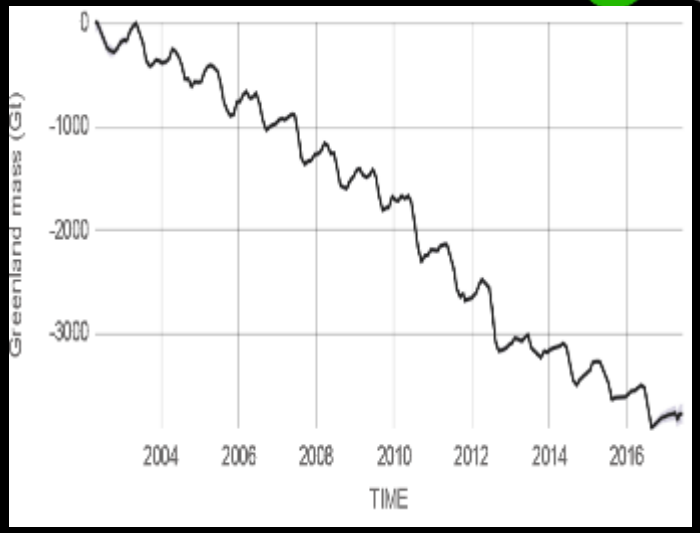
EFFECT OF CLIMATE CHANGE ON WATER SUPPLY

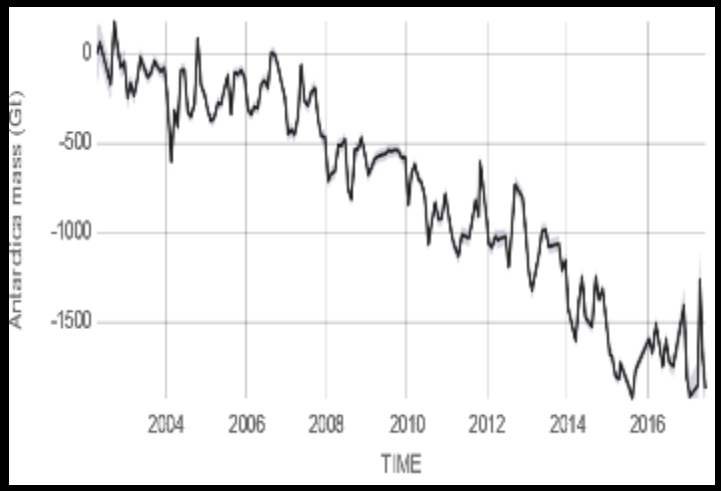
Shrinking of ice sheets

- The rate of Antarctica ice mass loss has tripled in the last decade.

- Greenland lost an average of 281 billion tons of ice per year between 1993 and 2016.

- Antarctica lost about 119 billion tons during the same time period.





Figures: The decreased in mass of the Greenland and Antarctic ice sheets over the time

Reference: climate.nasa.gov

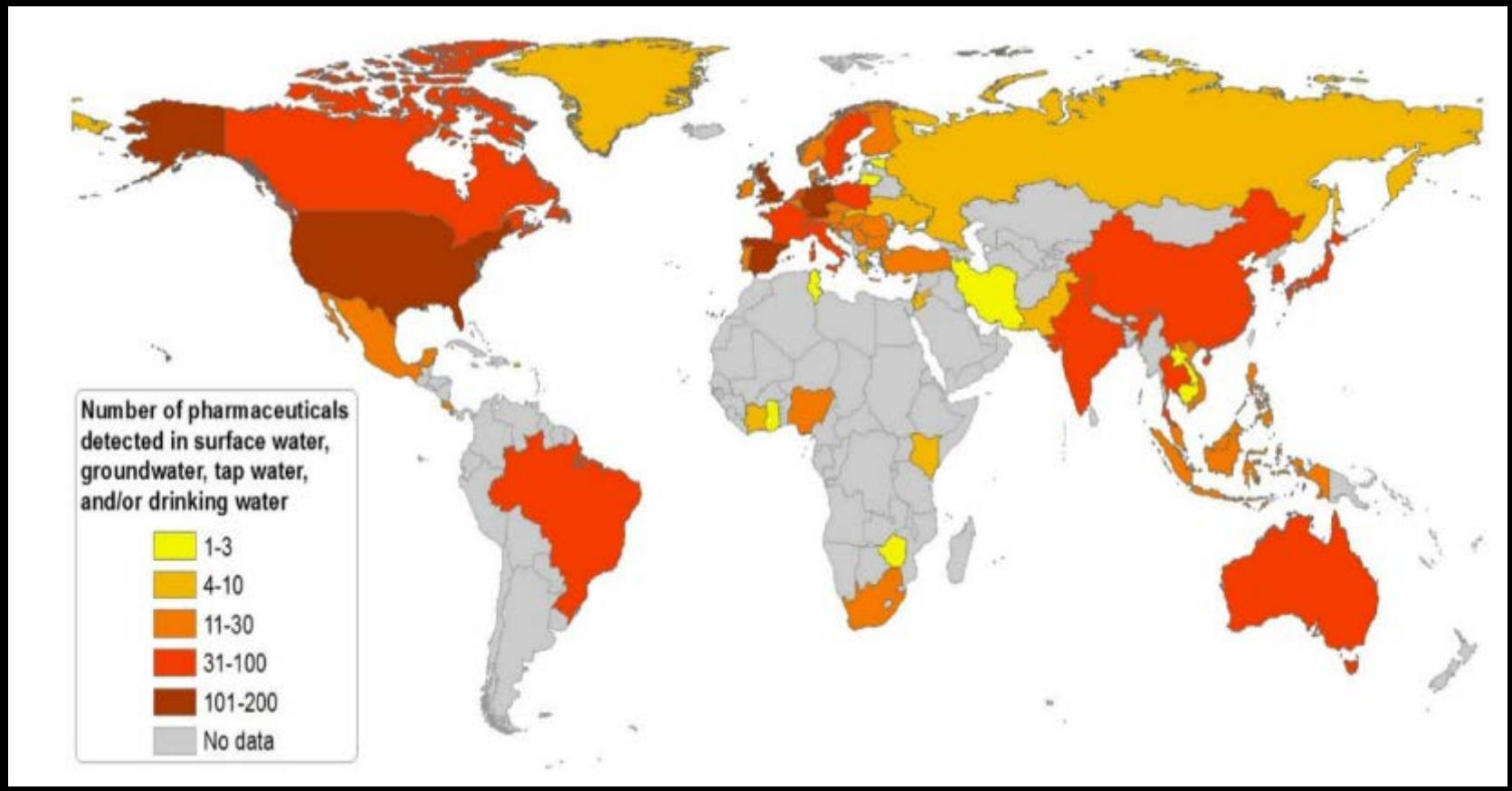
Glacial retreat

The disappearing snowcap of Mount Kilimanjaro, the highest mountain in Africa, from space.

February 1993 **February 2000**

Reference: UNEP,NASA

PHARMACEUTICALS IN WATER



Reference: Aus Der Beek, T., Weber, F. A., Bergmann, A., Hickmann, S., Ebert, I., Hein, A., & Küster, A. (2016). Pharmaceuticals in the environment-Global occurrences and perspectives. *Environmental Toxicology and Chemistry*, *35*(4), 823–835. https://doi.org/10.1002/etc.3339

PLASTICS

Global production is accelerating.
In 2015: 322 million tons
In 2050: > 600 million tons

Great Pacific Garbage Patch is
3 times the size of France

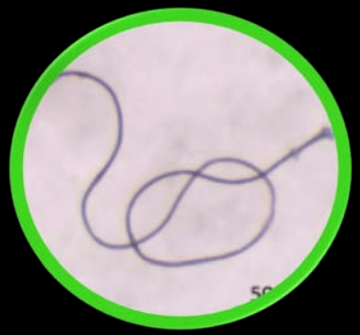
References:
Finnish Environmental Institute, SYKE Policy Brief, 2.3.2017. Microplastics – a growing environmental risk.
PlasticsEurope 2017. Plastics – the Facts 2017. An analysis of European plastics production, demand and waste data.
Lebreton et al. 2018. Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. Scientific Reports 8: 4666.

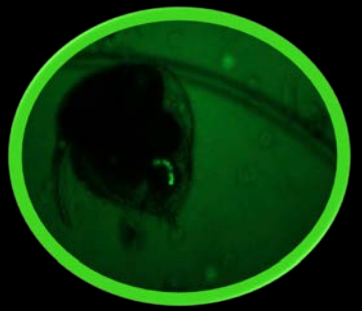
MICROPLASTIC POLLUTION

Shape:
fragments, spheres, films and fibers

Plastic items can have harmful and lethal impacts on animals due to entanglement or injuries on digestive systems.

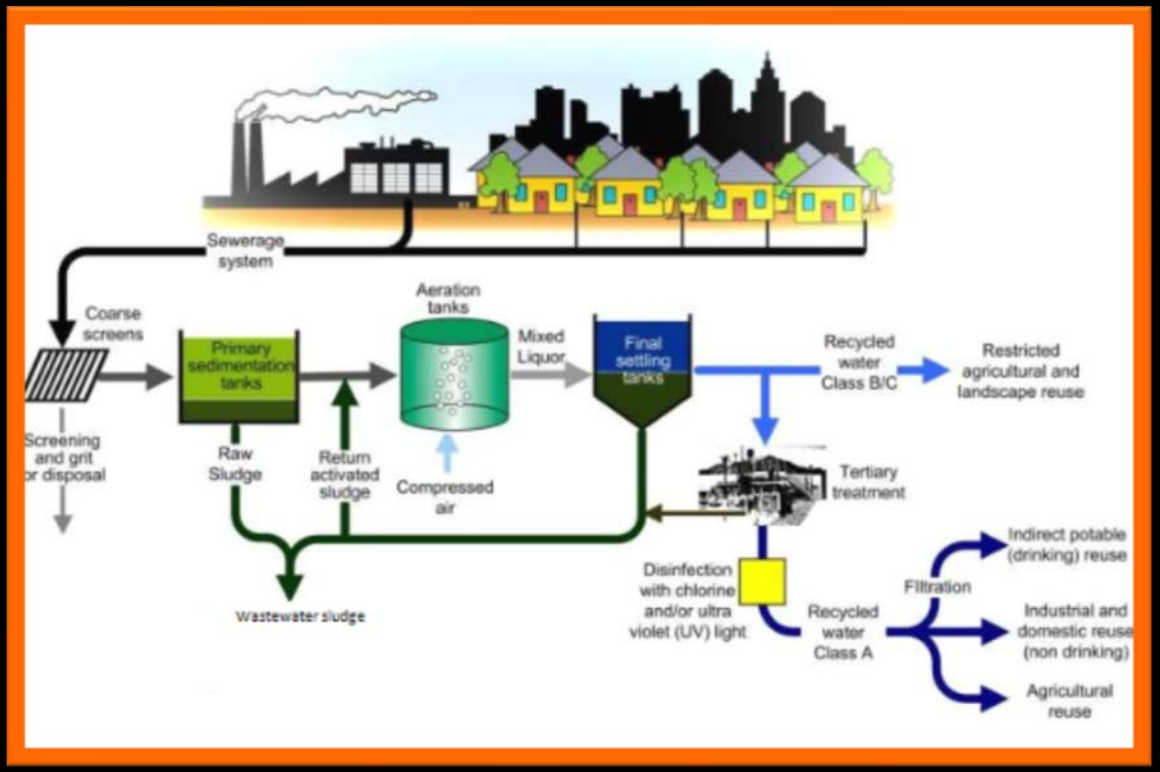
Size:
20 µm – 5 mm





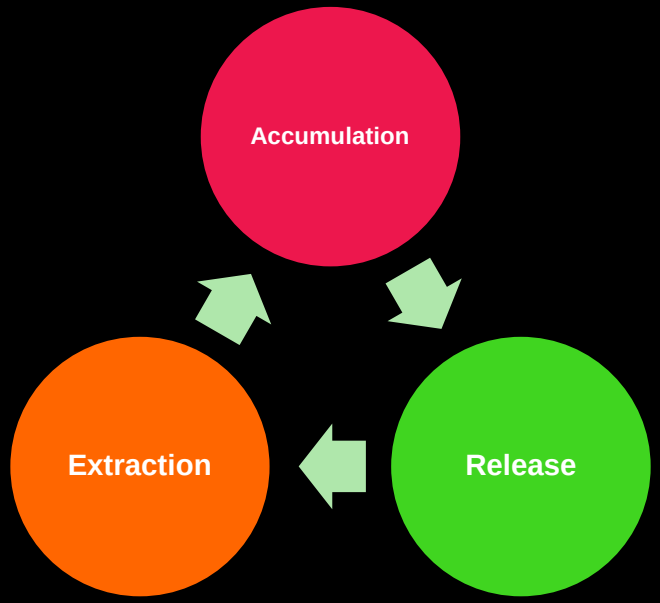
Lares et al. 2018. Occurrence, identification and removal of microplastic particles and fibers in conventional activated sludge process and advanced MBR technology. Water Research 133, 236-246.

CONVENTIONAL WASTEWATER TREATMENT

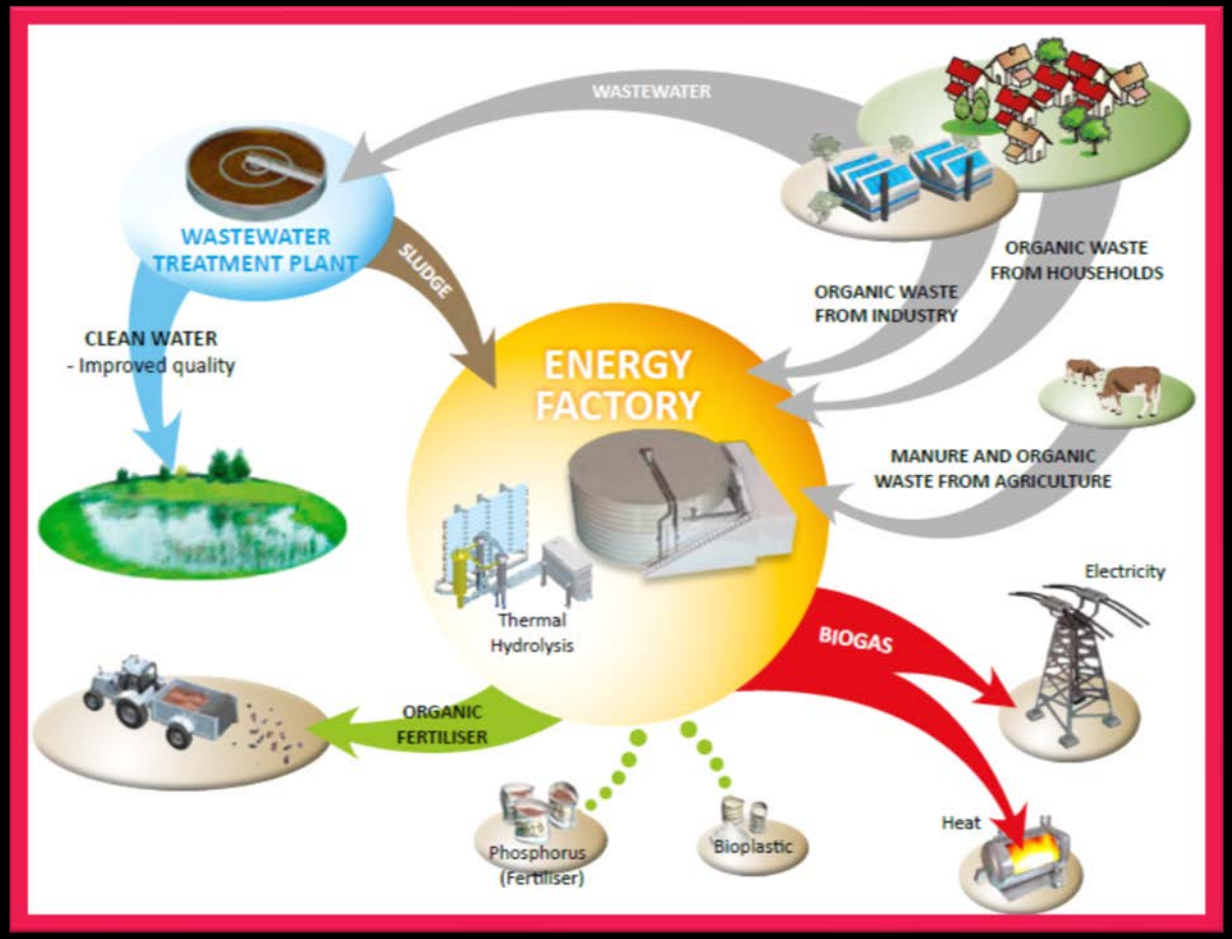


MOTIVES FOR RESOURCES RECOVERY

1. Reduce costs by recovering materials.
2. Reduce energy usage with the goal of becoming carbon neutral.
3. Mitigate risks from:
   - the occurrence of precipitates;
   - the emission of odours;
   - the discharge of metals into the environment;
   - the increase in salinity.



INTEGRATED RESOURCE RECOVERY

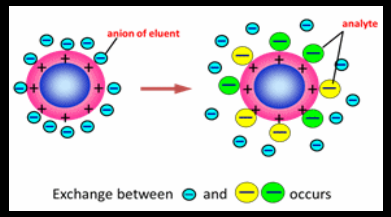


RESOURCES RECOVERY FROM WASTEWATER

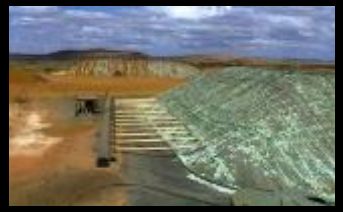
HOW TO RECOVER?

REE

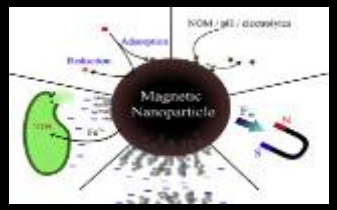
- Ion exchange



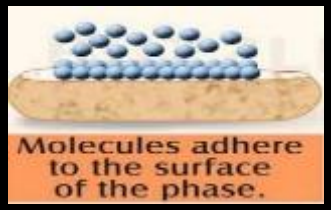
- Leaching



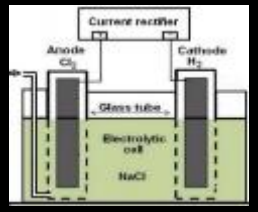
- Magnetic nanoparticles



- Adsorption

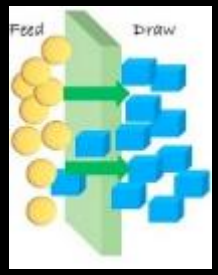


- Electrolytic recovery

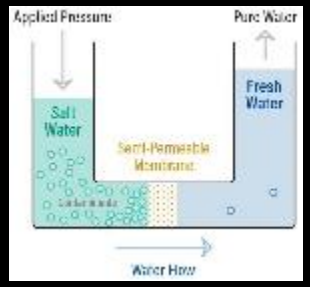


Nutrients

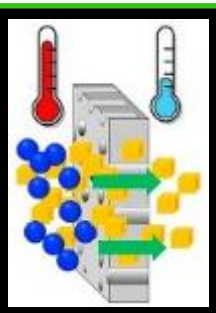
- Forward osmosis



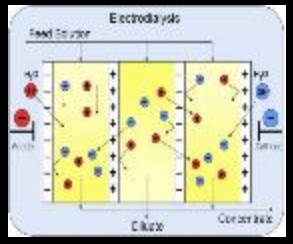
- Reverse osmosis



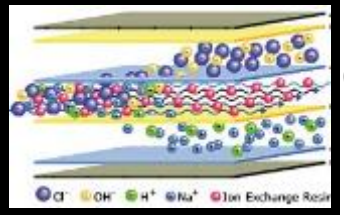
- Membrane distillation



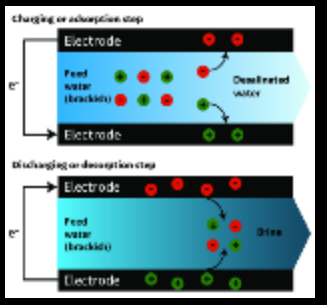
- Electrodialysis



- Electrodeionization



- Capacitive Deionization



Department of Green Chemistry (DGC)

- DGC is working for the green and sustainable development
- Department is specialized on:
  - Water and environmental analysis
  - Water, wastewater and soil purification technologies
- Aim is:
  - Hazardous waste minimization
  - Development of novel and sustainable water purification technologies
  - Maximizing the process efficiency while minimizing the use of energy and materials


Thank you!