ATMOSPHERIC CO2 MANAGEMENT

by

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TO SAVE A PLANET - THINK AS BIG AS A PLANET

01 July 2008 **ACO2M-REV01**
26 Jan 2016 **ACO2M-REV07**
01 Sept 2019 **ACO2M-REV08**
01 Aug 2020 **ACO2M-REV09**

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OVERVIEW

It is acknowledge that increased atmospheric CO2-e, as a result of burning fossil fuel, equates to increased global warming, extreme weather and sea-level rise. The objective then, would be to reduce our carbon emissions and extract Co2 from the atmosphere.

If you read Climate Talk and waded through the evidence in Big Oil v The Planet, you now have a better understanding of how the world works and, why we face government inaction on climate change.

Big oil, big finance, big armament and cohort governments are a combined global force capable of changing regimes and destroying countries to get what they want. And, what they want is business as usual. i.e. Keep fighting over and burning fossil fuels and keep pumping CO2 into the atmosphere. The human impact and global warming are just collateral damage.

What we have is the private sector pushing ahead with renewable clean energy and the fossil fuel industry, along with corporate governments, pushing back hard. So, action on climate change is a slow process and it's inevitable that we won't reach the IPCC carbon reduction targets as atmospheric CO2 concentrations continue to rise.

We need more - We need much more. The consensus now is that we also need to extract CO2 from the atmosphere on a monumental scale and as an ongoing process. We can plant billions of trees but, once again, it's painfully slow and, it is doubtful we will get ahead of global deforestation. So, it's conceivable that we should turn to Earths 360 million square kilometers of ocean for a solution. It's inevitable that Eco-engineering will be required to reduce atmospheric CO2 concentrations as we consider the research being done by the Foundation for Climate Restoration. One compelling possibility is increasing oceanic bio-mass.

OBSERVATION

Organic matter including coal, oil, natural gas, timber and, in fact, all life on Earth stores carbon/CO2. Burning or decay of organic matter releases that stored CO2 into the atmosphere. It follows then that a carbon capture program of propagating organic matter, in sufficient quantity, can reduce and stabilise atmospheric CO2.

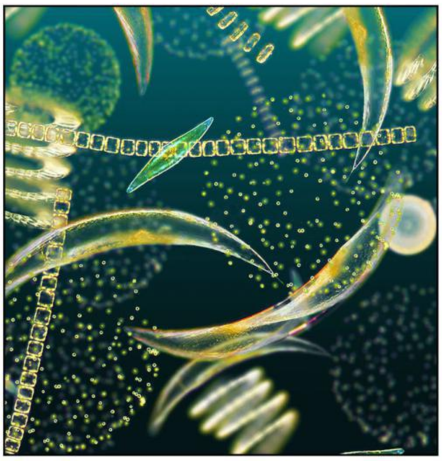
The object then, of this report, is to outline ways to stabilise carbon dioxide in the atmosphere to around 450ppm or better, thereby avoiding greater than 2°C global temperature increases, adopted as the critical point in the 2015 Paris Agreement and IPCC recommendations. The objective is to manage atmospheric CO2.

OBJECTIVE

As 90% of life on planet earth lies within it's oceans then this is where we will look to store our surplus carbon/CO2.

What I am proposing is the amplification of a natural process aimed at propagating oceanic bio-mass, starting at the bottom of the aquatic food chain, with fast growing phyto-plankton and zoo-plankton. Carbon capture and storage on a vast scale in a matter of months rather than the decades required by reforestation.

The project model works with a natural process and is based on the hypothesized first step in oil, gas and coal formation. Carbon dioxide stripped from the atmosphere is stored in oceanic biomass, the worlds largest carbon sink.

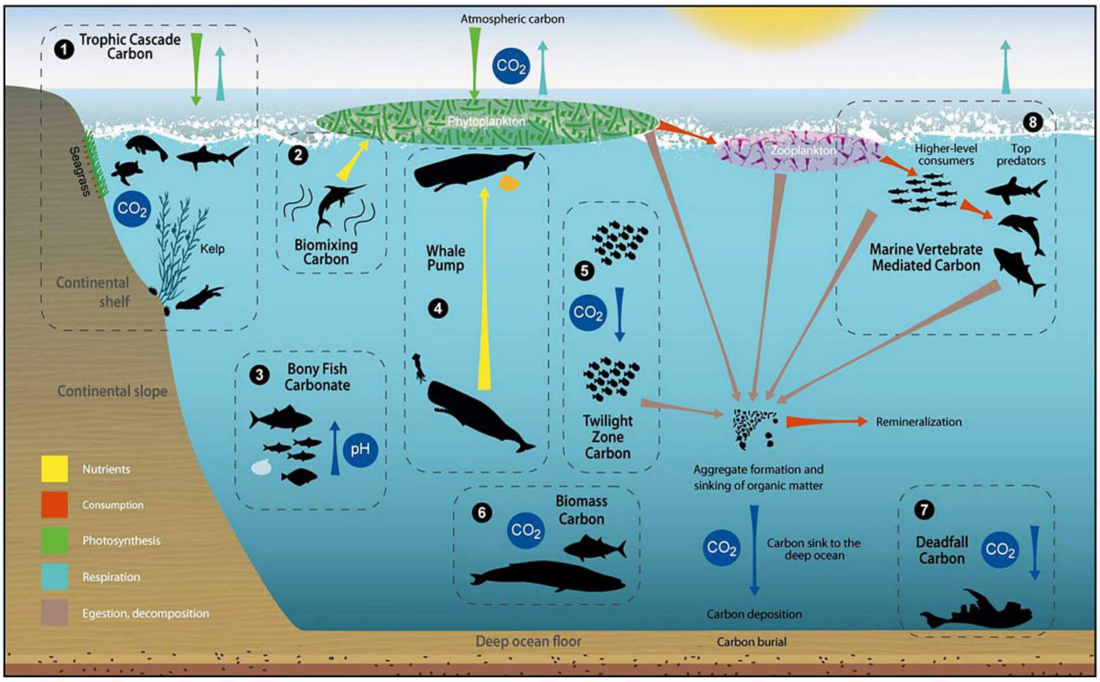



Plankton, and associated biomass, becomes trapped in natural ocean sediment and/or slowly works its way up the food chain. In effect, as an ongoing process, the object is to recapture and store carbon dioxide released into the atmosphere as a result of human activity. This equates to increasing oceanic biomass by an additional 20 Billion tonnes p.a. View satellite images of naturally occurring plankton blooms on pages 7 to 9 and "The Carbon Cycle" on page 11.

CO2 REMOVAL & MARINE PLANKTON:

Manage atmospheric CO2 and you manage the weather

Plankton growth, among other things, is dependent on the nutrient regime in the protozoic zone where it is consumed to become part of the food chain or settles to become part of the ocean sediment carbonation process.



Nutrients such as bio-available iron, phosphorus and nitrogen have been hypothesized to stimulate nuisance blooms of marine plankton. Two laboratory based biological assay techniques were used to test whether the addition of iron, phosphorus and nitrogen enhanced plankton growth. A three-way analysis of variance showed all nutrients stimulated growth and biomass under laboratory conditions, with organically chelated iron (FeEDTA) (From garbage) phosphorus and nitrogen.

An in-situ field experiment was also conducted concurrently on naturally occurring marine plankton to determine any growth response to phosphorus and iron additions. Field results showed prolific growth of bloom forming marine plankton and substantial and significant increases in biomass.

The way to regulate the amount of carbon in the atmosphere, on a global scale, is to regulate the amount of biomass growth on land and in the worlds oceans. i.e. Increase the carbon sink with terrestrial vegetation then plankton, crustaceans, fish, larger fish up the food chain plus what settles to the ocean bottom as "white snow" to be buried over time.

Plankton growth requires carbon (which comes from the ocean water, allowing atmospheric CO2 to be absorbed to replace it). Other critical ingredients are sunlight and nutrients = Iron or nitrogen. Basically plankton and subsequent carbon absorption is controlled by the nutrient regime.

Sinking provides the permanent removal of carbon by burial of the organic matter in sediment (later to become fossil fuel if buried long enough - Millions of years). Grazing passes the carbon up the food chain to animals where the carbon sinks (as dying animals), or is released back into the water due to respiration. So the process will be ongoing.

In terms of plankton growth - Phosphorus is usually the limiting nutrient in brackish or freshwater, while iron and nitrogen is usually the limiting nutrient in saltwater.

The addition of organically chelated iron or nitrogen and seeding with marine plankton in ideal open ocean conditions can result in between 2,000 and 4,000 tonnes of marine plankton biomass form each tonne of nutrient. Testing, monitoring and satellite observation is required for confirmation.

On this basis, and average scenario, the ocean needs to be selectively seeded with about 10 million tonnes of nitrogen based fertilizer annually, to counteract annual global carbon emissions and stabilise atmospheric CO2 levels. This of course, needs to be done in controlled conditions.

SEQUESTERING CARBON DIOXIDE:

A method of sequestering carbon dioxide (CO2) in an ocean comprises before and after monitoring of naturally occurring open ocean plankton blooms. Then, analyzing and recreating or encouraging these plankton bloom environments and associated marine life growth would be the best approach. i.e. Do exactly what nature does.

Next, test an area of the surface of suitable ocean in order to determine both the nutrients that are missing and the diffusion coefficient, apply to the area a first nutrient similar in composition and concentration to that found in a naturally occurring plankton bloom environment, and measuring the amount of marine growth and carbon dioxide that has been sequestered.

The nutrient preferably comprises a nitrogen or iron chelate that simulates the nutrients found in natural plankton blooms, prevents precipitation to any significant extent and releases nutrient over time in the photic zone. The method may further comprise applying additional nutrient, and reporting the amount of carbon dioxide sequestered. Comprehensive field testing and high altitude (satellite) observation are required during the development process.

Application in terms of the above will preferably include existing plankton bloom locations containing nitrogen-fixing phyto-plankton. To amplify the natural process, possibly the best method of application would be an automated land based system located at strategic river mouth during seasonal rain and snow melt runoff. The other possibilities are to enhance ocean up-wellings of natural nutrient and seeding cyclones or hurricanes to broadcast fertilizer over vast regions of ocean.

Besides production, the cost of ocean fertilization will also include monitoring, testing and reporting, so as to optimize the method of ocean fertilization, including the optimization of the composition of the fertilizer, the application rate, the location and method of application.

PROPOSAL IN BRIEF

Plankton and associated biomass is the first step in the oceans food chain and all life in the ocean exists either directly or indirectly as a result of the growth of plankton. In addition, it follows that the carbon and CO2 stored in organic matter whether living, decaying or trapped in ocean sediment is as a result of plankton growth.

The first step in atmospheric CO2 management is aimed at making Australia carbon neutral. Australian annual CO2 emissions, interpolated from results in 2018 are 588 million tonnes per annum or 23 tonnes per capita. That’s 1.3% of the global total. As the worlds largest coal exporter and major natural gas exporter, in aggregate, Australia is the source of at least 4.6% of total global carbon emissions or, 2.1 billion tonnes per annum. Half of this CO2-e stays into the Atmosphere each year. The other half is sequested by natural processes.

Associations between heavy rain or snow melt runoff and offshore plankton blooms are global and could be amplified with a land based automated system of adding suitable nutrient to existing oceanic phyto-plankton or, seeding. Initially then, the object is to increase oceanic biomass, in Bass Strait, to accommodate the capture of an addition of 1 billion tonnes of carbon/CO2 p.a.

The activity required to store 1 billion tonnes of CO2 p.a can be calculated in two parts of phyto-plankton growth. (1) The recycling amount of carbon stored in living biomass as grazing and, (2) The amount of CO2 stored in ocean sediment or sinking:

The greater the biomass the greater the amount of CO_2 and carbon capture. Primarily, CO_2 can be managed sufficiently to result in a zero carbon footprint for Australia. That's half of the 4.6% of the global total and a good first step for the world with Australia leading the way.

BASS STRAIGHT SATELLITE IMAGE

Naturally occurring Plankton Blooms

Showing microscopic marine organisms that thrive in nutrient-rich cold waters, like terrestrial plants, Plankton use the process of photosynthesis to create carbohydrates (sugar) from carbon dioxide, water and sunlight.

This plankton bloom north of Tasmania was taken Sept 1, 2005. Previous observations of this kind, last November, have been shown to be due to plankton blooms and cover almost all of Bass Strait.

This particular bloom covers an area of 43,000 square kilometers and produced 645,000 tonnes of bio-mass over a 12 week period. That bio-mass equates to carbon capture and enters the food chain or settles into ocean sediment.

NUTRIENT DISTRIBUTION - METHODS

(1) Amplify nutrient rich ocean up-wellings - By disturbing or heating ocean sediment.

This phenomena has been observed in Hawaii in relation to volcanic activity on Kilauea. Lava from Kilauea flowed into the Pacific last year and pushed nutrients to the surface. The result was a banquet for light-loving plankton and other microbes.

Scientists say the bloom was the result of lava heating deeper, nutrient-rich waters as it fell to the bottom of the ocean. The nutrients rose to the surface, where the phyto-plankton had a feast.

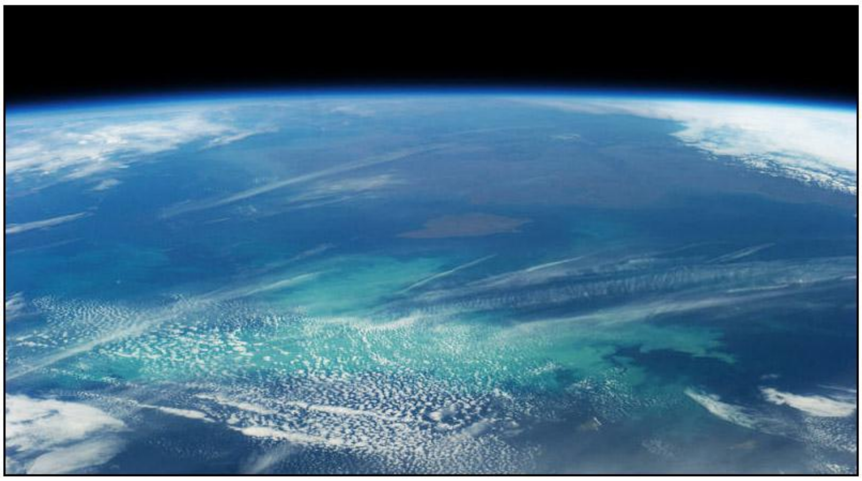
(2) Spray broadcast nutrients from flooded river mouth using chelated iron.

Associations between heavy rain or snow melt runoff and offshore plankton blooms are global and could be amplified with a land based automated system of adding suitable nutrient to amplify oceanic phyto-plankton blooms.

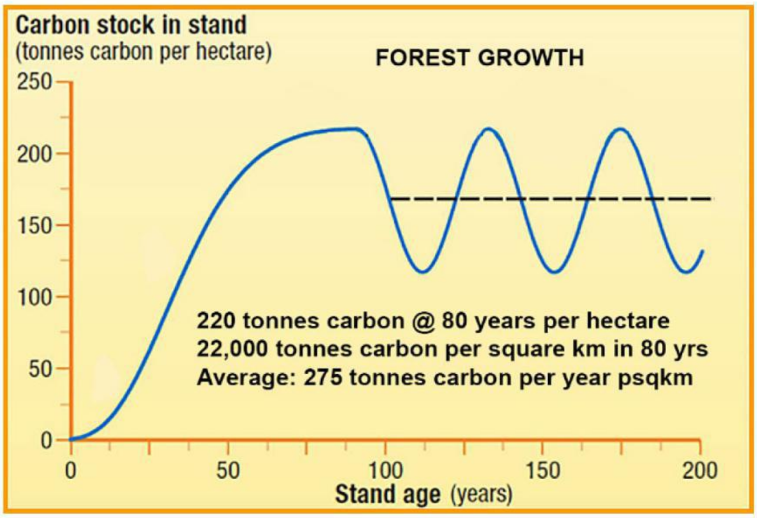
Plankton Bloom off Vancouver Island, Canada - NASA Aqua satellite handout image of phyto-plankton received 29 June 2006, Photo courtesy of AFP.

(3) Seed above open ocean cyclones and hurricanes or weather fronts with plankton producing nutrients.

Yet to be analised and testes but, consideration has been prompted by the massive north Pacific plankton bloom believed to have reduced atmospheric CO2 readings from Mauna Loa Observatory?



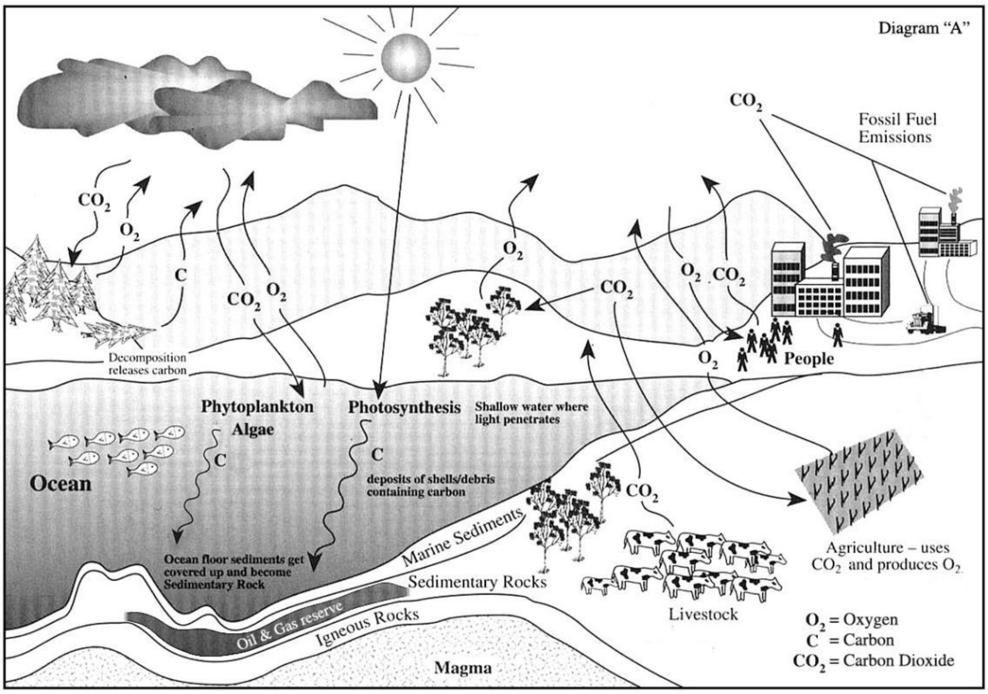
TREES v PLANKTON - (Carbon Capture Comparison)



As indicated on the Carbon Stock in Stand graph, maximum carbon capture and storage in forest growth takes about 80 years and then levels out. That equates to 275 tonnes of carbon capture per square kilometer per year over 80 years and fixed?

Phyto-plankton are a much bigger players in CO2 levels than realized. We can propagate about 15 tonnes of oceanic biomass in 10 to 12 weeks per hectare or 1,500 tonnes per square kilometer and then repeat the process up to 4 times a year.

CARBON CYCLE



Since all living things contain the element carbon, it is one of the most abundant elements on Earth. The total amount of carbon on Earth remains the same although carbon regularly changes its form. Carbon atoms are part of all living things and are free-floating in the air as carbon dioxide. Carbon is found in great quantities in the Earth's crust, its oceans and atmosphere. It is also found in many different chemical combinations, including carbon dioxide (CO2), calcium carbonate and a huge variety of organic compounds such as hydrocarbons like coal, petroleum, and natural gas.

When organic compounds decompose or are burnt the CO2 they contain is released back into the atmosphere. The object then is to generate a massive carbon sink and store enough carbon based organic matter to compensate for the CO2 release into the atmosphere as a result of mans activities.

If we can do this we can start to manage atmospheric CO2 levels and reach a sustainable level to avoid catastrophic climate change and devastating sea level rises.

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NOTE: This is not a published work but untrained observation and analysis. The intention is to have this researched and substantiated then submitted for peer review.