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

NEWSLETTER **Fall 2021**

PRESIDENT'S MESSAGE

By Al Tucker

What happens when the sun doesn't shine and the wind doesn't blow?

This question didn't appear important to me until my personal experience with my solar system intersected with my professional knowledge of electrical systems and caused me to ask that broad question above. I began to realize that the magnitude of the technical, social, and economic issues that the transition from fossil fuels to 100% noncarbon sources of energy is not well understood in the public sphere. The science behind the need to eliminate greenhouse gas emissions is well understood, but the public remains perplexed by the seemingly large number of interrelated technological, social, and economic choices that must be made to achieve this goal. Leadership at the Federal level is needed to set the priorities for the public to support the way forward. The effects of global warming are accelerating faster than previously thought. Therefore, time is of the essence if we wish to mitigate its adverse effects.

At our last Board of Trustees meeting in June, I presented my experience with my relatively new solar photovoltaic system. Subsequently, I have recorded a video of this presentation for others who were interested in my experience. I have attached the link[1] to the presentation below.

The impetus for this study arose because I thought my system was failing. I was shocked by the magnitude of variability of its solar production. As shown in the figure below, for more than two years, the system produced significantly less electricity than its design, as much as 40% less. But, almost miraculously this year, the system seems to have recovered and has produced more electricity so far this year than all last year in total.

To find the answer, I looked at the weather records, cloud cover statistics as well as the day-to-day variability. And what I found was that my system experiences extreme variability on a daily, monthly, and annual basis. Currently, the smoke from wildfires also seems to impact production. The figures on the next page compare two typical time periods of this year with last, and we can see the cloud cover dominated in August of 2020 (the gray areas).

Returning to my broader question, the variability of renewable noncarbon sources along with converting fossil-fueled machines to electricity reveals a host of technical, social, and economic implications.

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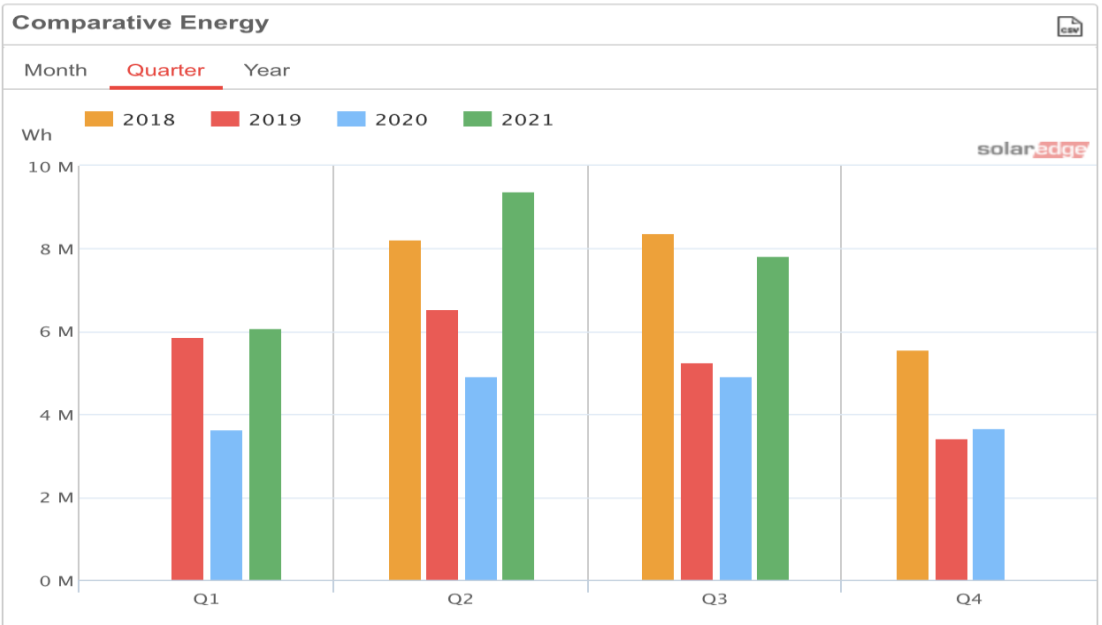
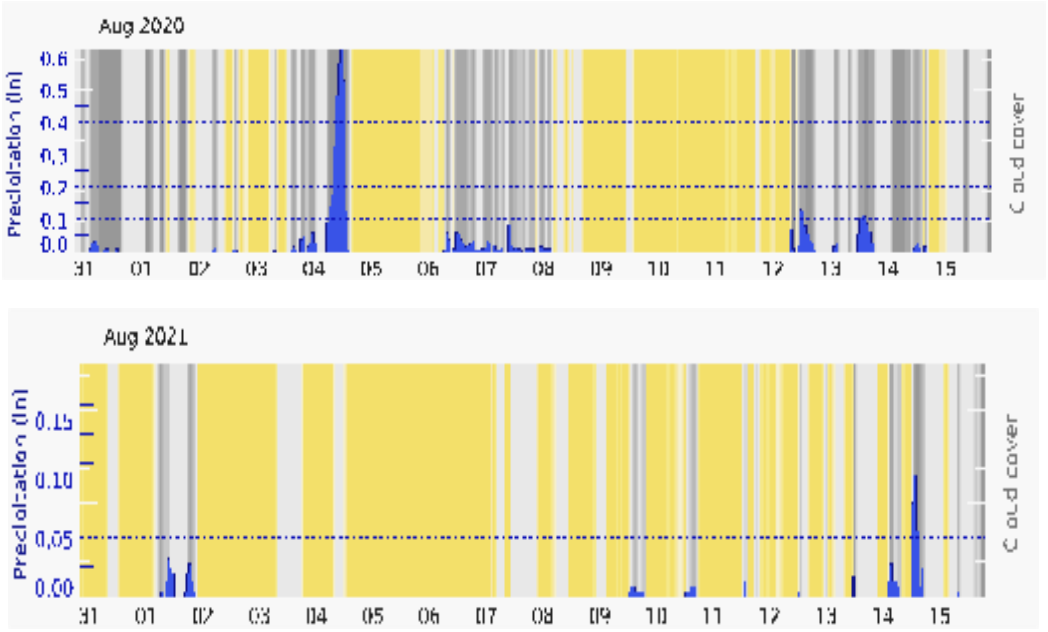


[1] https://vimeo.com/574091773/b27e1ab71e



The alternating current (AC) grid as we know it today is essential to our daily lives and will remain so for millennia. The average person simply does not have enough real estate to own a personal renewable energy system. They must rely on the grid for electrical energy. Unfortunately, the technology of the grid designed in 1880 by Nikola Tesla was not envisioned to carry variable, geographically dispersed generation. The electricity grid is only an electrical energy carrier, much like an oil pipeline. But it has a major difference - once an electron is generated it must be used or stored nearly instantaneously. The grid, however, cannot be stopped or restarted instantaneously. Electricity generation must always be in balance with the demand from consumers. That is its major drawback. Fossil-fueled power generators take days to start and are slow to respond to changes. In the past, our daily energy usage was predictable based on our daily habits and weather forecasts. While the current grid can respond to slowly changing hourly fluctuations, the minute-to-minute fluctuations caused by renewable sources require generators or storage systems to respond rapidly. Fortunately, new battery technology can handle these rapid fluctuations, but it remains inadequate for storing enough energy to supply energy deficits that exceed more than a few hours.

Some will argue that, if we have more geographically dispersed solar and wind installations, the renewable energy deficits will even out. Can we depend on the wind as an alternate source? Currently in the U.K., the wind provides only 7% of the country's energy makeup—a steep drop from the 25% it generated on average across 2020[2]. This result begs a further question. What is the effect of global warming on wind patterns and solar radiation? The observations currently indicate that the jet stream and the westerlies are shifting to poles, having a larger effect in the northern hemisphere. Future major changes to cloud cover remain a critical unknown for siting solar generation. Hence, the siting of present renewable systems may require changes in future decades.

Further compounding the problem, the electrification of transportation vehicles will require a doubling of electricity generation by 2050. This in turn will require a significant upgrade to the transmission and distribution networks to carry the additional energy. The social impact of new, dispersed renewable sources cannot be easily quantified. New transmission corridors from far-flung wind and solar sites to major metropolitan areas will have to be constructed. In urban areas, major distribution lines and transformer systems will need to be upgraded and expanded. The current NIMBY protests over solar and wind turbine sites will be minor in comparison to those against these other major disruptors.

From an economic viewpoint, the cost of these upgrades will necessarily be borne by the consumer. Current estimates place this number to be approximately 5 trillion dollars. (Compare this to the contentious debate in Congress over the current infrastructure costs.) The ongoing costs of generation and maintenance are not included. In a real-life experiment, Germany has attempted to convert to renewable electricity generation. The "Energy Transition" has resulted in 3-5 times the cost of electricity there compared to the US. This cost includes a surcharge to subsidize the insertion of renewables. In turn, this approach led to an over-investment in wind and solar generation while it ignored the capability of the grid to distribute it. However, only a relatively small reduction in CO_2 has resulted in the past two decades. Similar impacts to the grid are occurring in New South Wales, Australia where the abundance of sunshine produces more electricity than the grid can handle. Here, the grid operators are considering switching off the solar arrays of homeowners. Obviously, individual homeowners are not happy with this idea. In both cases, renewable energy is sacrificed to maintain the stability of the grid.

Unfortunately, building more renewable energy generators will not solve the climate crisis if this energy cannot be distributed to consumers. Without policy guidance from the federal government and a commitment to technology development, utility companies will continue to use the 1880's technology which severely hinders, if not blocks, the pathway to renewable energy. What the grid of the future will be requires a technical consensus for its operation. Massive changes to regulations

[2] Fortune.com, "The U.K. went all-in on wind power. Here's what happens when it stops blowing", https://fortune.com/2021/09/16/the-u-k-went-all-in-on-wind-power-never-imaging-it-would-one-day-stop-blowing/

dictated by the Federal Energy Regulatory Commission, the myriad of state public service commissions, regional transmission operators, and the utilities themselves will have to address technology choices, operational strategies, safety regulations, and more.

Perhaps the biggest challenge is human behavior. Saving resources through energy efficiency has led to the paradox of consuming more energy. People unconsciously think they are saving but tend to use their LED lights more or they drive their more fuel-efficient vehicles further because the costs are less. Hence, the paradox, increasing energy efficiency leads to more energy consumption. Changing consumers' behavior requires making them aware of the choice. One of the best ways is to raise the costs. However, German experience has shown us that unless a holistic approach from generation to consumption is devised, we will be unable to mitigate climate change in a timely manner.

For those of us who believe that drastic reductions in carbon dioxide are critically necessary to mitigate against the adverse effects of climate change, non-carbon sources of primary energy must replace fossil fuels. We must be prepared to accept that electrical energy will cost significantly more in the future. We will need to accept the social impacts of the change, even to the point of using less electricity. In Germany, the "Energy Transition" resulted from the fear of a nuclear power plant disaster like Chernobyl or Fukashima. The fear of creating a planet inhospitable to humans is more unthinkable. We have no choice but to stop using fossil fuels as an energy source.

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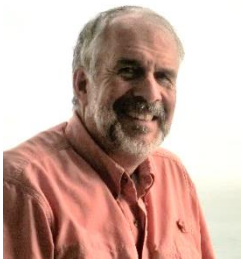
LOCH HAVEN BEACH RESTORATION

By William Vosburgh

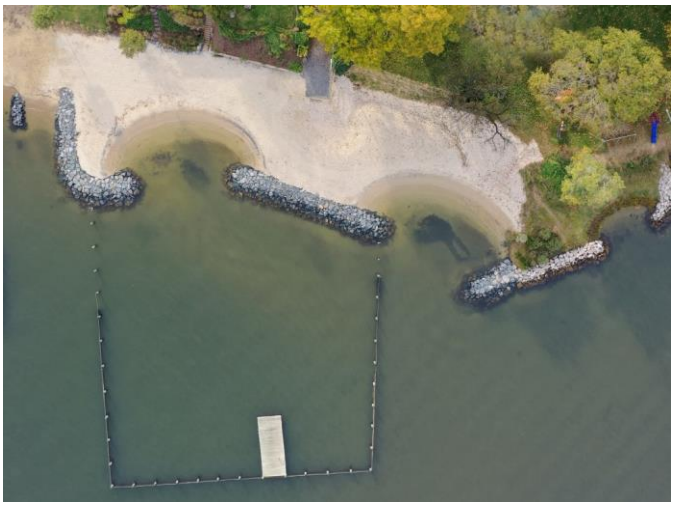


The Beach restoration project at the Loch Haven community in Edgewater Maryland was completed one year ago with an unusual partnership of a committed local civic association, Chesapeake Bay Trust funding and Anne Arundel County Bureau of Watershed Protection and Restoration leadership. The design of this project dated from 2018 but the cost estimates came in too high for the residents to afford it. Seeking grant funding required compromises that were fortuitous and forward thinking. The approach was to request only half of the project cost from the grant for living shoreline and the beach portion for community swimming access would be funded by the association.

The half dedicated to living shoreline was not located in one stretch alone but instead committed 50% of the square footage of the project to native grasses integrated around the swim and kayak area beaches. This approach showed how both missions could be completed in harmony. The result is an inviting setting along the water with the beauty of a waterfront with native grass enhancement. Also, the grasses provide one more way to hold sand in place adding stability to the design.

Stone breakwaters (625 tons) were established first and then sand (2,000 tons), all brought in by trucks from shore. Only heavy stone breakwaters can hold shorelines in place despite wind driven waves, rain erosion, tides and boat wakes. After final grading to precise specifications, the native plants were added according to design and protected with goose fencing for the next year.

Before and after drone images:



Recently, in September 2021, a re-assessment occurred with the design engineer monitoring the shifts in sand as the physics of this construction adjusted and settled. A 7:1 slope was monitored at three points along each beach arc and was within normal parameters. A minor loss of vegetation occurred at the west side of the kayak area for the native seagrass Spartina alterniflora (smooth cordgrass) in the tidal area. Overall, the grasses were thriving, the beach had adjusted itself but best of all was the welcome restoration of a long lost beach front for the community. The environmental credits for reduction in nitrogen (21.0 lbs/yr), phosphorus (8.7 lbs/yr), and suspended solids (40,390 lbs/yr) were signed over to the County for EPA reporting on Chesapeake Bay water quality improvement.

It's not your father's beach! Instead, it is a sustainable design for the Chesapeake with preservation of shoreline dimensions

and improvements in water quality. This can serve as an educational tool for future generations on how to preserve, sustain and enjoy our waterfront in harmony with nature.

AMMONIA – Another Bay Pollutant

By Gary Antonides

Ammonia has been in the news lately because there was a court ruling that Maryland must regulate the gaseous ammonia emitted by animal waste on poultry farms that could land in state waterways. Ammonia has many uses in our daily lives, and it's interactions with other substances make it's presence in our lives very complicated. It even has the potential to replace carbon based fuel for transportation and power generation. Ammonia as a fuel will be covered in our Winter 2021-22 newsletter.

The court ruling mentioned was by a Montgomery County Circuit Court judge back in March. This is described by Christine Condon of the Baltimore Sun on 3/16/21. (https://www.baltimoresun.com/news/environment/bs-md-court-decision-gaseous-ammonia-emissions-poultry-farms-eastern-shore-20210316-lplqea7l6jgj3e3h6zpoevjvpy-story.html%20Court%20decision%20will%20require%20Maryland%20to%20regulate%20gaseous%20ammonia%20emissions%20from%20poultry%20farms)

Ammonia vapor is pumped out of industrial chicken houses via exhaust fans. Ammonia breaks down into nitrogen and hydrogen in the environment, and excess nitrogen in waterways causes damaging algae blooms, which can block sunlight and suck up oxygen, creating dead zones devoid of oxygen that are inhospitable to marine life.

Environmental groups had been pushing for the state to monitor and regulate the pollutant from the concentrated animal feeding operations (CAFOs) on the Eastern Shore. But the Maryland Department of the Environment had argued that the gas may not end up polluting bodies of water and could simply settle on land or vegetation, and that regulating gaseous ammonia would be akin to regulating things "as varied as cars and chimneys." But Abel Russ, a senior attorney at the Environmental Integrity Project, says "The idea that you can't tell with precision where it goes — I think it's a red herring because you know enough about where it goes. You know that it doesn't go very far."

The Montgomery County Circuit Court Judge, Sharon V. Burrell, found that Maryland law, as an expansion of the federal Clean Water Act, requires the Department of the Environment to control "any liquid, gaseous, solid, or other substance that will pollute any waters of this State" — including ammonia. Specifically, the ruling compels MDE to include limits on ammonia emissions in the permit requirements for CAFOs.

The court case was partly a result of a study commissioned by the Chesapeake Bay Foundation released in 2019 that estimated that Eastern Shore poultry operations in Maryland emit about 33.8 million pounds of ammonia per year and about 24.4 million pounds of that ammonia is deposited to land and water on the Eastern Shore. The study was cited in the judge's ruling. The court case was actually brought by Assateague Coastal Trust, which was represented by Chesapeake Legal Alliance.

Ammonia is one of the most widely produced chemicals in the United States. In pure form, it is known as anhydrous (no water) ammonia. Ammonia is also produced in the human body and is commonly found in nature. It is essential in the body as a building block for making proteins and other complex molecules. In nature, ammonia occurs in soil from bacterial processes. It is also produced when plants, animals and animal wastes decay. (https://www.health.ny.gov/environmental/emergency/chemical_terrorism/ammonia_general.htm,)

Ammonia is a colorless, highly irritating gas with a sharp suffocating odor. It dissolves easily in water to form ammonium hydroxide solution which can cause irritation and burns. Most people are exposed to ammonia from breathing its gas or vapors. Ammonia gas is easily compressed and forms a clear, colorless liquid under pressure.

About 80% of the ammonia produced in industry is used in agriculture as fertilizer. Ammonia is also used as a refrigerant gas, to purify water supplies, and in the manufacture of plastics, explosives, fabrics, pesticides, dyes and other chemicals, and is in many household and industrial-strength cleaning solutions

Ammonia gas is lighter than air and will rise, so that generally it does not settle in low-lying areas. However, in the presence of moisture, ammonia forms vapors that are heavier than air. These vapors settle on the ground or bodies of water.

When ammonia enters the body as a result of breathing, swallowing or skin contact, it reacts with water to produce ammonium hydroxide. This chemical is very corrosive and damages cells in the body on contact. Exposure to high concentrations of ammonia in air causes immediate burning of the eyes, nose, throat and respiratory tract and can result in blindness, lung damage or death. Swallowing ammonia can cause burns to the mouth, throat and stomach. Skin or eye contact with concentrated ammonia can also cause irritation and burns.

In the Bay, in addition to breaking down into nitrogen and hydrogen, where the nitrogen causes nutrient over-enrichment,

https://www.epa.gov/wqc/aquatic-life-criteria-ammonia#what says that some ammonia will persist in aquatic environments and cause direct toxic effects on aquatic life. When ammonia is present in water at high enough levels, it is difficult for aquatic organisms to sufficiently excrete the toxicant, leading to toxic buildup in internal tissues and blood, and potentially death.

Ammonia is a common cause of fish kills according to https://www.epa.gov/caddis-vol2/ammonia. However, the most common problems associated with ammonia relate to fish growth, gill condition, organ weights and red blood cell levels.

https://www.health.ny.gov/environmental/emergency/chemical_terrorism/docs/ammonia_tech.pdf describes how ammonia interacts immediately upon contact with available moisture in the skin, eyes, oral cavity, respiratory tract, and particularly mucous surfaces to form the very caustic ammonium hydroxide.

Another article, https://thefishsite.com/articles/the-impact-of-costal-acidification-to-the-aquaculture-industry, describes a different effect. As noted, nitrogen causes a bloom in the zooplankton and phytoplankton, but as this small animal and plant matter then decomposes, it results in more carbon dioxide being mixed into the water. This forms carbonic acid, particularly damaging to shellfish.

Professor Li, from the University of Delaware's College of Agriculture and Natural Resources, is working on a project to control nutrient emissions from poultry houses. (https://www.poultryworld.net/Broilers/Housing/2016/2/Controlling-ammonia-emissions-from-poultry-houses-2760421W/). There are several products on the market to control ammonia in poultry houses, such as adding alum to poultry litter. However, Li says the effects of ammonia generated by poultry involves greenhouse gas emissions as well, which had been unappreciated. Li partnered with researchers at the United States Department of Agriculture (USDA), the University of Tennessee and Oklahoma State University for the project and the results of the research were recently published in the Journal of Environmental Quality. They not only looked at the ammonia reduction due to alum, they also looked at how the alum could potentially impact the greenhouse gas emissions. They showed that it reduced a considerable amount carbon dioxide emissions. Because alum is an acidic product, it reduces microbial activity in the litter and reduces the ammonia emissions. Ammonia also comes from uric acid being broken down by bacteria and enzymes. It becomes ammonia and carbon dioxide.

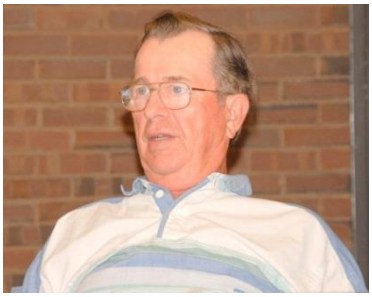
Some farmers already work to mitigate ammonia emissions by planting trees, shrubs and tall grasses near exhaust fans, adding treatments to chicken litter aimed at keeping ammonia levels low, adjusting the diet of the chickens, and by using biofilters. Biofilters work by absorbing noxious gases as they are exhausted from the coops into a biofilm where microorganisms break down the gases into carbon dioxide, water and salts. Environmental advocates say MDE should require these sorts of modifications, which are fairly inexpensive.

In 2018, the Environmental Integrity Project conducted a study that found poultry barns likely emit twice the ammonia that the U.S. Environmental Protection Agency had assumed. A 2019 study by researchers at North Carolina State University found that anywhere from 180 tons to 560 tons of ammonia could be landing in the Chesapeake Bay each year from poultry farms in the Delmarva Peninsula.

The Environmental Integrity Project, a nonprofit advocacy group, found that ammonia emissions have been increasing in part because the number of birds in the Chesapeake Bay region has been increasing, as well as the size of those birds.

The court's decision is a victory for Eastern Shore residents who have long fought for a better regulatory framework for the area's quickly industrializing poultry industry, said Kathy Phillips, executive director of the Assateague Coastal Trust, which brought the suit with the help of the legal alliance. It's a fight that has spanned several years and several similar but unsuccessful court bids. On a few occasions, small battles were won, Phillips said. Worcester County, for instance, has set requirements for the amount and type of vegetation that must be planted by exhaust fans to stymie the flow of gaseous ammonia.

PROFILE OF A TRUSTEE
Lloyd Lewis Ph.D.



Lloyd has been heavily involved in environmental issues and has worked with numerous volunteer organizations for many years. His knowledge and experience has benefited CEPA since he became a Trustee in 1999.

His formal education was in Engineering Physics at U.C. Berkeley (B.S.), Physical Oceanography at MIT (M.S.), and Ocean Engineering at U. of Rhode Is. (Ph.D.). He worked for the federal Government, including the Navy Department and the Department of Energy for a total of 25 years, and also spent 10 years with industry as an Oceanographer/Ocean Engineer, before retiring in 1995.

He has received many awards for his volunteer activities, including:

- Anne Arundel County Volunteer of the Year, 1996
- Maryland's "Most Beautiful People" Governor's Citation, 1996
- Anne Arundel County Utilities Citizen Volunteer of the Year, 1987
- Chesapeake Bay Foundation Oyster Restoration Volunteer of the Year, 2004
- Chesapeake Bay Foundation Maryland Bay Saver of the Year, 2006
- Maryland Senior Center Hall of Fame "Geri" award, 2015

The Bay Saver of the Year award was reported in the Annapolis Capital, and recognized his contributions to the CBF oyster restoration program. Lloyd especially enjoyed this work since it is outside, and many of his other interests, such as gardening are also outside activities.

He has served on the following Anne Arundel County Advisory Committees:

- Edgewater/Mayo Water and Wastewater (Chair)
- Mayo Wastewater Reclamation Subsystem (Chair)
- Beverly-Triton Beach Park Management Plan
- Patuxent Greenways Committee
- Anne Arundel County Septic Task Force
- Mayo Parks Advisory Committee

In addition to serving as a Trustee (currently as Secretary) of

CEPA, he volunteers with the Arundel Rivers Federation, the Smithsonian Environmental Research Center, and the Jug Bay Wetlands Sanctuary.

He is a member of the Southern Maryland Chapter, National Audubon Society; Maryland Ornithological Society; Anne Arundel Bird Club; Marine Technology Society; Nature Conservancy; and the National Resources Defense Fund.

In addition to his environmental interests, he has served in many other community service positions:

- Friends of Arundel Seniors (currently President)
- Commodore Mayo Kiwanis (Chairman of Community Services)
- Marine Technology Society - Anne Arundel County Science Fair Judge
- Mayo Peninsula Action Council
- South County Community Garden (Manager)
- Neighbors of the Mayo Peninsula, Parks Committee

He resides in Cloverlea on the Rhode River and spends as much time on the Chesapeake Bay as possible.

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