CHESAPEAKE ENVIRONMENTAL PROTECTION ASSOCIATION, INC.
P.O. Box 117, Galesville, Maryland 20765

NEWSLETTER Spring 2022

PRESIDENT'S MESSAGE

By Al Tucker

The Patuxent River

As a former member of the Patuxent River Commission, I don't recall the Commission ever discussing why the Patuxent River is important to Maryland. Discussions revolved around water quality, tourism, sewerage overflows and the management of the stormwater caused by development. The latter caused friction and dissension between the political members and the citizen commissioners. Priority was placed on economic development in the watershed over its negative impacts on the River's ecosystems. The River spans seven counties, each having a different set of economic priorities. In general, development's impact on the River is an afterthought. One county's use of the River's resources is often in conflict with others'. The metro Washington counties use the Upper Patuxent for drinking water, while sewer outfalls dominate the Middle Patuxent. The Lower Patuxent suffers degradation from the lack of natural replenishment. This description is, of course, an oversimplification, since the root cause is more development, i.e., ever more population growth, and it "drains" even more of the River's dwindling resources. In short, the River's role in our environment has not been examined wholistically.

So why is the Patuxent River important to us? As I delved into this rhetorical question, I found I didn't really have a good answer. So, I tried to start by answering the question, what is the function of a river?

A riverine system encompasses many different but interdependent biogeochemical cycles. Surprisingly, the first and maybe the most fundamental is the creation and transport of soil. As water falls on land it erodes rocks that form the soils. In the river, the soil particles – composed of gravel, sand, silt, and clay – become sediment. Yes, sediment! The fine particles – silt and clay – tend to remain suspended in water for days or longer. Forests and meadows are the first line of defense for capturing the fine particles, while the more granular particles are transported downstream to form the riverbeds. The granular sediments help maintain water clarity and support aquatic life while filtering water that recharges aquifers. Finally, the transported sediments reach the mouth and usually form a series of wetlands often referred to as the "delta". There it mitigates the extreme storm events of the sea and/or river surges and is further nourished by nutrients and biota it carries along. Like all physical systems, the river attempts to find a lower energy state. It does this by meandering across its floodplain. Meander lengthens the river and, as a result, slows the flows, creating wetlands at oxbows and turns. The river prepares itself for storm surges, where the wetlands absorb the energy and capture the suspended sediments. These cyclic processes have continued for eons, but in recent geologic time, humans have exploited some of a river's natural resources, mostly for food or energy.

In the industrial era, humans have dammed rivers to extract energy, to divert water for irrigation, to create canals for transportation, and more. These activities not only interrupt the river's natural cycles but also its basic ecological functions.

The exploitation of the Patuxent River began inadvertently as the colonists cleared the forests for agriculture. Clearing forests for agriculture removed the first line of defense, that of holding back highly erodible soils. The run-off from exposed soils filled many of its watershed tributaries with silt. Now the threat has shifted from agriculture to development. As development introduces impervious surface, water runoff gains energy that scours tributaries and deposits silt and clay into the main stem of the river. The occluding effect of silt defeats the purpose of the "good sediment" that supports aquatic life.

For the Patuxent, more development causes another concomitant impact. The dams at its headwaters divert hundreds of millions of gallons of water to supply drinking water to the metro Washington area. This diversion robs the Middle Patuxent of much of its natural function of building wetlands, which we now know are the bulwark against storm surges. The Washington Suburban Sanitary Commission (WSSC) mixes this supply with water from the Potomac. Hence the water that reaches the Patuxent sewer plants may or may not have originated in the Patuxent. This unnaturally "clean water" is now devoid of its natural constituents.

As a consequence, the Lower Patuxent, which is an estuary, does not have adequate ecological feedback systems to counteract the impacts of upstream degradation. An interesting study[1] assessed the outcomes of various best management practices (BMP) within the whole watershed in dealing with growth and climate change. Several scenarios were assessed as to whether these BMPs could meet the current target for the pollution levels of the Total Maximum Daily Load (TMDL). For example, one scenario assumed an average precipitation increase of 1.8%, a low population growth, and development restricted to infill. Best management practices would require an additional 1985 acres of wetlands and wet ponds. If the increased precipitation was 3.7%, the population growth follows its current trend, and the development is still restricted to infill, an additional 80,892 acres of urban filtering would be required.

The results of this study are disheartening. It is hard to see the political will to implement these minimal restrictions on growth even in the light of small changes of precipitation. But even

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more discouraging is where we would find the land to implement these practices. We have ruined the River's natural feedback loops that would naturally create more wetlands. We have diverted its water that would maintain the aquatic systems that naturally purify its water.

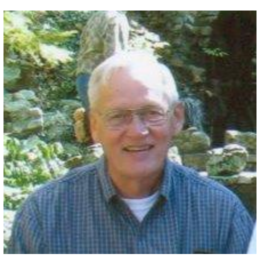
Many river systems have been restored by removing dams. These rivers in general had dams for mills or were used for downstream flood control. Their removal was successful because their primary watersheds were mostly undisturbed. However, the Patuxent's watershed has been inexorably changed. There is no hope of returning it to its natural function. We may clear the sediment, we may reduce the nutrient flows, but we will not be able to restore the Patuxent River's ability to provide us with a safety net against climate change and the impacts of future development.

A natural river would be important to us since it can respond to natural changes. But we have undercut the Patuxent River's natural ability to heal itself, so we are resigned to limiting the damage we are causing.

1 J. Fischbach et.al., "Managing Water Quality in the Face of Uncertainty", http://www.rand.org/t/RR720, (2015)

NET ZERO EMISSIONS

By Gary Antonides



Many countries and companies have vowed to reduce CO_2 emissions to "net zero" by a certain date. But "net zero" means different things to different people. Some of the inconsistencies are discussed in "So What the Heck Is Net Zero, Anyway," by Nick Cunningham, Feb 7 2022 (https://www.sierraclub.org/sierra/so-what-heck-net-zero-anyway).

In mid-January, ExxonMobil announced its "ambition" to reach net zero emissions by 2050, following some of its competitors in setting new climate-action targets. But, like many similar net zero by mid-century promises, Exxon's plan was light on details, and the pledge excluded the vast majority of the emissions for which the company is responsible. In addition, their plan hinges on speculative technologies.

In the last year or so, net zero pledges have become all the rage among countries as well as corporations to show a commitment to addressing the climate crisis. But many of the net zero claims use differing metrics to define net zero, and often use "creative" carbon accounting. Their targets vary in ambition, and their pledges serve a PR purpose at a time when public scrutiny on corporate climate records is increasing. All this casts doubt on whether net zero plans are honest efforts or "greenwashing."

What is "net zero" supposed to mean? After the 2015 Paris Agreement on climate change, reaching net zero greenhouse gas emissions by mid-century became a generally accepted international goal. In addition to decreasing emissions where practical, greenhouse gas emissions from difficult-to-decarbonize sectors like the aviation industry or beef production would be "offset," (discussed later) thus achieving net zero emissions. So, by the middle of this century, all human activities combined must be capturing or sequestering as much greenhouse gases as they are emitting. This would be expected to limit temperature rise to 1.5°C (2.7°F) above pre-industrial levels ("1.5 to stay alive"), which is the primary goal of the agreement.

A few years after the Paris Agreement, the UN-backed International Panel on Climate Change (IPCC) stated that emissions would need to fall by roughly half by 2030 to ensure the world stays on track for the mid-century target. And last year, the International Energy Agency (IEA) argued that net zero emissions by 2050 would require an immediate end to new fossil fuel projects and that existing production must be phased out.

In addition to big polluters like ExxonMobil, BP, and Shell having 2050 net zero targets, some corporations other than fossil fuel companies have more aggressive targets. Microsoft, Amazon, HP, Proctor & Gamble, and dozens of others have pledged to hit net zero by 2040 or earlier.

The UN-backed "Race to Zero" campaign, which seeks support for net zero commitments, has signed up pledges from over 5,000 businesses, 400 large investors, 1,000 universities, and more than 1,000 city and regional governments.

Problems with "Net zero." Unfortunately, there are no standards to gauge net zero. Companies can use different dates, omit some of their pollution from their pledges, and promise future reductions rather than take immediate action. A major problem is that many companies promise to cut emissions only from their immediate operations but take no responsibility for the pollution that comes from their products. Emissions are broken down into Scope 1, Scope 2, and Scope 3 emissions. The first two relate to a company's operations. Emissions coming directly from the smokestack at a factory are Scope 1. The indirect emissions, such as from its electricity use or from employees traveling for business, are Scope 2.

Scope 3 emissions are generally those that are released by consumers using their products. Depending on the industry, these can be difficult to track, and some companies even refuse to consider it. For a software company, Scope 3 may not be a big deal, but for oil and gas companies, addressing Scope 3 emissions may be an existential threat to them. Roughly 80 percent of ExxonMobil's emissions come from the burning of the oil and gas it produces, but Exxon only considers Scope 1 and 2 emissions. Exxon and other oil companies could plug methane leaks, electrify some their operations, and perhaps use carbon capture, and by mid-century, they could conceivably reach net zero from its drilling operations, but that would still ignore the vast majority of the emissions from oil and gas.

Automakers also have challenges, but the major automakers are doing better than the oil industry. Ford announced last year that it would cut Scope 1 and 2 emissions by 76 percent by 2035, and Scope 3 emissions by 50 percent. GM, Ford, and nine other major automakers signed an agreement in December 2021 to aim for selling 100 percent zero-emission cars by 2040. There are serious questions related to the electric car boom, such as where and how metals are mined for batteries, but automakers plan to make substantial strides, even on Scope 3 emissions.

Aviation and heavy industry, such as steel and cement, also have enormous Scope 3 problems. All will require progress on costly technologies. However, the steel industry, at least, is very enthusiastic about the future of "green steel," which produces steel with renewable energy rather than coal and hydrogen.

"Net zero" relies heavily on offsets. Some portion of emission cuts may not be feasible for a long time. "Offsetting" those emissions can be done in a variety of ways, such as: (1) purchasing credits that finance projects to build renewable energy, (2) paying for nature-based projects, such as soil management or reforestation, and (3) directly removing CO2 from the air.

If it is done right, 'offsets' can be a legitimate source of emission reductions. However, carbon offsetting is plagued with a long list of problems. Ensuring that a specific project genuinely removes a certain amount of CO2 from the atmosphere is difficult, and the accounting is complex. Companies can inflate the actual impact of offsets, and go on polluting as before.

Bloomberg Green reported last year on the effort by French oil giant Total to offset the emissions from a cargo of liquefied natural gas (LNG) it shipped from Australia to China. The offset project Total financed merely paid some volunteers in Zimbabwe to clear brush to reduce wildfire risk. Total marketed its LNG shipment as "carbon neutral."

In a 2021 report, the watchdog group Corporate Accountability reported on "greenwashing," calling many net zero plans a "Big Con," and amount to "Big Polluters" attempting to preserve business as usual.

Last year, JBS, the world's largest meat processor promised to invest $1 billion in an undefined "net zero" program consisting of offsets and carbon capture. They also said it would *try* to eliminate deforestation by 2030. We can expect that they will continue bulldozing the Amazon rainforest at least until then.

The oil and gas industry is probably the most infamous for strategies of delay. In its recent announcement, ExxonMobil promised to reduce its emissions by deploying "hydrogen, carbon capture and storage, and lower emission fuels," technologies that are costly, technically challenging, and not commercially viable today, so it's hard to believe it will happen.

"The time between now and 2030 is absolutely critical for reducing emissions on the order of 50 percent," Kathy Mulvey, from the Union of Concerned Scientists, said. But "they're just banking on a magic wand being waved some time past 2030 to really achieve the cuts that are necessary to get to net zero."

Not only is Exxon refusing to acknowledge responsibility for the consumption of fossil fuels, but it has spent decades engaging in PR and lobbying to derail any attempt by governments to address the problem. That campaign continues. Executives from BP, Shell, ExxonMobil, the American Petroleum Institute (API), and the US Chamber of Commerce appeared before a House Oversight Committee hearing last year, in which Congress was looking into the oil industry's history of climate denial. When pressed to end support for the lobbying outfits that obstruct climate action, they demurred.

Also, API and other corporate lobbying groups spent millions of dollars over the past year on PR and lobbying to kill Biden's Build Back Better Act, which would have included roughly $550 billion in investments in renewable energy and electric vehicles. Fighting to kill climate legislation while at the same time announcing net-zero targets strains their credibility.

What about country-level net-zero goals? In the lead up to the international climate change negotiations in Glasgow, Scotland, last year, countries updated their climate plans, and many offered up their own commitments to reach net zero by 2050. In April 2021, President Biden announced a net zero target by 2050 for the US.

Emerging economies have a bit longer to reach that goal. China said it would do so by 2060, and India by 2070. Even oil-producing countries have announced similar goals. Saudi Arabia said it would aim for net zero by 2060.

Should we be just as skeptical that net zero claims are a greenwashing exercise if they are made by a government? Greta Thunberg summed up her feelings last year in a speech in Glasgow. "Build back better. Blah, blah, blah. Green economy. Blah blah blah. Net zero by 2050. Blah, blah, blah."

But one big difference between a claim from an oil company and one from a government is that the country-level commitments by default include the Scope 3 emissions, at least those stemming from the combustion of fossil fuels within their borders. Of course, the emissions from the oil and gas that is exported shows up on the ledger of the country where the fuel is burned. Still, when all country commitments are added together, everything in theory should be accounted for.

Actually, countries have additional incentives to slash the use of fossil fuels, such as improved public health and national security. Even net zero claims from oil-producing countries may be more believable than those from oil companies.

The Problem With "Net Zero," By Tina Gerhardt, Nov.10 2021 (https://www.sierraclub.org/sierra/problem-net-zero-cop26-climate-talks) discusses the climate negotiations at COP26.

At COP26, the International Energy Agency (IEA) announced that the *pledges* made thus far could hold warming to 1.8 or 1.9°C, which blows past the 1.5°C goal. Worse, the Washington Post found that countries' pledges are based on faulty data. And a report by Climate Action Tracker (CAT) found that the targets would, at best, keep temperature rise to 2.7°C. The United Nations Environmental Programme (UNEP) report agrees.

The CAT based its conclusions on the Nationally Determined Contributions (NDCs) that each country released before the talks. They spell out how each country plans to cut emissions, and they range from specific to vague, and from extremely short to hundreds of pages. Under the Paris Agreement, which was adopted at COP21 in Paris in 2015, each country needs to submit its NDC every five years.

Because of the sheer volume of countries involved, the CAT focused on the 40 countries that are responsible for 80 percent of the world's emissions and ranked their plans based on how likely they are to result in the necessary cuts.

CAT found that only four plans (Chile, Costa Rica, the European Union, and the United Kingdom) were acceptable for holding warming to the stated goal of 1.5°C. Some reasons many other countries have managed to delude themselves and others is that, instead of laying out concrete plans to drastically cut emissions during the next crucial two decades, they plan to cut their emissions only minimally and get credits by doing things like buying carbon offsets, planting trees, and investing in carbon-capture technology. When countries promise that they can reach net zero without making sharp cuts to emissions in the next decade, those claims should not be taken at face value. The commitments are too far into the future, and action is needed now. Reliable methods of carbon capture and sequestration do not exist yet at the scale necessary to help meet those targets, and should not be counted on.

Some net-zero schemes rely on "nature-based solutions," such as using lands in the Global South as carbon sinks. But there is concern that, at least for that scheme, it could lead to land grabs, food insecurity, and rights violations for people living there. It must be accepted that there are simply not enough land and trees in the world to absorb our emissions.

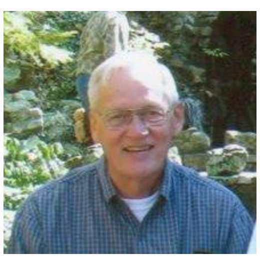
Promise now, deliver later. The cuts that nations have laid out in their NDCs fall into two categories: short-term (by 2030) and long-term (by 2050 for developed nations, later for developing nations). It is essential that these short-term emissions cuts are made this decade, but most of the "good news" from COP26 was based on long-term commitments, giving the nations making those pledges over a decade before they can be held accountable for failing to meet their goals, which is almost certain to happen.

At a press briefing, Professor Niklas Höhne, of the NewClimate Institute, said that if one takes into account only the short-term targets that the nations participating in COP26 have for 2030, temperatures would rise by 2.4°C. But with their existing policies and actions, temperatures will increase to 2.7°C. Since existing NDCs do not meet the 1.5°C goal, countries are "urged" to update and strengthen their NDCs before COP27 in 2022. And many nations are calling for NDCs to be reported every year instead of every five years from now on.

The countries at COP26 had trouble agreeing on realistic actions. The COP26 statement was the first time they even *mentioned* fossil fuels. It demands that members "accelerate the phase-out of coal and subsidies for fossil fuels." It's looking more and more probable that being able to get to net zero will depend on carbon capture and sequester.

CARBON CAPTURE AND SEQUESTER (CCS)

By Gary Antonides



While there are a number of techniques that are being considered for CCS, the most popular seems to be planting trees because they absorb CO2. To get a feeling for how much that will help, Penn State has published "How many trees are needed to take up the carbon dioxide I release every day?" by Bruce Logan, April 20, 2021. (https://iee.psu.edu/news/blog/how-many-trees-are-needed-take-carbon-dioxide-i-release-every-day#:~:text=If%20you%20add%20up%20all,7%20acres%20of%20forested%20land).

As we consume oxygen and release carbon dioxide into the air, the carbon we release comes from the food we eat. On average, we exhale about 2 pounds of CO2 a day. And it takes about 15 trees to take up that much CO2.

But the fossil fuels used to produce food releases a lot more carbon into the environment. Getting food to our homes or restaurants takes a lot of energy, most of which now comes from fossil fuels. Producing food requires energy for making fertilizer, plowing fields, maintaining and harvesting crops, processing, storing, and transporting the food. Adding it all up, in the US, each person needs about 375 trees to put food on the table.

To that total, add in carbon dioxide released from fossil fuels used for our other daily activities, such as driving our cars, heating and cooling our homes, and all the electricity we use. If you add up all the CO2 released for everybody in the country, you will need about 730 trees each, or roughly 7 acres of forest.

Compare this to how much land is available. Earth's total land mass is about 36 billion acres, but about a third is uninhabitable (mostly desert and glaciers), about another third is crop land, and the final third is forested. (Developed land is actually a small percentage of the total.) So about 12 billion acres serves almost 8 billion people, about 1-1/2 acres each, or about 1/5 what would be needed if the whole world had the same life style as the US.

So, other than not using fossil fuels and growing trees, what other options will we have? Although we can't sequester and store carbon on a large scale now, it may be a major factor in the future. This is discussed in "8 Ways to Sequester Carbon to Avoid Climate Catastrophe," Ensia, Jul 19, 2017, By Mary Hoff (https://www.ecowatch.com/carbon-sequestration-2461971411.html)

Klaus Lackner, from Arizona State University is working on a carbon capture system that would involve 100 million semi-trailer-size boxes, each filled with a beige fabric configured to maximize surface area. Each box draws in air, and as it does, the fabric absorbs CO2, which it later releases in concentrated form to be made into concrete or plastic or piped far underground. Though the technology is not yet operational, it's ready for a small pilot project. Lackner figures that the network of boxes could capture perhaps 40 billion tons/year at a cost of $30 per ton. Human-generated CO2 emissions worldwide were around 45 billion tons (Gigatons, or Gt) in 2015, according to the National Oceanic and Atmospheric Administration.

Lackner is one of hundreds, if not thousands, of scientists around the world who are working on ways to remove CO2 from the atmosphere using plants, rocks or engineered chemical reactions and storing it in soil, products such as concrete and plastic, rocks, underground reservoirs or the ocean.

Some of these "negative emissions technologies" are just unproven ideas. Others, such as the low-tech schemes like planting more forests or leaving crop residues in the field, or more high-tech negative emissions setups like the CO2-capturing biomass fuel plant that went online last spring in Decatur, Illinois (more on this below) are already underway.

Many Approaches. Virtually all climate change experts agree that to avoid catastrophe, we must do everything we can to reduce CO2 emissions. But an increasing number are saying we also need to actively remove CO2 from the air in large quantities. "It's almost impossible that we could limit temperature rise to 2°C, much less 1.5°C, without some sort of negative emissions technology," said Pete Smith, from the University of Aberdeen and one of the world's leaders in climate change mitigation.

In fact, scientists from around the world recently drew up a "road map" to a future that gives us good odds of keeping warming below the 2ºC threshold. It requires completely phasing out fossil fuels, but also sequestering 0.7 Gt of CO2 per year by 2030, 6.0 Gt by 2050, and 20 Gt by 2100.

One approach of sequestering CO2 is not going to be enough. Lots of trees will help, but they compete with agriculture for land. Soil can't store enough, machines like the ones Lackner envisions take too much energy, and we don't have the engineering figured out yet for underground storage. Several approaches, along with some serious research and development, are needed.

Smith suggests dividing the many approaches into two categories: (1) relatively low-tech strategies that are ready to go, such as reforestation and improving agricultural practices, and (2) advanced options that need substantial research and development to become viable. Then, start doing the former right away, and start developing the others. Here is a look at some of the main approaches being considered.

Afforestation and Reforestation. The IPCC estimated that a single acre of forest can take up between 0.6 and 13 tons of CO2 per year, depending on the kinds of trees, how old they are, the climate, etc. They figure that, worldwide, forests currently sequester on the order of 2 Gt of CO2 per year. (This is much less than Penn State's estimate mentioned earlier, which would be about 10 Gt per year). Planting trees in new places (afforestation) and replanting deforested acreage (reforestation) could increase this by a gigaton or more, depending on species, forest management, politics, etc., and possibly genetic modification of trees and plants to improve their ability to take up and store carbon

Another way to help trees' ability to store carbon is to make long-lasting products from them—wood-frame buildings, books and so on. Using carbon-rich wood for construction, for example, along with afforestation, might store 1.3 to 14 Gt CO2 per year, according to The Climate Institute, an Australia-based research organization.

Carbon Farming. Carbon farming uses plants to trap CO2, using practices such as reduced tilling, planting longer-rooted crops and incorporating organic materials into the soil to encourage the trapped carbon to move into, and stay in, the soil. Currently, many agricultural soils are losing more carbon than they are sequestering. Improving plant and soil management offers a practical and almost immediate method to reduce CO2. Research initiatives by the Advanced Research Projects Agency–Energy, a U.S. government agency, and others are aimed at improving crops' capacity to transfer carbon to the soil.

Other Vegetation. Although forests and farmland have drawn the most attention, other kinds of vegetation (grasslands, coastal vegetation, peatlands) also take up and store CO2, and enhancing their ability to do so could help. Coastal plants, such as mangroves, seagrasses and vegetation inhabiting tidal salt marshes excel at sequestering CO2 in vegetation, significantly more per area than terrestrial forests, according to Meredith Muth with the National Oceanic and Atmospheric Administration. That's because the oxygen-poor soil in which they grow inhibits release of CO2 back to the atmosphere, so carbon simply builds up. With mangroves sequestering roughly 600 tons per acre; salt marshes, 400 tons; and seagrass, 160 tons, restoring lost coastal vegetation and extending coastal habitats will sequester substantial carbon and also help protect coastlines from erosion as sea levels rise.

Bioenergy & Bury. In addition to storing CO2 in plants and soil, we can enhance sequestration by storing the carbon from plants in other ways. For example, the $208 million power plant that recently started operation in Illinois is one of several facilities that use what may be the most promising technology for removing large amounts of carbon from the air: bioenergy carbon capture and storage (BECCS). There are a number of industrial processes that can use biomass, including producing biofuels and generating electricity. The process might involve combustion, pyrolysis, or gasification of biomass, all of which produce CO2. Rather than sending the CO2 released into the air, BECCS captures and concentrates it, then traps it in material such as concrete or plastic or, as is the case for the Illinois plant, injects it into rock formations that trap the carbon far below Earth's surface. If the biomass used is agricultural waste, forest residue, even municipal waste, or ocean kelp, there is a net reduction of CO2 in the air. But if the biomass is grown specifically for fuel, the net CO2 may not be reduced, because how water, fertilizer, and land are used become factors.

Biochar. Another way to enhance plants' ability to store carbon is to partly burn materials such as logging slash or crop waste to make a carbon-rich, slow-to-decompose substance known as biochar, which can then be buried or spread on farmland. Biochar has been used for centuries to enrich soil for farming, but of late has been drawing increased attention for its ability to sequester carbon.

Fertilizing the Ocean. Plants and plantlike organisms that live in the ocean absorb immeasurable amounts of CO2 each year. Their ability to do so is limited by the availability of iron, nitrogen and other nutrients they need. So researchers are looking at strategies for fertilizing the ocean or bringing nutrients up from the depths. A decade or so ago, companies began planning to do just that, anticipating a global carbon market that seemed likely at the time. These plans have largely remained on the drawing board, due to delays in putting a price tag on carbon, concerns over disrupting fisheries and ocean ecosystems, and high energy requirements. In addition, we don't know how much of the carbon trapped would actually stay in the ocean rather than reentering the atmosphere.

Rock Solutions. CO2 is naturally removed from the atmosphere every day through reactions between rainwater and rocks. Some climate scientists propose enhancing this process by crushing rocks and exposing them to CO2 in a reaction chamber or spreading them over large areas of land or ocean, increasing the surface area over which the reactions can occur. As currently imagined, these strategies are expensive and energy-intensive due to the need to transport and process large quantities of heavy material. Some also require extensive land use. Researchers are looking at using mine waste as well as refining the strategy in other ways.

Direct Air Capture and Storage. The carbon-sequestering containers from Arizona State University that were mentioned before, along with other projects such as a Climeworks' carbon-trapping facility in Switzerland, represent one of the more widely proposed greenhouse gas capture and storage technologies. Known as direct air capture and storage, this uses chemicals or solids to capture the gas from the air and store it underground or in long-lasting materials. Already used in submarines and in space vehicles, this theoretically can remove CO2 from the air a thousand times more efficiently than plants, according to Lackner. The technology, however, is embryonic, and it is a huge energy hog.

Where to From Here? With the need to do something becoming ever more urgent, researchers are starting to take a closer look at the various technologies and putting together research agendas to advance the most promising. In May 2017, a National Academy of Sciences study panel began holding a series of meetings to identify research priorities.

But technology may not be the limiting factor in the long run. Getting carbon storage up and running is also about creating markets and/or policies that reward it. The most obvious way to do this would be to affix a price to carbon, which would provide a financial benefit for sequestering it.

PROFILE OF A TRUSTEE
George D. (Jerry) Hill

Jerry has been a member of the CEPA Board of Trustees since 1994.

He was born in Washington and resided in Bethesda, Maryland through high school. He went to American University in Washington for a bachelor's degree in Business and then went on to the University of Maryland for a bachelor's in Mechanical Engineering. He later returned to College Park for a master's degree in Mechanical Engineering.

He has worked in ship design and navy ship survivability for most of his engineering career. He is currently working on a part-time basis with Serco Inc. in Alexandria, Virginia in the Maritime Engineering division of the company (formerly John J. McMullen Associates, Inc.). He is responsible for efforts involving survivability of machinery and systems in combat scenarios. Earlier in his career he worked in test and diagnosis of ship structures, propulsion systems, and machinery along with fellow CEPA trustee, Gary Antonides.

Jerry's affiliation with CEPA is a family affair. After moving to the area from Bethesda in 1971, his father, Jim Hill, an attorney, joined the CEPA Board of Trustees. Jerry's mother, Nancy, who worked with Jim at his Washington law practice, served as recording secretary for many years. They passed down a respect for nature and the environment and a belief that all should participate in the public policy process that affects us all.

Over the years Jerry has been active in a number of responsibilities on the CEPA Board, including President. He currently serves as Chairman of the Planning Committee. This committee, on a bi-annual basis, reviews CEPA's mission and objectives and provides direction and guidance for CEPA's activities. He also is Chairman of the Forum Planning Committee which conducts the planning and preparations for CEPA's environmental forums.

Jerry is an active pilot and shares ownership of a single engine airplane based at Lee airport in Edgewater. He knows no better way to appreciate the Chesapeake Bay watershed than to fly over it in a small plane. Jerry and his wife, Ava, use the plane on vacations, both short and long. They have flown the east coast from the St. Lawrence to the Bahamas and annually use it for a summer vacation trip.

Jerry and Ava live on Lerch Creek in Galesville, where they keep a boat and a canoe for experiencing the beauties of the Bay from sea level as well as from above.

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