Clean Cut Quarterly

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In collaboration with Rowan University

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Image Curtesy of L.N.Blackburn

Auditing the Rowan University Engineering Auditing Clinic. See page 2 for more details.

Find out about EV charging stations at NJARNG sites near you on **page 4.**

IMAGE: National Renewable Energy Laboratory

Discover your IAQ and learn what you can do to improve it on **page 6**.

IMAGE: EPA.gov

Auditing the Rowan Audit Clinic

By: Jenna Migliorino

The Henry M. Rowan College of Engineering students at Rowan University (RU) participate in semester-long, hands-on clinics in each academic year. Clinics during the first two years involve integrated and structured projects. In the final two years of clinics, engineering students are given the opportunity to perform research or work on projects for actual clients. The building audit clinic offered by the Sustainable Facilities Center (SFC) in the Civil and Environmental Engineering Department offers clinics working with NJDMAVA on its facilities. Building audit clinic students learn by doing comprehensive energy and water audits of NJARNG buildings to satisfy the federal and state mandates. Each clinic has three teams. A clinic team comprising 2 to 5 students is led through the process by a graduate student, SFC staff, an RU professor, and DMAVA personnel.

The steps taken by the clinic teams to perform the audits are listed in the sidebar - How to Audit. The audit teams meet to formally present their findings to DMAVA twice during the semester and create a report. That includes any concerns that the team might have found, a potential solution, estimated project costs, and any payback that the project would yield. Suitable renewable energy measures are presented as well.

According to the 2016 ARNG Energy Manager Handbook, NJDMAVA benefits from the audits in a number of ways. Audits identify facility improvement needs, including resolving operational and maintenance issues or staff training. Audits provide a vehicle to assess energy and water use and identify projects of significant direct energy and/or water savings with accompanying reductions in utility and operating costs. Audits also help facilities to meet organizational sustainability goals by identifying ways to reduce green house gas (GHG) emissions and building Energy Use Intensity (EUI).

How to Audit

1. Collect and analyze recent energy usage, utility billing, GHG emissions, and building EUI as part of a preliminary energy and water assessment.
2. Study the building, the occupants, and its operational characteristics; collecting onsite data on where necessary.
3. Identify potential changes to building, building use, or equipment that will reduce the energy or water use and/or cost
4. Perform engineering and economic analyses of the potential changes including heat loss.
5. Report on the data collected, the analyses, and recommendations

Different Perspectives

I interviewed Justin Costa, EMIT, EIT, LEED Green Associate, who participated in the building audit clinic as a RU student in 2011. He is now the NJDMAVA energy manager. While Costa's participation in the clinic allows him to pay things forward, he is always learning new details about the buildings and ways to make them more efficient. I asked if Costa had always wanted to be in the energy field. He responded that he had always enjoyed learning about energy efficiency and even worked with his dad at the latter's HVAC company. Costa recalled that as a student, he knew that he wanted to do something related to energy; however, the clinic opened his eyes to the auditing process. He regularly visits the clinics to answer site-specific questions and pass on his knowledge. Costa gave one piece of advice to clinic students. He recommended that all students should look at every project or job as an opportunity to learn something. Explaining that the skills and experiences learned in the clinic or on a job can be very transferrable. You never know what skills might prove useful in the future.

'Auditing..' continued on page 3

Auditing… (cont.)

I also interviewed Charles Rudderow and Bri Wietecha; both were in the Audit Clinic in Fall 2021 (Figure 1). Charles and Bri are both Civil and Environmental Engineering majors in their junior year; Charles is from Jackson, New Jersey, and Bri is from Matawan, New Jersey. At the beginning of the clinic, they noted that they were quizzed on the information they learned to make sure that they were ready for the site survey. Charles and Bri relayed to me that they are learning how to analyze energy consumption data and how to make facilities more efficient.

To learn more about the reports, I interviewed Dr. William Riddell, a professor at Rowan University for 18 years and audit clinic principal. He hopes that NJDMAVA uses the reports of the audit clinic to implement changes to save energy or water. He feels that the reports are a great way to document a building and how it can be improved. This aligns with Costa's goal to providing project justifications. Overall, the clinic is a learning opportunity that benefits many people.

Image Curtesy of Jenna Migliorino

Figure 1. Rowan engineering students Charles Rudderow and Bri Wietecha participated in the audit clinic.

Just Charge It

By: Lucas Stroud

Federal and state governments offer incentives to motivate people to buy electric vehicles (EVs). Tax cuts, rebates, and other incentives are available for those who qualify in hopes of EVs completely taking over the road and can be found on the alternative fuels data center's website (https://afdc.energy.gov/fuels/laws/ELEC?state=NJ). Like the gasoline distribution system, an infrastructure of EV charging stations is needed to enable the adoption of EVs.

To jump start the growth, Governor Murphy has in his Energy Master Plan the "It Pay$ to Plug-In" incentive program (https://www.drivegreen.nj.gov/overview.pdf). Not only does this program provide incentives for the purchase of the vehicle, but it also provides incentives for the installation of the charging stations or Electric Vehicle Supply Equipment (EVSE). The incentive program provides reimbursement grants for the cost and installation of EVSE at workplaces, government and educational facilities, and non-profit organizations. NJDEP will reimburse a percentage of the cost of installing EVSE up to $200,000 to those who apply. Qualifying incentives can depend on many factors; however, some contribute to the success of a charging station itself. One qualification for the EVSE installation incentive is that the charging station must maintain a 95% annual uptime requirement [2]. Uptime refers to the percentage of time that the station is accessible and operating in a year. Keeping the juice flowing is essential.

Regardless of the incentives, there are state and federal mandates to meet as DMAVA vehicles get plugged-in. Expressly, the NJ Governor has set a goal by December 2025 of transitioning to plug-in EVs for a quarter of the state's light-duty vehicles that are not used in emergencies [3]. DMAVA is working to acquire EVs and encourage their use to meet this goal throughout the state. In an interview with Justin Costa in October 2021, the energy manager noted that charging stations at DMAVA headquarters are just the first of many to be planned and installed. Additional charging stations at the farthest and busiest NJARNG sites to facilitate day travel will follow.

'Just Charge It' continued on page 4

Just Charge It (con.)

For those with EVs now, maps of EVSE throughout the country can be found on mobile phone apps and online. The maps below are from the US Department of Energy's Alternative Fuels Data Center (AFDC). One can search the map by type of charger (Levels 1-3) and charging connector. According to the AFDC, Level 1 charging is the slowest, needing up to a day to fully recharge an EV with 120 volts AC power. These are available in most homes without special installations. Level 2 chargers are the most prevalent in commercial areas and may require nearly 8 hours to recharge an EV with 240 volts of AC power fully. Level 3 or DC Fast chargers can fully recharge a battery in less than 1.5 hours using DC power of 480 volts. L3 stations can reduce EV charging down to a long rest stop.

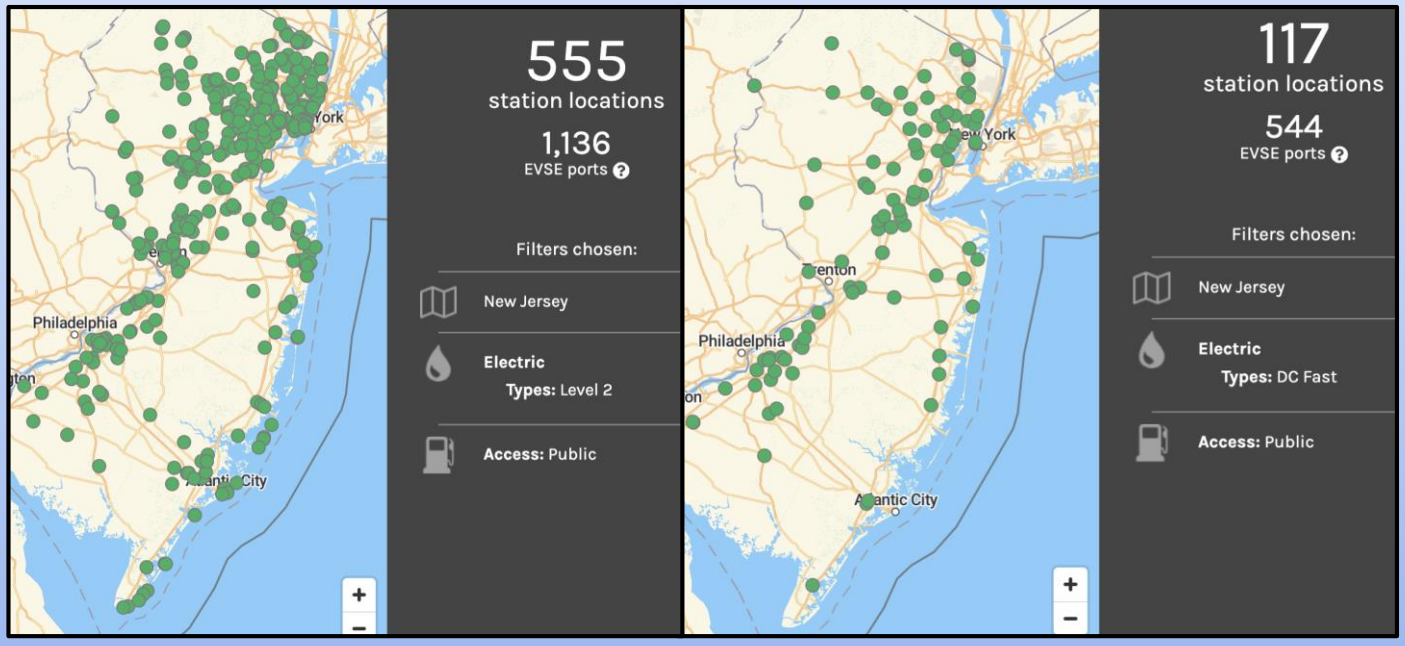

Figure 2. Electric vehicle charging station locations in New Jersey according to the Alternative Fuels Data Center by the The Office of Energy Efficiency and Renewalbe Energy, Department of Energy. Level 2 stations are concentrated in the most populated and heavily traveled areas of the State. Level 3 (DC Fast) charging stations are generally limited to major highways.

Unfortunately, L3's make up only 15% of the chargers in the country and 17% of NJ charging stations.[3] There is much work to be done to fill out the state map with L3 stations (Figure 2). The federal government has acknowledged that need. Last month, a joint Office of Energy and Transporation was announced to help states deploy an effective and equitable network of 500,000 EV charging stations using $2.5 billion in funding from the Bipartisan Infrastructure Law. [4] Charging stations located all over New Jersey play an essential part in keeping DMAVA's EVs moving along, and now more funding will be available to get the job done.

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Cool is the New Black

By: Matteo Agresti

Cool roofs reflect sunlight and emit high amounts of thermal energy [1]. The coolest roofs have the highest solar reflectance index (SRI). The SRI combines a material's solar reflectance and thermal emittance measurements into a single value of up to 100 [2]. Inside buildings with cool roofs, temperatures remain lower than those with non-cool roofs. The lower temperatures can significantly affect worker comfort in buildings with no air conditioning (A/C). Lower temperatures can reduce building cooling needs too and, therefore, utility bills in buildings with A/C. The U.S. Dept. of Energy's Oak Ridge National Laboratory has even developed a cool roof calculator tool to help one estimate cool roof savings (https://web.ornl.gov/sci/buildings/tools/cool-roof/).

Selecting roofing materials that are 'cooler' than others can have a real impact. Simply painting a roof white does not guarantee the coolest roof, but it can be an excellent first step [3]. Other options are available, whether the roof needs to be replaced or not. Cool roof products are tested and rated by the Cool Roof Rating Council (CRRC). The CRRC tests a product to calculate its initial SRI and then retests it after three years [4]. The SRI must be 60+ to be considered 'cool'. One can find many product ratings on the CRRC website (coolroofs.org), including coatings, sheetings, tiles, foam, and asphalt shingles. Starting in 2022, the CRRC will also provide ratings on exterior wall products. Reducing the sun's effect on building walls offers additional opportunities for energy reduction and increased indoor comfort [4].

Many Colors can be Cool

White cool roofs are great reflectors and emitters, but other cool colors are available. Some specially formulated darker roofing coatings or materials can reflect sunlight up to 40% more than standard roofing products while allowing a building's roof to fit with required architectural standards [4]. The Cool Color roofs may not have the highest SRIs, but they present an option for reducing summer high-temperature loading while being architecturally pleasing. The solar reflectance can vary between colors, but cool-colored tiles are an improvement over conventional tiles, as illustrated in Figure 3.

Cool-colored tiles (top row) look just like conventionally colored tiles but have higher solar reflectance (R). *Image Source: American Rooftile Coatings and Lawrence Berkeley National Laboratory*

IMAGE:USA DOE

Figure 3. Tile solar reflectance in comparison

Making a cool roof

Existing low-pitched roofs can be made cool by rolling out high SRI films over a membrane roof, changing the ballast on built-up roofs, or applying elastomeric roof coatings or foams. They can all improve reflectance and emittance depending on the chosen material and application. There are three types of elastomeric roof coatings - acrylic, silicone, and urethane. All three usually come in white or other light colors [2]. Compared to regular paints when being made, elastomeric roof coatings use less water and use more binder and additives to gain more reflectance and emittance. Because of that, the coatings tend to be much thicker than standard paints [1]. The coatings and foams can extend the life of an existing roof by covering potential cracks and reducing UV degradation. Some coatings and foams will also provide additional sound insulation [5].

'Cool is the New Black" continued on page 6

[1]Ferguson, B., Fisher, K., Golden, J., Hair, L., Haselbach, L., Hitchcock, D., ... & Waye, D. (2008). Reducing urban heat islands: compendium of strategies-cool pavements.
[2]Cool roof guide - energy. US Department of Energy. (n.d.). Retrieved November 9, 2021, from https://www.energy.gov/sites/prod/files/2013/10/f3/coolroofguide.pdf.
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What's Your IAQ?

By: Andrew Barbaro

October was indoor air quality (IAQ) awareness month for a good reason. Increasing colder weather drives many people in New Jersey to spend more time indoors. Now with COVID-19 concerns, it makes even more sense to assess the air quality in these spaces. Indeed, indoor air in the winter is generally dry and maybe poorly filtered. While we can usually deal with dryness using lotion and humidifiers, pollutants are different [1].

Outdoor air pollutants generally make their way indoors along cracks in windows and door seals and through small holes in ceilings, walls, and floor coverings. Indoor air pollutants are another concern according to the Environmental Protection Agency (EPA) indoor air quality website https://www.epa.gov/indoor-air-quality-iaq . Studies have 'found levels of about a dozen common organic pollutants to be 2 to 5 times higher inside homes than outside, regardless of whether the homes were located in rural or highly industrial areas [2]'. Volatile organic compounds (VOCs) are released into indoor air from chemicals found in cleaning products, paints, building materials, and office equipment such as copiers and printers [2].

The World Health Organization (WHO) states that 'indoor air pollutants commonly found in households cause up to 3.8 million premature deaths annually'. Important pollutants to be removed from the air include VOCs, mold, bacteria, viruses, and allergens such as pet dander or pollen [2]. They can lead to adverse health effects when concentrated in a poorly ventilated room for an extended period.

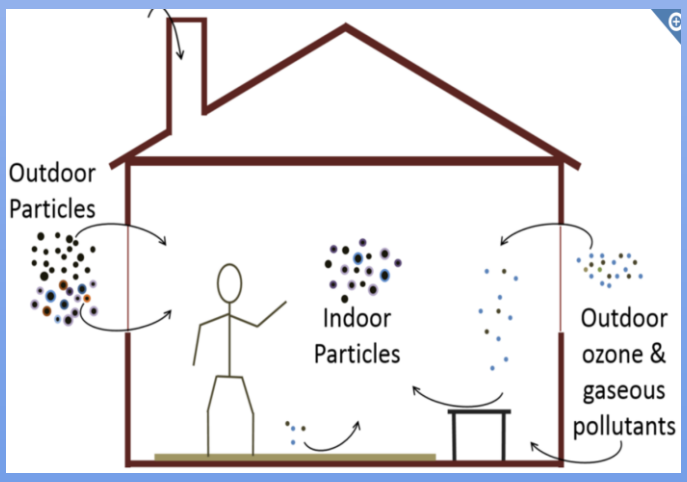

IMAGE:NIST, USA DOC

Figure 4. Outdoor air particles and pollutants can mix with particulate matter to create harmful indoor air situations.

The amount of particles that are found inside a building is affected by pollutant load as well as a building's ventilation system and any additional IAQ improvements (eg. filters and plants) [3]. Luckily, newer living and working spaces have equipment to maintain good IAQ due to required building codes. Heating, ventilation, and air conditioning (HVAC) systems generally keep one comfortable in temperature, humidity, and air quality. It's fairly easy to tell if a HVAC system are keeping you at a comfortable temperature, but checking a building's ventilation system can require a little bit of math.

'What's Your IAQ? continued on page 7

How to measure IAQ?

One way to measure IAQ is to determine the number of times the air is cycled through a room in an hour or Air Changes per Hour (ACH). The ACH is calculated by knowing the airflow rate (cfm) divided by the room volume (cft).

$$ACH = (Air\ Flow \times 60) / (Room\ Volume)$$

Airflow in a room can be determined by looking at the building's ventilation equipment specifications or can be measured in place with a simple anemometer (air flow meter). If the air in a room is replaced every 20 minutes, the ACH would be 3. The EPA recommends following minimum recommendations of 0.35 ACH, but not less than 15 cfm per person in the room. [3] Greater ACH may be desired depending on outdoor air quality or persons in a room.

Increasing IAQ

Increasing IAQ in a room or building can be achieved in some combination of three ways, 1) decreasing pollutant loading, 2) increasing ACH, and 3) filtering the air [3]. If pollutant loading is not controllable, increasing ACH and filtering are your options. Increased ACH can be achieved by increasing an HVAC system's blower speed or operational time per hour. Buildings with Building Management System (BMS) have controls that can be adjusted to achieve this goal. A building's HVAC system may need to be upgraded if its systems are not meeting ACH demand. Upgrading is expensive, so a thorough building audit should be performed before designing a replacement HVAC system as described in the 2016 ARNG Energy Manager Handbook. Many building features and uses may have changed over time so understanding the current situation is key.

In older buildings with no ventilation systems, simply using a portable fan or ceiling fan will do the job if air can be circulated from larger room, hallway, or open window. Window AC units are not a good choice to increase IAQ as they generally do not use fresh outdoor air nor filter indoor air very well [4]. The other options provided can be applied with generally lower costs and are relatively simple to implement.

Increased filtering of indoor air can also increase IAQ. HVAC system filters are changed regularly in most buildings, but increased change frequency or increased quality of filters can improve IAQ. In buildings without ventilation systems, a portable air filter will do. There are many filters, so knowing the Minimum Efficiency Reporting Value (MERV) rating helps compare effectiveness. The higher the rating, the better the filter will be at trapping particulates. Take filtering to the next level by purchasing a High-Efficiency Particulate Air (HEPA) filter [5]. The HEPA filter captures 99.97% of micron-sized particulates compared to 90% by a MERV-rated filter of 13 [4]. The CDC recommends a HEPA filter in operating rooms for the best protection against spreading bacteria and viruses [5].

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Meet the Writers

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 Writers

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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Learn more about the Rowan University Sustainable Facilities Center **here** or scan our QR code!

SCAN ME

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