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

NEWSLETTER **Winter 2017-18**

PRESIDENT'S MESSAGE

By Al Tucker

Solar Arrays in AA County

Recently, there has been a rush to develop solar photovoltaic facilities on farmland in Anne Arundel County. Many citizens have objected to the development on the grounds that it removes farmland from production, further exacerbating the loss of agriculture and open space. Others assert that direct conversion of solar energy to electricity mitigates the production of greenhouse gas, carbon dioxide (CO_2), from fossil fuels. While the focus has been on the attractive economics of solar, it is often taken for granted that solar energy is inherently environmentally sustainable and that its carbon credentials don't require scrutiny. Hence, one draws the conclusion that solar photovoltaics (PVs) are "green" and "sustainable" and, therefore must be good for the environment. This idea has led me to reexamine the bases for trading one ecological service for another and poses the following question: is one ecological function more valuable than the other?

As with most energy sources, we place too little value on the effects on our health, or the fact that a fossil fuel energy source may not be sustainable. We now realize how unhealthy air pollution from fossil fuels is. We have known for decades now that particulate emissions from power plants have caused cancer and premature death. The Regional Greenhouse Gas Initiative of the northeastern states forced mid-western power plants to clean up their act. As a result, there has been a significant improvement of air quality in these states. Who paid for the power plant technology to remove particulates? It was the ratepayers in the mid-west. In this case, we have transferred the northeastern health costs to the ratepayers in the mid-west.

But what about the global warming caused by CO_2, which affects the entire planet? [Did you know that burning 1 ton of carbon produces 3.7 tons of CO_2.] Who will pay? And how? At present there is no man-made technology to remove CO_2 from the atmosphere. That leads us to the idea of finding non-carbon sources of energy, which we define as "renewable". Maryland legislated a Renewable Portfolio Standard[i], which requires electricity suppliers in the state to procure 25% of their electric retail sales from eligible renewable energy sources by 2020. There is a special "carve out" for solar that requires that 2.5% of the electricity generated must come from solar. All of these eligible sources have technical and environmental drawbacks. But solar has caught the attention of the public as a "renewable" source of energy.

As with many technologies, the optimum technology is often not the most cost effective. PVs got their start from the waste stream of the computer industry, where the intense energy investment that transforms silicon into polysilicon had already been made. As the demand for solar panels increased, dedicated manufacturing plants were put into production with the resulting decrease in panel costs. At the same time, the electric efficiency of the panels increased. Currently, the best solar panels convert about 20% of the sun's energy into electricity. The net economic impact of these technical advances has reduced the cost of installing solar panels to the point where the installation cost is dominated by the labor and administrative costs, not the cost of the panels[ii]. The costs bear little connection to their impact on the global ecosystem.

Let's look at whether or not PVs are an optimum environmental solution. First, are they green? When they are placed in operation, they appear to be benign; they do not emit gases, create noise, generate traffic, or make demands on public services. Local zoning protects the landscapes with setbacks and view screening. Thus, they seem to be a perfect solution. But this conclusion ignores the environmental impacts of manufacturing the panels. First, the entire manufacturing process is an extremely energy intensive process. The basic material is mined quartz, which is then refined into metallurgical grade silicon of the sort that is used for hardening steel. Blast furnaces are kept hot consuming mostly fossil fuels and producing CO_2. This silicon is further refined into polysilicon, requiring expenditure of more energy and creating extremely toxic waste byproducts. For every ton of polysilicon, 3-4 tons of toxic silicon tetrachloride are produced. Several manufacturers recycle this waste, but the handling and additional energy adds millions of dollars to the costs. Therefore, some unscrupulous operations just discharge this highly toxic mess into the environment, especially in Asia. New rules require manufacturers to recycle 98.5% of the waste, but enforcement seems to be lax. This, however, is not the end of the toxic processes. To improve the efficiency of electricity production,

(Cont'd on Pg. 2)

IN THIS ISSUE

REMINDER – GDP LISTENING SESSIONS

The update of the Anne Arundel County **General Development Plan** (GDP) is underway well ahead of time. The GDP will establish policies and recommendations to guide land use decisions over a 20-year period**.** The new plan, called "Plan 2040" will be adopted in 2020.

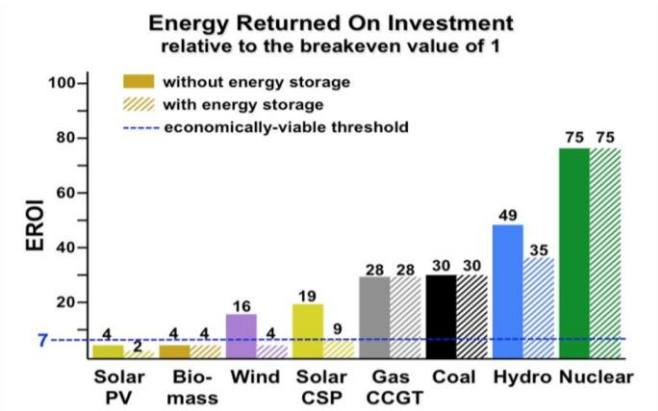
The county scheduled eight "**listening sessions**" to give the public the opportunity to express their concerns and desires. If you haven't already been to one, please attend one of the two remaining sessions from 6:00 PM to 8:00 PM as follows:

February 8: Southern High School
February 22: Brooklyn Park Middle School

To learn more about the new plan, visit
www.aacounty.org/Plan2040

(From Pg. 1)
cadmium and telluride are added into the polysilicon. Each of these toxic processes may have future technological remedies, but millions of panels have already been produced that will create a highly toxic waste stream when their useful life has ended. In fact, 80 to 90% of PV emissions are generated during the manufacturing process. So what appears to be a clean technology, has really just shifted a dirty problem geographically to someplace else, often where people don't have the power to protest.

Now let us examine the question, are PVs sustainable? Do PVs generate more electricity than it takes to manufacture, operate and decommission them? For various energy sources there is a number, called the Energy Return on Investment (EROI), that compares these two energies. When this number is 1, there is no advantage, since the energy generated is equal to that consumed over its lifetime. If the EROI is less than 1, then effort is wasted, because the energy returned never recovers the energy invested to produce it. The figure below shows this number for various energy sources.



Source: Forbes Feb

When the the cost of oil is about $60 per barrel, an EROI above 7 becomes economically viable. The EROI for PVs is extremely difficult to determine: 4 represents an average number of many sources, having a range of 0.82 to about 8.0. If it truly is below 1, then it is a wasted effort. A consensus has not been reached for the value of EROI for current PVs, but the general consensus is that the EROI for PVs will remain a small number. So there is an international race to find cheaper, easier to manufacture, less polluting sources of non-crystalline PVs. If the energy input to manufacture PVs can be reduced, then the EROI will increase and at least guarantee that the EROI is greater than 1.

So how do we compare a solar installation to farmland? Fortunately, the Intergovernmental Panel on Climate Change (IPCC) has given us given us a pathway to the answer. The IPCC has calculated the carbon intensity of various energy sources, or how much CO_2 is emitted per unit of energy for various sources as shown (from Wikipedia). Solar PVs emit about 20 times less CO_2 than coal or 10 times less than natural gas, but they still inject CO_2 into the ecosystem.

Technology	Description	50th percentile (g CO_2-eq/kWh$_e$)
Hydroelectric	reservoir	4
Wind	onshore	12
Nuclear	various generation II reactor types	16
Solar PV	Polycrystalline silicon	46
Natural gas	various combined cycle turbines without scrubbing	469
Coal	various generator types without scrubbing	1001

What about agriculture? Although a direct comparison between PVs and agriculture cannot be made on an energy basis, studies have estimated the net flux of CO_2 from agricultural lands. The 2014 IPCC report devotes an entire chapter to this discussion. Clearly fossil fuels are used by farm machinery, for production of fertilizers, etc. However, there is a major difference between agriculture and PVs. Agriculture has the potential to be a major carbon sink. Currently, the IPCC estimates that the net global agriculture production of CO_2 is about zero. That is, the CO_2 generated in production is balanced by the amount it sequesters. Many IPCC recommendations for improving carbon sequestration in soils are already employed in Maryland, such as min-till, no-till, cover crops, forage crops and organic farming. Thus, in Maryland, many farms are sequestering CO_2 instead of generating it. Improving agricultural practices globally has the potential to sequester far more carbon than any other method of sequestration. The IPCC estimates that agriculture has the potential to sequester between 10 and 15% of the global CO_2.

Current PVs will never be totally green or totally sustainable. Improved technology will find ways to solve the major issues with toxic production and increase the efficiency of electricity production. The dream of building truly sustainable "solar breeders", namely solar powered plants to produce solar panels is not currently cost effective largely because the intensity of the sun is not sufficient to meet the high energy demand required.

Returning to the original question of whether or not we should place solar photovoltaics on agricultural lands, the answer clearly is NO! It makes no sense to replace agricultural lands, a net sink of CO_2, with PVs, a net producer of CO_2. However, it does make sense to put PVs on land and buildings that do not have the potential to be carbon sinks. So PVs do have their place in the current strategy to reduce the injection of CO_2 into the atmosphere. Strategies that reduce the production of CO_2 should be pursued, but a natural process that sequesters CO_2 should receive a higher priority over reducing CO_2 production. Displacing farmland with solar PVs makes **no** sense.

[i] The eligible sources are: Solar Water Heat, Geothermal Electric, Solar Thermal Electric, Solar Photovoltaics, Wind (All), Biomass, Hydroelectric, Geothermal Heat Pumps, Municipal Solid Waste, Landfill Gas, Tidal, Wave, Ocean Thermal, Wind (Small), Geothermal Direct-Use, Anaerobic Digestion, and Fuel Cells using Renewable Fuels. Some challenge whether some of these energy sources are truly renewable.

[ii] The recent import surcharge on solar panels and the loss of tax credits in 2019 may change this cost ratio.

RECHARGING AQUIFERS WITH POTABLE WATER

By Bill Klepczynski

Last year, we learned that California was faced with a critical shortage of water because of overconsumption by agricultural and domestic sources. This year we are starting to hear that Capetown, South Africa is facing the possibility of a severe drought by May 2018 and 4 million people will be in dire need of water because of a lack of rainfall. Whatever the cause, whether it is human activity or a natural phenomenon, shortage of water is a problem for which communities must be prepared to face.

The governmental and financial structure of Anne Arundel County (AAC) is such that it needs growth in order to meet its obligations. However, growth brings with it the problems of increased population and stress on its infrastructure. Currently, there is sufficient water to meet demands but it can be seen that the future will strain the water supply system. Farming on the eastern shore, as in California, is starting to shrink the aquifers that are critical to its water supply. Also, many old-time residents of AAC may remember the problems that were raised by the local droughts of 1930-32, 1960-66 and 1977-81. While no one can predict the future as to whether groundwater sources will become a problem, should steps be taken now to plan for such possibilities? The SWIFT (Sustainable Water Initiative for Tomorrow) Program (Ref. 1) is one to be watched. If it is successful and can economically produce potable water, it should be taken into consideration for the future of AAC.

One community that has realized that they will have a water shortage problem is Hampton Roads, VA. They have developed the SWIFT program in order to **recharge** the Potomac Aquifer which is their main source of potable water. This will combat other problems caused by groundwater depletion: saltwater intrusion and sea level rise.

Many other communities situated along the Coastal Plain aquifers are dealing with many similar environmental challenges. Aquifer levels are dropping, leading to aquifer consolidation and ground subsidence. Coupled with sea level rise and saltwater intrusion, utilities from North Carolina up to New Jersey are facing significant environmental hurdles. For these utilities, water reuse for managed aquifer recharge is a desirable option, particularly for those that also maintain wastewater treatment facilities with effluent nutrient limits.

The Hampton Roads Sanitation District (HRSD) has developed the SWIFT Research Center, an advanced wastewater treatment facility. It starts with water that has been reclaimed at one of their 13 district wastewater treatment plants for release into local waterways. These wastewater treatment plants produce water that **surpasses** strict Virginia Pollutant Discharge Elimination System requirements.

The process that is used by these Wastewater Treatment Facilities can be described by three main treatment levels: **Primary Treatment**, **Secondary Treatment** and **Tertiary Treatment**. These processes ensure that the final water meets stringent state-regulated environmental standards and the Chesapeake Bay total maximum daily loads (TMDLs), and they support the intended use of the receiving waterbody, but it is **not** yet drinkable.

Primary treatment

When wastewater enters an HRSD treatment plant, it first flows through a bar screen that removes large floating objects such as trash, sticks and rags. The captured material is properly disposed of in a landfill and the wastewater flows to a grit chamber and a sedimentation tank. These devices slow the flow of the water and allow sand, grit, human waste solids, and other small particles to settle to the bottom. These solids are then removed along with any scum or grease floating on top.

Secondary treatment

Next, the wastewater travels to secondary treatment facilities that speed up the processes of nature, allowing microorganisms (bacteria and other organisms) to consume 80-90 percent of the "organic matter" – or human, animal and plant waste. The most commonly used secondary treatment technique in HRSD plants is the *activated sludge process*. An activated sludge process speeds up the work of the microorganisms by pumping oxygen-rich air and sludge into close contact with the wastewater in an aeration tank. Over several hours, the organic matter is broken down into harmless by-products. The wastewater is then sent to a final clarifier. In the final clarifier, the microorganisms that grow during the activated sludge process sink to the bottom and are recycled back to the aeration tanks, and the remaining water moves on to the final treatment process.

Tertiary treatment and disinfection

Advanced treatment systems remove additional pollutants such as nutrients, heavy metals and chemical compounds. These systems may use microorganisms that differ from those in secondary treatment, additional chemicals, or an effluent filtration system. This significantly increases plant construction and operation costs but improves the final quality of HRSD's highly treated water. Finally, the water is disinfected by chlorine, and the use of ultraviolet light. HRSD facilities remove excess chlorine before discharging the cleaned water to local rivers. These processes kill 99 percent of disease-causing pathogens such as bacteria and viruses. The water quality now supports the intended use of the area waterway, meeting the needs of its aquatic life, and it can be released back into the environment.

The effluent from one of these wastewater treatment plants will then be input to the SWIFT Test Facility where it is be subjected to an 8-step process that produces water that meets drinking water standards.

The overall procedure as shown in **Figure 1** prepares water for recharging the Potomac Aquifer. A majority of planned potable reuse schemes use reverse osmosis (RO) membranes and advanced oxidation processes (AOPs) to ensure maximum removal of contaminants from waste water. Whereas the use of RO technology is expensive, energy intensive, and requires the disposal of a concentrated brine stream, the process used in the SWIFT approach provides an alternative but similar approach to that which treats water at the wastewater treatment plants. They also introduce additional steps for removal of trace organic compounds and treat the water to make it compatible with the Potomac aquifer.

The first phase of the SWIFT program is now underway. It is planned to have a one million gallon per day (1 MGD) system in operation by the end of 2018. By 2030, a fully operational 100 MGD system could be putting purified water into the aquifer.

Reference 1:

Design-Build of a 1 MGD Demonstration Facility for Advanced Treatment and Managed Aquifer Recharge – Phase 3 of HRSD's SWIFT Porgram, John J. Dano (HRSD) and Aaron W. Duke (Hazen and Sawyer)

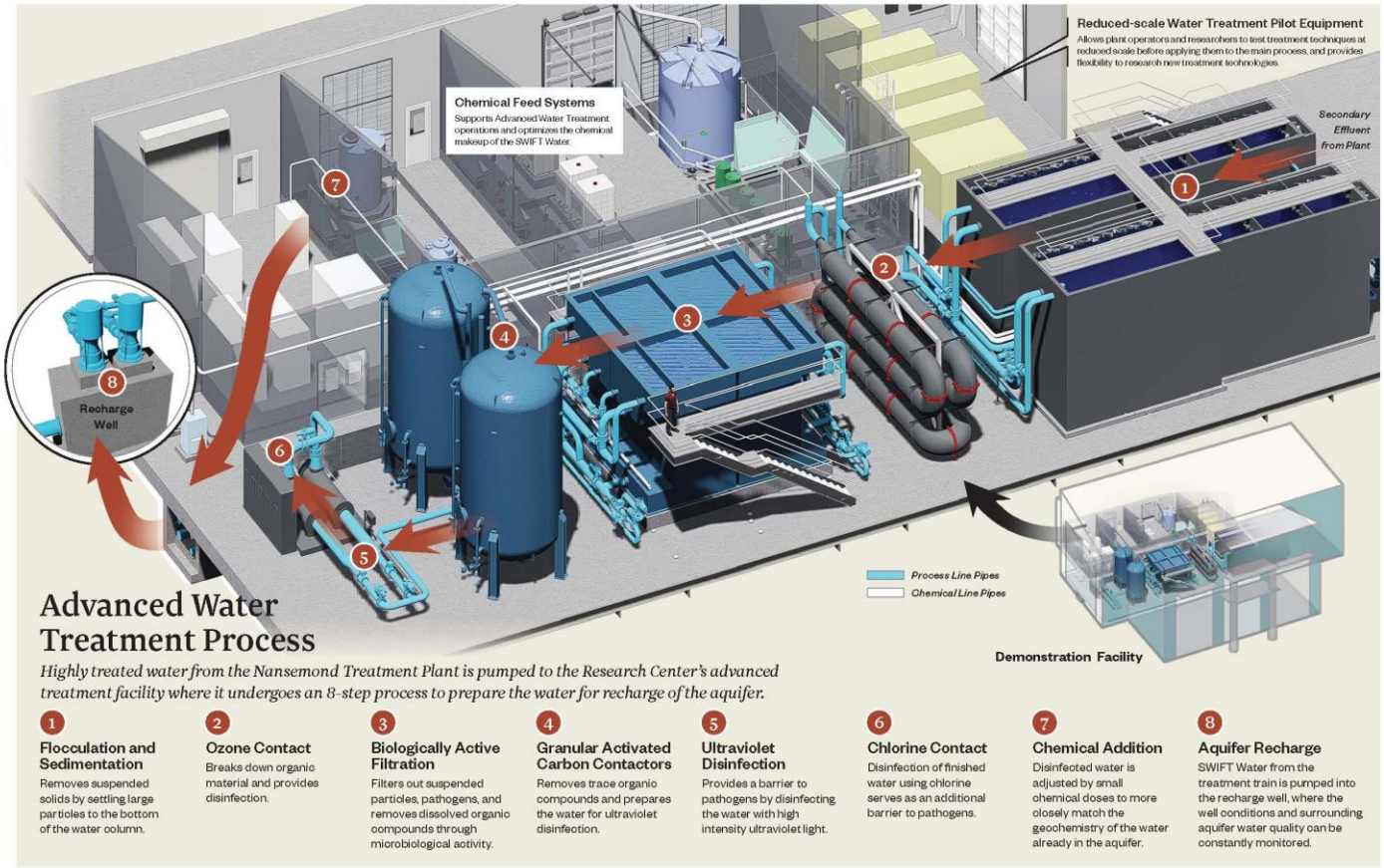


Figure 1

NUTRIENT TRADING IN MARYLAND

By Gary Antonides

For many years, Maryland and other states have been trying to get farmers to use more "Best Management Practices" (BMPs) to reduce the amount of nitrogen and phosphorous that runs off with rainwater into our waterways. Decades of efforts with voluntary programs met with little progress, but now, under the U.S. Environmental Protection Agency's mandatory Total Maximum Daily Load (TMDL) requirements, progress is being made in the Chesapeake Bay and other bodies of water. Details of how the TMDLs are met are left to the state, and each state has its own challenges in implementing policies that will satisfy the requirements. Pennsylvania is the most problematic because it has so much farm land that drains into the Susquehanna River and thence into the Bay, and because it has not committed sufficient resources to meet the requirements.

One of the practices implemented in Maryland, Virginia, and Pennsylvania is the Nutrient Trading Program. http://mda.maryland.gov/Documents/ag_brief/AgBrief_NutrientTrading.pdf describes Maryland's Program. Maryland farmers, wastewater treatment plants, and stormwater systems must all control the amount of nutrients that run from their operations into the Chesapeake Bay watershed. If a farm has met the requirements for nutrient reduction called for by the TMDL for the watershed segment where the farm is located, it can choose to implement additional BMPs to reduce nutrient run off even more and generate credits for doing so. The farmer can then sell those credits to an entity that is having difficulty meeting its nutrient reduction obligations. The price of the credits is based on market prices. This buying and selling of credits is called nutrient trading, and it can provide farmers with a new source of revenue. The Maryland Department of Agriculture (MDA) and the Maryland Department of the Environment (MDE) are responsible for developing a comprehensive nutrient trading policy and administering the Maryland Nutrient Trading Program. Trades can take place between "Point sources," usually wastewater treatment plants, and "Nonpoint sources," such as agriculture and stormwater. Maryland's regulations divide the state into three large trading zones (Potomac River watershed, Patuxent River watershed, and the rest of the Bay watershed in Maryland). Trading must be done within the zones.

The BMPs that can be used to generate credits include planting cover crops, reducing fertilizer applications, fencing cattle out of streams, and installing grass or forest buffers and wetlands. These practices must satisfy USDA's specifications, and be inspected and certified. Each Soil Conservation District in Maryland has personnel who are trained to use a web-based calculation tool, www.mdnutrienttrading.com (now under construction), and can perform on-farm assessments of credit generation capacity for farmers. BMPs will be verified annually by a third-party to ensure the practice is being maintained. All trades must result in a net decrease in nutrient loads. Approved credits can be posted on the Nutrient Trading Program's Marketplace and Trading Registry.

It is anticipated that many buyers of the credits generated by farmers will include wastewater treatment plants, developers, and local jurisdictions who may find it less expensive to pay for credits than to install BMPs themselves.

http://www.baltimoresun.com/news/maryland/environment/bs-md-nutrient-trading-20171011-story.html, October 15, 2017, by Pamela Wood reports that supporters of nutrient trading, also called water-quality trading, say that, when done properly, the practice uses market forces to achieve environmental benefits. "It's a very important step, and it's a necessary step," said state Environment Secretary Ben Grumbles.

Nutrient trading aims to address the fact that some cleanup projects are much more expensive than others. Projects on farms, such as planting cover crops in the winter or adding trees along farm streams, are less expensive than, for example, upgrading a sewage-treatment plant. Up until now, however, agricultural operations such as factory farms have largely been left unregulated, and only a small subset has to get permits under the Clean Water Act.

The proposed regulations will be reviewed by a joint Senate-House of Delegates committee and will be subject to a public comment period after that.

Gov. Larry Hogan has been a proponent of water-quality trading and last year proposed an ambitious plan to use $10 million to start a trading program. After limited interest from environmentalists and farmers, he reduced his proposal to a $2.5 million annual grant program for certain innovative pollution-fighting practices.

Not everyone is completely happy with the concept of nutrient trading. Officials with the Chesapeake Bay Foundation (CBF) said the regulations are an important step, but have some flaws. For example, credits can be traded anywhere within the three large regions, creating the possibility that polluters in one area could buy a lot of credits from areas across the bay, allowing high pollution in that area. Doug Myers, from the CBF, said they are also concerned that the regulations allowing for credit trading between states are "way too premature."

https://www.foodandwaterwatch.org/insight/case-against-water-quality-trading, Dec. 10, 2015, by Zach Corrigan, says that water quality trading undermines the Clean Water Act (CWA) and should be illegal, and that the Act does not allow pollution trading at the expense of tried-and-true methods for reducing water pollution (issuing and enforcing permits).

CWA permits have been largely successful in curtailing pollution from industrial or point sources, but much more work is needed to clean up our non-point sources, including runoff from farms. Agriculture is the single largest source of pollution. In 2003, the EPA endorsed pollution trading, in part, to get at this pollution. What the EPA neglected, says Corrigan, is that pollution trading is not permissible under the Clean Water Act and it kicks the can down the road, banking on an illusory regime. Nothing in the statute allows facilities to buy their way out of compliance.

Food & Water Watch maintains that that pollution trading will result in point sources increasing their discharges, thus causing spikes in pollution, or "hotpots" that will have negative local impacts. Since these sources are typically located in low-income communities, these discharges disproportionately harm the waters where the neediest fish and swim. The supposed offsets are to come from agricultural sources, which are not usually even regulated. Thus, the amount of pollution reduced by such sources is inherently uncertain. Also, states do not have sufficient tools to ensure that agricultural BMPs actually reduce pollution. Last, pollution trading incentivizes the use of brokerage houses that are not regulated and get commissions on trades, meaning they have a strong incentive to generate paper trades regardless of actual pollution reductions.

In 2010, Food & Water Watch and Friends of the Earth sued the EPA for authorizing state trading programs for the Chesapeake Bay Watershed. A federal district court dismissed the case on procedural grounds, but left the door open for future suits. Meanwhile, states move forward with their trading programs.

http://www.progressivereform.org/chesbaynutrienttrading.cfm, "Nutrient Trading for the Chesapeake Bay" says that the Maryland proposed regulations for nutrient trading, issued in December 2017, are flawed. According to and in-depth analysis by the Center for Progressive Reform's Evan Isaacson and the Environment Integrity Project's Abel Russ, Maryland's rule-writers lost sight of the goal. They warn that "Trading programs are only a means to an end. The end is clean water, not establishing a high-volume trading market. If the rules are drawn poorly, they could facilitate an increase in pollution." The report, *Trading Away Clean Water Progress in Maryland*, identifies three major failings in the state's proposed regulations:

Hot Spots: By dividing the state into three very large trading zones, it allows the sale of credits in such a way that pollution will end up being concentrated in particular parts of the state, which often affect the most vulnerable communities.

Paper Credits: The rules allow wastewater treatment plants to get credits for pollution reductions that are already in place, so the "pollution savings" will be on paper only.

Unaccounted Uncertainty. One lesson from other trading markets is that, for a variety of reasons, real pollution reductions are likely to be smaller than projected. Most trading programs (and EPA guidance) account for that by requiring buyers of credits to buy credits for twice as much pollution as they need to reduce. Maryland ignored this in its new regulations.

Nutrient Tax. Instead of nutrient trading, it would be possible to implement a nutrient tax. This would be similar to the way carbon is treated in some jurisdictions. Carbon taxes can be instead of or in addition to carbon trading programs. This type of tax is a "Pigovian" tax - a tax on any market activity that generates costs not included in the market price. Ideally, the tax is set equal to the social and other non-included costs.

http://greedgreengrains.blogspot.com/2013/04/how-farmers-could-benefit-from.html, "How farmers could benefit from fertilizer taxes," April 24, 2013 by Michael Roberts advocates a nutrient tax. Since some of the worst water quality problems result from nutrient leaching and runoff from agricultural lands, and even though there have been efforts to deal with these problems over the years, water quality continues to decline in the Mississippi, the Gulf of Mexico, and the Chesapeake, the Great Lakes, and countless other water bodies. One obvious remedy would be to tax fertilizer. Better would be to tax runoff and leaching directly, but that's practically impossible.

Politically powerful farmers would fight a tax, but demand for agricultural commodities is nearly constant regardless of prices,

so food prices would probably go up enough to compensate for the tax. Other taxes could be reduced to compensate.

Some economists propose fertilizer taxes on a graduated scale. If fertilizer is applied at a sufficiently low rate, no tax would be levied, but the tax would then rise sharply with higher application levels (which causes most of the runoff and leaching). This would be harder to monitor, but would hit the biggest fertilizer users the hardest.

Hopefully, the induced rise in commodity prices would more than compensate farmers for the fertilizer taxes they would have to pay under the graduated tax system, and their profits would go up. Farmers may get on board with a tax if it benefits them.

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 masters degree in Mechanical Engineering.

He has worked in ship design and navy ship survivability for most of his engineering career. He is currently employed by Alion Science and Technology in Alexandria, Virginia in the naval architecture and marine engineering division of the company (formerly John J. McMullen Associates, Inc.). He is responsible for a group that designs navy and commercial ships and ship systems. 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 the 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 positions, 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 Key West 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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