

# PODenergy Could Solve the World's Climate, Energy, and Food Challenges

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Plankton Ocean Digester (POD) energy is a holistic, sustainable solution to all of the following challenges:

- Abundant, economical renewable bio-energy to replace all coal, oil and natural gas burning
- Inexpensive sequestration of all previously emitted carbon dioxide
- Reduction of CO<sub>2</sub> concentrations to human-friendly levels
- Reduction of ocean acidity to pre-industrial levels
- Plentiful, affordable, healthy food to feed the entire world's population
- Restoration of the health of the world's oceans and sea life
- Reduction of dependence on land agriculture and livestock production for food
- Decrease of air pollution from burning coal and oil
- Address the issue of dwindling oil supplies

PODenergy's ocean engineering technologies sustainably, economically and humanely accomplish all of the above through the following steps (see links in the home page picture and publications on PODenergy.net for more details):

**1. Algae absorb CO<sub>2</sub>:** Sunlight powers algae (kelp, sargassum, or microalgae/plankton) to grow anywhere in the top few meters of the world's oceans, as long as there are sufficient nutrients. (Presently sustainable growth occurs mainly where currents bring up nutrients from the ocean floor.)

**2. Bacteria digest algae:** The algae are collected into large porous "tea-bags" which are pulled into thin impervious plastic "balloons" positioned at depths below 100 meters. Naturally present ocean bacteria convert the collected algae through anaerobic digestion into the following products:

- a. **Pure biomethane gas**
- b. **Pure carbon dioxide**
- c. **Vital nutrients**

**3. Biomethane is recovered:** Because of the high pressure at 100 meters deep, the carbon dioxide remains dissolved with the nutrients in the water inside the balloon. But relatively little methane dissolves, so it can be pumped to shore and used to replace fossil natural gas and eventually any coal and oil not already displaced by other renewable energy.

**4. CO<sub>2</sub> is sequestered:** After the methane is removed, the carbon dioxide is captured for sequestration in a permanent and easily inspected container, stored below 2,500 meters where it is a liquid heavier than seawater.

**5. Nutrients are recycled:** The "tea-bags" full of the digestion by-products are brought back to the surface to provide nutrients that support expanded plant growth (which continues the PODenergy process).

**6. Fish production is increased:** Acting like an "ocean rainforest," the additional plants support the natural growth of many diverse species of sea life, including an abundance of fish and sea vegetables some of which can be used for human consumption.

**PODenergy is a holistic solution.** It is powered by sunlight. It does not mine ocean nutrients or thermal gradients, consume fresh water or precious metals, require a monoculture, displace food production, or decrease species diversity. (Marine mammals, birds and large fish can be warned away

so they are not harmed while the algae is collected.) PODenergy's biomethane can be used as is, or converted into hydrogen or liquid fuel. It also can be converted into plastics, fertilizers and other products to sustain human civilization.

**PODenergy is economically viable.** With or without carbon sequestration pricing, PODenergy expenses are completely covered by the sale of the biomethane. Then a portion of the value of the fish and other food produced by the nutrient recycling can make a substantial profit.

**PODenergy is environmentally sustainable.** The biomethane produced replaces coal, oil, and fossil natural gas. The biomethane also provides the continuous energy source needed for the world to supplement intermittent electricity from wind, wave, solar-photovoltaic, solar-thermal, and other forms of non-fossil fuel renewable energy.

**PODenergy can solve global warming.** PODenergy can be scaled up to meet the entire world's climate challenge as follows:

1. Algae covering about 6% of the world's oceans could annually absorb **all** the carbon dioxide from the world's present annual fossil carbon dioxide emissions.
2. The anaerobic digestion of this quantity of algae would yield an amount of biomethane roughly equivalent to the entire world's annual fossil fuel energy, and thus could replace **the entire** world's present burning of coal, oil and natural gas.
3. The anaerobic digestion of this quantity of algae would yield an amount of CO<sub>2</sub> equivalent to about **50%** of the world's present annual fossil carbon dioxide emissions.
4. If 90% of this CO<sub>2</sub> is captured and permanently sequestered, it would cause an annual **decrease of about 3 ppm from the current CO<sub>2</sub> concentration** in the atmosphere (which would also reduce the CO<sub>2</sub> in the oceans, and thus reduce ocean acidity).
5. At the current level of about 390 ppm, the CO<sub>2</sub> concentration in the atmosphere could be reduced to the target level of 350 ppm in less than **30 years**.
6. Note that this calculation includes the CO<sub>2</sub> produced by the burning of the biomethane.

**PODenergy can help feed the world.** The recycling of essential nutrients supports the increased growth of all forms of sea life, from algae to sea vegetables to fish. We project that the example involving 6% of the world's ocean surface could support an additional harvest of more than 1,000 kg per year per person of fish, sea vegetables, and algae that could provide a balanced, healthy diet for all of the 7 billion people on the planet.

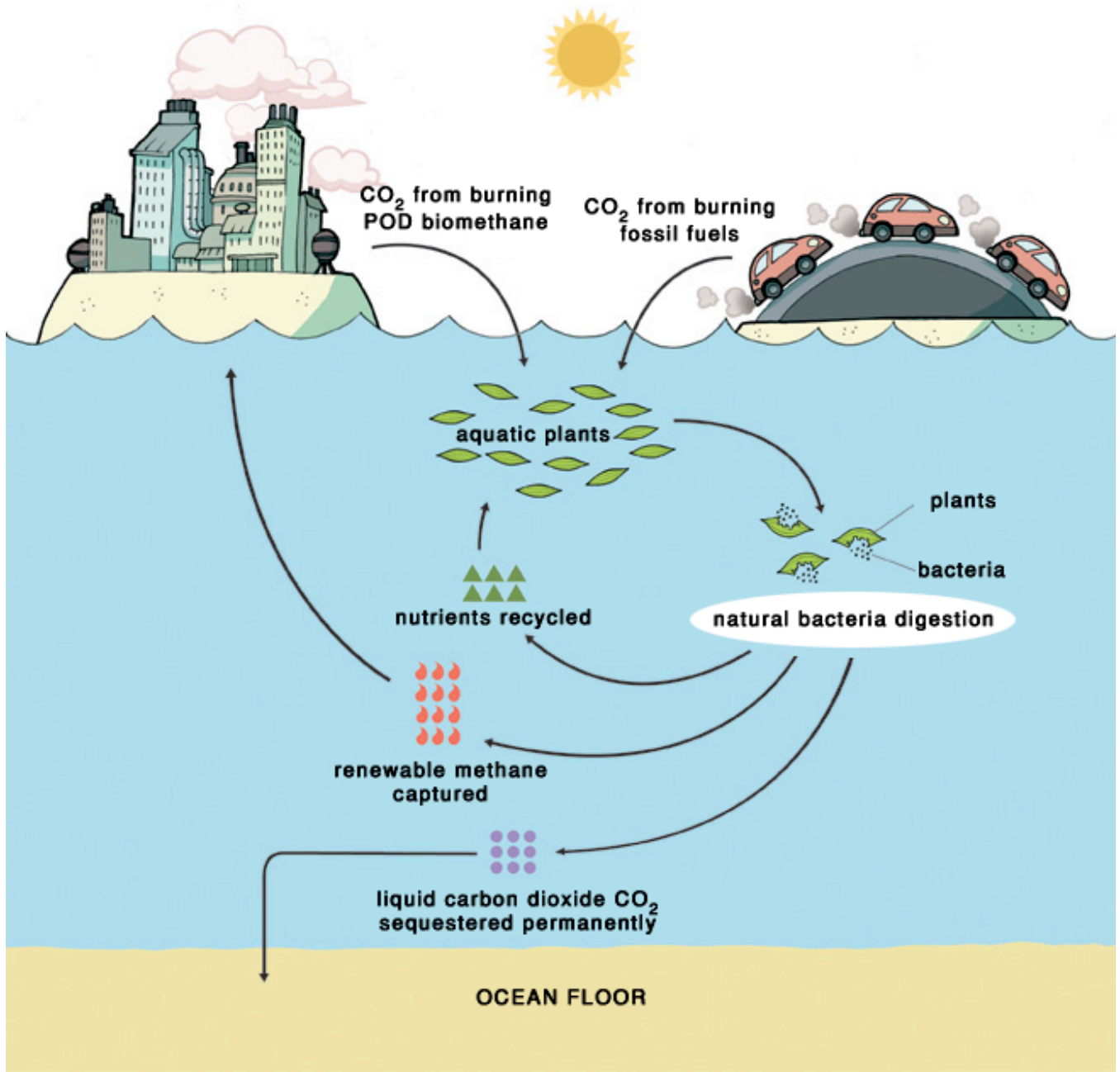
**References:** The quantification, 6% of ocean surface relative to world energy demand and fossil carbon emissions, is based on calculations using research contained primarily in:

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U.S. Energy Information Administration, "International Energy Outlook 2009," estimate of world fossil energy production for 2009 at [www.eia.doe.gov/oiaf/ieo/highlights.html](http://www.eia.doe.gov/oiaf/ieo/highlights.html)



**Overview of the PODenergy Process**