Clean Cut Quarterly

NJARNG Sustainability Newsletter

In collaboration with Rowan University

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IMAGE: Port Authority of NY NJ

Clear Skies

How New Jersey's air quality was impacted by the shutdown in March. Story on **page 1**.

Dangerous algae? Learn how too much of it harms our lakes, and what one NJ community is doing about it on **page 2**.

IMAGE: NJDEP

IMAGE: THE STATE OF NJ

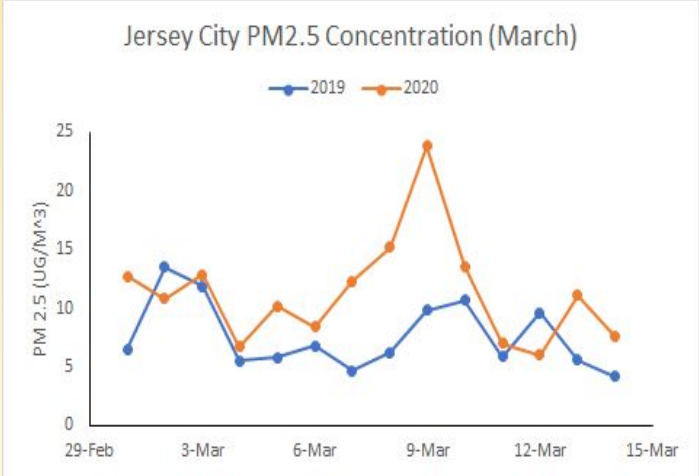
Explore the U.S. energy sector and how New Jersey plans to become more sustainable. Read about it on **page 5**.

New Jersey's Lockdown Setting Record Highs (and Lows) By: *Jake Bohn*

Despite the havoc COVID-19 has raised across the United States, a silver lining has emerged, literally, in the form of clear skies. New Jersey is the most densely populated state, and there are usually thousands of vehicles travelling on the roads and highways daily. While electric vehicles (EVs) are increasing in popularity, most on-road vehicles still have internal combustion engines that release pollution into the atmosphere. These tailpipe emissions contain PM 2.5, particulate matter that are very small (2.5 microns in diameter or less). Individually, PM 2.5 cannot be seen by the human eye, but with high enough concentration in the atmosphere, this pollution can lead to a multitude of problems.

Pollution plummets during lockdown

New Jersey has thirteen monitoring stations distributed across the state that measure the concentration of PM 2.5 at ground level. In March, almost every station recorded a massive drop off of these particles during the statewide lockdown. Data from Jersey City exemplifies the decrease in particle concentration (see figure).



Graph of PM 2.5 concentration in Jersey City using AirNow data from the U.S. Environmental Protection Agency (EPA).

In addition to New Jersey's reporting, NASA has taken satellite images and measurements of nitrogen dioxide (NO_2), another common tailpipe emission, over the northeast United States since 2005. As expected, normally New Jersey has a very high yearly average of NO_2 in part, from vehicles on its congested roadways. NASA also recorded a massive decrease of NO_2 in March. In fact, NASA reported that "nitrogen dioxide levels in March 2020 are about 30% lower on average across the region of the I-95 corridor" [1].

The effects of PM 2.5

But what is the big deal about PM 2.5? These particles impact air quality and can affect both visibility and the health of anyone that breathes it. Due to their microscopic size, these particles can be inhaled and deposited deep in the lungs, occasionally finding their way into the bloodstream. According to an article from the Institute of Earth, Ocean, and Atmospheric Sciences at Rutgers University, "scientists have a high degree of confidence that long-term exposure to the tiny particles can do great damage" [2]. In addition to the undesirable medical issues these particles can contribute to, they can also cause a heavily polluted area to appear hazy. This "fog" is also known as smog and is an indicator of heavy pollution.

Unfortunately, the cleaner air came with a hefty price tag. COVID-19 hit New Jersey notably hard in the spring, peaking at roughly 3,000 new cases per day. Although fewer vehicles on the roadways was positive for the environment, there are better means than a pandemic to achieve this outcome. If we want to lower New Jersey's pollution, we must act sooner than later and continue to focus on decreasing emissions from transportation. ■

[1] "NASA," NASA Satellite Data Show 30 Percent Drop In Air Pollution Over Northeast U.S. https://www.nasa.gov/feature/goddard/2020/drop-in-air-pollution-over-northeast

[2] "Rutgers," You Can See Clearly, For Now. https://eoas.rutgers.edu/you-can-see-clearly-for-now/

Harmful Algal Blooms: A Threat to Lakes

By: Karl Hauck

Over the past few years there has been an increasing number of blue-green algal blooms appearing in the serene lakes of northern New Jersey. However, blue-green algae is not algae at all—it is cyanobacteria, microscopic single-celled organisms that occur naturally in water.

In small numbers, the presence of cyanobacteria is normally not an issue, however, it can be extremely toxic in high concentrations. Cyanobacteria thrive in calm, warm waters, with lots of sunlight and nutrients (especially phosphates). When the cyanobacteria reach a high concentration, the toxin they release becomes concerning. The cyanotoxin released from the blue-green algae can cause illness in humans and can be fatal to organisms that interact with the water.

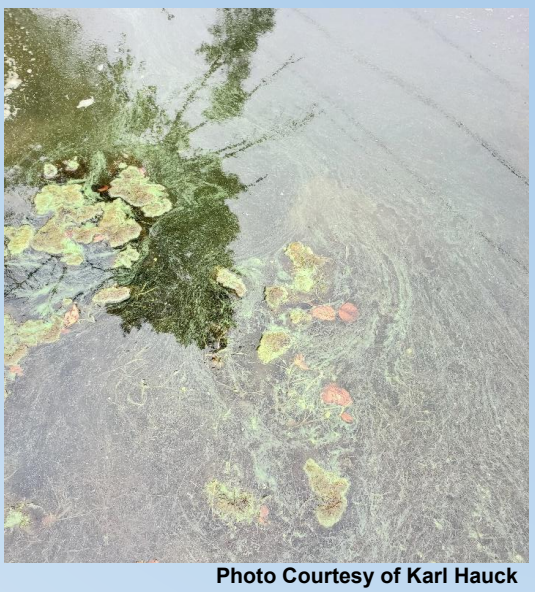


Photo Courtesy of Karl Hauck

High concentration of cyanobacteria near the pool side of Lake Mohawk

NJ Community Battles the Blooms

In 2019, a string of lakes in northern New Jersey, including the largest freshwater lake in the state, Lake Hopatcong, were shut down due to their high numbers of cyanobacteria. The lakes were deemed too dangerous for people to swim by the NJ Department of Environmental Protection (DEP), and the beaches were closed [1].

Amidst the prevalence of harmful algal blooms (HABs), one lake community is taking strides to prevent the infamous blue-green algae from becoming dangerous. Lake Mohawk in Sparta, NJ has used several different methods to inhibit the growth of blue-green algae. One of these methods is the application of an algicide, made of copper sulfate, that explodes the cyanobacteria cells. This method works to kill the cyanobacteria temporarily, but it does not fully fix the problem. The cyanobacteria cell count will be lower for a short period, but then will spike since the cells are able to grow back. Another effective method is aerating aluminum into the water. Underneath the waters of Lake Mohawk lie a network of pipes connecting to tanks that contain aluminum. The aluminum particles are released into the water through air bubbles. The aluminum floats in the water and binds to phosphates. When the aluminum binds to phosphates, cyanobacteria are unable to absorb the phosphate, cutting off their food supply. A similar method that is currently being researched substitutes peroxide for the aluminum. The peroxide is also a phosphate binder but does not have to be applied as often as aluminum, and may be more effective. This technique is being tested in a single location called Turtle Cove on Lake Mohawk before it is rolled out lake-wide.

Through these control measures, Lake Mohawk's cell count of cyanobacteria is being successfully managed. Hopefully these methods can be applied to other lakes around the state to keep cyanobacterial levels low and the state's water bodies open for recreation. ■

[1] "State of New Jersey Department of Environmental Protection," Harmful Algal Blooms. https://www.nj.gov/dep/hab/

A New Way of Farming in the Garden State?

By: Hannah Coiffi

New Jersey, nicknamed “the Garden State”, has an abundance of farmland with thousands of acres being utilized for agriculture annually. A diverse set of crops are grown year-round including peaches in the summer, apples in the fall, broccoli in the winter, and strawberries in the spring—every season the slogan “Jersey Fresh” proves true. However, traditional farming has a significant environmental impact, and new technologies are being explored that have the potential to revolutionize the world of agriculture.

Environmental Impacts of Agrochemicals

Although locally grown produce is satisfying to consumers that enjoy fresh and delicious fruits and vegetables, traditional farming methods can have harmful consequences to the environment. Agrochemicals are the various chemical products that are used in agriculture. This term refers to the wide range of pesticides, insecticides, herbicides, fungicides, nematicides, synthetic fertilizers, and other chemical growth agents that are used on farm fields.

Agrochemicals are used because they assist in increasing plant crop yield, resulting in more abundant harvests that increase the revenue of farmers and feed more people. However, excessive use of agrochemicals can cause contamination of groundwater and drinking water wells with chemical byproducts that are toxic to humans and animals. When runoff containing agrochemicals flows into water bodies, the aquatic ecosystem is disrupted. This can lead to negative impacts including harmful algal blooms and oceanic dead zones.

USGS

Pesticides are applied to a field of crops.

Persistent Organic Pollutants (POPs) are toxic chemicals that adversely affect human health and the environment; they last for long periods of time in the environment and can accumulate and pass from one species to the next through the food chain [1]. Of a list of 12 toxic chemicals that environmentalists have nicknamed the “Dirty Dozen”, eight are pesticides used in agriculture. These chemicals are aldrin, chlorane, dichlorodiphenyl trichloroethane (DDT), dieldrin, endrin, heptachlor, mirex, and toxaphene. The long-term use of any of these agrochemicals is likely to have a detrimental effect on the environment, depleting the soil of its nutrients, and poisoning ecosystems. The increasing concerns over the effects of traditional field farming have encouraged the advancement of methods of more sustainable farming.

A Revolutionary Alternative to Farming

A new method of farming referred to as “vertical farming” is a promising development in agriculture. Vertical farming utilizes space vertically instead of horizontally, and with targeted delivered light and nutrients, can have 390 times greater productivity per square foot annually than traditional field farming. What’s more, is that these yields can be achieved using zero pesticides.

AeroFarms, a company that specializes in aeroponics and the vertical farming method, recently relocated to Newark, New Jersey about a year ago [2]. AeroFarms uses aeroponics to spray the roots of growing crops with water, oxygen, and nutrients in a closed loop system. This method utilizes 95% less water than field farming and 40% less water than hydroponics. The system requires no soil and utilizes a reusable cloth medium that is made from BPA-free recycled plastic. The crops grow indoors, so food can be grown independent of the season or weather. So far, AeroFarms has been successful in growing 700 different varieties of plants.

Specialized LED *Smart Lights* provide the plants exactly the spectrum, intensity, and frequency of light they need for photosynthesis in the most energy-efficient way possible. These *Smart Lights* actually achieve more effective photosynthesis indoors than is achievable outdoors. This technology optimizes the plants' growth cycle, so plants can go from seed to harvest in about half the time as traditional farming. Because aeroponics farming is specifically tailored towards the plant's needs, it also optimizes the flavor, making not only more sustainable produce, but better tasting too! This revolutionary way of farming could completely change agriculture, making it healthier for both the consumer and the environment, and prove to be a much more sustainable option long term.

Availability of Aeroponics Still Limited

AeroFarms currently has a retail company called Dream Greens that distributes to select Whole Foods Stores and ShopRites in New Jersey and New York. However, expect to pay more for this specially-grown produce —Dream Green's prices are about double what you would pay for the same organic greens farmed the traditional way.

As vertical farming becomes more widespread, hopefully this sustainable option will become increasingly available and affordable to consumers looking to reduce their carbon footprint through the food they consume. ■

U.S. DEPARTMENT OF STATE

An AeroFarms vertical farming facility.

[1] "U.S. EPA," Persistent Organic Pollutants: A Global Issue, A Global Response. https://www.epa.gov/international-cooperation/persistent-organic-pollutants-global-issue-global-response

[2] "AeroFarms®," Environmental Impact. https://aerofarms.com/technology/

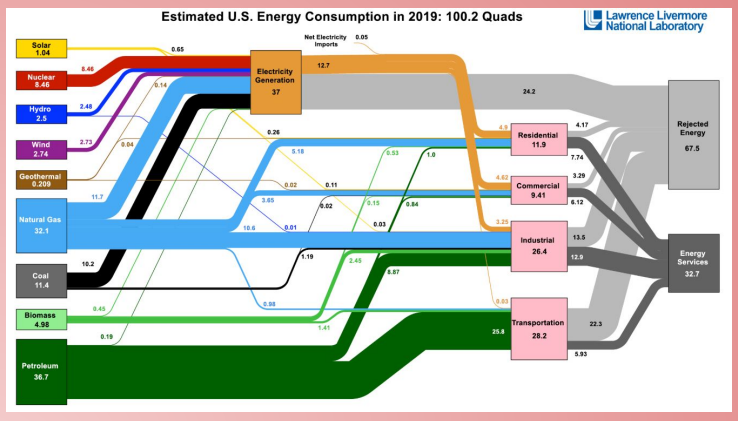
The Energy That's Never Used

By: Victoria Santanello

Out of all the energy generated and consumed in the United States in a given year, a surprisingly large amount is actually rejected energy—or, energy that is wasted through various inefficiencies. According to the Lawrence Livermore National Laboratory, a federal energy research facility, in 2019 the U.S., 67% of all energy generated was wasted [1]. The figure shows the sources of energy generation and consumption of different sectors (residential, commercial, industrial, and transportation) and the amount of energy wasted from each.

Fossil Fuels Still Dominate U.S. Energy Sector

The majority of the electricity used in the U.S. is generated by the burning of fossil fuels, particularly, natural gas and coal. While the transportation sector is powered largely by petroleum products, another non-renewable fossil fuel.



LAWRENCE LIVERMORE NATIONAL LABORATORY (DOE)

Energy Consumption breakdown in the U.S. in 2019.

According to the U.S. EPA, burning fossil fuels for electricity and transportation produce most of the greenhouse gas (GHG) emissions in the United States [2]. GHGs contribute to climate change by trapping heat in the atmosphere. They also can lead to negative health outcomes including respiratory disease from smog and air pollution. By reducing energy losses through energy efficiency upgrades, less energy will be used overall, and therefore fewer GHG emissions will be produced.

Energy Outlook in NJ

In New Jersey, a recent energy master plan has put forth a roadmap to achieve 100 percent clean energy by 2050. This plan will greatly reduce the amount of wasted energy in New Jersey and contribute towards making the country more energy efficient. The strategies in the energy master plan include not only reducing energy consumption (i.e. conservation) but also increasing the adoption of renewable energy technologies. With the increasing demand for clean energy, there are now many ways to produce it. While many people are familiar with solar panels and wind turbines, there are many more clean (low-carbon) energy sources including solar water heaters, geothermal heat pumps, and hydroelectric turbines.

As a state entity, DMAVA is interested in contributing to New Jersey's clean energy future by expanding on-site renewable energy production at NJARNG facilities and reducing consumption of fossil fuels to heat buildings. This semester, the Rowan University Sustainable Facilities Center (RU-SFC) Resiliency Team is conducting research on vertical axis wind turbines and electric heating and cooling technologies for use at NJARNG facilities. ■

Energy Tip: *You can decrease energy use (and lower your energy bill) in your home by installing more efficient appliances. When making your next upgrade, consider purchasing models that are EPA Energy Star certified.*

[1] "Lawrence Livermore National Lab," Energy Flow Charts. https://flowcharts.llnl.gov/commodities/energy

[2] "U.S. EPA," Inventory of U.S. Greenhouse Gas Emissions and Sinks. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Vermicomposting: A Greener Solid Waste Management

By: Alex Salazar

Solid waste management is the disposal of inorganic and organic waste once it is deemed unusable by its owner. According to the World Bank, the most common waste management practices around the globe are dumping or landfilling, which contribute to the pollution of soil and water [1]. Other waste management methods include incineration, recycling, and composting. In this article, we are going to take a look at the challenges and benefits of composting, and the particular technique of vermicomposting.

Breaking Down Organics

Composting is simply the biological decomposition of organic matter. It is not only a way to dispose of organics (think your lawn clippings, dead fall leaves, vegetable scraps, and used coffee grounds); it turns what once was waste into a useful product. Some products of compost can improve soil conditions, stimulate plant growth, and reduce the potential for erosion. Properly produced compost can also add humus to soil. Humus is dark, organic material that forms in soil when plant and animal matter decays. Humus provides key nutrients to soil that keeps it and its inhabitants healthy.

There are three main types of composting: aerobic, anaerobic and vermicomposting. Aerobic composting is the decomposition of organic matter using microorganisms that require oxygen. These inhabiting microorganisms give off byproducts such as carbon dioxide, heat, and water that nourish the soil. Anaerobic composting is the opposite. It utilizes microorganisms that do not need oxygen to survive. There are quite a few flaws with both aerobic and anaerobic composting including odor, the release of harmful chemicals such as methane, and the difficulty in controlling the decomposition. Vermicomposting overcomes these challenges: it generates very little odor, emits very little or no methane, and can be performed both indoors and outdoors.

Worms do the Work

Vermicomposting or “earth worm farming” offers new life to discarded materials in a cost-effective and environmentally friendly manner. Vermicompost or earthworm castings is worm manure and is considered to be one of the best soil conditioners available. Some notable benefits of earthworm farming include an increase in the capacity of the soil to hold water the enrichment of the soil with microorganisms, and the attraction of earthworms that are already in the ground.

Potential for Widespread Use

The U.S. EPA estimates that 55-65% of the waste generated in the United States is from the residential sector, i.e. our homes. Most of what we throw away is organic waste, and that all has the potential to be vermicomposted. And think about it: other institutions such as schools, office buildings, stores/restaurants produce significant amount of organic wastes. If the right infrastructure was created to collect and process this waste, vermicomposting could become an integral part of the sustainable solution to our solid waste management challenge. ■

COLORADO STATE UNIVERSITY

Earthworms used in the vermicomposting process.

[1] “The World Bank,” What a Waste 2.0. https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

Meet the Editors

Karl Hauck

Civil & Environmental Engineering, Junior

This past summer Karl interned with the municipal engineers at the Lake Mohawk Country Club (LMCC). Karl's experience with the LMCC gave him a deeper understanding about how the processes of a down function and the importance of sustainability in a lake community. Karl plans to pursue his interest in environmental studies by entering graduate school for Environmental Engineering.

Jake Bohn

Civil & Environmental Engineering, Junior

Being the big outdoorsman he is, Jake always knew he wanted to make an impact helping the environment. In the RU-SFC's engineering clinic, Jake researches how the NJARNG could expand their on-site renewable energy generation. He hopes to one day be a part of large-scale environmental engineering projects that reduce pollution. In his free time, you may find him at a golf course or his local fishing pond.

Hannah Coiffi

Mechanical Engineering and Mathematics, Junior

Hannah is a lover of nature, health, and holistic living. She hopes to use her background in mathematics and engineering to make progress in the world of sustainability, and make day-to-day living healthier for both the environment and people. In the future, Hannah would like to work for a company that shares her same goals and beliefs, and eventually have a self-sustaining, off-grid home.

Meet the Editors

Alexander Salazar

Civil & Environmental Engineering, Junior

Alexander is interested in the transportation engineering sector, specifically rail. He has gained experience in this subfield, interning for NJ Transit for two summers in a row and has worked extensively on different train station projects. He also has an interest in environmental engineering as he is passionate about the well being of the environment, while catering to the needs of all consumers.

Victoria Santanello

Civil & Environmental Engineering, Senior

Victoria has a passion for indoor gardening and sustainable living practices. She hopes that her background in engineering and green practices can help to better educate the public. She is currently working on an NJARNG project to electrify DMAVA buildings. In the future, she hopes to work as an environmental engineer and help make the world more sustainable.

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