LowTEMP

Tap Water Production

Technical Introduction and Implementation

Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

LowTEMP training package - OVERVIEW

Introduction

- Intro Climate Protection Policy and Goals
- Intro Energy Supply Systems and LTDH
- Energy Supply Systems in Baltic Sea Region

Energy Strategies and Pilot Projects

- Methodology of Development of Energy Strategies
- Pilot Energy Strategies – Aims and Conditions
- Pilot Energy Strategy – Examples
- Pilot Testing Measures
- CO_2 emission calculation
- LCA calculation

Financial Aspects

- Life cycle costs of LTDH projects
- Economic efficiency and funding gaps
- Contracting and payment models
- Business models and innovative funding structures

Technical Aspects

- Pipe Systems
- Combined heat and power (CHP)
- Large Scale Solar Thermal
- Waste & Surplus Heat
- Large Scale Heat Pumps
- Power-2-Heat and Power-2-X
- Thermal, Solar Ice and PCM Storages
- Heat Pump Systems
- LT and Floor heating
- Tap water production
- Ventilation Systems

Best Practice

- Best Practice I
- Best Practice II

Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

1. General Information

Freshwater resources

Household water use

Water footprint: „Invisible water“

General Information

Freshwater Resources

- Freshwater is availabe to over 90% of Europes population, but:
- A third of Europe is affected by scarcity and droughts
- **60%** of water is used in agricultulture!
- The share of municipal water (household distribution system) is only about 10 percent.
- Water is an essential resource for all aspects of our life!

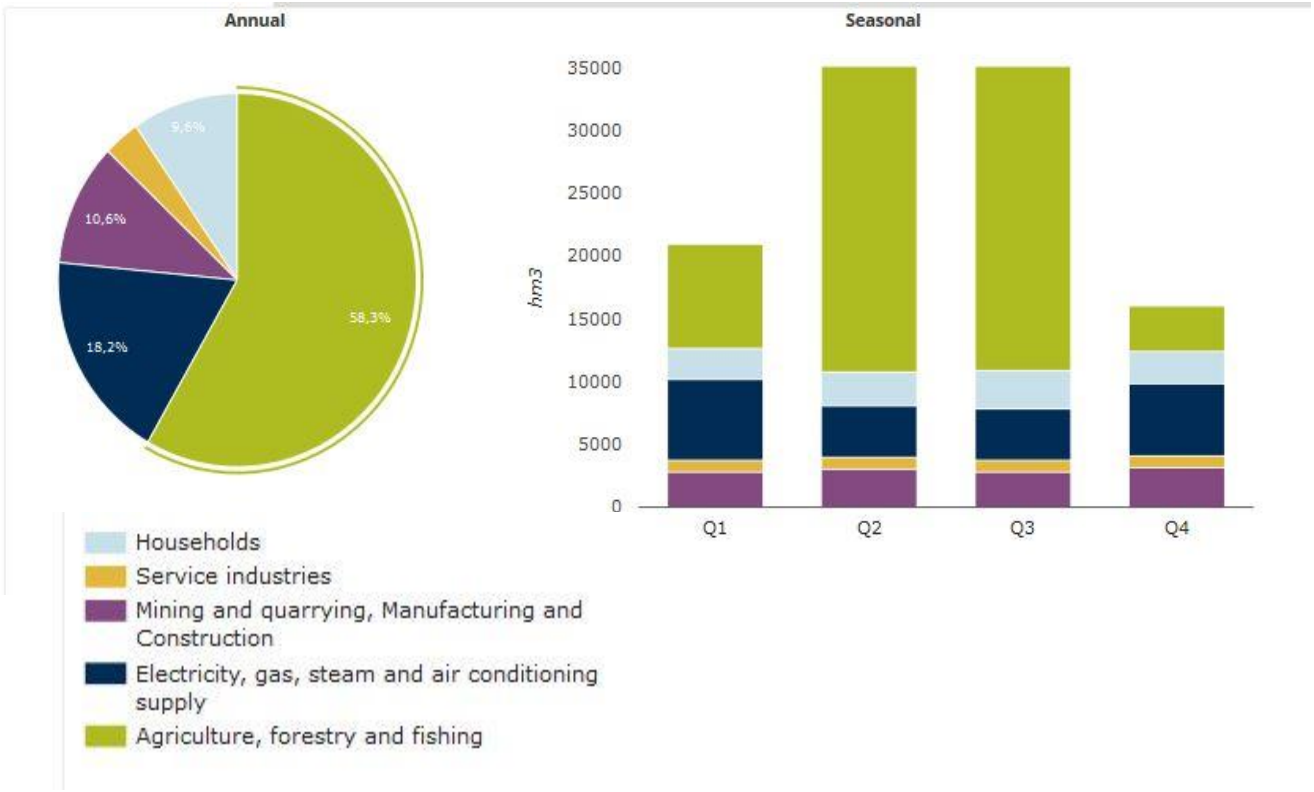

Figure 1: Water use in Europe by economic sector. Source: EEA [1]

General Information

- Global freshwater use has increased sixfold since 1900, with sharp increase since 1950.
  - This is mainly due to growing population and industry!
  - Countries with the highest water consumption are India, China and the U.S.A.
- While the absolute amount of freshwater use has increased, the distribution between regions has not changed significantly

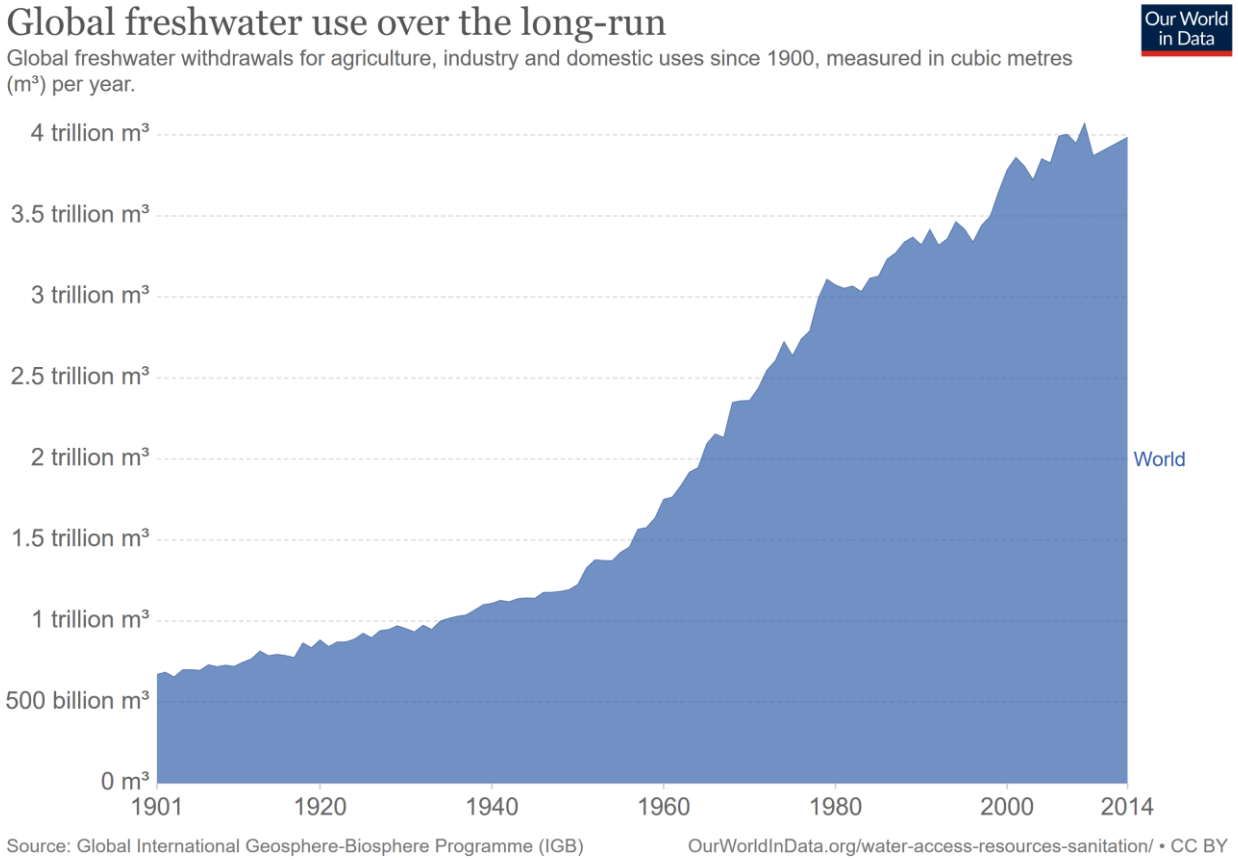

Figure 2: Global freshwater use since 1900. Source: IGB [2]

General Information

- Renewable freshwater resources describe the amount of replenishable water from rivers or rain downfalls in a country
  - The rescources decline, when more water is extracted than renewed
  - If the sources are constant, but the population increases, the total amount also declines
- Renewable internal resources are an important indicator for water scarcity in a country

→ **Water is a finite resource!**

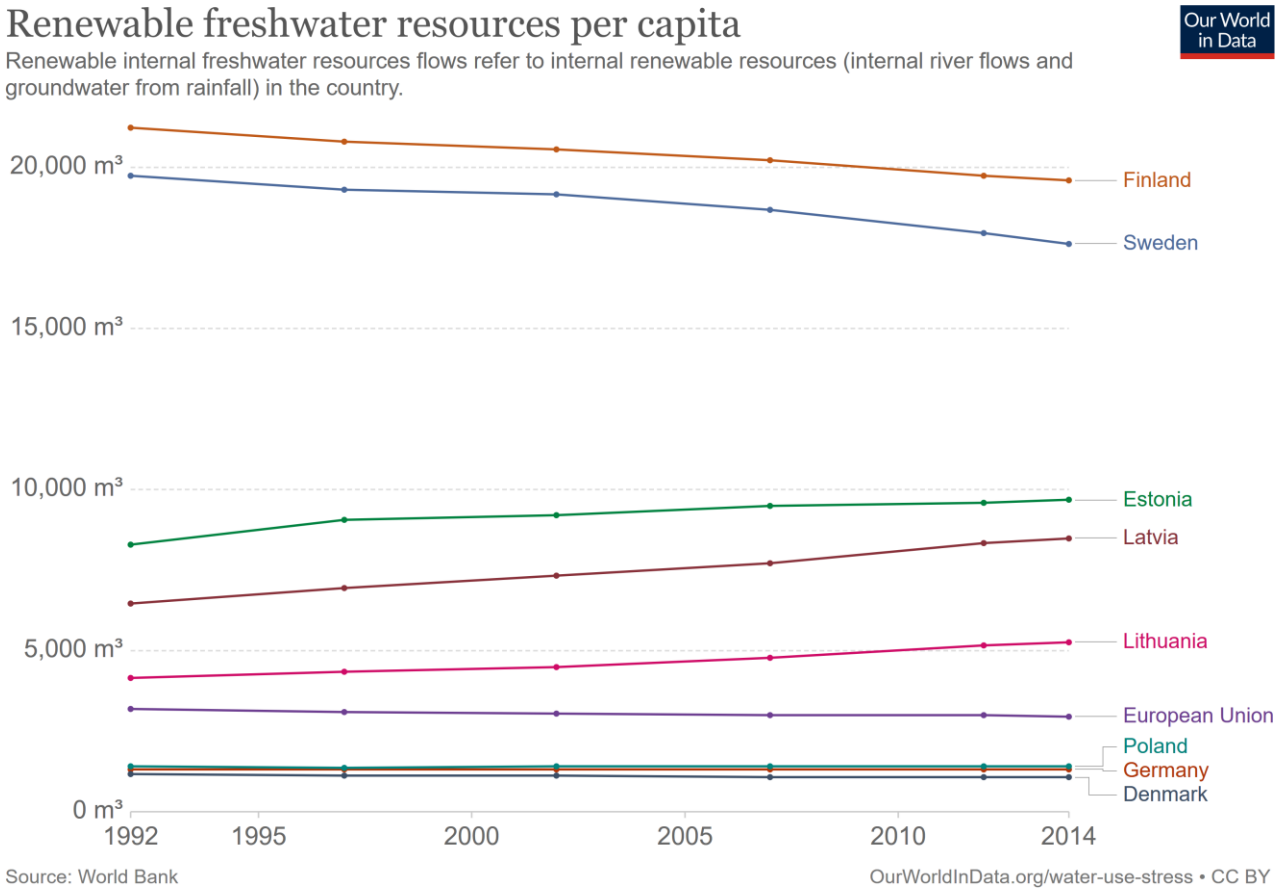

Figure 3: Renewable freshwater resources in the BSR. Source: UN FAO [3]

General Information

Household water use

- The most obvious water use is common household activities. This includes:
  - Flushing the toilet
  - Shower/ bath/ bathroom sink
  - Kitchen sink (cooking and dish washing)
  - Laundry mashines
- Another use for residential freshwater is watering lawns, washing cars and filling swimming pools

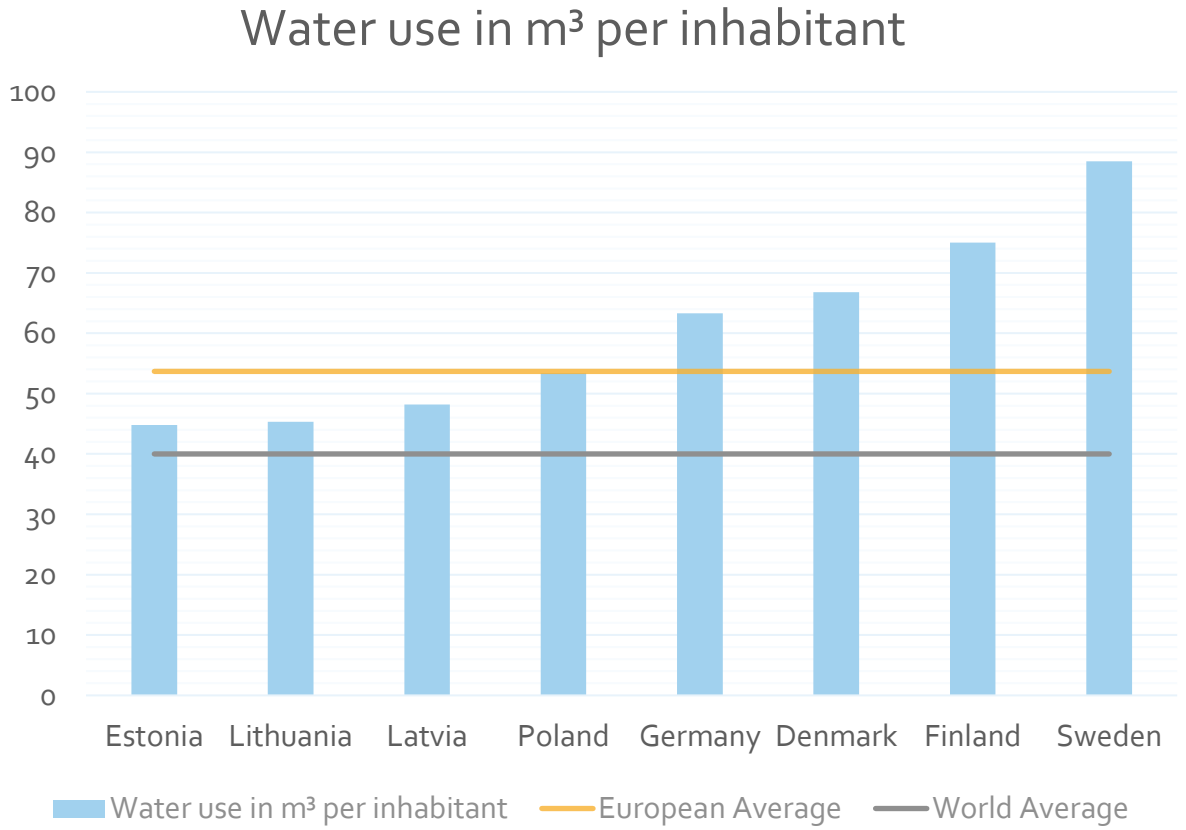

Figure 4: Public water use per inhabitant by country. Source: Eurostat [4]

General Information

Water footprint: „Invisible water“

- Every persons water footprint also includes less direct water uses that far exceed the municipal use:
- Agriculture and industry use water to produce, clean, cool, and transport products that we consume
- Energy production, especially hydroenergy holds the second biggest share of global water use!
- Communities use water for fire fighting, watering and cleaning areas, and providing water in buildings
- Businesses like restaurants, hotels, gyms and shops all add up to the local water demand

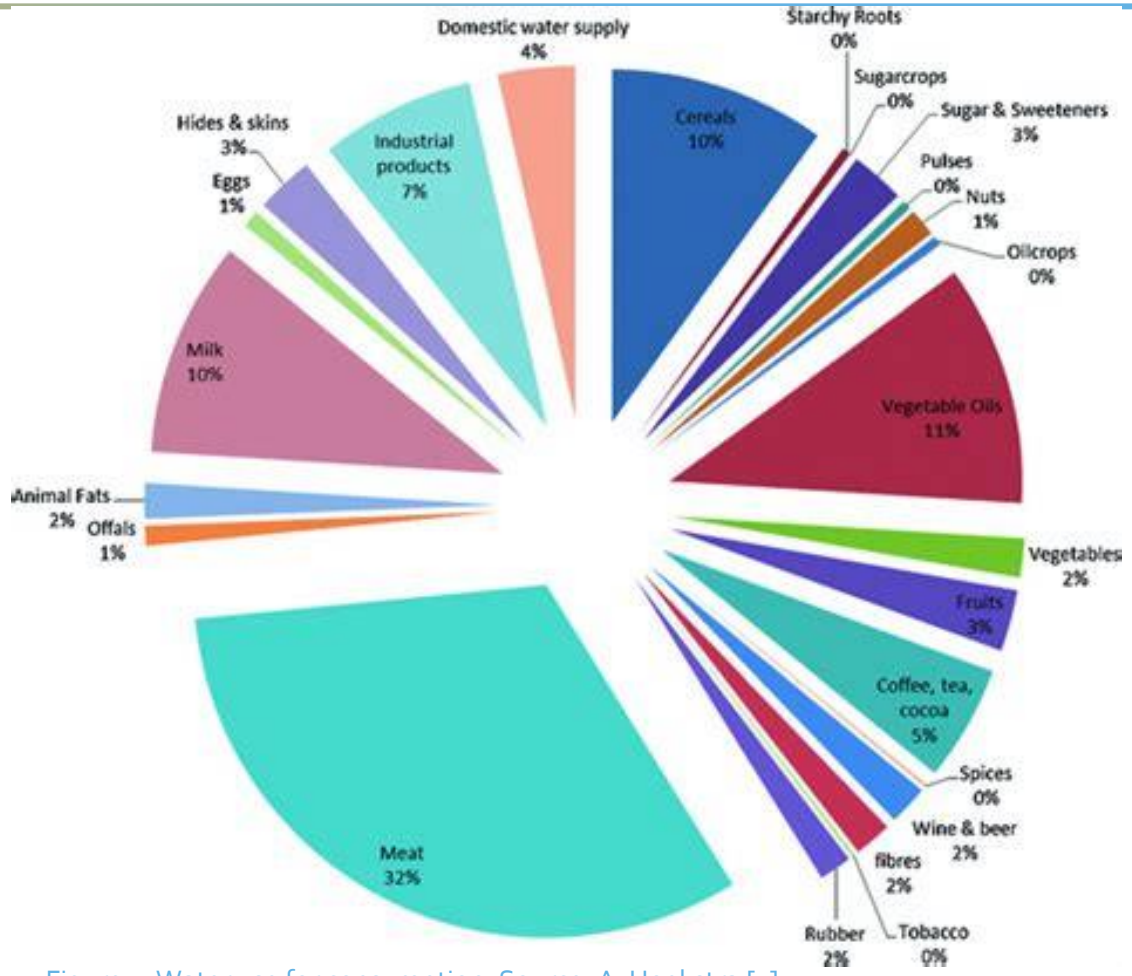

Figure 5: Water use for consumption. Source: A. Hoekstra [5]

2. Technical Introduction

Hot water supply

Applications

Fresh water station

Ultrafiltration

Technical Introduction

Household water supply

- The water supply used in households can be divided into cold (<20°) and hot (>60°) water supply
- A common source for hot water is the local heating water distribution system, which has connection/ exchange points for the households.
- Other sources are fuel/ gas boilers, electric water heaters, solar/ geothermal energy and heat pumps
- The supply systems are either central or decentral, each having their own devices
- Devices can be demand-type/ instantaneous heaters, or storage water heaters
- Demand heaters tend to save 30% of energy in comparison to conventional storage tank heaters, because storage units experience heat losses while in standby

Technical Introduction

Centralised hot water production

- One generator supplies several apartments in a building or several units (hotels, dormitory)
- Some advantages of central systems are:
  - Provision/storage of large quantities of water
  - Possible combinations with different energy sources
  - Use of special tarifs, self-generated electricity
  - Central heat generator, e. g. also for space heating
  - Rehabilitation of an existing central hot water generator

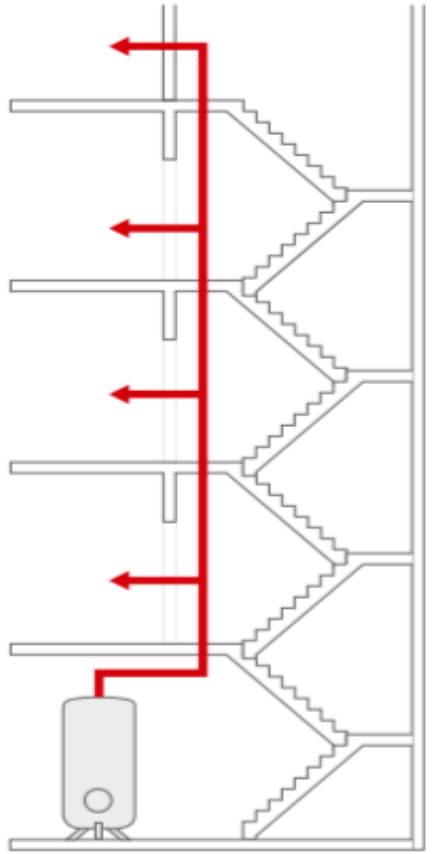

Figure 6: Centralised hot water supply. Source: Stiebel Eltron GmbH [6]

Technical Introduction

Decentralised hot water production

- The water is heated directly at the point of use (individual tapping points)
- The most suitable device can be chosen for each situation

DEVICE TYPE	APPLICATION AREA
Comfort instantaneous water heater	Washbasin, kitchen sink, hand basin, shower, bathtub
Compact instantaneous water heater	Washbasin, hand basin
Presureless (open)/ pressure-resitant (closed) small accumulator	Washstand, kitchen sink, hand basin
Water boiler	Kitchenette, kitchen sink

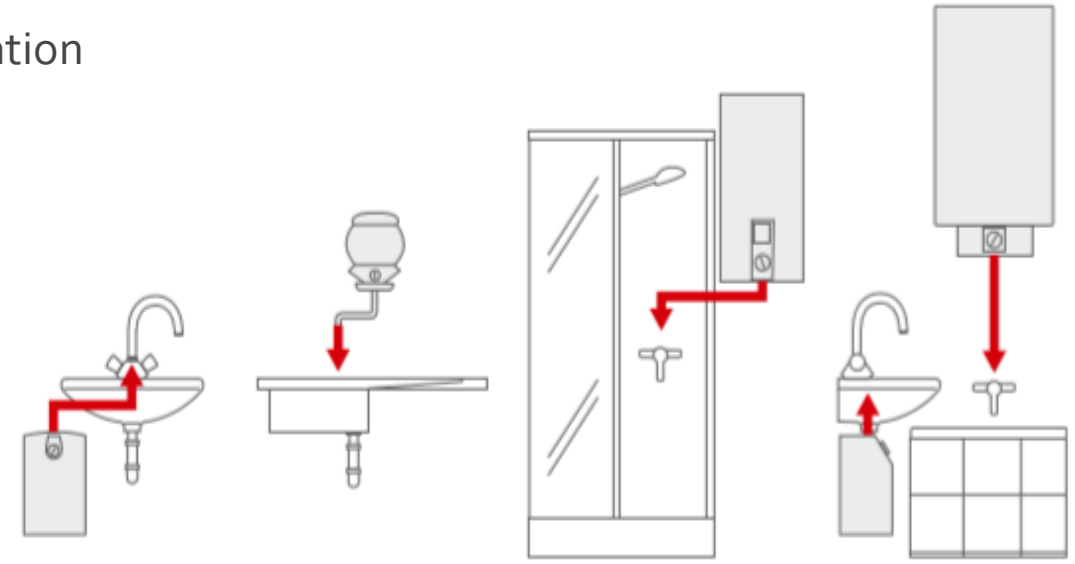

Figure 7: Decentralised hot water supply. Source: Stiebel Eltron GmbH [6]

Technical Introduction

Decentralised hot water production

- The water is heated in close proximity to the demand, one unit serves multiple tapping points (group supply, central apartment unit)

DEVICE TYPE	APPLICATION AREA
Instantaneous water heater	Bathroom with washstand, shower and/or bathtub in one room
Wall storage or continuous flow storage	Bathroom, kitchen, WC in flat, at a common installation wall
Hot water heat pump	Central apartment unit supply for all tapping points

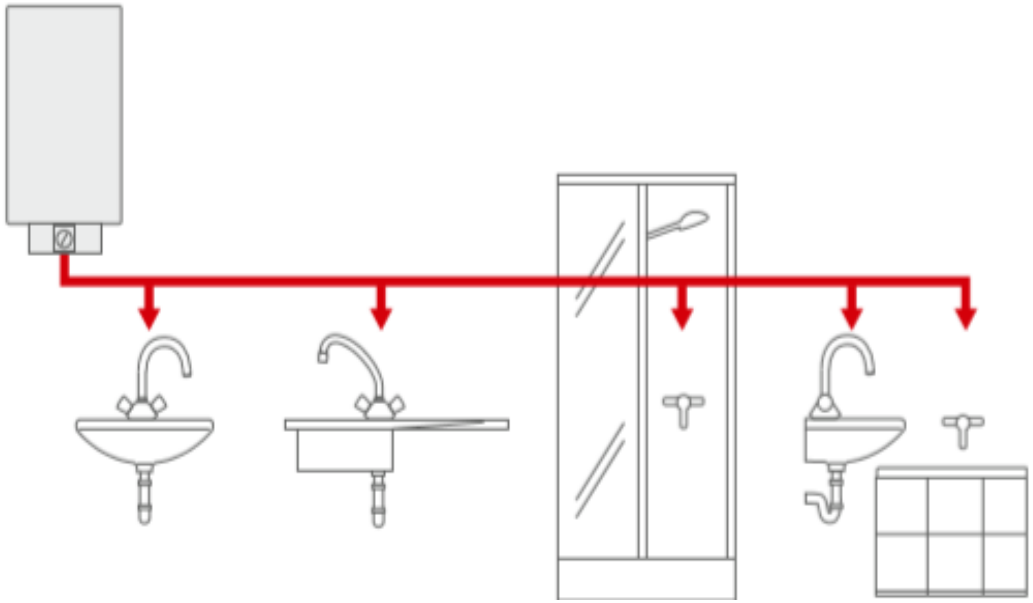

Figure 8: Decentralised hot water supply/ group supply. Source: Stiebel Eltron GmbH [6]

Technical Introduction

Hot water supply applications

Traditional systems

- Central distribution of hot water
- Storage tank
  - With gas/ oil/ fuel boiler or electric heating
- Demand-type heater
  - With gas/ oil/ fuel boiler or electric heating

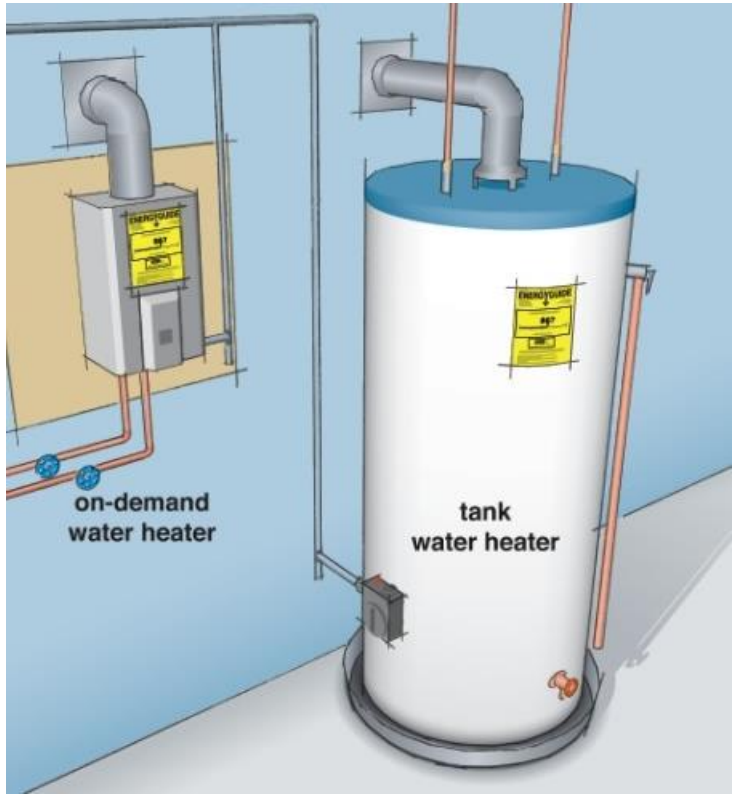

Figure 9: Storage tank heater and demand heater.
Source: Combined Energy Services [7]

Technical Introduction

	STORAGE UNITS	TANKLESS UNITS
+	Large amounts of water Low purchase costs Supplies multiple outlets Constant hot water flow	Energy efficiency - Saves up to 30% Easy installation Very little space required Instant heating to desired temperature
-	Heat losses in "standby" Needs to adjust temperature with mixer Requires a lot of space	Limited hot water flow Provides hot water for limited use Can drive up the electricity bill

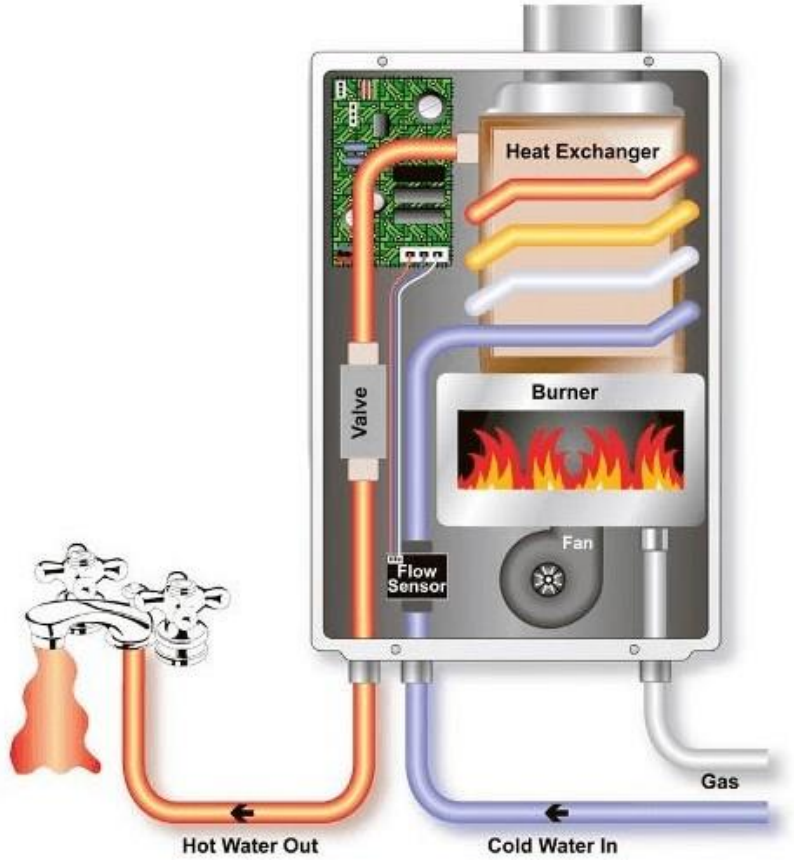

Figure 10: Demand heater diagram. Source: heatersforlife.com [8]

Technical Introduction

Renewable energy options

- Solar thermal energy
  - Needs back-up system for peak loads
- Heat pump boiler
  - Needs electric input
  - 100% of demand is covered
- These can also be used in combination with other systems to cover peak loads!

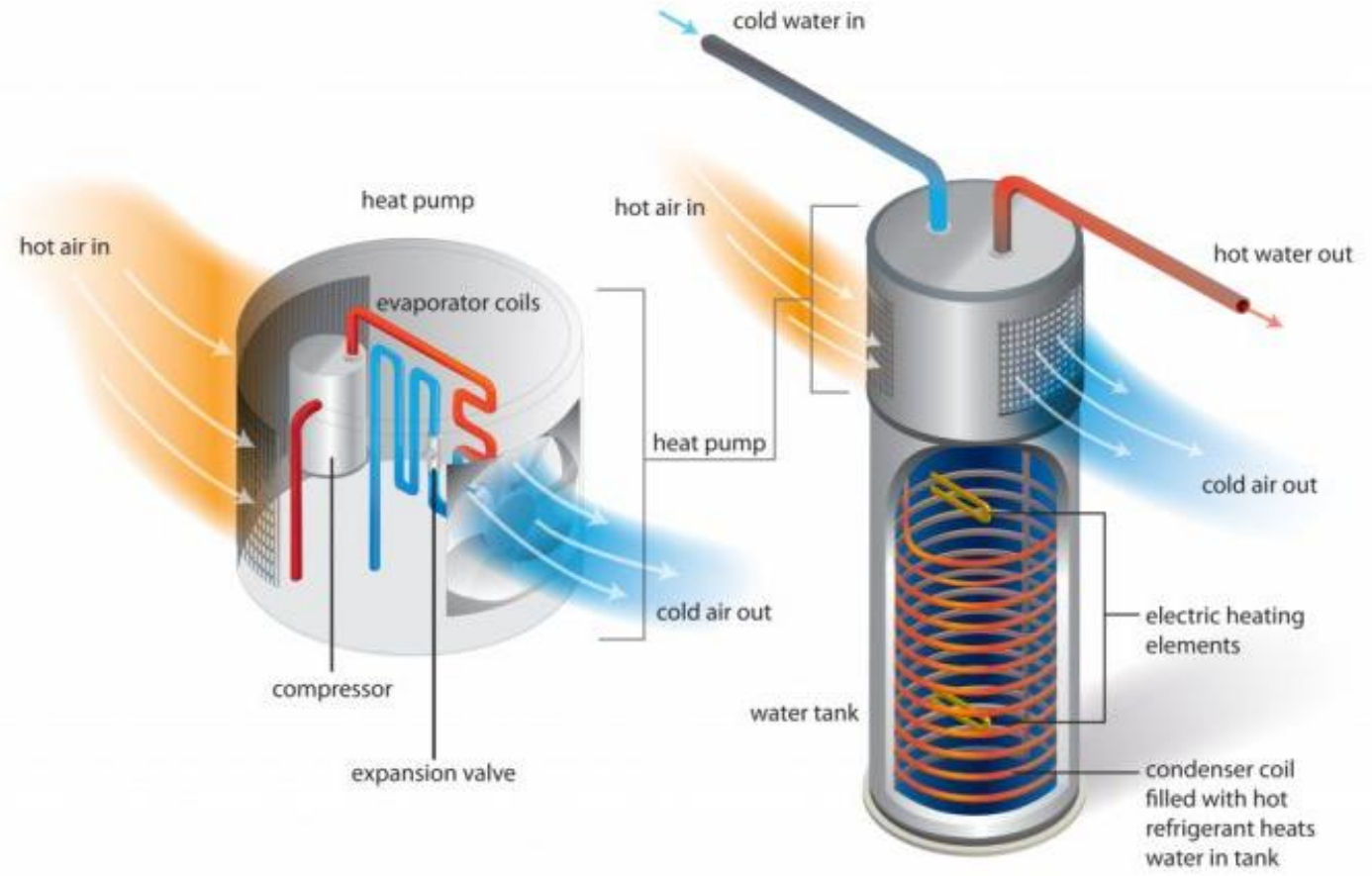

Figure 11: Air source heat pump hybrid water heater. Source: Fine Homebuilding Editors [9]

Water health and safety

- Clean tap water is important for our health!
- Bacteria and viruses breed in warm water, preferably 30°C – 45°C
- Legionella are the most common bacterias, they affect the respiratory tract
- Every 2 to 3 hours they multiply
- They can be very dangerous , especially for sick or elder people and babies!

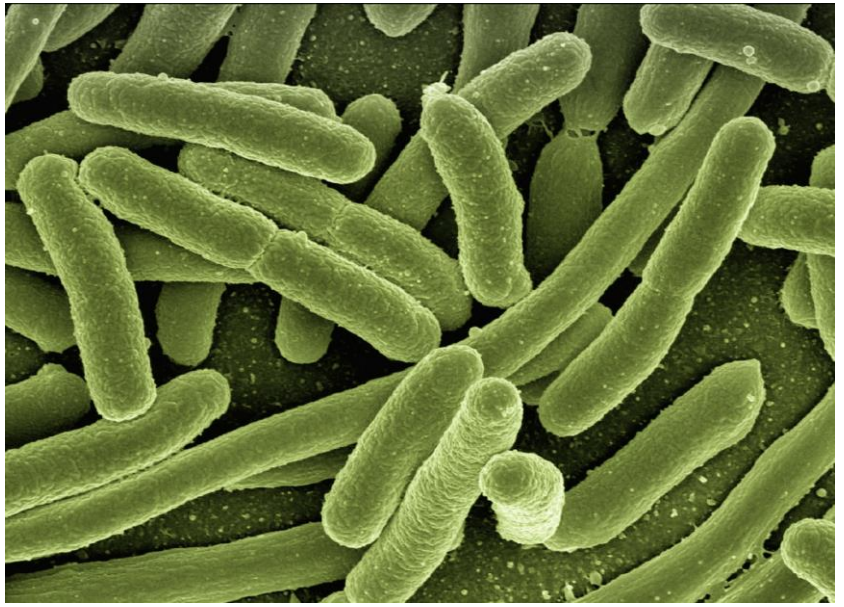

Figure 12: Bacteria in water. Source: geralt [10]

Legionella avoidance

- Many countries have norms to avoid legionella and other bacterias (Example Germany):
  - At the outlet of the domestic water heater, the drinking water must be at least 60°C hot
  - For central water heater with a high water exchange, 50°C is enough
  - 3-Liter rule.
    If the pipe contains more than 3 liters between the water heater and the tap point, circulation pipes must be installed
  - Correct pipe insulation is important to establish these temperatures throughout the distribution

Technical Introduction

Water safety and LTDH

- Water temperatures of 45°-60° in the LTDH are perfect breeding ground for bacterias
- Legionella are prone to form in hot water storage tanks, so it is recommended to heat them up to 65° daily

  → massive energy losses!

- So how can we make efficient use of the thermal energy in the distribution network, without endangering our health?
- By using the existing thermal energy, but clean fresh water instead!

Technical Introduction

Fresh water station

- Heating storage tank heats up clean fresh water usually by using a *plate heat exchanger*
- Heating circuit and fresh water dont mix
  → Hygenic and safe
- The water used for heating circles back to the buffer tank and gets reused
- A temperature of 50° in the tank is sufficient to reach a temperature of 45° at the outlet
- Can provide over 40l/min in very short heating time

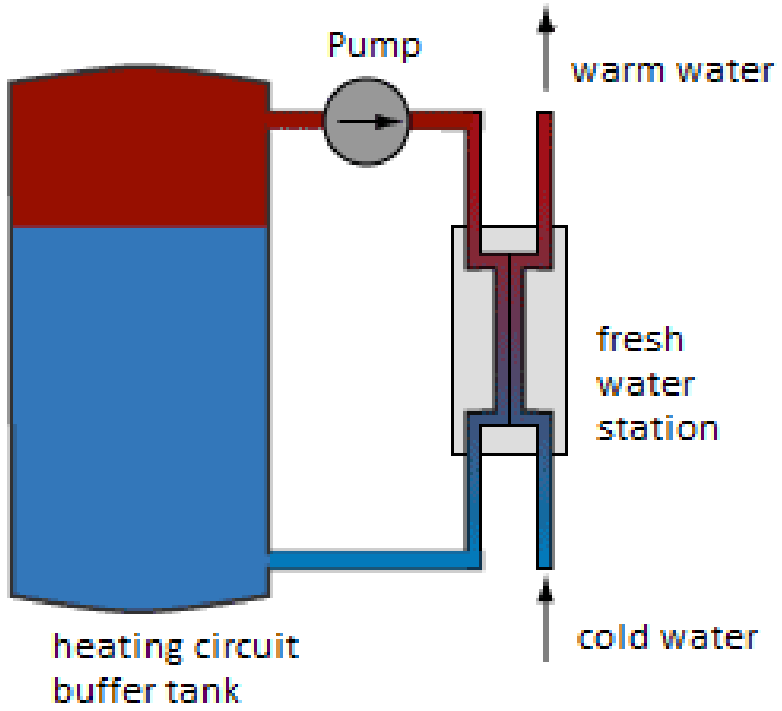

Figure 13: Diagram of fresh water station and tank.
Source: Energie Lexikon [11]

Technical Introduction

Fresh water station

- The thermal energy can be extracted from different sources, fuel as well as renewable (solar, heat pump)
- The application is easy to adapt into an existing system with a storage tank unit
- The water is always heated to the required temperature
- Storage tank systems need to mix the hot and cold water to adjust tempreature → Inefficient!

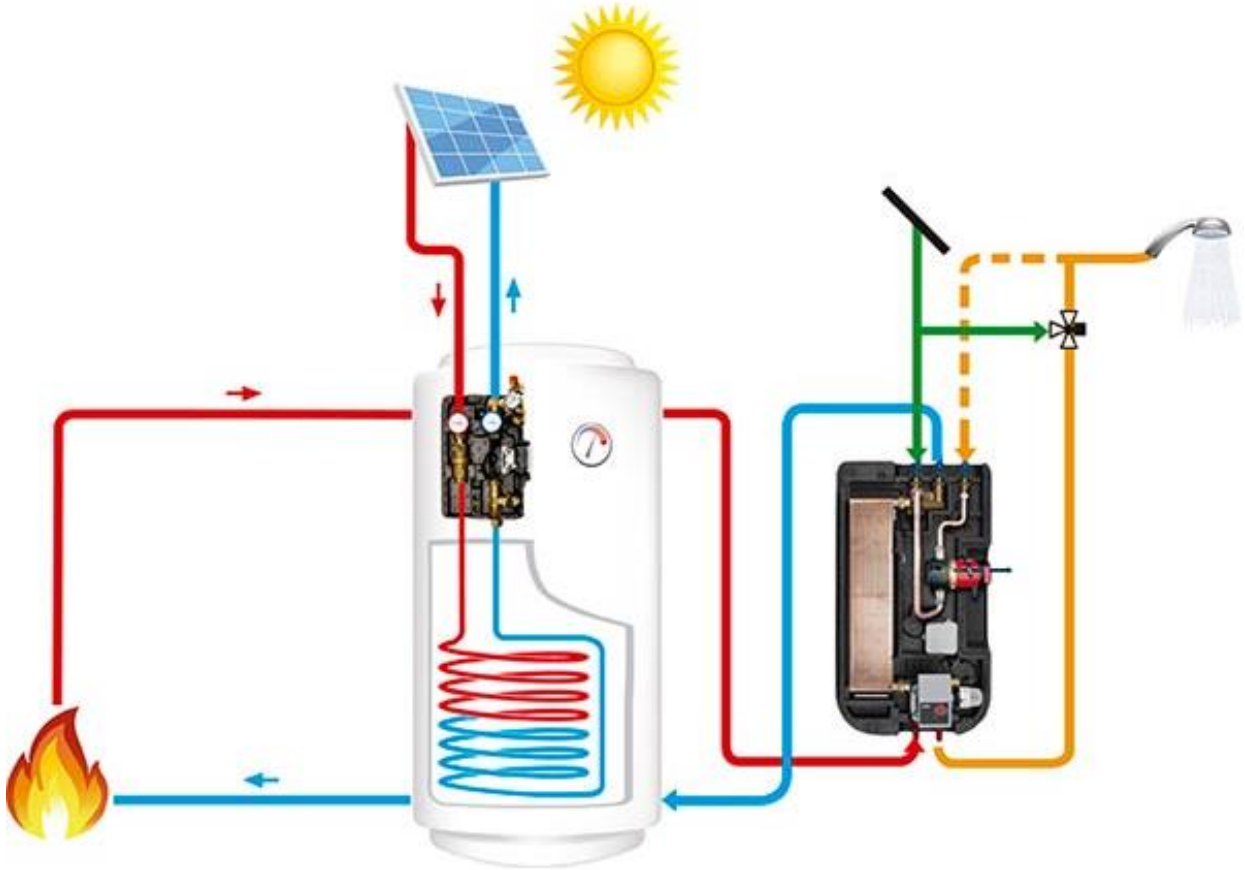

Figure 14: Diagram of fresh water station and tank. Source: Orkli [12]

Fresh water station

ADVANTAGES	DISADVANTAGES
Low risk of legionella	Expensive installation, especially using solar energy
Efficient system, no over heating	A loss of heat is not completely avoidable
Storage tank can be heated by various options, including renewable!	Formation of chalk and lime
Works with low temperature - Perfect for LTDH and Solar	Needs regular maintenance
Little space required for station	
Easy to integrate in existing systems with storage tank	
Reuse of the heating water	

Figure 15: fresh water station. Source: Oventrop GmbH & Co. KG [13]

Ultrafiltration

- Ultrafiltration works with a set of membranes
- The smallest particles filtered are 0,02 µm !
- The filters are automatically rinsed
  → no maintenance needed
- Ultrafiltration is a simple and efficient disinfection procedure
- This system works very well with low temperatures

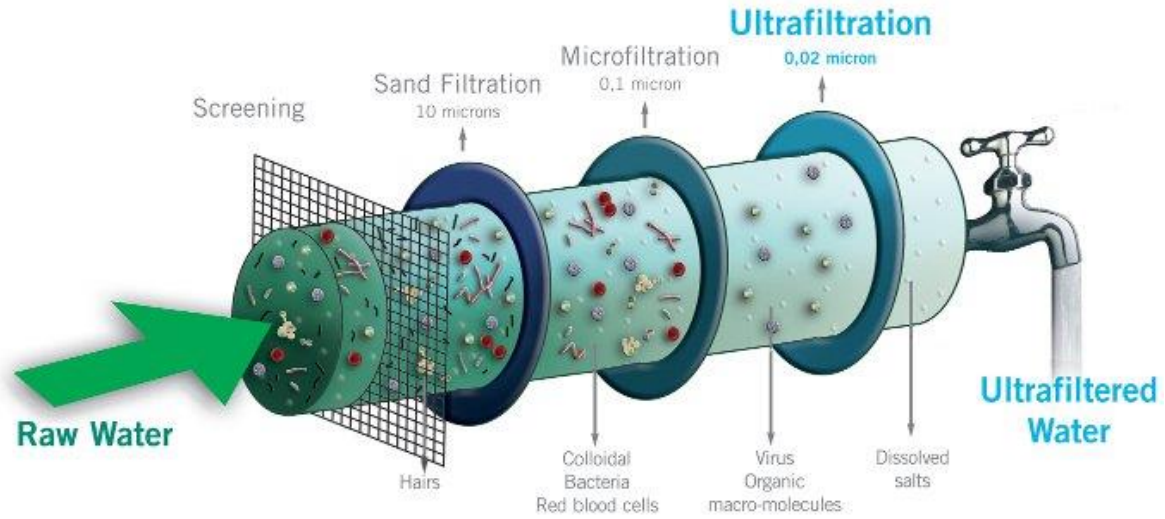

Figure 16: Ultrafiltration scheme. Source: My Water Earth [14]

Implementation

Pilot projects and status

- These technologies are already being used in various places in the BSR, but should be integrated in all new water and heating systems.
- Bavaria for example has implemented **80** ultrafiltration stations in the past 10 years
  - The capacity ranges from 4 to 300 m^3/h
  - They are efficiently cleaning and disinfecting the municipal drinking water

References

- [1] EEA, European Environmental Agency. Use of freshwater resources (2017). https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4
- [2] IGB, Global International Geosphere-Biosphere Programme. http://www.igbp.net/globalchange/greatacceleration.4.1b8ae20512db692f2a680001630.html
- [3] UN FAO, United Nations Food and Agricultural Organization. AQUA. http://www.fao.org/nr/water/aquastat/data/query/results.html
- [4] Eurostat. Water statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php/Water_statistics
- [5] A. Hoekstra. The water we eat (2012). https://waterfootprint.org/media/downloads/Hoekstra-2015_1.pdf
- [6] Stiebel Eltron GmbH. Planung und Installation Warmwasser (2019). https://www.stiebel-eltron.de/content/dam/ste/de/de/products/downloads/Planungsunterlagen/Planungshandbuch/Planungshandbuch_Warmwasser.pdf
- [7] Combined Energy Services. https://combinedenergyservices.com/water-heaters/
- [8] heatersforlife.com. https://heatersforlife.com/best-tankless-water-heater/

last reviewed on 13.04.2021

References

- [9] Fine Homebuilding Editors. https://www.finehomebuilding.com/2019/04/09/heat-pump-water-heaters-2
- [10] geralt. Pixabay. https://pixabay.com/de/photos/koli-bakterien-escherichia-coli-123081/
- [11] Energie Lexikon, Frischwasserstation. https://www.energie-lexikon.info/frischwasserstation.html
- [12] Orkli. https://www.orkli.com/de/web/confort-calefaccion/beliebteste-produkte
- [13] Oventrop GmbH & Co. KG. https://www.oventrop.com/de-DE/produktesysteme/artikeldetails/1381580
- [14] My Water Earth, Ultrafiltration. https://www.mywaterearth.com/the-difference-between-ultrafiltration-reverse-osmosis

last reviewed on 13.04.2021

Contact

ZEBAU GmbH
Centre for Energy, Construction, Architecture and the Environment

Jan Gerbitz / Andreas Broßette / Merle Petersen

Große Elbstraße 146
22767 Hamburg
Germany

E-mail: info@zebau.de
Tel: +49 40 - 380 384 - 0
www.zebau.de