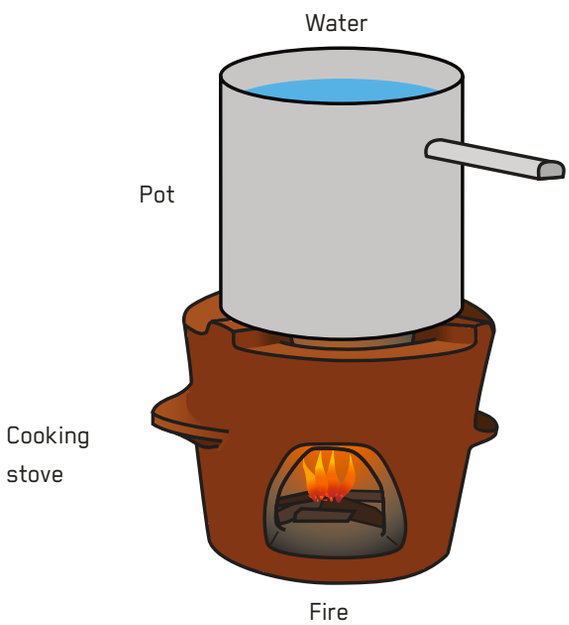
Boiling

Response Phase	Application Level	Management Level	Objectives / Key Features
** Acute Response ** Stabilisation ** Recovery	** Household Neighbourhood City	** Household Shared Public	Point-of-use treatment, water disinfection
Local Availability	**Technical Complexity**	**Maturity Level**	
*** High	* Low	*** High	



Boiling water is the oldest and most used method to disinfect small quantities of water at the household level worldwide. Boiling water inactivates all microorganisms including bacteria, protozoa and viruses, but does not remove turbidity or chemical contaminants from drinking water.

Inactivation of microorganisms already occurs below the standard Boiling point of 100° C, as most bacteria, viruses and protozoa are inactivated in less than one minute once temperatures exceed 70° C. However, to ensure user compliance it is better to recommend heating water to a boil, as the appearance of bubbles is a good visual indication of adequate disinfection. To avoid recontamination, water should be stored in a clean and covered container **(see H.1)** after Boiling. Despite its effectiveness and simplicity, Boiling has the disadvantage of requiring affordable and sufficient fuel as well as being quite labour-intensive.

Design Considerations: Normally, available pots and stoves are used. Indoor cooking spaces with an open fire should be well ventilated. Water containing high concentrations of iron and calcium form a white scale at the bottom of the container. The container should be washed properly after every use or cleaned with vinegar or lime juice regularly to remove the scale deposits. To avoid contamination, any clarification of turbid water should be done before Boiling. Boiling requires fuel, which needs to be available or made available. The feasibility of using alternative fuel sources as well as advanced stoves consuming less fuel compared to traditional methods should be considered.

Materials: Boiling requires a pot, stove and reliable source of heat. Where electricity and fossil fuels are not available, rudimentary (e.g. wood, charcoal) or non-conventional (e.g. biogas) methods of heat generation can be used.

Applicability: Boiling is simple, known to most households and well accepted. When fuel is available and accessible during the acute response phase, it can be fast and simple to advise users to boil water before consumption when water quality is unknown, when water is contaminated with pathogenic microorganisms or when water quality deterioration is expected. However, when fuel is expensive, poorly accessible or the environment is strongly affected by deforestation, other methods of water treatment should be introduced in the medium and long term to reduce expenditures, protect the environment and save limited fuel for cooking purposes.

Operation and Maintenance: If the fuel must first be collected or treated, this may be time consuming. At the kitchen level, everyday maintenance includes checking the stove and pots. The frequency with which the stove will need to be repaired or replaced will depend on stove design, the quality of materials and workmanship, and intensity of use. Pots are seldom repaired, and earthen pots often need to be replaced. The necessary skills for O & M activities are usually available in all communities.

Health and Safety: Boiling effectively inactivates pathogenic microorganisms of all classes, and it is currently the most effective method for household water treatment. However, contamination of the boiled water during and after cooling is possible. Water should be handled carefully, and no utensils should contact it when transferring to a clean container for consumption. Boiling may not be appropriate for chemically contaminated water, as the concentration of some chemical contaminants will increase after Boiling or be volatilised into the breathing zone, such as nitrates and solvents. Boiling water can cause burn injuries. Long-term exposure to smoke from fires and stoves may cause associated respiratory diseases.

Costs: Pots and stoves may already be available in households or need to be also distributed for cooking purposes. The fuel costs vary depending on fuel type, availability and local context. Costs of between 3–20 USD/year per person were reported in different contexts.

Social and Environmental Considerations: In many places, it is an ingrained cultural practice to boil water for drinking, so the acceptance of this method is very high. This makes it suitable for emergencies in any phase when fuel is or can be made available. As it tastes flat, which may impact its acceptance, boiled water is often consumed in the form of hot drinks such as tea that mask the changed taste, increasing its acceptance. Boiling can be used in combination with other technologies, e.g. Boiling for hot drinks but another treatment method for direct consumption of water. The taste might be improved by chilling the water (avoiding the addition of possibly contaminated ice). Depending on the fuel, Boiling may be environmentally unsustainable and contribute to greenhouse gas emissions, as well as other local problems related to deforestation, that will affect health and safety. Especially in densely populated areas, Boiling with firewood is not appropriate due to the overexploitation of the wood resources and the subsequent environmental damage.

Strengths and Weaknesses:

⊕ Presents very effective method to inactivate pathogenic microorganisms of all classes
⊕ Easy, simple and wide cultural acceptance

⊖ Can be expensive due to high fuel consumption
⊖ The use of traditional fuel (e.g. firewood, fossil fuels) can contribute to deforestation and carbon emissions, while creating indoor air pollution issues
⊖ Does not remove turbidity, chemicals, taste, smell or colour and is time consuming
⊖ Water needs to cool down before use, except for hot drinks

→ **References and further reading material for this technology can be found on page 222**