

The Three Threes: A [not so] New Organizing Principle to Save the Planet

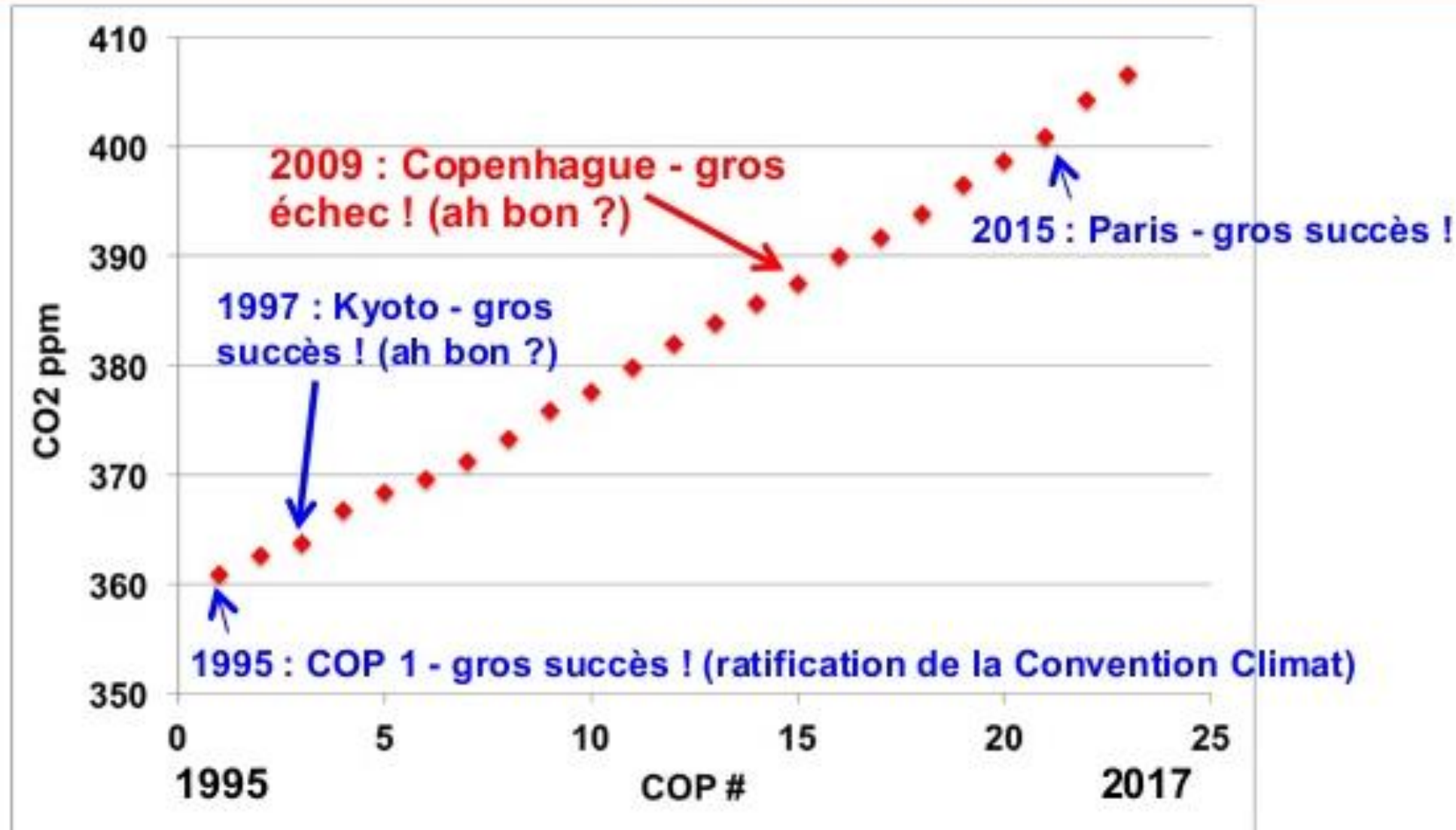
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We've had 25+ years to figure this out...



***...the
UNFCCC
process
is not
working
and
will not
work!***

The *three 3s*

A typical person can live for

- *3 weeks without food*
- *3 days without water*
- *3 minutes without oxygen*

These are not luxuries.

The 6th great extinction includes *homo sapiens*.

How to feed 9 billion people without destroying the planet

Urban / vertical farms – consistent with global trend of rural-to-urban migration



How to feed 9 billion people without destroying the planet

***Rural farming
concentrates on
energy crops and
carbon
sequestration via
biochar, etc.***



Mariculture: potential for > 100x current marine seafood output



Photos courtesy of Leow Ban Tat, ACE Eco Ark

Regenerative marine aquaculture – “no feed” operations with artificial upwelling as necessary.


Creating natural capital

- Retire ships @ 20 years
- 0.5 million tons CO₂e/ship avoided
- Avoided CO₂ value =
\$17.5 million per ship retired
- ADB financial assistance TBD
- Convert ships to floating aquaculture
- \$10 million per ship for retrofit (?)
- 100 ships by 2030 (?)
- Global scale-up to 10,000 ships (?)



Shellfish sequester 0.44 tons CO₂ in each ton of CaCO₃ (the shells)

How to provide safe drinking water for 9 billion people

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- An aerial photograph of a building's roof. The roof is covered with numerous solar panels. A red circle is drawn around a specific section of the roof, highlighting a cluster of solar panels and some associated equipment. The background shows the building's structure and other parts of the roof.
- **Atmospheric resource: 2 million liters/person/day**
 - 100% climate-proof drinking water – adaptation
 - Solar powered -- mitigation
 - ***Infinite scalability with respect to global need***
 - 2-5 Liter / day / unit production at ADB HQ since June 2017
 - US\$0.11/ Liter vs. US \$0.50 / Liter for bottled water

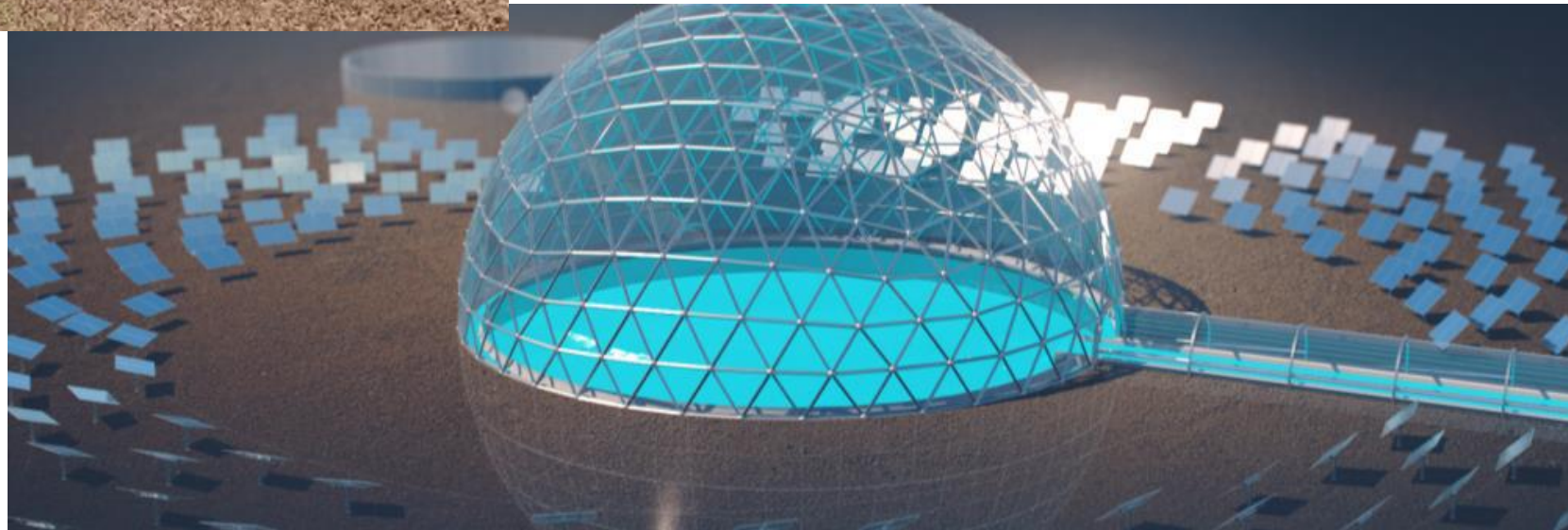
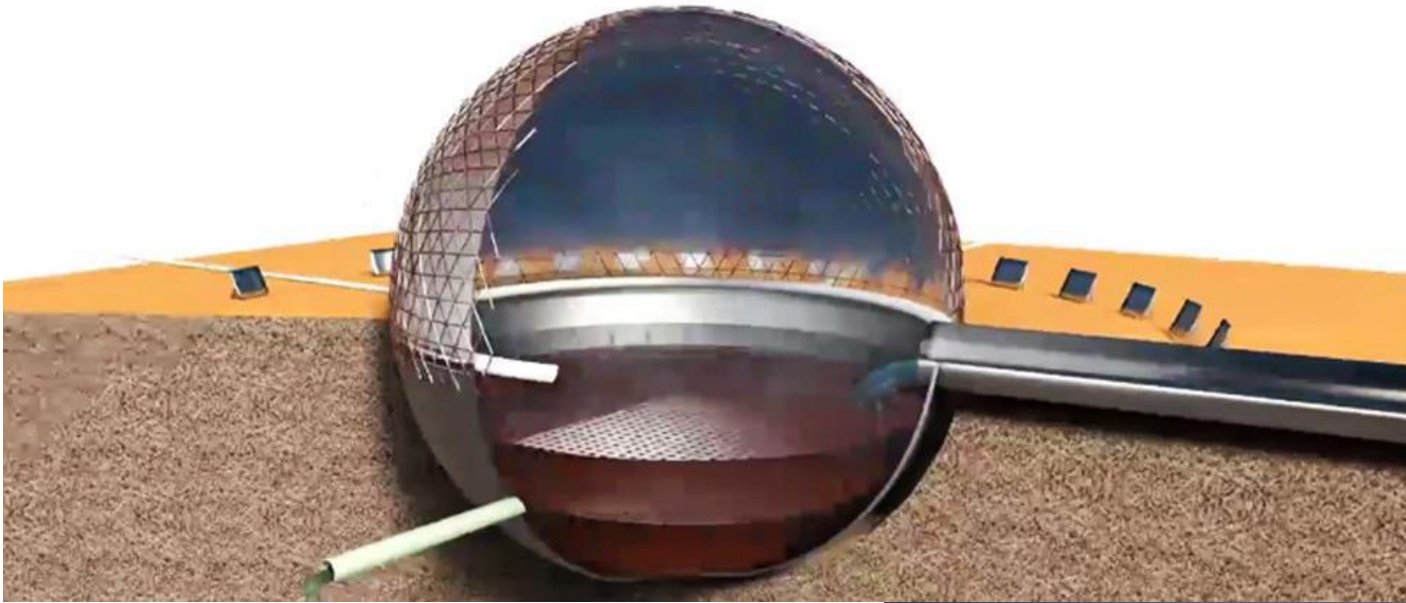
How to provide safe drinking water for 9 billion people

Solar-powered zero-discharge desalination: Solar Water PLC – ACEF 2019

Hydropanels, desalination, etc. are inherently modular with manufacturing economies of scale: **build more to make it cheaper ***

* $2 + 2 = ???$

What do you want it to be?



Zero discharge desalination retrofitted for sustainable “mining” of Lithium & other high-value metals from seawater (some assembly required)

Existing / new desalination plants:

Power with RE for sustainable & scalable climate proof water (\$\$)
Develop new packaging to eliminate plastic bottles

Modify brine treatment system for low- or zero-discharge

Recovery & sale of edible salts (\$\$)

Produce carbonates from concentrated brine with modified EMA system

- Treat carbonates with acid solution for recovery of Lithium and/or other high-value elements: wholesale prices for Lithium carbonate and lithium hydroxide are > \$10,000 / ton (\$\$\$\$\$)
- CO₂ from seawater is retained in the acid process solution

Carbon capture and storage

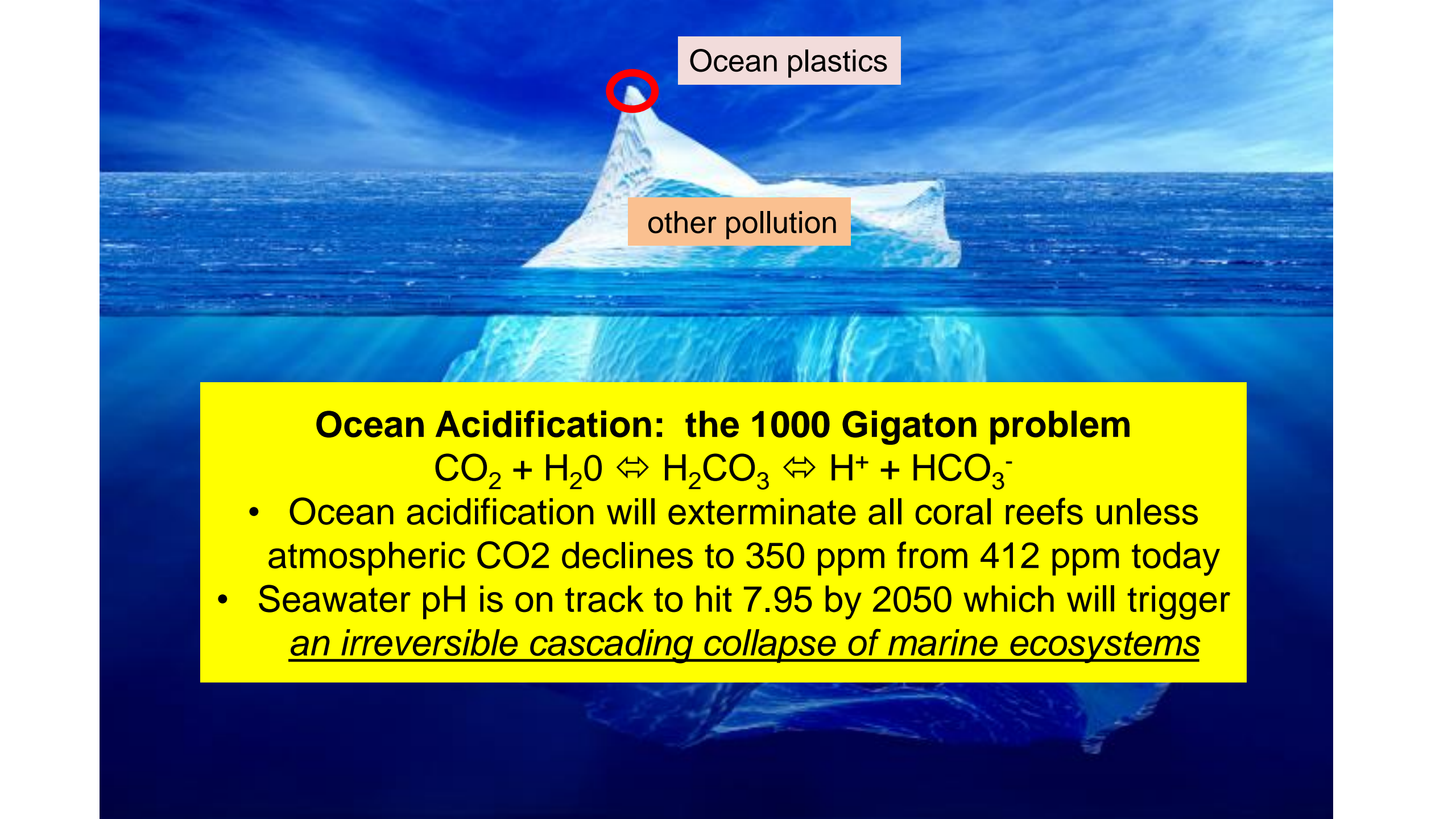
Dispose of acidic solution with CO₂ into saline aquifers – proven technology but requires exploratory drilling to confirm suitable aquifers

Possible to monetize carbon credits as a 4th revenue stream? (\$\$??)

Now, for the hard part...

50-75% of the oxygen we breathe comes from the ocean



An iceberg floating in the ocean. The tip of the iceberg is above the water, and a much larger portion is submerged below the surface. A red circle highlights the very tip of the iceberg. A label 'Ocean plastics' points to this tip. Another label 'other pollution' points to the submerged part of the iceberg.

Ocean plastics

other pollution

Ocean Acidification: the 1000 Gigaton problem



- Ocean acidification will exterminate all coral reefs unless atmospheric CO₂ declines to 350 ppm from 412 ppm today
- Seawater pH is on track to hit 7.95 by 2050 which will trigger *an irreversible cascading collapse of marine ecosystems*

Acidification



Calcification



Gigatech solutions:

- Grow reefs, seagrasses, and shellfish faster than pollutants are killing them by mimicking natural processes
- Grow other marine carbon sinks (*Deep 6 Carbon* ©)

Long-term: need to draw down 50 Gigaton CO_2 / year for 20 years*

**Note to carbon market experts: an avoided emission does not drawdown CO_2 , and the ocean knows this even if you don't*



The Ocean Economy Today

- **Energy** – > 99% oil & gas
- **Fishing** – a nautical version of strip mining
- **Tourism** – mostly unsustainable
- **Shipping** – transformation began in 2020 due to IMO cleaner shipping regulations



The Ocean Economy To Help Save The Planet

- **Marine Aquaculture**
- **Reefs**
- **Renewable energy / offshore (ORE)**
- **Ecotourism**
- ... all for preservation, restoration and growth of **Ecosystem Services**



**MARES aligns with SDG 14, SDG 7, etc., and
ADB Strategy 2030 Operational Priorities 1, 3, 5, & 7**



Don't forget cleaner shipping!



MARES* - “just add money”

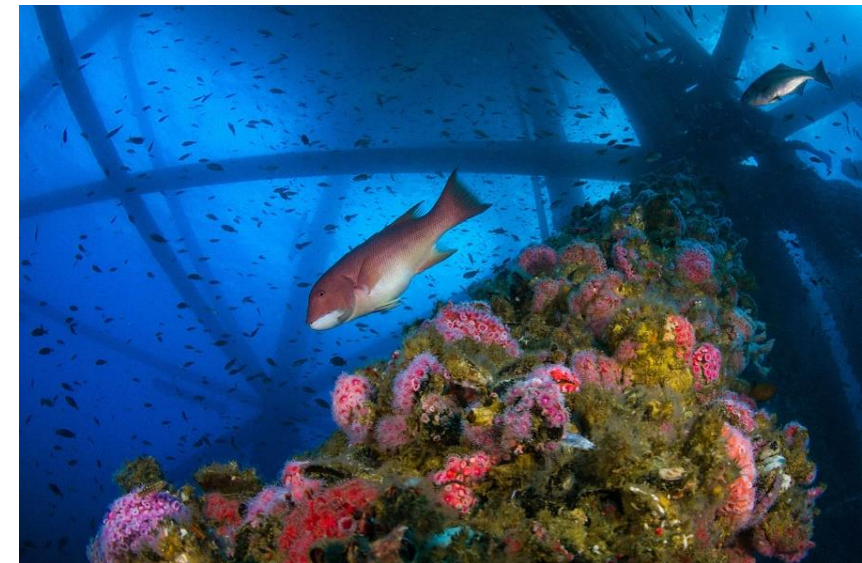
Need to leverage \$25 – 50 Billion investment in Asia & the Pacific to achieve \$1 Trillion/year globally

*If you think it's too expensive,
you can have a dead planet at no extra charge*



Thank you!

*** ADB RETA 6619**



Key References

Scott Countryman, 2017. *Sustainable Building Materials Grown In Seawater*. Asia Clean Energy Forum. Manila. [Presentation in main forum session on the Food-Energy-Water-Climate Resilience Nexus.]

Goreau, T.J. (2014) *Electrical Stimulation Greatly Increases Settlement, Growth, Survival, and Stress Resistance of Marine Organisms*, Natural Resources, 5, 527-537, <http://dx.doi.org/10.4236/nr.2014.510048>

Wolf H. Hilbertz, 1979, Electrodeposition of minerals in sea water: Experiments and applications, IEEE Journal on Oceanic Engineering, 4:1-19

Wolf H. Hilbertz, 1992, Solar-generated building material from seawater as a sink for carbon, Ambio, 21, 126-129

W. H. Hilbertz & T. J. Goreau, 1996, Method of enhancing the growth of aquatic organisms, and structures created thereby, United States Patent Number 5,543,034, U. S. PATENT OFFICE (14pp.).

Millison, D. and S. Countryman, 2017. *Sustainable Pre-stressed Concrete from Seawater*. International Conference on Sustainable Infrastructure; American Society of Civil Engineers, New York City, October 2017.

References (2)

In 2009, former chief scientist of the Australian Institute of Marine Sciences made a presentation to the UK Royal Society titled “Is the Great Barrier Reef on Death Row”. The massive bleaching that occurred in 2015-16 was clearly anticipated in the 2009 presentation:

<https://www.oceanarkalliance.org.au/dr-verons-coral-crisis-presentation-to-royal-society-london/>

In April 2019, some scientists say marine life will be extinct by 2048 “it’s not a prediction”:

https://earthmaven.io/sustainablehuman/old-story/salt-water-fish-extinction-seen-by-2048-Udxlu7LsXkisG0OmuzAbcA/?utm_campaign=meetedgar&utm_medium=social&utm_source=meetedgar.com

The first commercial operation in US federal waters combining seagrass plus shellfish is operating offshore California; see: <https://catalinasearanch.com/> Catalina Sea Ranch’s initial 100 acre mussel farm was expected to have 50% profit margin; the operation is proposed to be expanded to 1000 acres with up to 90% profit margin. See:

<https://static1.squarespace.com/static/591e33d3e6f2e191e5349dc6/t/596f7ebf37c58152ae4aff2b/1500479170878/Aquaculture+NA.pdf>

References (3)

The ability of kelp and other seagrasses to metabolize CO₂ and mitigate pH locally is noted here:

https://e360.yale.edu/features/kelp_seagrass_slow_ocean_acidification_netarts

<https://www.dw.com/en/making-coral-grow-50-times-faster-than-nature/a-45794571>

At least one company is attempting to commercialize coral farming based mainly on the micro-fragmenting method. See: <http://www.coralvita.co/coral-farming>

Two of the largest artificial reef programs using the “biorock” process are in Indonesia. The site at Gili Trawangan off the northwest coast of Lombok offers courses in reef surveying and protection, and how to design and grow electric reefs. See: <http://giliecotrust.com/biorock/>

Catalina Sea Ranch’s website notes: The legs of three offshore oil platforms located about two miles away are teeming with marine life and blanketed with mussels and scallops thriving on their consumption of single-celled phytoplankton. See: <https://catalinasearanch.com/offshore-aquaculture>

References (4)

The inspiration for combining marine aquaculture with rigs-to-reefs is from the case studies on these topics in: OECD. 2019. *Rethinking Innovation for a Sustainable Ocean Economy*, OECD Publishing, Paris.
<https://doi.org/10.1787/9789264311053-en>

Living breakwaters:

<http://nrcsolutions.org/living-breakwaters/>

New York City “living breakwater” for climate resilience 2017

<https://stormrecovery.ny.gov/sites/default/files/crp/community/documents/Appendix%20D%20-%20Breakwaters%20Project%20Benefit%20Cost%20Analysis.pdf>

Breakwater cost estimates:

https://www.researchgate.net/figure/Costs-versus-water-depth-and-wave-height-reduction-extents-of-Nature-based-Defence-NbD_fig3_301791321

Natural climate solutions (NCS) – US prospects

<https://advances.sciencemag.org/content/4/11/eaat1869>

Biomimetic CaCO₃ formation with CO₂ capture from air:

<http://www.blueplanet-ltd.com/>