Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Distinguished Professor of Earth and Planetary Sciences, UC Santa Cruz.

#263 May 27, 2018
Energy from Offshore

A wind farm offshore of the UK

Visions from over half a century ago of mining the seafloor and feeding much of the world's population from the sea have not come to fruition and it is unlikely that they will anytime soon.

As long as there are still minerals on land that are easier and less expensive to obtain, it makes no economic sense to go hundreds or thousands of miles offshore and try to recover those same minerals in water thousands of feet deep.

The amount of wild fish we can take from the ocean has reached a maximum, and given the pressure on these declining swimming resources from a global fishing fleet, the picture isn't likely to improve anytime soon.

There were several other exciting and optimistic scenarios from the past: fresh water from salt water, energy from the ocean, and living in the sea in offshore floating or submerged cities. How are we doing on those? For the time being I'm going to put off discussing fresh water from seawater and look at the other two.

Are we getting any energy from the oceans today? There are two quite different answers to this question. We have been drilling into the seafloor and extracting oil and gas along the California coast since 1886. This began as oil wells were drilled from piers extending into shallow water, which then migrated to artificial islands (1954), and then to offshore drilling and production platforms in deeper water (1958).

Globally about 30% of all of our oil comes from offshore sources. As of 2012, California waters had nine offshore platforms in state and municipal waters and 23 more in federal waters (beyond the three-mile limit). In contrast, the Gulf of Mexico was home to 3,858 platforms in 2006.

To be clear, whether the oil is pumped from under the seafloor or from land, burning it produces carbon dioxide (a greenhouse gas) and contributes directly to global climate change and its many impacts.

The other type of ocean energy is that coming directly from the ocean itself, which is renewable, doesn't produce greenhouse gases and doesn't contribute to global

warming. This includes harnessing waves, tides or currents (collectively known as hydrokinetic energy), offshore wind, and ocean thermal energy conversion (OTEC).

Each of these have been experimented with for decades. Lots of interesting and novel devices have been patented, but how much progress have we made in actually producing power on a commercial basis? How much energy are we generating from offshore?

The big one without question is offshore wind. While a number of wind farms have been built along coastlines, placing the wind turbines offshore has the advantages of not taking up valuable coastal land and access to stronger winds and, therefore, the potential to generate larger amounts of electricity. These benefits, however, are partially balanced by greater construction costs to place turbines offshore.

Due to the large coastal concentrations of people around the world, offshore wind farms can be sited close to electrical grids, and therefore, eliminate overland transmission line costs and power losses. An additional benefit is that there may be less public opposition to offshore wind farms than onshore installations, although public response in the United States is somewhat unpredictable. History shows us that no matter what is proposed and where, it is highly likely that there will be someone or some group opposing it.

We have had NIMBYs for years (Not in My Back Yard), but more recently a new group has emerged: BANANAs- Built Absolutely Nothing Anywhere Near Anything. This makes developing even renewable energy resources more costly and time consuming and discourages investment. More to come on this challenge.

To be clear, installing offshore wind turbines is no simple matter, even when all of the approvals and permits have been received. The turbine itself makes up about one-third to one-half of the cost of offshore installations, with infrastructure, maintenance and operations making up the rest. To place an offshore wind turbine with 200-foot-long blades requires some extraordinary machinery, including a very large ship, which is specially designed to transport and erect turbines and their foundations.

Denmark installed the first offshore wind farm in 1991, and by the end of 2017, eleven European countries had installed 4,149 grid-connected offshore wind turbines with a total capacity of 15,780 MW (megawatts). This provide for the electrical needs of about 10 to 15 million homes. While Europe has over 4,000 individual offshore turbines, the United States has five. You may ask why?