

DESALINATION USING SOLAR PONDS

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SITUATION

The growing demand of freshwater is placing huge pressure on existing supplies. Seawater is a vast source to satisfy this demand. However, seawater cannot be directly consumed and therefore, desalination of seawater is a necessity [1].

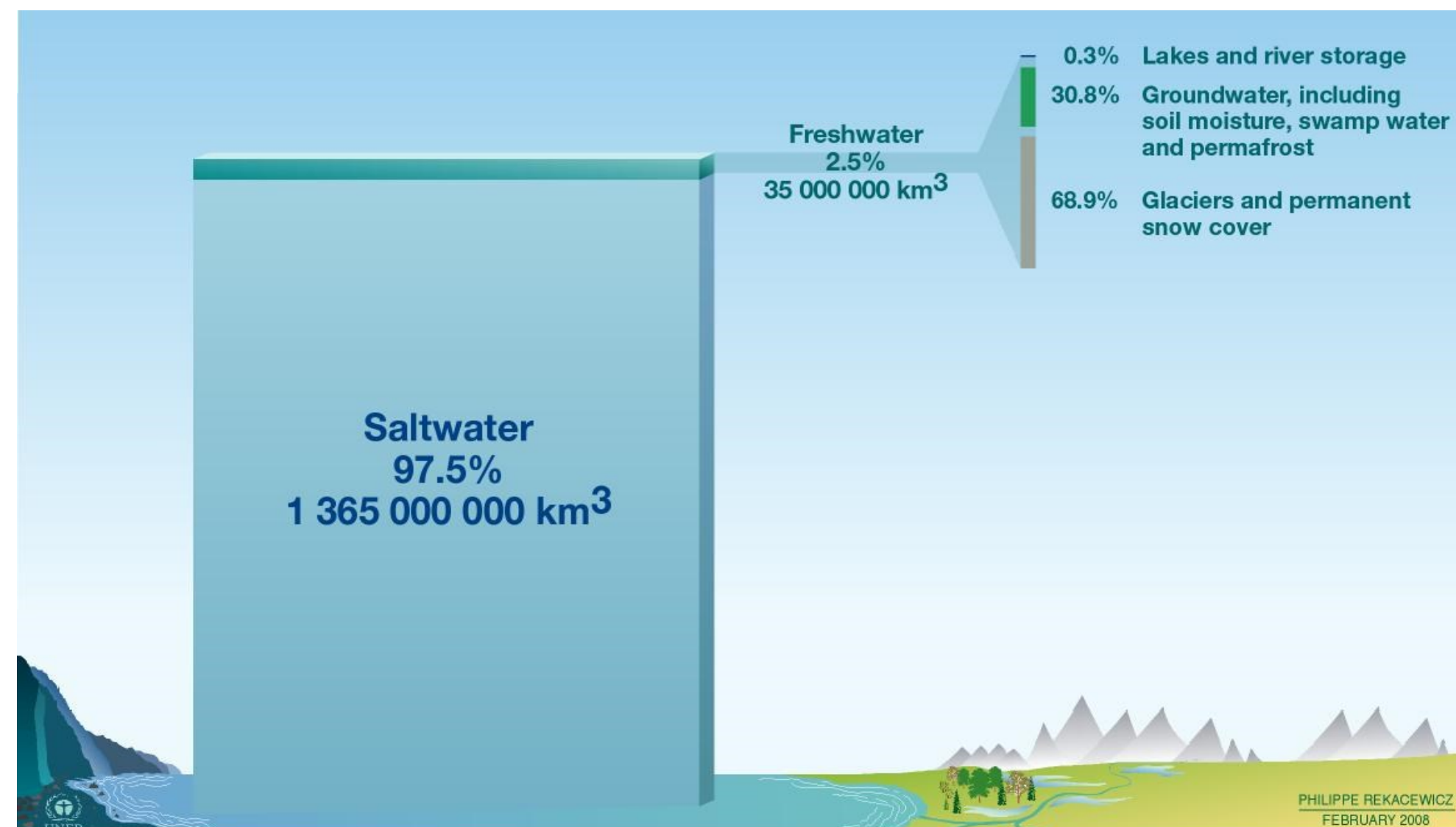


Figure 1: Water distribution around the world [2]

PROBLEMS

The current methods of desalination have problems associated with them:

- Usage of non-renewable resources of energy, therefore adding to the depletion of these resources
- Contribution to greenhouse gas emissions, such as oxides of nitrogen, carbon and CFCs
- Inefficiency

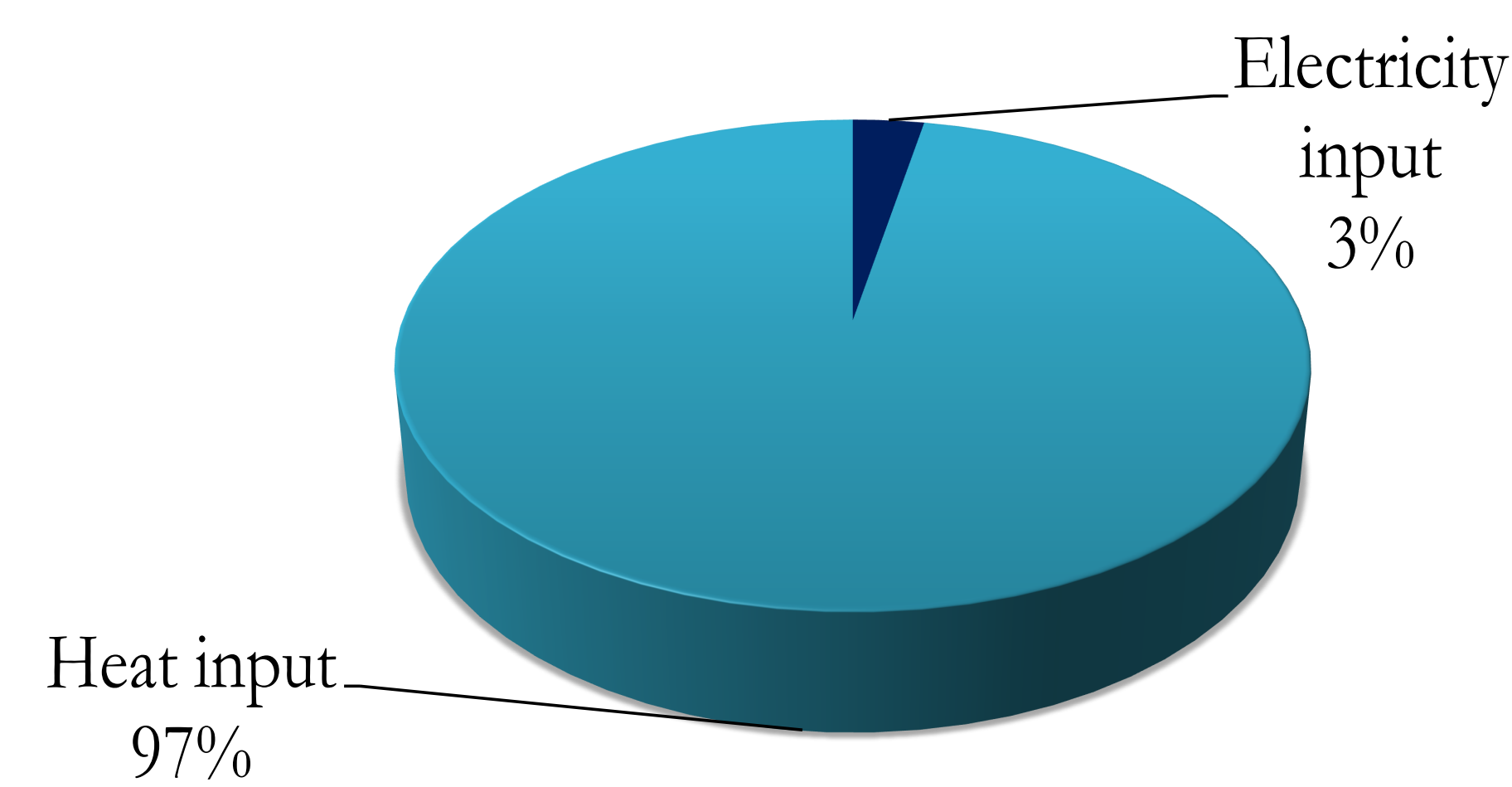


Figure 2: 50 kWh of energy consumption in thermal desalination [1]

THE SOLUTION

What is a solar pond?

A solar pond is a shallow body of saline water several meters deep, set up in such a way that there is increasing salinity with depth. Solar radiation entering the pond is stored as heat in the lower layer. This heat (up to 80 °C) is then available on a 24 hour basis [3].

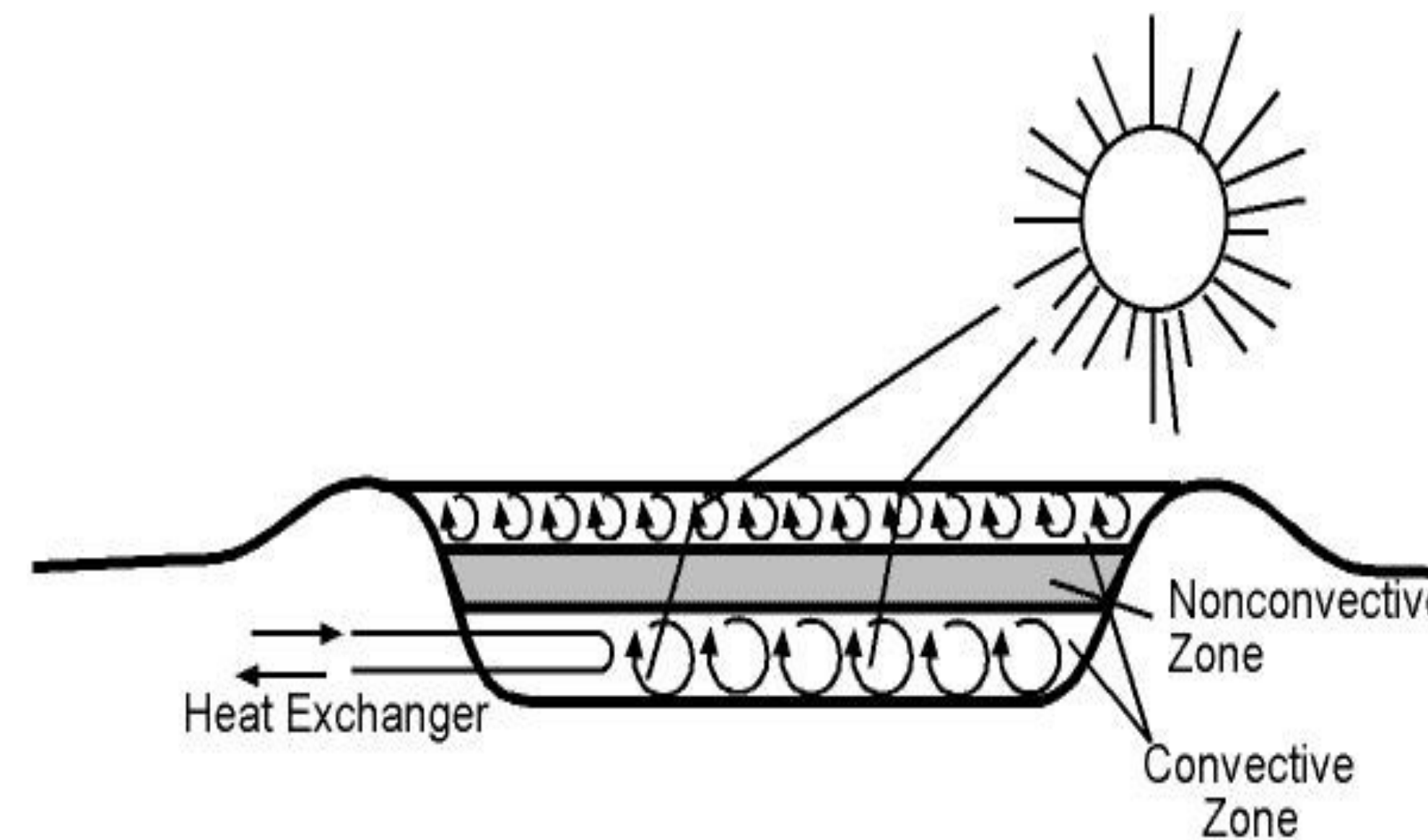


Figure 3: A solar pond [4]

How does it work?

The Organic Rankine Cycle (ORC) is a thermodynamic cycle that converts heat into mechanical energy. The ORC uses organic, high molecular mass fluids, such as n-pentane or toluene. The working process of the ORC which consists of a solar pond are as follows [5]:

- (4-1) Pumping of working fluid
- (1-2) Extraction of heat by the working fluid
- (2-3) Expansion of the working fluid to generate mechanical energy
- (3-4) Cooling of the working fluid

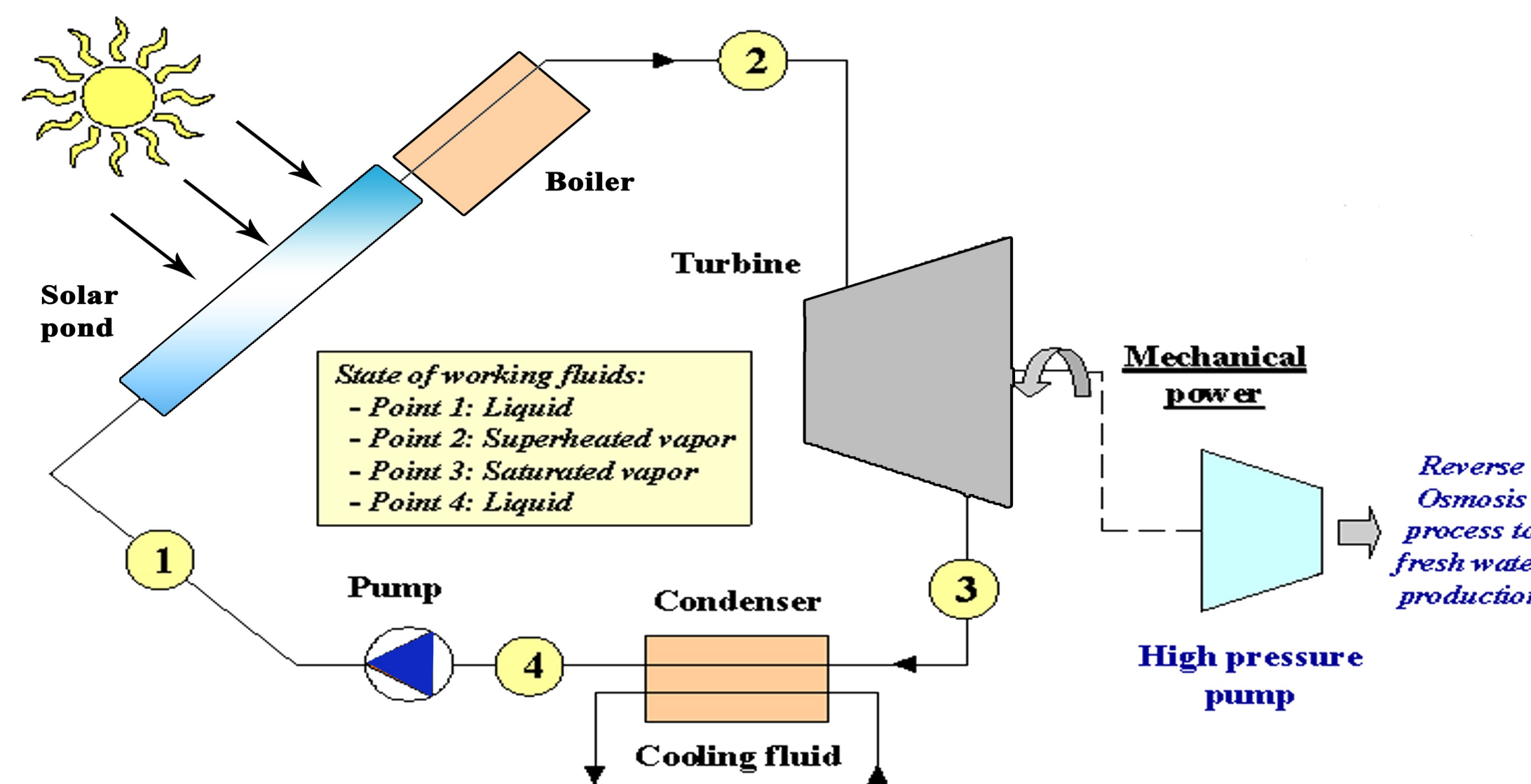


Figure 4: Desalination by ORC (adapted) [5]

EVALUATION

There are three things to take into consideration while using solar ponds as a solution:

Cost

Solar ponds in Northern Victoria in Australia were found to produce heat at a lower cost than LPG and electricity. However, solar ponds are not very effective in regions where natural gas is cheaply available [3].

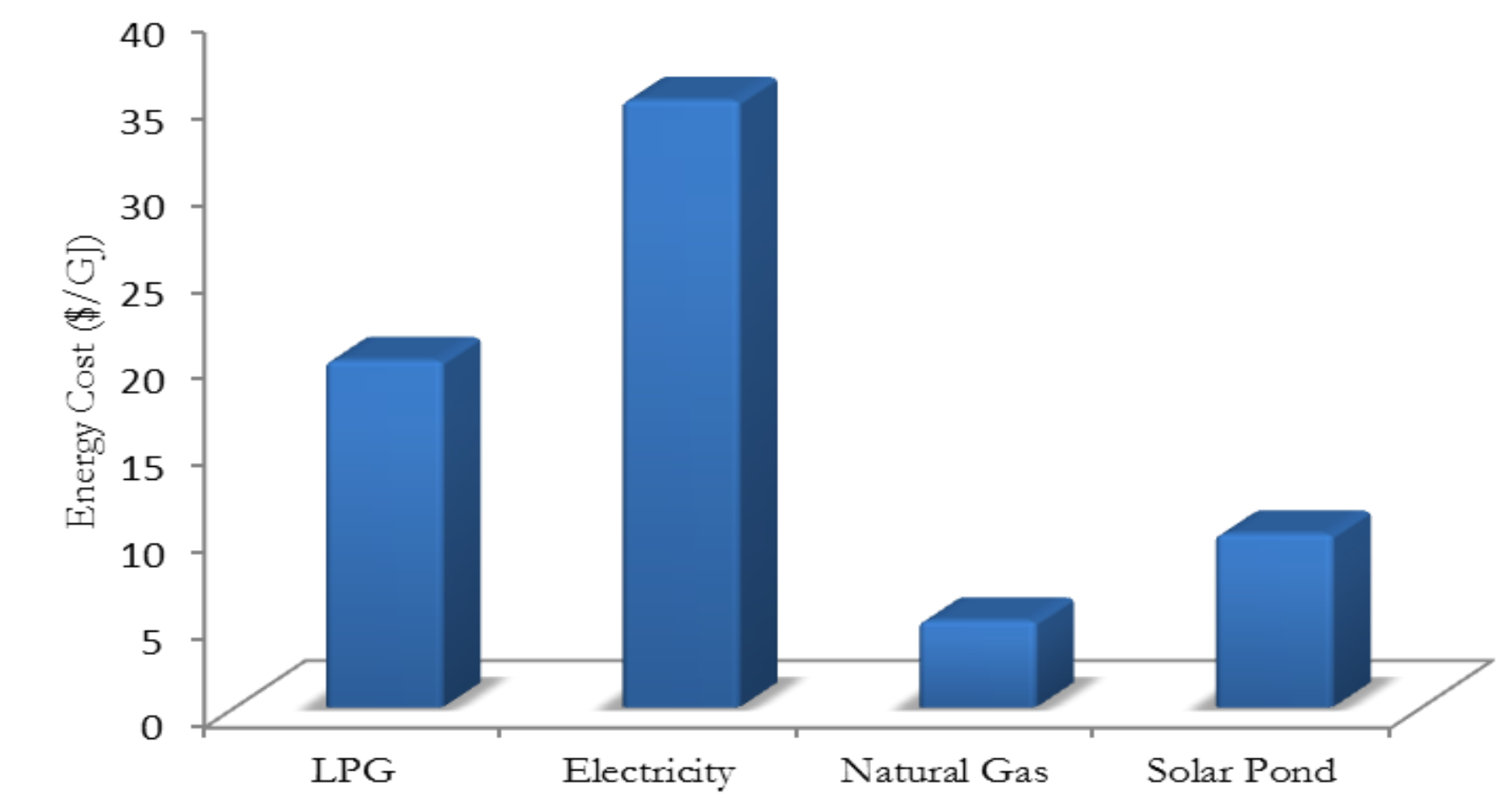


Figure 5: Cost of heat production methods [3]

Efficiency

For the conversion efficiency of electricity generation of 30%, the reverse osmosis process consumes the least amount of energy [6].

Table 1: Energy consumption of desalination systems [6]

Process	Energy consumption (kJ/kg of product)
Multi-stage flash	338.4
Multiple-effect boiling	149.4
Vapor Compression	192
Reverse Osmosis	120

Size

As the demand for freshwater increases, more energy is required to carry out desalination and therefore, solar ponds need to be larger.

References

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