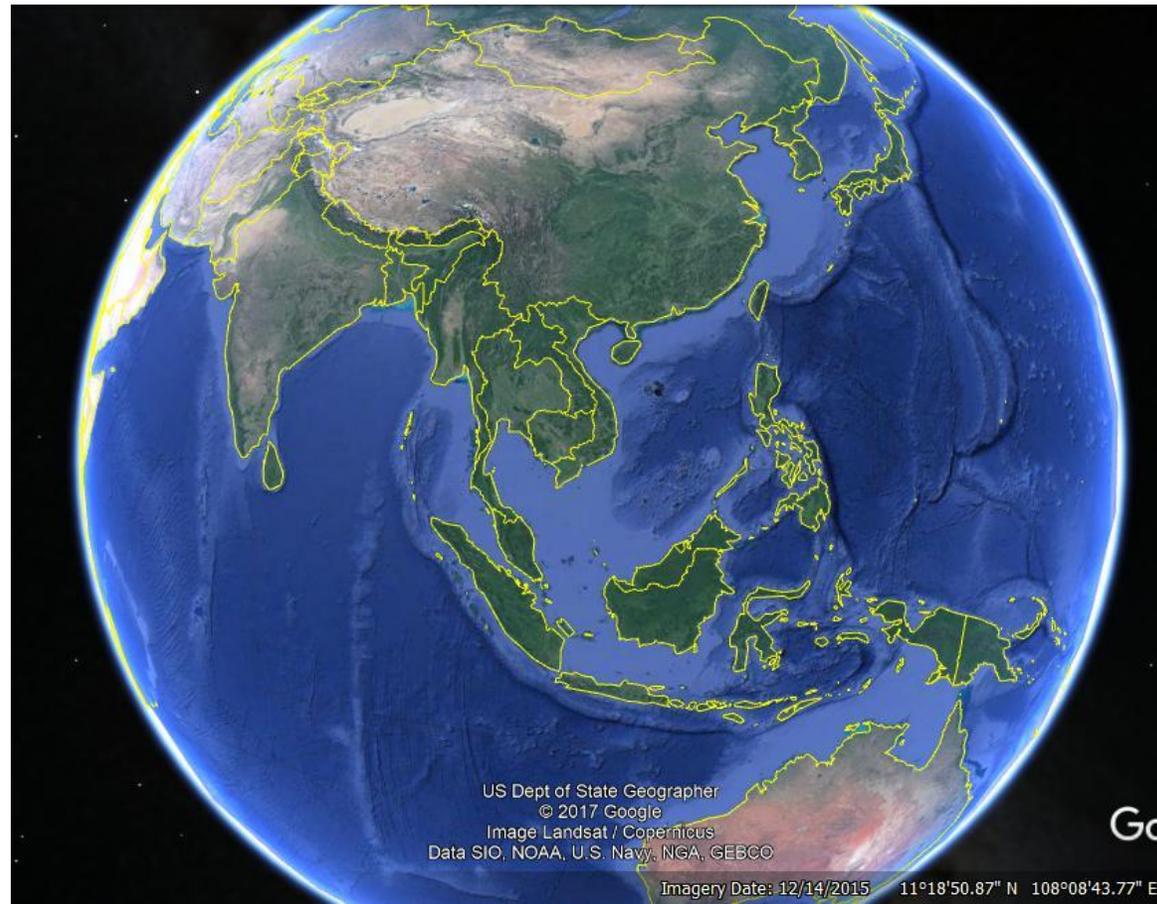


# ***The Three Threes: A [not so] New Organizing Principle to Save the Planet***

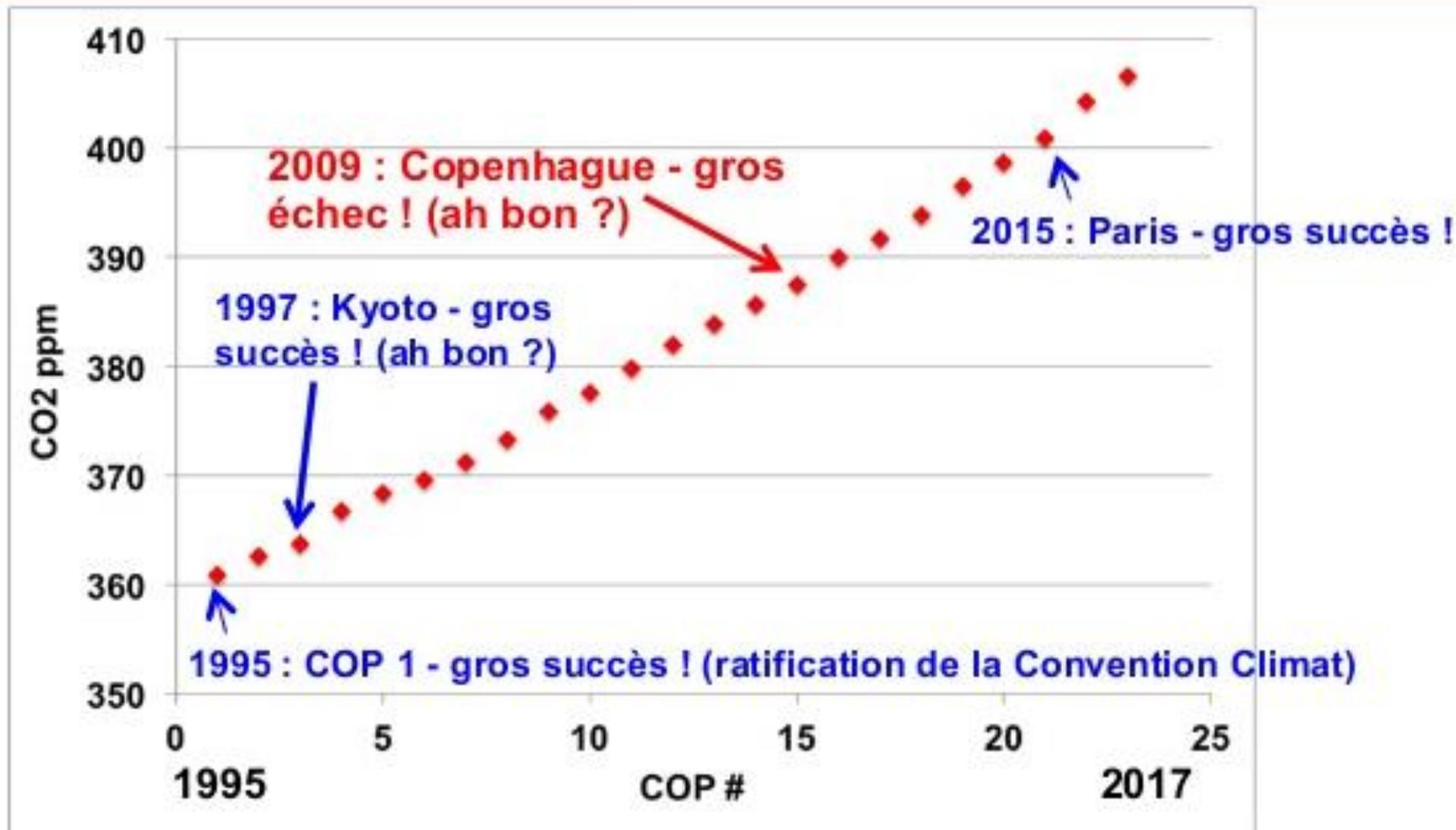
***Asia Clean Energy Forum  
June 2021***



Dan Millison  
Manager  
Transcendery, LLC



*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 6<sup>th</sup> 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



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

Photos courtesy of Leow Ban Tat, ACE Eco Ark

## Creating natural capital

- Retire ships @ 20 years
- 0.5 million tons CO<sub>2</sub>e/ship avoided
- Avoided CO<sub>2</sub> 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 CO<sub>2</sub> in each ton of CaCO<sub>3</sub> (the shells)*

# How to provide safe drinking water for 9 billion people

- 
- An aerial photograph of a building's roof. The roof is covered with numerous solar panels. A red circle highlights a specific area in the center of the roof, which appears to be a water collection or treatment unit. The building's exterior is visible on the left side of the image.
- **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

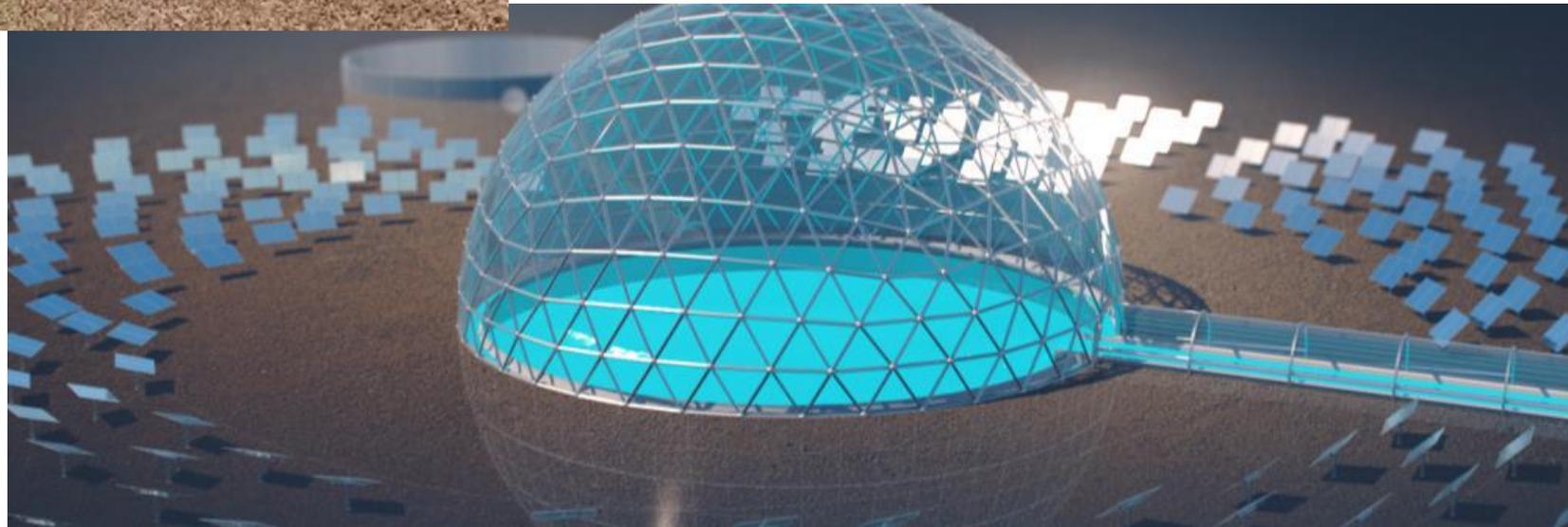
# How to provide safe drinking water for 9 billion people

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

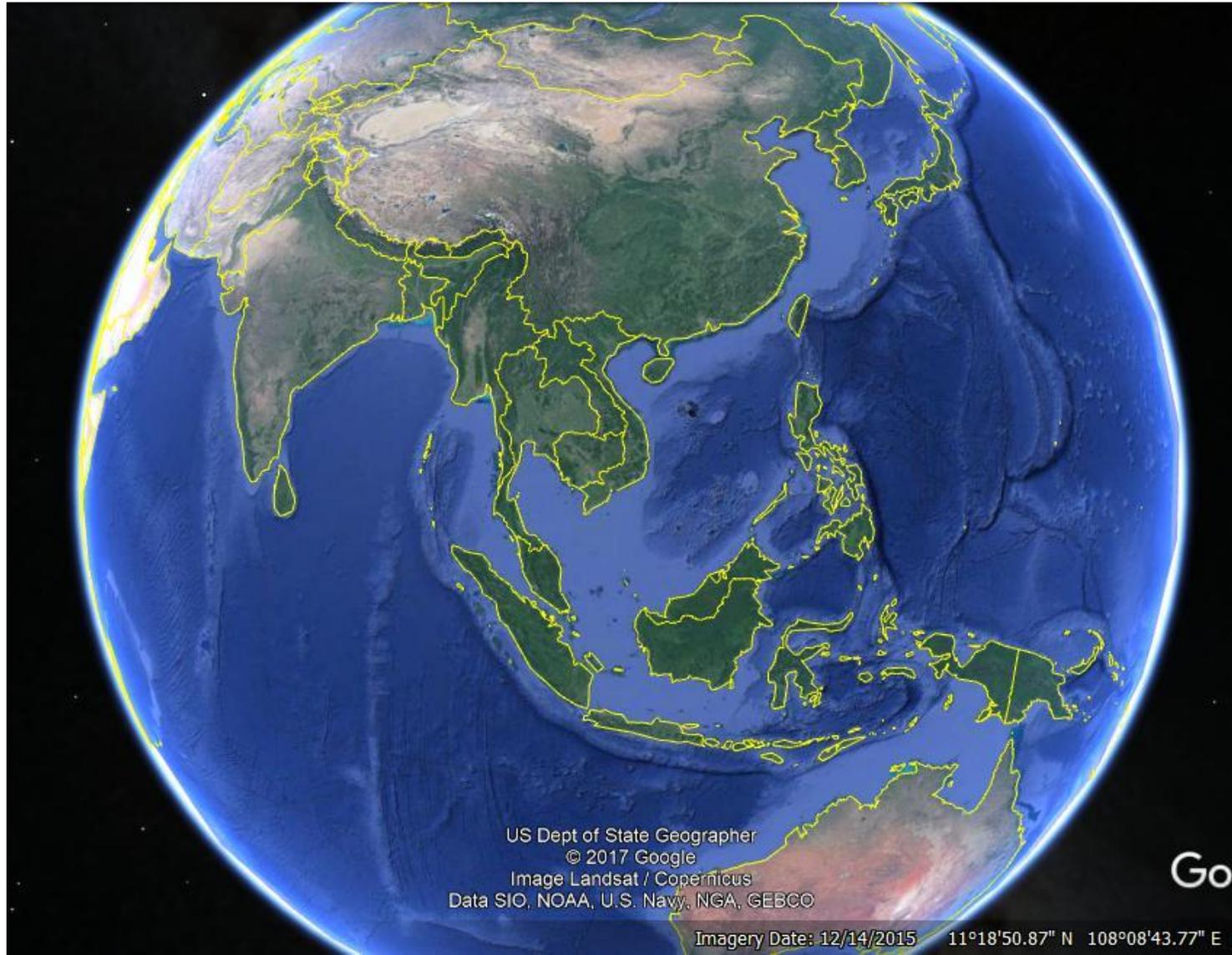
## Carbon capture and storage

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 4<sup>th</sup> revenue stream? (\$\$??)***

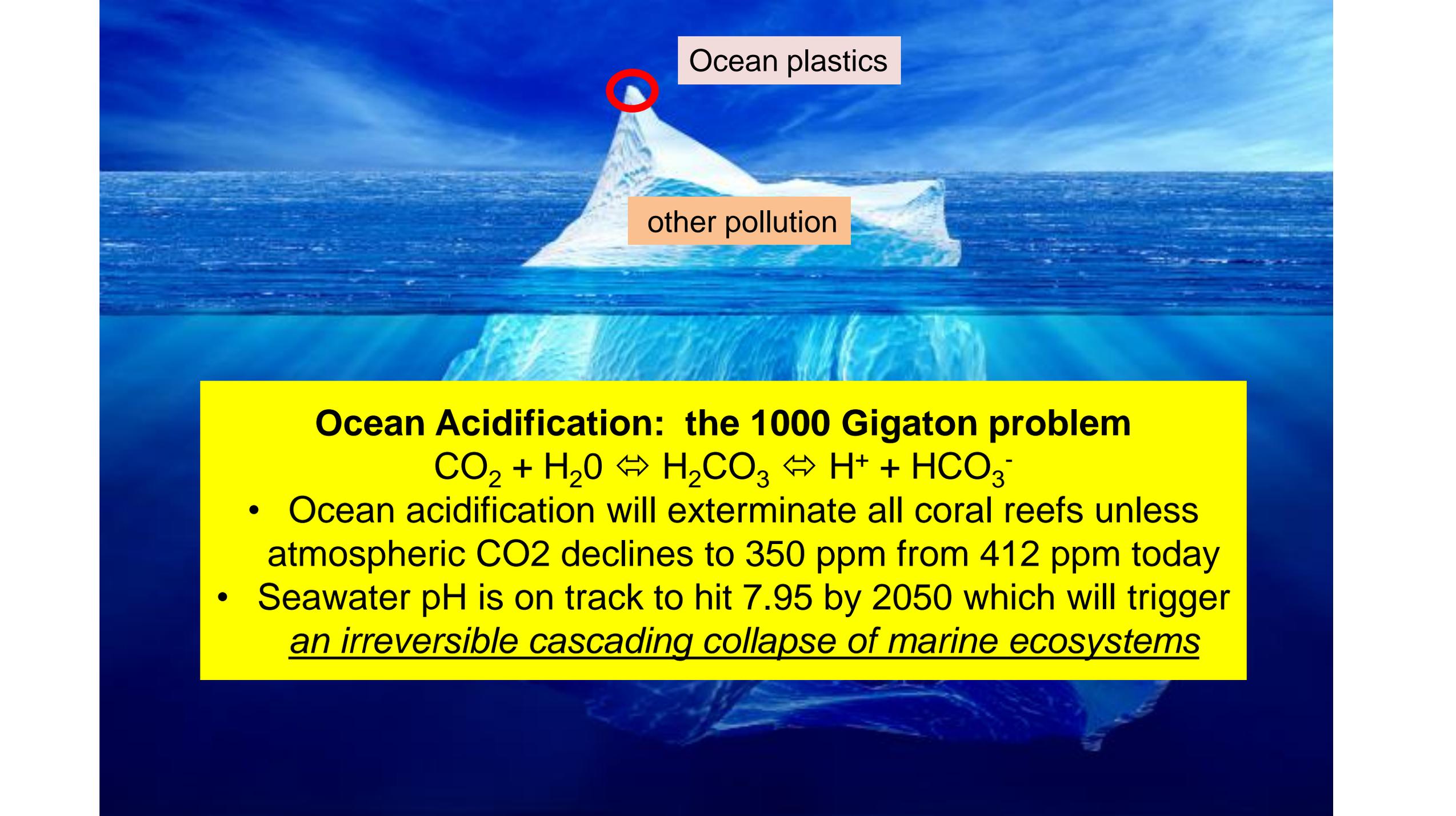
***Now, for the hard part...***

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



US Dept of State Geographer  
© 2017 Google  
Image Landsat / Copernicus  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Imagery Date: 12/14/2015 11°18'50.87" N 108°08'43.77" E



Ocean plastics

other pollution

## Ocean Acidification: the 1000 Gigaton problem



- Ocean acidification will exterminate all coral reefs unless atmospheric CO<sub>2</sub> 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<sub>2</sub> / year for 20 years\*

*\*Note to carbon market experts: an avoided emission does not drawdown CO<sub>2</sub>, 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

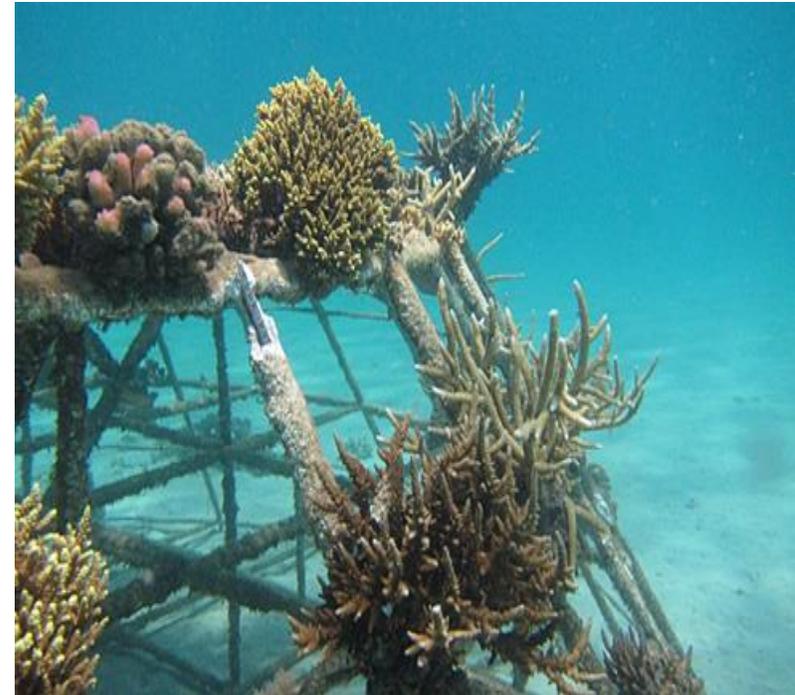
- **Marine Aquaculture**
- **Reefs**
- **Renewable energy / offshore (ORE)**
- **Ecotourism**
- ... all for preservation, restoration and growth of **Ecosystem Services**



**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](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 CO<sub>2</sub> and mitigate pH locally is noted here:

[https://e360.yale.edu/features/kelp\\_seagrass\\_slow\\_ocean\\_acidification\\_netarts](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](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 CaCO<sub>3</sub> formation with CO<sub>2</sub> capture from air:

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