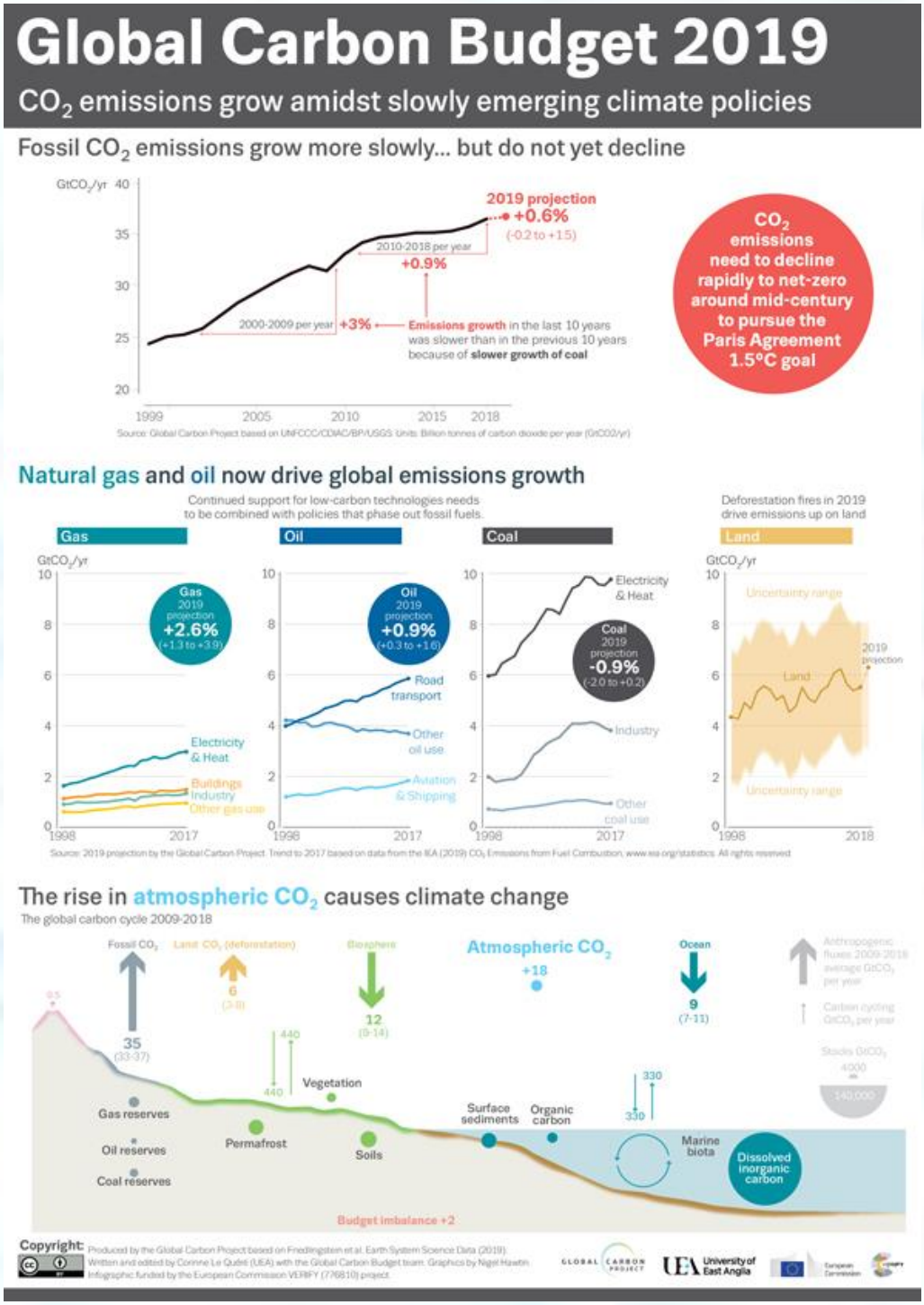
the weekly anthropocene

dispatches from the wild, weird world of humanity and its biosphere

By Sam Matey, December 11 2019



State of the Planet: 2019 Carbon Emissions. A new report from the Global Carbon Project international research consortium gives a picture of where human civilization is in terms of greenhouse gas emissions for 2019. The researchers found that by the end of this year, industrial activities and the burning of coal, oil, and natural gas around the world will have pumped 36.8 billion metric tons of carbon dioxide (CO2) into the atmosphere, rising to 43.1 billion tons from all human activities when emissions from agriculture and deforestation are factored in. However, the good news is that the rate of growth is the slowest yet-emissions rose by 0.6% in 2019, compared to 2% in 2018 and an average of 3% from 2000 to 2009. In short, on a planetary perspective, we're still pushing in the wrong direction, but ever more slowly. All this comes as the COP 25 climate talks continue, with the final results indeterminate so far. Hopefully, perhaps as soon as next year, we'll start moving in the right direction, towards net zero carbon emissions. For more on this fascinating and hugely important story, see tinyurl.com/rhwcsek and globalcarbonproject.org/.

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ESA Carbon Monitoring. In an unexpected windfall, EU member states have greatly increased the budget for the European Space Agency (ESA), allotting it a 12.5 billion-euro three-year budget, the agency's largest ever. A big chunk of that will go to expanding the Copernicus fleet of Sentinel satellites, which monitors Earth's atmosphere, seas, and land cover. (Pictured: impression of the fifth Sentinel satellite in the Copernicus fleet, launched in 2017). This is amazing-the expanded Copernicus fleet will be able to monitor CO_2 emissions worldwide on a daily basis, becoming the first program able to accurately monitor all Paris Agreement emissions reduction pledges. This is the kind of data we'll need in the effort to stabilize our atmosphere. Great news! For more, see tinyurl.com/tauju4s.

World War Zero. John Kerry, Madeleine Albright, Leonardo DiCaprio, Sting, Cindy McCain, Emma Watson, Al Sharpton, and Arnold Schwarzenegger are among the celebrities and politicians teaming up in World War Zero, a new bipartisan coalition to raise awareness about the need to solve the climate crisis by waging a "world war"-level effort to reach net zero carbon emissions. This is an awesome consciousness-raising project! For more, see worldwarzero.com/.

Climate Models. A new study has analyzed 17 climate change forecasts drawn from 14 historic computer models published between 1970 and 2001, in order to "grade" how well they did in predicting the modern extent of climate change. They found that the historic models were highly reliable-for 10 of them, there was no statistically significant difference between their output and real-world observations. In short, their predictions were perfect. Even among the seven that were off to some extent, five of them had the science right, but simply didn't foresee some decreases in certain pollutants (for example, the fall in greenhouse gas refrigerants like Freon after the Montreal Protocol in 1989). In short, historically, climate models have been highly reliable, indicating that we should continue to use them for future planning. For more, see tinyurl.com/t9reyfn.

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Penguins. Over the past few decades, chinstrap penguins (*Pygoscelis antarctica*) have seen their population decline somewhat (although there are still millions of them, so no need to worry just yet about the survival of the species), while the population of the closely related gentoo penguin (*Pygoscelis papua*) has, amazingly, risen six-fold. (Pictured: gentoo penguins with the orange beaks, chinstrap penguins with black beaks and the eponymous black "chin strap" marking). A new study analyzed the nitrogen isotopes in the amino acids of chinstrap and gentoo penguin feathers collected over the decades (isotopes differ depending on one's food source) to look at how their diet may have affected these differing fortunes. In the oldest samples, both gentoo and chinstrap penguins ate krill (a sort of Antarctic shrimp, vital to the local food web) almost exclusively. However, as krill declined due to climate change and other factors, gentoo penguins started eating more plentiful prey, like fish and squid, while chinstraps remained focused entirely on krill. This study is another example of the trend that in the rapidly changing Anthropocene, the adaptable will thrive and the specialist may suffer. For more, see tinyurl.com/uauxq8e and tinyurl.com/uxwssp7.

"Blue Energy" From BNNT Membranes. On December 3rd, a research team from Rutgers University reported that they had created a new sort of boron-nitride nanotube (BNNT) membrane that could open the door for an entirely new sort of renewable energy, to join wind, solar, hydro, and geothermal. Their membrane, the development of which was spearheaded by Ph.D. student Semih Cetindag, makes practicable for the first time the theoretical concept that power can be generated from charge differentials in partially salty water. The membrane, with 10 million BNNTs per square centimeter, works by pumping positively charged sodium ions through a semipermeable membrane, resulting in one positively-charged side and one negatively-charged side (where all the negatively charged chloride ions stayed). Put an electrode in each one, and voila, you're generating lots of clean power! The world is full of partially salty places-cities from New York to Mumbai to Recife are at points where rivers meet the sea. In a decade or so, this could be a great new tool in the clean energy toolbox! Spectacular news. For more, see tinyurl.com/sogojjk.

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Some Good News for Coral Reefs. Coral reefs have had a lot of bad news lately. They're facing two separate but related existential threats (death by "bleaching" when their symbiotic algae-like zooxanthellae are expelled due to warming waters, and dissolution in oceans acidifying due to high CO2 levels in the atmosphere reacting to form carbonic acid) as well as an array of smaller ones, ranging from pollution from sunscreen on swimmers to coral diseases being carried on plastic waste. Just a week ago, the world's coral reefs were identified as one of nine Earth systems at risk of a "tipping point" due to climate change. Now, two new groundbreaking studies from different parts of the considerably degraded Great Barrier Reef have shown that humanity can do more than we thought to help protect and restore coral reefs, and forge a path ahead for this unique, vibrant ecosystem in the Anthropocene.

Acoustic Enrichment.

One of the best ways to help coral reefs survive the threats of the Anthropocene is to ensure that they have a healthy fish community. (Pictured: a healthy coral reef, with attendant fish). Fish graze on algae, keeping reefs clean and leaving space for new coral larvae to settle and grow. However, once a patch of coral starts to become degraded (from any of the threats mentioned above), fish avoid it, which of course accelerates that decline. Now, researchers have tested a fascinating new way to recruit young fish to help degraded coral. A healthy coral reef emits a complex undersea orchestral chorus, of sounds ranging from snapping shrimp to grunting fish, while a dead one is silent. The team placed underwater loudspeakers on patches of recently degraded coral in the northern Great Barrier Reef (a spot hit hard by massive bleaching events in 2016 and 2017). They found that the "acoustically enhanced" reef patches got double the number of arriving fish and 50% more fish species that un-enhanced degraded reef! Plus, the arriving fish stayed, and included species from across the food web, ranging from herbivores to detritivores to planktivores to piscivores-all essential for reestablishing a thriving ecosystem. This is a great new tool to help restore coral reefs! For more, see tinyurl.com/yx243cq6 and tinyurl.com/tcu8kns.

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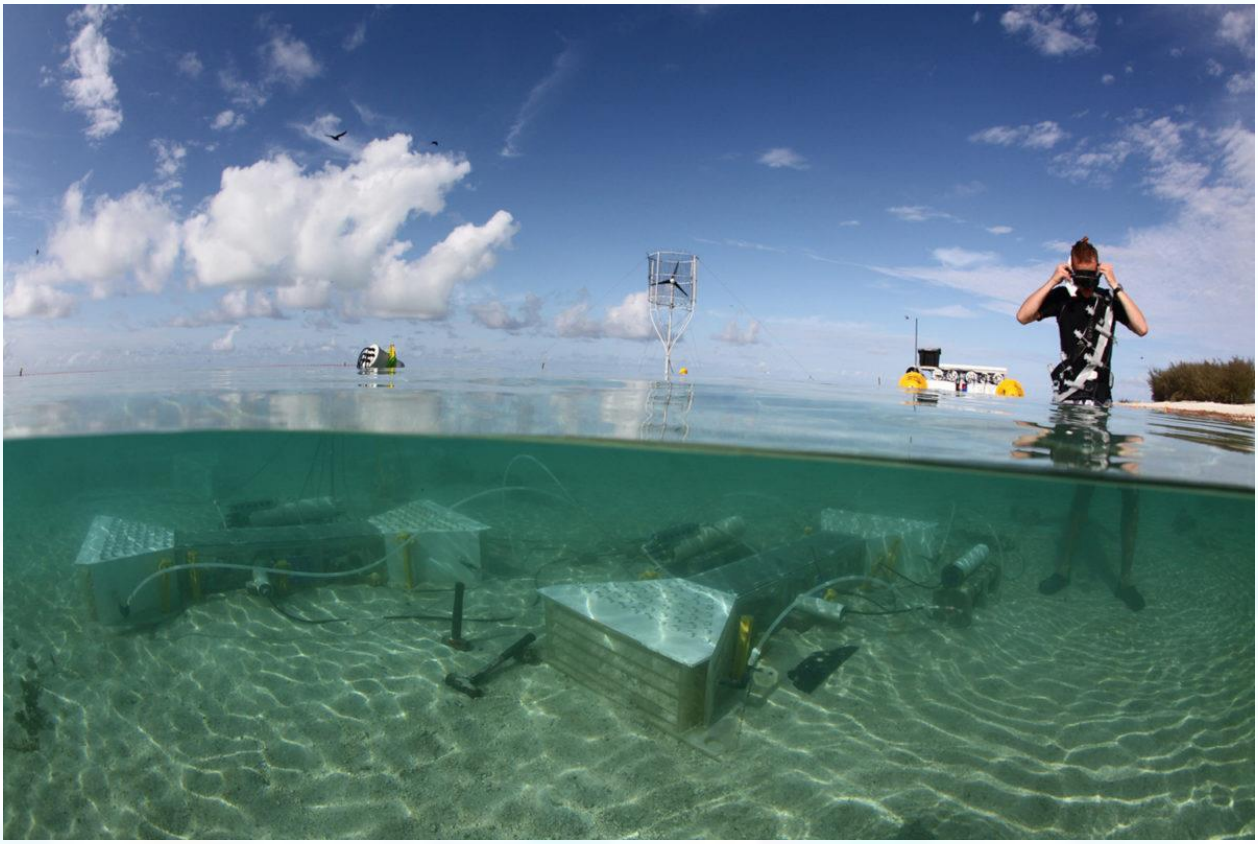

Resilient Living Corals. An innovative, multinational research team sought to understand how coral reefs in the wild would respond to ocean acidification, adding to previous aquarium studies. At the Great Barrier Reef's Heron Island, they placed samples of living and dead corals inside open "Free Ocean Carbon Enrichment" devices, where they could change water conditions but still have the corals be open to local fish and microorganisms. (Pictured: the FOCE devices. Science at work!). The researchers then lowered the water's pH by 0.25 pH units, what the IPCC expects carbon-induced ocean acidification will do to reefs by 2100. They found, as expected, that already dead corals disintegrated quickly in the acidified waters. However, in a hopeful sign, they also found that the living corals, while they did slow or stop growing, were better at resisting dissolution than expected, to the point where it now looks like it will take 50 to 100 years for seawater acidity to change enough to kill the Great Barrier Reef's living corals. That gives us more of a window to save coral reefs that previously thought. Plus, we can shift more reefs to have more living corals through conservation efforts, from coral gardening to pollution reduction to fishing limits to all-new techniques like acoustic enrichment (see above). "The huge difference between the fate of living and dead corals in a natural environment gives me hope," said lead researcher Dr. David Kline, of the Smithsonian Tropical Research Institute. "As we create marine reserves and learn how to increase the amount of living coral by restoring reefs, we're setting up a positive feedback loop because living coral will grow the reef and slow dissolution." Great news! For more, see tinyurl.com/tnthxz2.