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TITLE: Negative-CO₂-emissions ocean thermal energy conversion

AUTHOR: ['Greg H. Rau', 'Jim R. Baird']

ABSTRACT:

Conversion of the ocean's vertical thermal energy gradient to electricity via Ocean Thermal Energy Conversion (OTEC) has been demonstrated at small scales over the past century, and represents one of the largest (and growing) potential energy sources on the planet. Here we describe how OTEC could be modified to provide a large source of CO₂-emissions-negative energy while also allowing heat removal from the surface ocean, helping to directly counter ocean/atmosphere warming. Most OTEC energy potential is far offshore, thus the conversion of the produced electricity to a chemical energy carrier such as H₂ or derivatives is required. This can be achieved by employing a method of electrochemically generating H₂ that also consumes CO₂, converting the carbon to a common form of ocean alkalinity. The addition of such alkalinity to the ocean would provide high-capacity carbon storage while countering the chemical and biological effects of ocean acidification. For each gigawatt (GW) of continuous electric power generated over one year by the preceding negative-emissions OTEC (NEOTEC), roughly 13 GW of surface ocean heat would be directly removed to deep water, while producing 1.3×10^5 tonnes of H₂/yr (avoiding 1.1×10^6 tonnes of CO₂ emissions/yr), and consuming and storing (as dissolved mineral bicarbonate) approximately 5×10^6 tonnes CO₂/yr. The preceding CO₂ mitigation would result in an indirect planetary cooling effect of about 2.6 GW. Such negative-emissions energy production and global warming mitigation would avoid the biophysical and land use limitations posed by methods that rely on terrestrial biology.

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