Clean Cut Quarterly

NJARNG Sustainability Newsletter

In collaboration with Rowan University

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Image Curtesy of L.N.Blackburn

Development in electric vehicles keeps rolling along. See page 2 for more details.

Sun shading and louvers match design with style. See **page 2** for more details.

IMAGE USDA.gov

Aquaculture: there's something fishy going on in these gardens. See story on **page 6**.

IMAGE: LN and RL Blackburn and Mark Rain /Creative Commons/CC by 2.0

Sun Shading with Style

By: Jenna Migliorino

Throwing a little shade at a friend may be just a joke, but throwing shade on a building can be really cool. Sunlight shining through a building's windows can cause overheating and uncomfortable glare. External sun shading on a building can control whether heat or light from the sun is blocked or absorbed throughout the day or year. By preventing heat from the summer sun from entering a building, sun shades dramatically drop indoor temperatures. Lower summer temperatures lead to less energy consumed by air conditioning equipment and greater comfort for occupants. In the winter, sun shades let the sunshine in and reduce heating needs by warming rooms.

Sun shades can also provide indirect indoor light to building occupants in a method called daylighting. Daylighting a building decreases electricity costs by reducing the need for artificial lighting. Blocking the harmful effects of sunlight gives building occupants an opportunity for safe sun exposure. The benefits of safe exposure to sunlight, according to Forbes, are elevation of mood, promotion of bone growth and better sleep quality, strengthening of the immune system, lowering of blood pressure, reductions in weight, and decreased skin cancer risks[1].

Louver love

Louvers are sun shading features that can be installed on many kinds of buildings. They last longer than internal shading options, are architecturally more interesting, and don't require daily work from the occupants. Exterior louvers can withstand exposure to the elements for the entire life of a building and are easily incorporated into the design elements of a building, providing interest and movement. The picture below shows reed-like vertical louvers. They are more uniformly interesting than interior shades or roller blinds.

Generally, a fixed louver is most effective on south-facing walls if the blades are placed horizontally above a window to block the high, mid-day sun. Low, mid-day sun in winter is not blocked. They act just like roof overhangs on every floor. Alternatively, fixed sun louvers placed on east and west-facing walls should be vertical for maximum glare reduction. Louvers are not needed on the northern sides of buildings, but may be employed to create a uniform look.

Much like fixed louvers, movable louvers can be installed vertically or horizontally. A mechanism attached to the shade adjusts the blades' angle. The blades may be moved automatically to block the sun throughout the day or moved manually less often. Depending on the design, vertical louvers can survive harsh weather conditions better than fixed horizontal louvers. While many methods to increase the energy efficiency of building cooling systems are available to building owners, implementing external shading can permanently reduce cooling needs and provide healthy, usable daylight for workers while increasing a building's energy efficiency.

IMAGE:M.O. Stevens//Creative Commons/CC BY-SA 3.0

A combination of sunshades make the moderized Edith Green Wendell Wyatt Federal Building much cooler than originally designed.

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Rolling Along with Electric Vehicles

By: Lucas Stroud

The goal of Gov. Murphy's 2020 Energy Master Plan is to ensure a sustainable and environmentally-friendly future for all of us. A significant portion of this plan focuses on reducing energy consumption and harmful emissions in the transportation sector [1]. According to the United States Environmental Protection Agency, the transportation sector is responsible for more than 55% of nitrogen oxide (NO) emissions in the United States [2]. NO is a harmful byproduct of burning fossil fuels, which can be linked to respiratory illnesses and other health deficiencies. Studies conducted in China reveal that there is a potential for a 30-80% reduction of NO emissions if all vehicles were converted to electricity [3]. Since NJARNG has about 50,000 vehicles, there are plenty of reasons to go electric [4].

The conversion to electric vehicles has the potential to significantly reduce the harmful air emissions from US transportation industry.

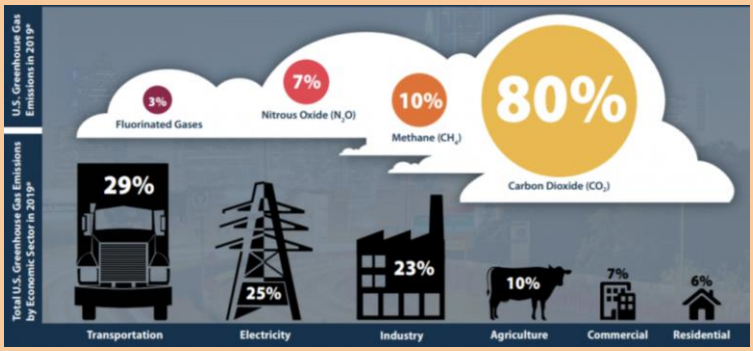

IMAGE: US BTS

Ruling the road

Electric vehicles (EVs) now available include passenger cars and trucks, heavy-duty trucks, and even buses. The electric vehicle market has been producing products that can outperform their gasoline-powered counterparts in low speed torque, power output [4], reduced maintenance needs [5], as well as the reduced direct emissions and noise levels. EVs have immediate torque availability. Equivalently-rated vehicles with internal combustion engines take more time and energy to move, so EVs are significantly more efficient. EVs such as the Ford F-150 Lightning, have built-in electric panels to supply energy to work power tools, or a house in emergency situations [6]. No portable generators needed! EVs also have fewer moving parts, so the maintenance costs are 50% less than for fossil-fueled vehicles while the probability of mechanical problems is much less[7].

Some bumps along the way

As with any newer technology, there are concerns surrounding widescale production and implementation. These have been recognized and most are being actively addressed.

- The current batch of passenger EVs can range up to 400 miles - twice NJ's length! DMAVA and others are working towards having charging stations to allow for daily use.
- Batteries are denser than fossil fuels, so EVs will weigh more than existing vehicles. The average truck weight may increase by around 3% [8] . This may require roads or bridges to be maintained a bit sooner [9]. Funds are needed to make our highway system and bridges resilient as they exceed design life and capacity.
- Although relatively rare, battery fires have occurred [10,11]. Further research on battery thermal regulation and fire suppression is being conducted.
- Battery warranties are typically 8 years or 100,000 miles [12]. Battery replacement costs for older vehicles should come down as battery replacement markets expand.
- Governmental regulations and incentives, banks, and NGOs are working to alleviate environmental damage caused by mineral mining operations and to promote recycling instead of battery disposal.

'Rolling along..' continued on page 4

Thumbs up

Regardless of the concerns stated here, the benefits do outweigh the unresolved issues. Continued research and development are sure to reduce the negatives of battery use while increasing EVs ownership numbers will improve air quality dramatically for all. If you are interested in driving change yourself, the NJ DEP sponsored website Driveelectricus.com may have answers for you for your car desires. Many truck manufacturers have electric and hybrid trucks on the market or in production. New Jersey is buying electric buses for some more urban areas.

New Jersey offers many incentives to buy electric vehicles and to pay for charging station purchase and installation.

IMAGE: NJ DEP

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Making Plastics Fantastic Again

By: Len Eslava

Billions of tons of plastic have been produced around the world. An estimated 165 million tons have trashed our oceans, with around 11 million metric tons pouring into them every year - equivalent to one garbage truck per minute[1]. Given that only about nine percent of plastic gets recycled [2], there is much room for improvement.

Industry leaders are turning to bioplastics in addition to direct recycling. Many large corporations such as Coca-Cola are marketing “eco-friendly” packaging such as its PlantBottle. This bottle consists of thirty percent sugar cane and other plants and seventy percent oil-based plastic [3]. Bioplastics are a good start towards eliminating oil-based plastics, but only with proper disposal can it meet their strong expectations[1].

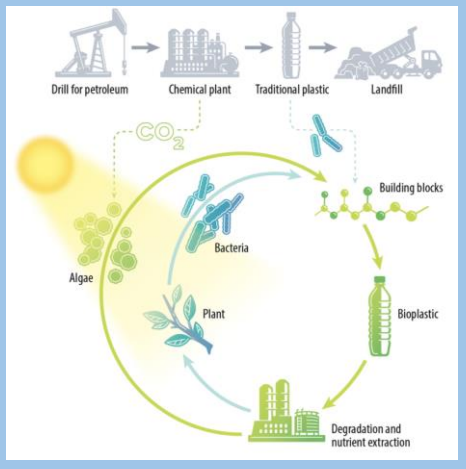

IMAGE: Los Alamos National Lab

Bioplastic development can lead to a circular economy for plastic bottles instead of a straight to landfill use process.

‘Plastics...’ continued on page 5

What is a bioplastic?

Bioplastics have at least twenty percent renewable materials[4] and can be derived from many natural sources. Two examples of bioplastics are PHA (polyhydroxyalkanoate) and PLA (polylactic acid). PHAs, made from sugars grown from algae, are primarily used in biomedical applications such as drug delivery due to their high biocompatibility. PLAs, made from the sugar from corn and sugarcane are most commonly used for takeout containers and fresh produce packaging [4]. Not all bioplastics are biodegradable, but all contain bio-based materials [5]. The advantages of using bioplastics include reduced use of fossil fuels yielding a smaller carbon footprint, faster decomposition, and less toxicity than traditional oil-based plastics [6].

The bioplastics industry is continually developing. Significant obstacles need solutions to increase the adoption of bioplastics while decreasing its environmental impacts. These obstacles pertain to costs, ecosystem destruction, and waste stream infrastructure. Oil-based products remain cheaper as economies of scale are significant in the plastics industry. Governmental encouragement could balance those costs by establishing incentives, taxes, or mandating that companies recycle post-consumer waste. Forests and wetlands are being replaced with cropland to grow corn and sugarcane for bioplastics, and greater amounts of fertilizers and pesticides pollute these fields. Traditional and organic farming methods can reduce pollution. Algae-based bioplastics can take land out of the equation entirely.
The co-mingling of recycling streams lands bioplastics in landfills where it does not degrade well. Proper recycling streams or compost sites are needed to prevent bioplastics from being more harmful to the environment [1].

TerraCycle has recycling solutions

Located in Trenton, New Jersey, the TerraCycle company offers a range of national, easy-to-use recycling platforms. They oversee recycling programs funded by manufacturers and retailers worldwide to help collect and recycle hard-to-recycle waste. A consumer can also choose to pay boxes fitting their particular recycling needs- from large event recycling to offices, and family homes. [7]

One of the products that TerraCycle offers is a zero-waste box for biodegradable plastic. The recycling box is meant for any brand of biodegradable or compostable plastic goods, including PLA cups, utensils, plates, and containers. Once TerraCycle receives zero-waste packages, the contents are sorted and cleaned. The biodegradable plastic is then appropriately composted in an industrial composting plant.

IMAGE: TerraCycle Website

TerraCycle's Zero Waste Boxes

TerraCycle has pioneered zero-waste boxes to compost bioplastics effectively. Although their recycling program handles only a tiny amount of plastic yearly, it provides proof of concept. By encouraging the adoption of proper composting globally, plastics may again be fantastic.

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A Roof Cooler Than You!

By: Matteo Agresti

Gotta wear some cool shades when you are on a cool roof. These roofs reflect massive amounts of sunlight using reflective paint, tiles, or shingles. While an average roof can reach up to 160 °F, a cool roof can be up to 40°F lower because lighter colors absorb less heat (See illustration below.) Anyone who has sat on a black car seat in summer can relate to this phenomenon and quickly remembers to put a towel on their seat next time they park!

Scientifically speaking, cool roofs have high solar reflectance and high thermal emittance. Solar reflectance is the ability of an object to reflect solar energy to the atmosphere instead of absorbing it. Thermal emittance describes how much heat will be radiated away from a surface per unit area at a given temperature [1]. Solar reflectance and thermal emittance are both rated on scales from 0 to 1. Where 0 is the lowest and 1 is the highest for reflectance and emittance. Cool roofs have reflectance levels around 0.75 and thermal emittance levels above 0.80 [2].

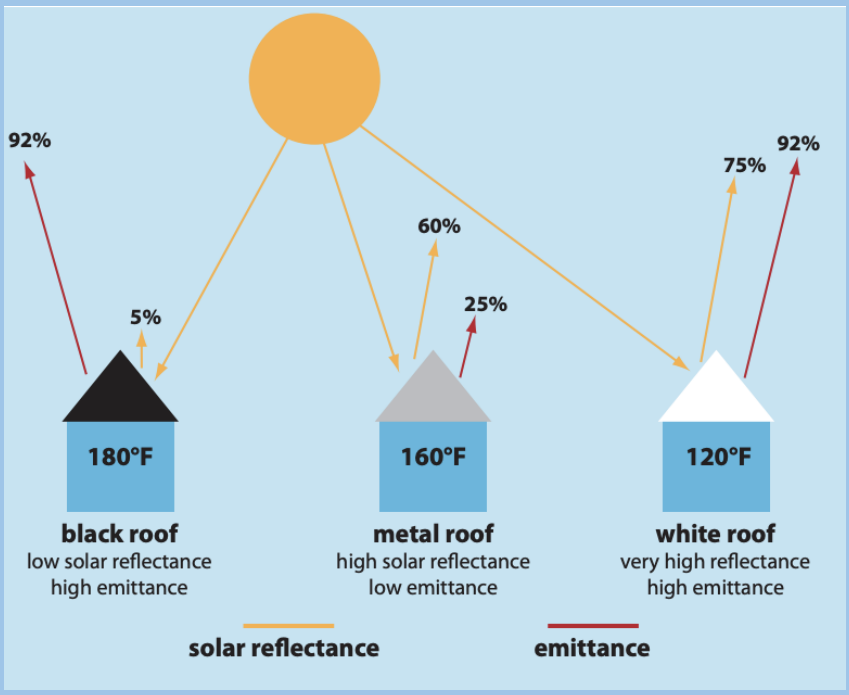

IMAGE: EPA

Illustration of solar reflectance and thermal emittance shows how they vary with color and material. White roofs reflects the most amount of sun, and although both white roofs and black roofs have high emittance, white roofs keep much cooler overall.

The benefits of a cool roof

Cool roofs save energy. Since less heat is being absorbed, the building stays cooler and causes the air conditioning to be used less. Property owners can save lots of money on their electric bills if building peak demand charges are lower on hot summer afternoons. An added benefit of cooler roofs is that they make rooms without air conditioning more comfortable, especially when combined with fans and cooler air circulating from lower building levels. Lastly, cool roofing materials have non-temperature related benefits too. Significant money can be saved when cool roofing materials dramatically increase the life of the roof by providing a protective barrier from water intrusion [3].

'Cool roofs...' continued on page 7

How are roofs made cool?

The easiest way to make a roof cool is to use thick paints known as cool roof coatings. Cool roof coatings are generally either super white in color or have reflective pigments. There are two categories of cool coatings materials - cementitious and elastomer. These coatings protect the roof from ultraviolet light and chemical damage [4].

Built-up roofs are a type of low-slope roofing and consist of layers that can be made cool. One option involves covering the roof with a cool white coating similar to very thick paint. The second option is to lay down a layer of reflective mineral granules above the currently-used darker granules.

High-pitched, shingle or metal roofs are typically found on houses and on many readiness centers. These roofs shed water and snow fairly well, but usually are found in dark colors in New Jersey. There are two ways that shingle roofs can be made cool. Special cool asphalt shingles can be used which are coated to have high solar reflectance. Some shingles can be painted with regular cool roof coatings without replacement, but that would be up to the manufacturer to approve [4]. Metal roofs, on the other hand, are good solar reflectors but are not good at thermal emittance. Painting a metal roof in a light color or using a cool roof coating will improve its thermal emittance. A few hours of work could result in many years of cooler savings.

Image Curtesy of L.N.Blackburn

Above, the high-slope roof on the right is a good candidate for cool roofing methods, as the storage shed's roof to the left illustrates.

Image Curtesy of L.N.Blackburn

This low-slope roof is a good candidate for cool roofing methods.

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Aquaponics: From Tanks to Table

By: Andrew Barbaro

Aquaponics is a blended farming method that involves farming fish (aquaculture) and growing plants (hydroponics). This integrated farming can be traced back thousands of years to Asia, where rice cultivation and fish farming were a way of life [1]. In modern times, aquaponics "produces up to 11x more yield with 60-90% less water than field crops," according to Souders & McDowell [2].

In New Jersey, farms using closed-environment agriculture occupy only small land areas to produce large yields. According to its website, the Branchburg, New Jersey AquaSprout Farm grows over 880 pounds of tilapia every season, along with 28,000 heads of lettuce per year.

IMAGE: NOAA

A variety of greens grown in mixed media in the aquaponics system.

HS farms in Toms River, NJ, uses very little fertilizers, pesticides, and antibiotics in their aquaponic systems. This reduces the environment impact of farming while providing a healthy food source [3]. In the West Virginia National Guard Adjutant General's department sponsors a program called the Patriot Guardens [4]. It provides healthy food awareness, agricultural job training in aquaponics and hope to people in recovery.

How does aquaponics work?

Believe it or not, the plants in this system are grown in water without soil. Rocks, plastic piping, or wire hold the plants in place. Fish grow in tanks with water circulated from the plants. As the fish grow, they produce waste that creates nutrient-rich water thanks to ammonia-eating bacteria. After the plants uptake the nutrients, the water is filtered and recycled back into the system [2].

Every aspect of an aquaponics system can be tailored to available resources. The main components needed are a hydroponic tank, a fish tank, a water pump, an air filter, a sediment tank, and a biofilter. Electricity is required to pump water through the system, but solar panels or other alternative energy sources can be used instead. Growing algae to feed the fish can eliminate buying fish food. By employing these two enhancements, the need for system inputs and costs can be dramatically reduced. The result is a thriving system of plants and animal life growing around the clock, throughout the year.

Some common crops that thrive in these systems are tomatoes, leafy greens, peppers, and herbs. Fish such as tilapia, bass, trout, and catfish are often chosen for aquaponics systems [1]. These crops can mitigate local food shortages and provide for those in areas of prolonged poverty. An aquaponics farm and learning center named Oko Farms, based in Brooklyn, NY, grows food on city roofs to meet health needs and educate residents. Founder Yemi Amu sells to customers directly and donates or sells to local markets as well [5].

The Future of Agriculture

Aquaponics or closed-environment agriculture are the farming methods of our future, solving significant farming issues related to accessibility, resource allocation, and health. The systems are very adaptable and can be scaled-up to meet needs. Furthermore, many kinds of fish and produce can be grown to suit local tastes. With all the fantastic features of aquaculture, it shouldn't be too long before you will be stopping by your local tank farm for dinner.

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IMAGE: USDA

Aquaponics combines aquaculture with hydroponics to grow food in one of the most environmentally sustainable methods used today.

Meet the Editors

Jenna Migliorino

Civil & Environmental Engineering, Junior

While she didn't grow up in The Big Apple, it was a prominent part of Jenna's childhood. Spending most of her time in the city that never sleeps caused Jenna to understand the need for increased energy efficiency, and carbon dioxide emission reductions. She aspires to being involved in large-scale structural engineering projects with sustainability concerns and increased energy efficiency. In her free time, you may find Jenna singing opera, or helping younger children who are interested in STEAM.

Matteo Agresti

Civil & Environmental Engineering, Junior

Matteo has always had a love for math and science classes which led him to engineering. As a young child, he was fascinated by different types of roofs and how they work. In the future he wants to design buildings that are more energy efficient and friendlier to the environment. In his free time he likes taking his dog on long walks and playing video games.

Lucas Stroud

Civil & Environmental Engineering, Senior

CEE, Senior

Lucas has enjoyed expanding his knowledge of ARNG facilities and how they are managed. Upon graduation, he hopes to be a part of an engineering team that are leading implementers of electric vehicle technology. Furthermore, Lucas hopes to make electric vehicles available on all platforms including air travel. When he is not working, Lucas enjoys playing the guitar, playing video games, and going to the gym.

Meet the Editors

Len Eslava

Civil & Environmental Engineering, Junior

Having visited numerous national parks in recent years, Len's curiosity regarding the preservation of the natural environment has encouraged him to pursue a career in Civil and Environmental Engineering. Len is researching the use of drone thermography to increase the resiliency of NJARG buildings. His career aspirations are focused on water resources and renewable energy. In his free time, Len likes to go hiking and plays in a basketball league.

Andrew Barbaro

Civil & Environmental Engineering, Junior

Being born and raised in South Jersey, Andrew is no stranger to the many lakes, rivers, and coastlines that contribute to the diverse ecology of this area. In his free time, Andrew can be found outdoors or playing the drums. He hopes to build upon his engineering field experience and eventually work in Subsurface Utility Engineering or land surveying.

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