

Ocean Thermal Energy Conversion (OTEC)

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Situation

- Depletion of fossil fuels and gasoline, and their effect on the global climate, necessitate the need for an alternative source of energy.
- Approximately 170,000 TW of solar radiation fall on the earth's surface and is not fully utilized [1].
- OTEC is a method of electricity generation using solar radiation (refer to Figure 1).



Figure 1: Energy conversion in OTEC

- OTEC uses the temperature difference between the warm surface ocean water and the cooler deep ocean water.
- There are three types of OTEC cycles: Open, closed and hybrid (refer to Figure 2).

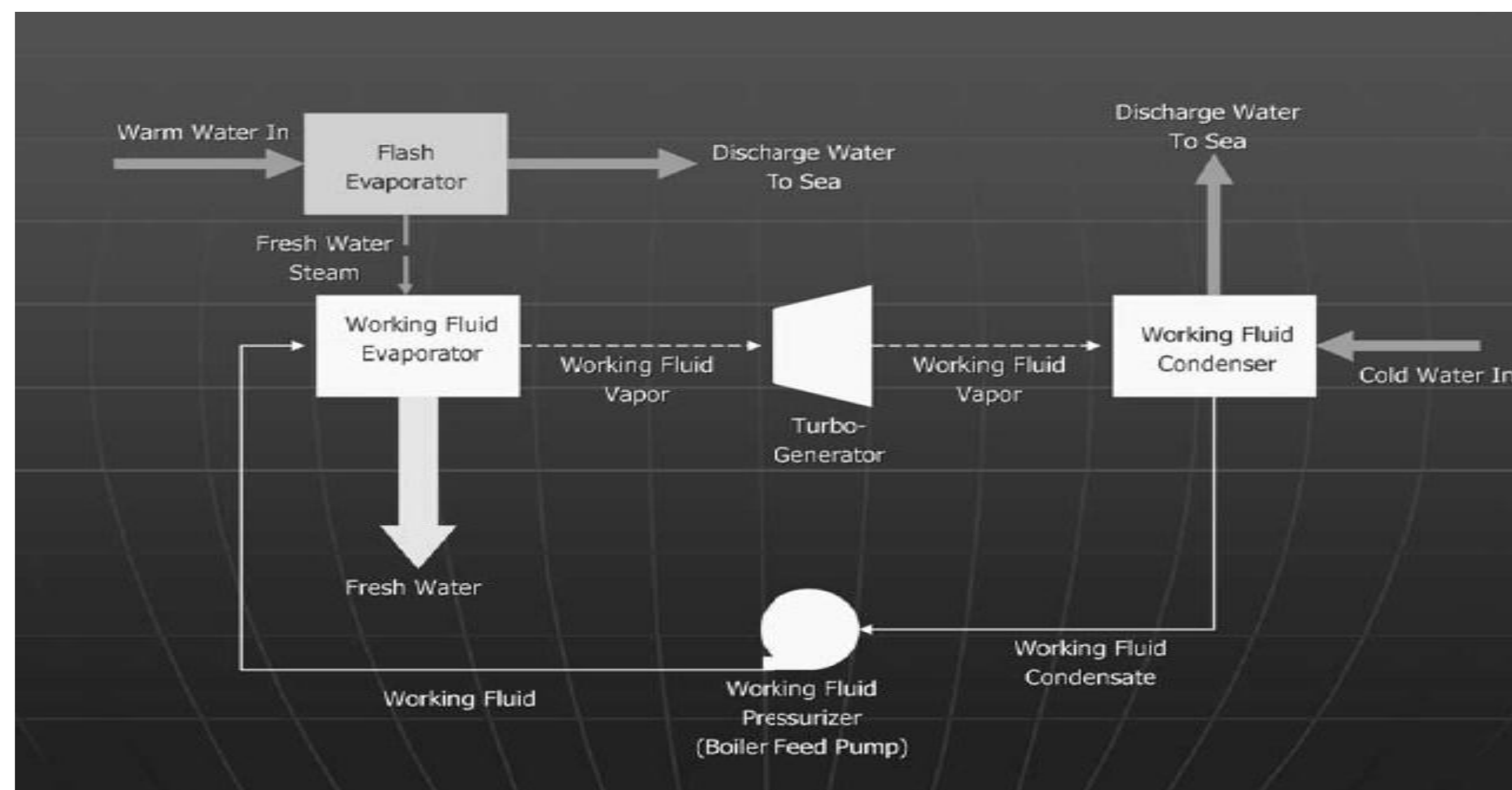


Figure 2: Simplified OTEC hybrid cycle [2]

Problems

There is a high initial cost which is due to the components needed, maintenance and other factors.

The OTEC system, although discovered in 1889, is yet to be implemented on a large-scale.

Is the power production enough to meet the world's demands?

The energy needs to be transported from the sea back to the land efficiently.

Where does OTEC stand in comparison to other renewable energy sources?

Solutions

- HVDC lines are used for long distance bulk power transmission and the best type of cable for this system is Extruded XLPE (refer to Figure 3).

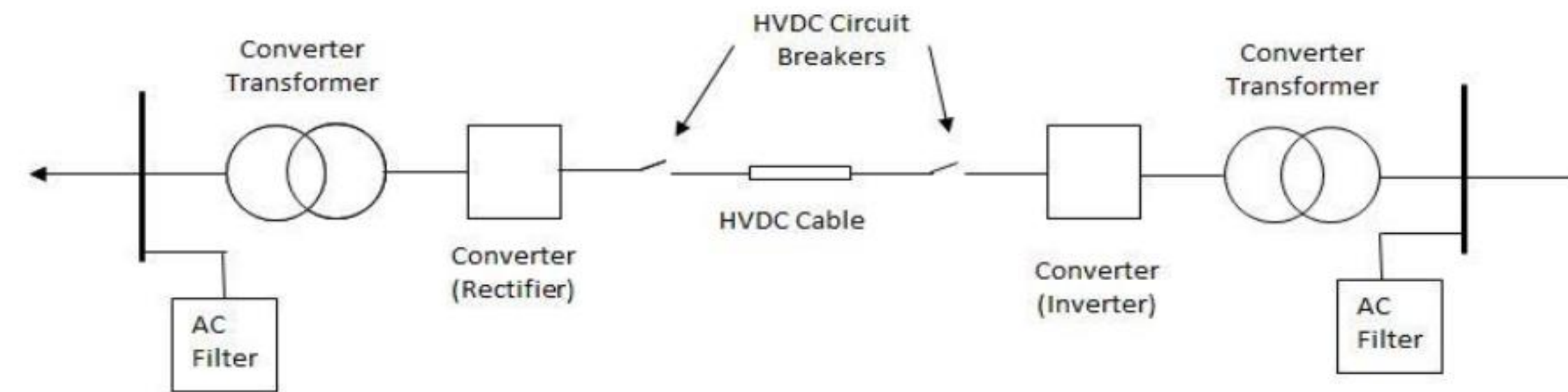


Figure 3: HVDC System [3]

- The high profits generated through by-products from OTEC plants make up for the high initial cost.
- Lockheed Martin has currently been working on the biggest ever OTEC plant in Hawaii [4].
- The OTEC plant can produce upto 50 MW of energy.
- OTEC releases only a fraction of carbon dioxide as compared to the fossil fuel power plant hence, is more environmentally friendly.

Evaluations

- "It is the OTEC, which has a potential to become powerful solution to three greatest global issues of clean energy, fresh water and food without vital harmful influence on irreplaceable earth environment" [5].
- Deep sea water (DSW) is the major by-product which has a profitable market for many industries such as:

Table 1: By-products of OTEC system [6]

Gross Power Output (MW)	1	10
Net Power Output (MW)	0.7	7.5
Net Electricity (MWh/year)	4,900	52,500
Up-welling DSW (t/h)	4,700	43,300
Fresh Water (t/h)	1,100	10,000
Hydrogen (Nm ³ /h)	2,000	22,000
Lithium Chloride (kg/day)	30	260
Mineral Water (bottle/day)	16,000	150,000

- Based on several parameters such as toxicity and chemical stability, refrigerants are a suitable choice for the working fluid.
- Submersible pumps are used to pump DSW to the surface since they are more efficient.

Limitations

Marine life

- Disruption in the natural temperature balance of the ocean poses serious threats to marine life.

Tropic condition

- OTEC is only applicable in regions with the required minimum temperature difference.

Weather conditions

- Weather conditions such as storms and huge waves affect the functionality of the OTEC plant.

References

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