October NEWSLETTER

CLEAN ENERGY AND SUSTAINABLE TECHNOLOGY EDITION

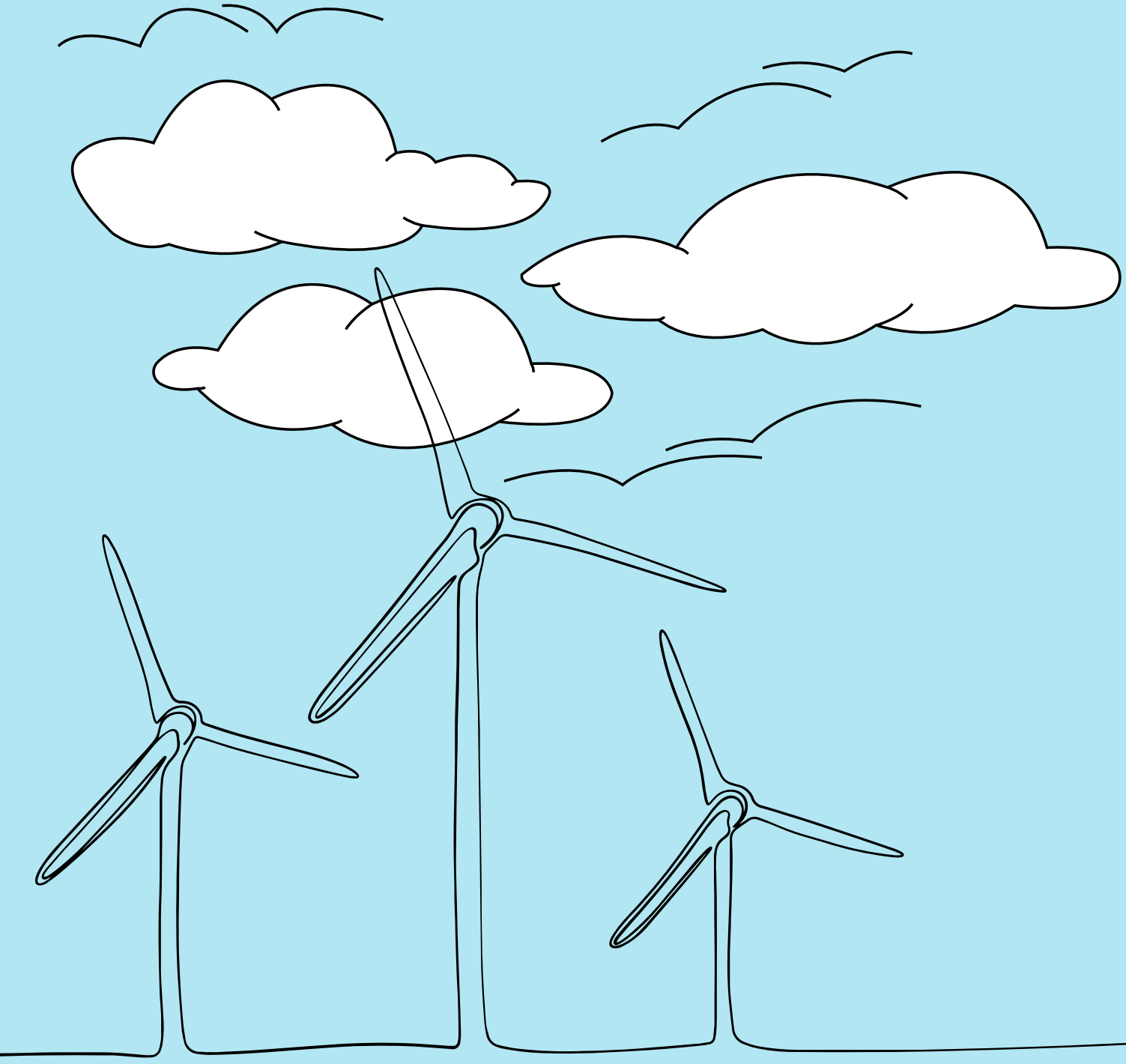
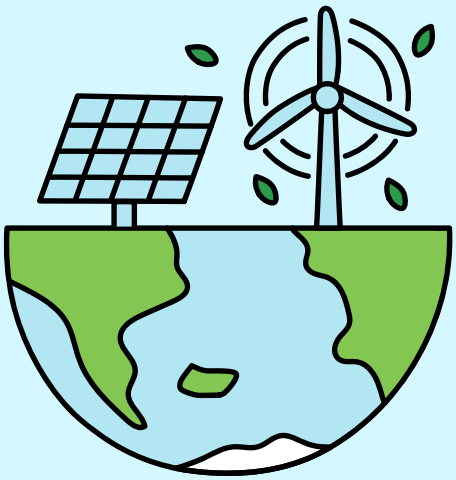
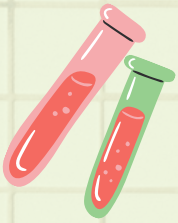


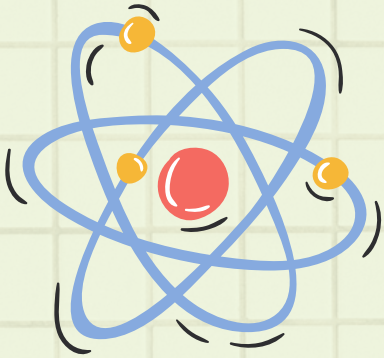
TABLE OF CONTENTS



NUCLEAR: A SAFE BET FOR THE FUTURE OF ENERGY

By Nicolo Dolge





While it isn't without drawbacks, nuclear energy is a competitive, sustainable power source that has many benefits over alternative options. A technology originally developed in 1951 by the American Atomic Energy Commission, nuclear energy has since been adapted worldwide as a leading source of energy production due to its low pollutant output and highly sustainable nature.

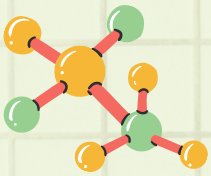
What we call nuclear power today is based on the fission reactions that split apart atoms to create heat energy. This process is not to be confused with "fusion," an opposite reaction that combines atomic particles to create energy. Nuclear fission is a multi-step process. First, uranium atoms are split apart and the energy produced heats a water source in the core of a nuclear reactor. The heated water then flows out of the core and heats a separate source, which turns into steam and runs through a turbine to generate electricity. The excess steam is released from the plant in the form of "fumes" that can be seen leaving the top of the nuclear reactor smoke stacks.

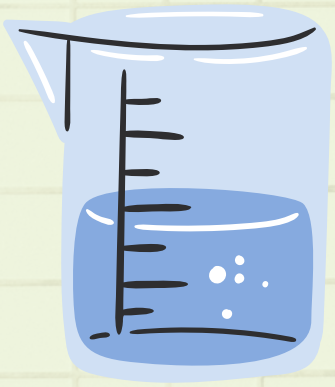
Since its widespread adoption, nuclear energy has faced a variety of media attention, mostly in the form of negative pushback. Several Godzilla movies have created scary portrayals of nuclear radiation and energy as being responsible for the creation of the monster and its ensuing destruction. There have been a variety of real nuclear threats, including the disaster at Chernobyl in 1986 and the Fukushima nuclear crisis, a nuclear meltdown which occurred in Japan following a 9.0 magnitude earthquake in 2011. Besides that, there have been other safety concerns, including the transport and storage of radioactive waste materials, and the contamination of areas surrounding nuclear plants.

However, the nuclear energy industry is taking important steps to solve these issues. Many people are averse to the transportation of nuclear waste materials through their cities, towns and neighborhoods, and the Environmental Protection Agency understands this.

Highly radioactive materials are most often transported via highway, away from heavily populated areas. Additionally, radioactive material may be tracked and escorted by state and local officers to enhance the safety of the shipment. When stored, radioactive waste is put deep underground, too far out of the way to harm the public, and sealed until it is once again safe. New technologies are granting us the power to create deeper, safer repositories for such wastes, allowing us to use more space for storage.

Even before this waste is stored, nuclear engineers take the utmost caution when creating nuclear power facilities. The core, which houses the active uranium, is surrounded by two feet of concrete, and the water that runs through the core is cycled back into the reactor rather than being released as a waste product. Even when there is an accident, our current technology has allowed for much better cleanup and mitigation processes than before. At Fukushima, water has recently accumulated in the destroyed site and become radioactive, but we have ways to treat, dilute, and reduce the water's potency, which has allowed Japan to begin releasing it into the ocean as of August 24, 2023.

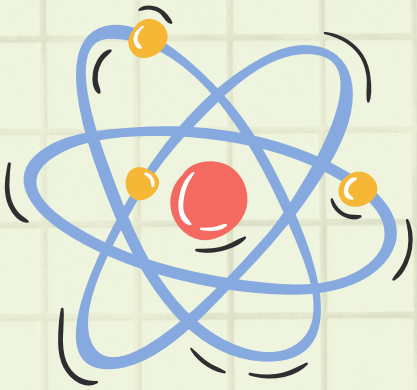




Scientists are currently working on many ways to make nuclear reactors more cost effective, including alternative coolant options, improved fuels, and better construction methods. Nuclear energy faces competition from renewable energy sources like solar power, hydropower, wind power, and even geothermal energy, which are less expensive and easier to set up. However, while these are certainly safer and better options, they require far more land than nuclear energy, and some require very specific topographical features to be present, such as large water sources or natural hot springs. Currently, infrastructure and investment in these methods is limited

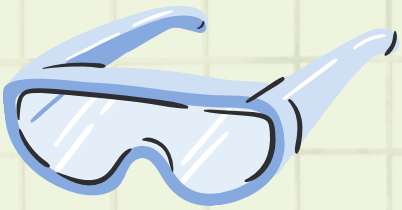
While it is true that nuclear plants take decades to create and billions of dollars to fund, there is much progress being made towards more cost effective nuclear energy. One such way is to streamline the process of building parts with newer technologies, like assembly drones and 3D printing. Yet another, better option, is to use infrastructure that we already have. More and more US coal-fired power plants are being decommissioned in response to the aging of the US coal industry and increased maintenance prices in the face of better energy options.

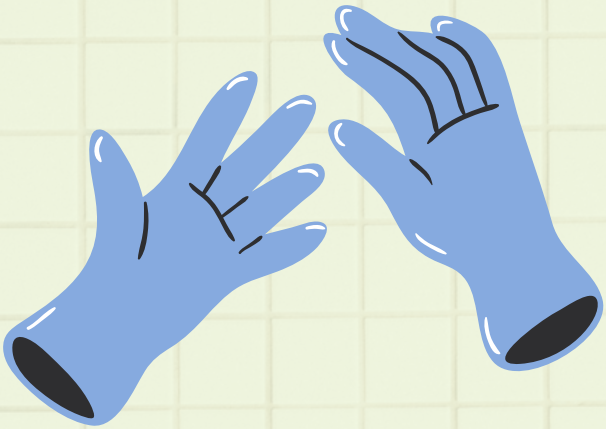
Between 2023 and 2030, the US is preparing to close 173 currently operational coal plants. These closures are perfect for the nuclear industry, which can repurpose the old facilities into nuclear power plants at lower costs than simply building new ones. Terrapower, a Bill Gates-backed nuclear startup, is partnering with the utilities company PacifiCorp to begin designing and installing a Natrium nuclear reactor in Kemmerer, Wyoming. Terrapower's Natrium reactor is an "advanced" nuclear reactor design called a Sodium Fast Reactor.



It's much smaller, at roughly a third of the normal size, and uses liquid sodium as a coolant, which can operate under higher temperatures and lower pressures than water. While typical nuclear reactors take 6-8 years and $6 - $9 billion dollars to build, the Natrium reactor is projected to have a $4 billion dollar cost, and plans are in place to construct it at the decommissioned Kemmerer coal plant between 2024 and 2028.

As with all emerging technologies, nuclear energy has its issues. While it has become much safer and more efficient in recent decades, high costs and construction times cause it to lag behind competing renewable energy sources. However, converting coal-fired power stations into nuclear energy plants serves the dual purpose of decreasing non-renewable energy production and lowering the costs of building safe nuclear reactors. Converting our remaining coal plants to nuclear will prevent untold amounts of emissions, finding an environmentally friendly use for a dying industry that has done nothing but hurt our planet.





Carbon Sequestration

By Alison Chiu

One of the biggest problems the world faces today is the unprecedented, escalating issue of climate change and global warming caused by the excess greenhouse gasses in our environment. One of the most potent greenhouse gasses is carbon dioxide, which is released from a variety of anthropogenic sources.

The effects of climate change have resulted in a 1.5 degree increase in the global average temperature, putting many biological and ecological processes at risk. Fortunately, there are ways to combat this. Decreasing the amount of carbon dioxide in the air is one of the most common and well-known solutions to better regulate global temperature.

One promising way to remove carbon dioxide from the atmosphere is carbon sequestration, or the "the process of capturing and storing atmospheric carbon dioxide," according to the United States Geological Survey. The two main types of carbon sequestration are **geological** and **biological**.

The first main type of carbon sequestration is geological; in other words, it is the process of storing carbon dioxide in "underground geologic formations." This can be done by pressurizing carbon dioxide and injecting it into rock foundations, replicating similar natural geological processes. Similarly, the way that fossil fuels are created is through the pressurization and accumulation of fossil fuels in rock, but it can take the natural process thousands of years to store carbon (certainly not at the urgency that is needed currently).

Carbon sequestration can also be biological. Biological sequestration is the "storage of atmospheric carbon in vegetation, soils, woody products, and aquatic environments," which can occur with encouraged plant growth due to the biological process of photosynthesis. Photosynthesis allows for plants to take in CO2 from the atmosphere, use it to make energy, and release O2 into the atmosphere. Yet, despite its benefits, humans have historically and continuously damaged the process of biological carbon sequestration with photosynthesis through deforestation and other over-harvesting practices, ultimately harming the plants that are helping protect the longevity of our planet.

Human efforts at carbon sequestration can fall within a range of different processes such as using different gasses, planting different plants, and exploring new ways to expedite the natural cycles. However, there are still many associated risks that need to be explored before the full implementation of any solution to the problem of excess CO2. The economics of any solution also has the power to completely change the feasibility of its implementation as well as the "utilization of other energy-related gasses such as helium, which can make otherwise un-economic natural gas deposits a viable part of the national natural gas resource base," according to the United States Geologic Survey.

Ultimately, carbon sequestration is one of the most important methods we have to fight the prevalent disaster of climate change. If we wish to slow it down, it is crucial that we find cheaper and more efficient solutions to speed up geological and biological processes.

The Brentwood Windmills

By Carmen Corona
Art By Hritika Trivedi

What type of energy is your stove powered by? Is it fossil fuels, solar energy, or water? Or could it be a clean form of energy from the very air we breathe? As we learn more about fossil fuels and their harmful effects on our environment, scientists and engineers have begun working hard to find efficient forms of renewable energy, one being wind power. Similar to how the blades of fans are powered by electricity, the blades of wind turbines, powered by the rush of wind, turn to create energy. This kinetic energy is channeled into a generator, producing electricity which goes on to power entire cities. Approximately 7.2% of the power in California is sourced from wind energy, and that number grows each year.

One of the largest wind farms in California, a collection of many wind-capturing turbines in one area, is right here in Contra Costa County. Known as the Vasco Wind Energy Center in Livermore, California, the farm can be spotted when driving off of I-580, where 34 massive 430-foot windmills cover a 50,000-acre field. The wind farm was once the property of cattle ranchers until 780 small windmills were built there in the 1970s. Over time, improvements have been made, and today, one windmill at the Vasco Wind Energy Center can power 600-700 homes per turbine and at least 19,500 houses each year.

With new developing technology and improvements made on wind farms, questions have been raised about the advantages and disadvantages of this energy source. As a form of green energy, windmills use no fossil fuels and don't produce greenhouse gasses. So far, wind turbines globally have

prevented 329 million metric tons of carbon dioxide from entering our atmosphere, equaling the emissions of 71 million gas-powered cars every year. Wind power has also provided 100,000 new jobs for Americans, making it a profitable, supportive market for the U.S.

Some people argue that wind farms aren't aesthetically pleasing, make too much noise, or are detrimental to the ecosystems surrounding them. Many bats and birds have fallen victim to the spinning blades of wind turbines, raising concerns about the deadly effects these farms could have for certain airborne species. With population numbers dropping due to these deaths, scientists have begun researching innovative ways to prevent turbines from damaging living animals. NextEra, the company responsible for half of the Brentwood wind farm, has a solution for this. For every new windmill built, 23 old ones are taken down. By reducing the hundreds of windmills that hurt these animals to a smaller number, the chances of these animals getting caught in the blades has decreased.

As the damage to our Earth grows, the need for green energy in America has increased, and the pace of technological innovation has developed along with it. We've come a long way since the opening of the Brentwood windmills in the 1970s, and scientists are continuing to explore ways to improve the wind farm's effectiveness. From solar power to wind power, and even water power, we are working hard to find eco-friendly energy sources that don't leave us with the same toxic byproducts of fossil fuels. With 59% of energy in California coming from sustainable sources, the importance of these types of resources continues to grow, as do scientists' efforts at exploring ways to treat our Earth better with green energy – and the Brentwood wind farm is only the beginning.

Climate Careers Chat Recap: ECOLOGY & VERTICAL FARMING

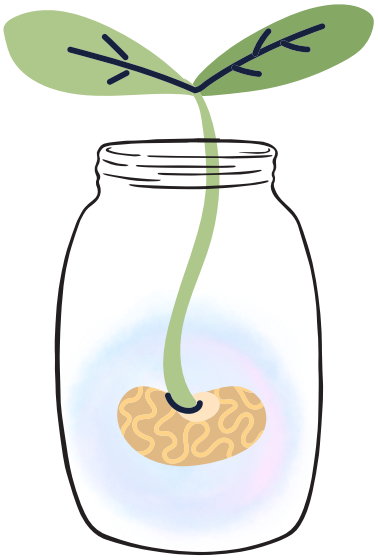
By Nina Damiano

Ecology and its subfield, vertical farming, is key to today's understanding of the environment and its applications. In September, SLIA hosted a Climate Careers Chat discussing just this. The digital chat featured two experts: Rebecca Nelson, a graduate student at UC Davis studying ecology, and Jim Pantaleo, a business coordinator in the vertical farming industry. Here's a recap of the conversation about their education and career pathways as well as their advice for anyone looking to learn more about these fields!

Rebecca Nelson on Ecology

What is ecology?

Ecology is a branch of biology that studies the relationship between organisms and their environment.



Rebecca Nelson started her journey in ecology just out of high school as an undergraduate at Stanford University, where she got a Bachelor's degree in Biology before moving on to University of California, Davis, to get a Masters degree in Ecology. Currently, she is a PhD candidate in ecology doing lab work at UC Davis. In her work there, Rebecca combines fieldwork with data collection to research how climate change's impacts to the environment affect the relationship between the plants and pollinators of California grasslands. Her goal is to inform climate-resilient ecological restoration and pollinator conservation and she has spread her influence on these issues outside the lab as a board member for Northern California Botanists and chair of the California Invasive Plant Council Student Section working with other environmental NGOs!

Jim Pantaleo on Vertical Farming

Jim Pantaleo's career in vertical farming wasn't clear from the beginning- he originally got a degree in International Relations before spending 20 years in the technology industry. Deciding that this path wasn't right for him, he switched his career track to become a pioneer in indoor vertical farming for food production, landing a job at the landmark indoor vertical farm company, Urban Produce- Southern California's first large-scale indoor vertical farm. He later worked at Oasis Biotech, an advanced indoor vertical farm in Las Vegas, engaging them with universities and the government as well as helping with seed trials (tests on seeds that would be used in vertical farms). Like Rebecca, he eventually ended up in UC Davis, where he is currently the Business Development Coordinator at the Artificial Intelligence Institute for Next Generation Food Systems.

What is vertical farming?

Vertical farming is the practice of growing crops in layers stacked vertically. Usually, variables such as temperature, growth medium, and light are controlled in order to fully maximize plant growth.

Oasis Biotech

Urban Produce

Clean Energy Trivia

How much do you really know about clean energy? Test your knowledge!
(answers at the bottom of the page)

1. **WHAT IS THE #1 MOST USED RENEWABLE ENERGY SOURCE IN THE UNITED STATES?**

2. **WHAT PERCENTAGE OF GLOBAL ENERGY COMES FROM RENEWABLE SOURCES?**

3. **WHAT TYPE OF RENEWABLE ENERGY SOURCE GETS ENERGY FROM EARTH'S CRUST?**

4. **IN HYDRO POWER, WHAT IS SPUN TO GENERATE ELECTRICITY?**

5. **WHICH COUNTRY HAS THE GREATEST SHARE OF NUCLEAR POWER IN TOTAL ELECTRICITY GENERATION OF ANY COUNTRY WORLDWIDE?**

6. **WHAT WAS THE FIRST RENEWABLE ENERGY SOURCE TO BE INVENTED?**

ANSWERS

1. WIND POWER
2. 29%
3. GEOTHERMAL
4. A TURBINE
5. FRANCE
6. HYDROPOWER- IN WATERWHEELS!

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SUSTAINABLE LEADERS IN ACTION