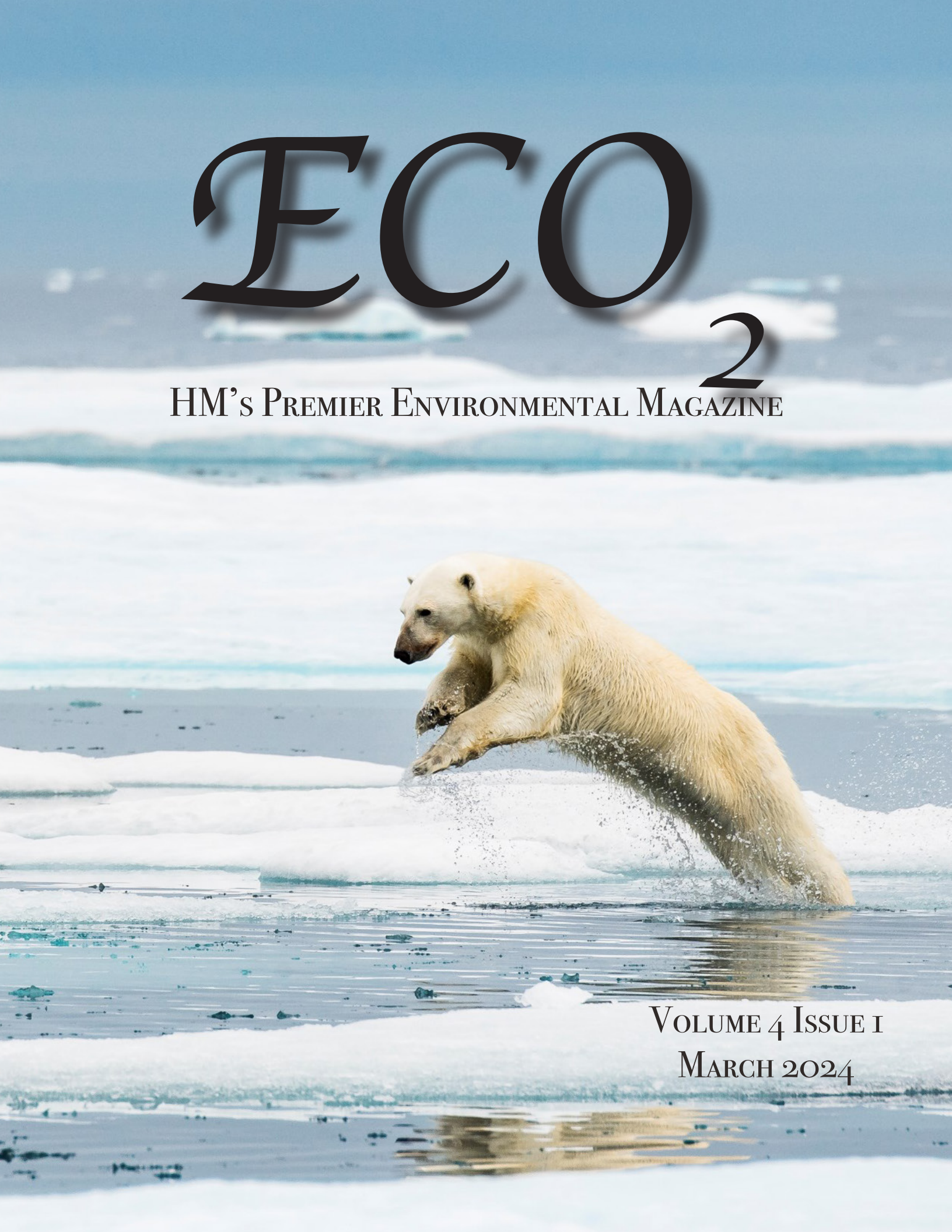
ECO 2

HM's Premier Environmental Magazine



Volume 4 Issue 1
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Letter From the Editors

Dear Readers,

Welcome to Volume 4 Issue 1 of ECO_2!

This issue tackles controversial issues, such as the dark side of carbon sequestration and the environmental impacts of fast fashion. This edition of ECO_2 also pays homage to the woman who discovered the "greenhouse effect."

We want to thank all of the contributing authors, editors, our design editor, David, and Dr. Reesbeck for their tireless efforts. None of this could have been possible without all of you. We are confident that you will find the entire magazine to be topical and thought provoking. We hope you enjoy!!

Sustainably yours,
Ava Lipsky and Tyler Rosenberg

Editorial Board

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The Environmental Cost of Fast Fashion

Jacqueline Shih

H&M, Zara, Urban Outfitters, Brandy Melville, Princess Polly, Edikted, and Garage are among the most popular clothing brands in our HM community. Ever wonder why these brands can produce such cute, trendy clothes for a shockingly cheap price? Seems like a steal! What these brands have in common is their unsustainable but highly profitable fast fashion model that allows for their unescapable advertisement, popularity, and revenue generated.

Fast fashion can be defined as a business model that combines three elements, these include: quick response, frequent assortment changes, and fashionable designs at affordable prices. The fast fashion business model allows for quick turnover, high volume, and cheap prices which is extremely attractive for investors and companies. Looking from an operations standpoint, fast fashion requires a responsive supply chain that is capable of supporting a product assortment that is constantly changing. Currently, trends recycle as new seasons, new styles pass. Consumers often buy more cheap clothing and continue to throw away these items when time passes. In fact, these habits that are a result of fast fashion have led to pollution, waste and emissions that fuel the triple planetary crisis: climate, nature and pollution. In fact, the annual Black Friday sales stands as a reminder of the repercussions of fast fashion. We must rethink what is bought, what is thrown away and what it costs the planet. The main issue is the lack of transparency from large clothing brands and education on the impact of our actions.

Most consumers are not aware of the cause and effect of their seemingly smart buys. Consumers have a significant role to play in which companies/brands they choose to support. These individual decisions ultimatley do make a difference in mitigating the effects of fast fashion.

What exactly is the impact of fast fashion? According to the UN environment programme, the the Ellen Macarthur Foundation, a UNEP partner, has estimated that "a truckload of abandoned textiles is dumped in landfill or incinerated every second." At the same time, it is estimated that people are buying 60 percent more clothes and wearing them for half as long. The pollution produced by the fast fashion industry results in devastating impacts in both terrestrial and aquatic environments. Examples include habitat degradation, proliferation of chemicals and microplastics in bodies of water, and the increasing impact of climate change from anthropogenic greenhouse gasses from fast fashion factories. Further, fast fashion causes rivers and streams to become polluted. While 85% of all textiles go to dumps each year, even washing clothes releases a whopping 500,000 tons of microfibers into the ocean each year, in perspective it is the equivalent to 50 billion plastic bottles dumped into the ocean.

The solution to this problem is firstly education and transparency on fast fashion companies but most importantly a circular economy for textiles. Sustainable fashion and the recycling in the textile value chain is very feasible, yet consumers around the world are attracted to fast fashion brands because of their alluring price. "[Companies] want resilient garments from a sustainable industry, a goal supported by the UN Alliance for Sustainable Fashion.", as stated on the UN Environmental programme. One prominent example of how the garment industry can embrace the principles of a circular economy is the US outdoor clothing brand Patagonia. Patagonia earlier announced this year that they would transform into a charitable trust with all profits from its US $1.5 billion in annual sales going towards climate change, this would make the planet its only shareholder. There are many others in the industry also making important changes.

How the Melting Ice is Affecting Wildlife in the Artic

Robbie Lipsky

Global warming is causing animals that rely on sea ice to survive, such as polar bears, narwhals and walrus, to be at risk of starvation and habitat loss. Warming temperatures in the Arctic is causing decreases in sea ice length and thickness as well as higher ocean temperatures, stronger winds and currents, and shoreline erosion around the Arctic" (MMC). Changes to sea ice can have a negative impact on the Arctic ecosystem as well as the entire planet.

Rising ocean temperatures are causing many animals, whose bodies are built for icy waters, to change their behavior and trajectory, in attempts of finding colder water. This will affect other animals such as humpback, fin, and gray whales, which travel to the Arctic from warmer temperatures to feed during the summer. The melting of ice, also causes many birds and mammals that rely on the ice to slowly lose their homes and decrease chances at survival. According to scientists, by 2100 polar bears could be at risk of extinction due to starvation and reproductive failure. This is because the polar bear relies on the ice to hunt for its prey, rest, and overall survival. Since the ice is melting at a faster rate, polar bears have been forced to move around a lot more than they are accustomed to, which leads to poor health conditions and lower reproduction rates.

As the ice disappears and the polar bears environment is destroyed, they have been forced to leave the Arctic to find new land to live in. This is putting both humans and bears at risk, since the polar bears are moving into human inhabited areas in search of more resources.

The change in polar bears' lifestyle also affects food webs. Foods webs will have many different predators, large differences in prey population, and new species (MMC). Distruptions in food webs can lead to significant changes in natural ecosystems. Studies show that harmful algae blooms are getting closer to the north as more ice sinks. The chemicals within the algae have been found in walruses and other arctic animals. The ice melting also provides humans with more open water to conduct shipping, tourism, commercial fishing, oil and gas exploration and development. Vessel strikes, pollution, fishing nets or lines, and exposure to human-caused sound and other disturbances are some of new threats to arctic animals (MMC).

If the ice in the arctic continues melting, it could cause many problems for humans and animals in the future. Many scientist believe that we could see our first ice-less winter in 2030. Climate change induced problems must be prevented in order to preserve both human and animal health and survival.

AI Role in Climate Change

Anusha Kumar

Machine learning. Quantum computing. ChatGPT. We all have heard about these AI platforms and they clearly have so much potential. All the way from school essays to healthcare problems to encryption, AI will soon be the "new Google". Right now, AI is in a relatively primitive phase. While it is impressive that you can ask any question to ChatGPT and it will spit out an answer, AI can be used for so much more than that. Far in the future, things like AI, machine learning, and quantum computing can be used for global issues, such as vaccine development, encryption, security, and even solving problems, such as New York traffic and space travel, as well as even larger problems like climate change. I'm sure you know where I'm going with this. What is AI's role in solving the climate crisis?

There are a number of ways that AI can be utilized to help the climate crisis. To address them, first I am going to break climate change down. There are many causes of climate change, even more effects, and even more aspects that we need to consider when even thinking about solving it. Let's start with the causes.

The main contributor to climate change is carbon emissions. We can break the emissions down into two main parts: inherent and human-caused. Yes, arguably, all emissions that are contributing to climate change are human-caused, but I'm going to redefine the words "inherent" and "human-caused". When I say "inherent" I mean chemical or natural processes, such as creating cement: emissions that cannot be avoided because we don't have the innovation to do it a different way. When I say "human-caused" I am talking about things like cars, factories, manufacturing, electricity; most of these things have a greener alternative - even if they aren't as efficient or economical - the necessary technologies to replace them do exist. How can AI help?

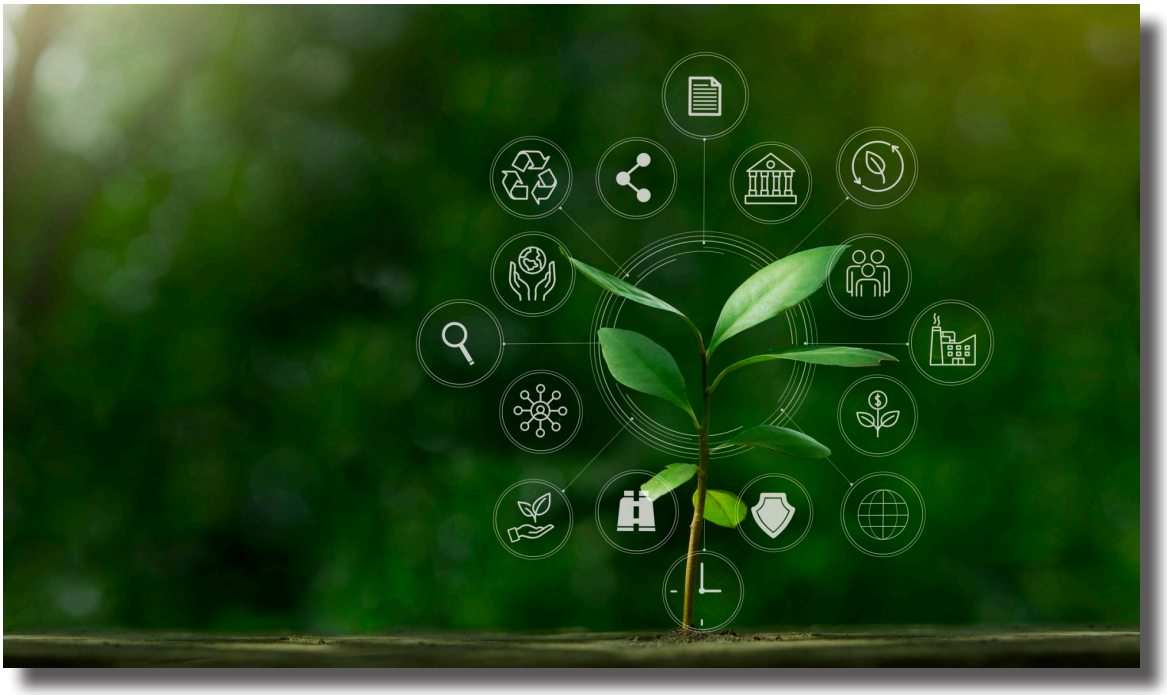
Let's start with the inherent emissions. Some examples of inherent emissions are cement production and synthetic fertilizer. In cement production, the inherent emissions come from burning limestone, which results in necessary calcium for cement and a byproduct, carbon dioxide. As of now, there is not another way to make cement that avoids this problematic chemical reaction. The second example that I mentioned was synthetic fertilizer. Synthetic fertilizer is fertilizer that was manufactured in a factory. Synthetic fertilizer is abundant in nitrogen, and it is atrocious for the environment for this reason. Nitrogen is necessary for plants, however, less than half of the nitrogen applied to farm fields is actually used by the plant. The remaining nitrogen pollutes water or, more importantly, air. It enters the atmosphere in the form of nitrous oxide; a greenhouse gas that has 265 times the global warming potential of CO_2 and is significantly more detrimental to the environment. In a nutshell, synthetic fertilizer is terrible for the environment. There is no practical way to make cement or synthetic fertilizer greener for a few reasons. First, the heat, electricity, and gasoline used in the production and transportation cannot be replaced with their zero-carbon alternative because it would be so expensive to a point of impracticality. In terms of the actual chemical processes and the inherent emissions, as of now, we do not have alternative methods that are less harmful for the environment. We have one way to do these things, and that way inherently produces greenhouse gasses. We don't have a greener way because that would take years of trial and error and large sums of money – money that people don't want to spend because the current methods work so well. This is where AI comes in, specifically, quantum computing. Quantum computers work in a way that let them explore many, many possibilities at once. You can see where I'm going with this. In the future, once it is developed, quantum computing can explore the different possibilities and ultimately come out with methods to make cement and fertilizer which are economical and don't harm the environment. It sounds wishful, but this is what quantum computing promises to do. Therefore, while it seems bleak, there is hope for finding ways to eradicate our inherent emissions.

So, let's look at the human-caused problems. Like I said, human caused emissions consist of things that can be

avoided, such as cars, factories, electricity, and consumerism. Overall, we have a lot of innovation in these areas. For instance, there are numerous forms of clean electricity, electric cars, and electric water heaters and furnaces. All of these things exist, they just need to be affordable, efficient, and scalable. Some of our current technologies check one or two of these boxes, but they need to check all three. In these situations, in which we have the innovation and green alternatives we need, there isn't much that AI can do. Some of the solutions for problems with scaling new technologies would require illogical steps, such as extremely high taxes, reducing social service investments, like healthcare, and heavy, unfair regulations on the private sector. In these situations, it is up to us to adopt these technologies and place reasonable, yet stern laws in place that allow these technologies to become cheaper and more widely available. Many of the innovations that we already have can be scalable, if we do the right things in terms of the government, and private and public sectors, but those steps require human action, not AI insights. AI can tell us what to do, it can give us new technology, it can lay out a perfect step-by-step plan, but ultimately we have to be the ones to execute it.

Now let's look at the effects. AI can help here. Climate change is going to cause dislocation, harsher, unpredictable weather conditions, increased drought, warmer temperatures and much more. Then, these initial effects cause a number of other things including loss of biodiversity, exacerbation of poverty and hunger, insect outbreaks, colder temperatures, and rising sea levels. AI can solve these issues in a number of ways. Recognizing weather patterns can help give early storm warnings and decrease human casualties. Organizing efficient methods of relocation and protection can help solve for a soon overwhelming number of climate refugees. Finding ways to protect crops from insects, floods, droughts, and heat is a way to prevent the exacerbation and cause of a new hunger crisis. These sound ambitious, but they are very real and probable things that can happen at a fast rate with the help of AI.

AI is very promising when it comes to the inherent emissions and effects of climate change, and in the future, it might even be able to solve some of the human-caused emissions. AI can help so many people who will suffer from the effects of climate change. Not now, but soon, AI, piece by piece, can help us solve the climate crisis. Of course, this promise is not one that means we can continue our daily lives and wait for AI to save the day. We must still continue and enlarge all our efforts to solve the climate crisis because while AI can give us solutions, it is ultimately up to us to carry them out. In the future, developed AI can pave the road for us. But it's up to us to make it to the end.



Flesh and Brain-Eating Pathogrens on the Rise due to Climate Change

Ava Lipsky

Deadly flesh and brain-eating pathogens are on rise due to climate change. While these cases are rare, they are becoming more common each year as temperatures continue to increase. The two main pathogens causing this harm are Vibrio vulnificus and Naegleria fowleri.

Vibrio vulnificus is a flesh-eating bacteria from the same family as the bacteria that causes cholera. It is found in warm, brackish, or salty water around the world. In the United States, it can be found in the Gulf of Mexico and East and West Coasts. Vibrio vulnificus can be contracted by eating contaminated seafood or coming into contact with bacteria-infested water (CNN). Cases of Vibrio vulnificus are rare and sometimes deadly with a mortality rate of 18% (InsideClimate News). It causes a flesh-eating infection called necrotizing fasciitis that eats away at the skin, muscles, nerves, fat and blood vessels by the infected area. Mild cases can cause symptoms such as chills, fever, diarrhea, stomach pain and vomiting, with these symptoms visible during the first day of exposure. Each year, it is estimated that Vibrio vulnificus causes 80,000 illnesses and 100 deaths. This number is growing. In 2022, Florida had 64 Vibrio vulnificus infections and 13 deaths while in 2021, there were only 34 cases and 10 deaths. The last time Vibrio vulnificus cases rose above 50 was in 2008. Vibrio vulnificus infections are treatable with antibiotics if treatment is taken immediately, however, surgery or amputation of the affected area is sometimes necessary to stop its spread (CNN).

Naegleria fowleri is an even deadlier pathogen. This amoeba lives in warm bodies of fresh water like lakes, rivers, and hot springs all around the world. A person will be infected by this pathogen if water containing Naegleria fowleri enters the body through the nose. This is why most people contract the amoeba while swimming. From the nose, the amoeba makes its way to the brain. Naegleria fowleri causes primary amebic meningoencephalitis (PAM) -- an infection that destroys brain tissue (CDC). PAM is usually fatal with a mortality rate over 97% (CBC). As of 2021, of the 154 PAM victims known in the U.S., only four survived. PAM symptoms typically start five days after infection and can include headache, fever, nausea, vomiting, seizures, or coma. Victims typically die in less than a week. Few treatment options are available for PAM due to its infrequent but rapid infections. Different drug combinations usually involving amphotericin B, azithromycin, fluconazole, rifampin, miltefosine, and dexamethasone have been used for treatment, but they are not always effective. Fortunately, Naegleria fowleri infections are uncommon with only 31 cases diagnosed from 2012 to 2021 in the U.S. (CDC).

However, scientists fear that, with climate change, Vibrio vulnificus and Naegleria fowleri infections will become more common. Vibrio vulnificus prefers water temperatures above 64.4 degrees and thrives in warmer months when ocean temperatures are higher (USA Today). Studies found that the uptick in Vibrio vulnificus cases in recent years are due to the warming waters. The bacteria has been moving up the East Coast at a rate of approximately thirty miles each year (USA Today). In 2018, Vibrio vulnificus cases in the northeast were eight times greater than in 1988 since northern waters that were previously too cold to support the bacteria got warmer (InsideClimate News). While previous cases typically occurred from Texas to Florida, new cases have been seen as far up as Massachussettes. If the waters continue to warm in the next few decades, Vibrio vulnificus could possibly double its infection rate (USA Today).

Naegleria fowleri also proliferates in warmer waters and is more common during warmer months of the year. The amoeba functions optimally at high temperatures up to 115 °F and can survive at even higher temperatures. In lakes that caused PAM cases, the temperatures were higher than 80 °F. Geographical expansion of this pathogen also occurred with more cases seen in northern states such as Nebraska, Iowa, Minnesota, Indiana, Maryland, and northern California.

As climate change accelerates higher water temperatures and heat waves, there is a greater risk of contracting Vibrio vulnificus or Naegleria fowleri infections (CDC). Both pathogens thrive in warm water. As climate change worsens, water temperatures will increase, providing the optimal living conditions for these pathogens. Preventing climate change is the only solution to slowing their spread. Stopping global warming will prevent salinity and water temperatures from increasing (InsideClimate News). Also, methods like electrolyzed oxidizing (EO) water treatment can help prevent these pathogens from contaminating bodies of water. While these pathogenic infections are rare, it is important to curb climate change to prevent future risks of infection.

The Woman Who Actually Discovered the Greenhouse Effect, Yet Never Got the Credit

Anusha Kumar

We spend a lot of time talking about the present and the future, whether that's at school, at work, in the stock market, or even when talking about the climate crisis. I am going to take you on a quick trip to the past and focus on who is to be credited for discovering the Greenhouse Effect. The Greenhouse Effect is the phenomena where greenhouse gasses, like CO_2 get trapped in the atmosphere, then heated, warming the Earth.

John Tyndall was an Irish physicist in the 19th century who did a variety of research and scientific work. He developed the first double beam spectrometer, he ultimately explained why the sky is blue (through something now known as the Tyndall Effect), he invented an efficient method to destroy bacteria in food, called Tyndallisation, and disproved the idea that life could be spontaneously generated. Tyndall was all over the place in the world of science, but one of the most notable things he did was, supposedly, discovering what is known today as the greenhouse effect.

Tyndall showed that gasses, such as CO_2 and water vapor have a high global warming potential - the ability to heat the Earth - and absorb and radiate heat. His experiment had a copper cube with boiling water inside radiate heat and testing the effects on the different gasses. As a result of his experiment, he concluded that without water vapor, the Earth would be a freezing cold icebox. Ultimately, he is commonly credited towards discovering the greenhouse effect.

However, 5 years before, in 1856, a woman named Eunice Newton Foote discovered the greenhouse effect, yet she is rarely credited for it. Foote's experiment consisted of two glass cylinders, two thermometers, and an air pump. She filled one cylinder with CO_2 and one with air and set them both out in the Sun. She quickly realized that the cylinder filled with CO_2 heated much faster and took much longer to cool than the cylinder with air. She performed her experiment on numerous gasses and concluded that carbon dioxide got the hottest and took the longest to cool.

She concluded that an atmosphere full of CO_2 would lead to drastic increases in Earth's temperature, making her paper and experiment the first scientific research done on the greenhouse effect and global warming. However, her findings were cast aside until the 21st century, while John Tyndall was credited for his discovery and labeled a founding father of science.

There is a lot of debate over whether or not Tyndall actually stole Foote's research, however, it is worth noting that a research paper of his, on animal color blindness, was published in the same publication as her research on the greenhouse effect. There is no mention of her in his work.

Regardless, Foote's discoveries undoubtedly came first, and her credit certainly came last. Ray Sorenson, an amateur historian, came across Foote's work in 2010 and had the findings republished. In 2019, the University of California set up an exhibition about Eunice Foote's work, giving her the recognition she deserved.

So, an American scientist in 1856, was the first discoverer of the greenhouse effect. Not an Irish physicist named John Tyndall, but an overlooked, undercredited, brilliant scientist named Eunice Newton Foote. Although it may seem unimportant to know about the past, as we live in the present and look to the future, it is crucial to understand and credit the people who have dedicated their lives to researching something that has shaped history. We should recognize that not everyone is honest and that we often learn only what people want us to learn.

A Not-So-Perfect Storm: Extreme Weather and Climate Change

Bethany Jarrett

On every news site, it's plastered across the front page: "New hurricane/thunderstorm/tsunami/blizzard ravages another city!". Extreme weather events have occurred more frequently and ferociously over the past few years to an unparalleled extent. However, among all the unpredictable aspects of these natural disasters, one consensus has become clear - their increasing magnitudes are anything but natural. Carbon emissions caused by human activity are directly responsible for the worsening weather conditions we are seeing. As atmospheric pollution skyrockets, so will these dangerous manifestations of what happens when we disrupt the natural processes of our Earth.

Increased carbon dioxide (CO_2) emissions are proven to lead to rising global temperatures (Fecht, 2021). When CO_2 is released into the atmosphere, plants absorb it and use it for photosynthesis. However, when the amount of carbon dioxide present in the atmosphere is greater than what the plant populations in an area can process, which is now common due to the relentless burning of fossil fuels, the excess CO_2 remains in the atmosphere and bands together to do what it does best - trap heat. CO_2 molecules absorb infrared energy from the sun and reflect it back to Earth's surface, holding energy that would, in a balanced atmosphere, return to space. With the high volume of CO_2 molecules in the air today, a colossal amount of infrared energy is being confined in the atmosphere, resulting in higher temperatures around the globe.

Unprecedentedly high temperatures are known for the sticky, uncomfortable feeling they produce in the summer, but their impacts stretch far beyond sweat and sunburns. Wildfires are a direct consequence of extreme heat, which makes dry organic materials such as wood and paper more flammable and susceptible to spreading flames. California wildfires alone burned more than 4 million acres of land in 2020, marking the year with the most American wildfire destruction in history (Di Liberto, 2020; Mulkern, 2022). Furthermore, high temperatures result in heightened energy usage, due to private homes and businesses turning up the air-conditioning in

an effort to stay cool. For instance, in Texas, energy usage goes up by 1% percent for every degree when temperatures are above 24 °C (75.2°F) (Howarth et al., 2023). 75.2 °F is currently at or below the average daily high from April to October in El Paso, Texas, with average daily highs reaching 95°F in July (NOAA). 1% still may not seem like much, but in a state with upwards of 20 million residents like Texas, the proportional strain on the power grid becomes overwhelming. Especially here in the United States, where fossil fuels are our primary energy source, extreme heat creates a vicious cycle of resource depletion, energy consumption, and carbon emission that is pushing our already overloaded natural and manufactured infrastructure to its limits.

High temperatures are brutal enough as a stand-alone environmental problem, but they are also the root cause of other weather patterns that pose a substantial threat. For example, hurricanes draw their energy from warm ocean water. Thus, rising ocean temperatures due to carbon dioxide emissions are creating the perfect environment for hurricanes to proliferate and enact more damage than ever before. This is evident in hurricanes we've seen just this year - Hurricane Idalia made landfall in August 2023 and caused 2.5 billion USD worth of damage within its 13-day lifespan, destroying over 4,000 homes in just one Florida county - the total residential destruction was too much for analysts to reasonably quantify (Axelbank, 2023). Idalia also created 12 tornadoes in its wake, a reminder of the sheer power that natural disasters hold, all fueled by an unseen but mighty excess of carbon dioxide.

While the urgency and tangibility of these events are enough to spur many prior "climate-change deniers" to environmental action, the disconcerting truth remains that there is little that the average person can do to place a drain on our overflowing sink of atmospheric carbon. This responsibility lies squarely in the hands of the monopolistic corporations that consistently use the air as a dump for the toxic gasses released in their manufacturing processes, then donate to exploitative fossil fuel mining so that they can perpetuate this vicious cycle of pollution. Each day, these businesses prioritize profits over the preservation of the environment, and only legal restrictions can truly bring this behavior to an end. Until serious legislative reform is passed to limit large-scale atmospheric pollution and bolster carbon sequestration efforts, expect to see many more extreme weather events pop up across the globe, each one more exceptional than the last.

Emotions Experienced While Becoming Climate-Conscious

Gabrielle Hayden

Climate change has become a nearly inescapable topic of discussion. As a result, heightened awareness of the topic has been promoted in the media. Due to the volume of information available about climate change and the depth of the crisis, learning about it can be overwhelming. Understanding climate change takes time and can even put people through an emotional rollercoaster. Grappling with the stark reality that the environment and human safety is deteriorating with each day requires an array of emotions. As people get more aware about the climate crisis, fluctuating emotions often come hand-in-hand with it.

Apathy, the lack of interest or concern for a topic, is often the term used to describe the first stage of the emotional process associated with becoming climate-conscious; however, ignorance is the word to better describe it. The reason being, many people have heard of climate change, but have never delved into the topic with consideration making them ignorant to the gravity of the issue and also apathetic to climate activists' cause. Therefore, climate apathy is merely the result of a lack of knowledge, not intentional detachment from the problem at hand.

However, people may have understandable grounds for their hesitation to increase their awareness of the climate crisis. In a Cambridge University Press article on the emotional motivations of youth climate strike leaders, a student comments on the emotional steps concerning climate learning: "it starts with apathy because that is kind of a defence mechanism to everyone saying 'this is your burden, this is your burden' because if you thought about it too much it would be so terrifying." From this perspective, initial resistance to comprehending climate change makes sense.

However, once aware of climate change, movement beyond apathy is essential for progress. Some find themselves unable to focus on anything else. For example, youth climate-strike leaders found themselves obsessed with the subject. For others, in-depth climate awareness produces changes in attitudes.

The next stage of climate emotions is typically anxiety. Commonly referred to as climate distress or eco-anxiety, this mental affliction stems from general anxiety around the climate crisis and the looming risk of environmental disasters. Symptoms of eco-anxiety are obsessive thoughts, panic attacks, and insomnia. While some people experience climate distress at extreme levels, others have slightly elevated concerns for their well-being. From here, there are two opposing trajectories. Depending on personal traits, the path outward from eco-anxiety looks different. Those prone to paranoia and fear spiral into despair. Harboring immense fear for the future can be dependent on age and the type of information one consumes about climate change. For instance, reading only declensionist narratives about climate change, ones that heavily emphasize the impending doom of global warming, can result in greater fear than progressive narratives that provide hope for the future. Additionally, it is likely that age plays a factor in one's emergence from eco-anxiety. Young people must deal with the long-term consequences of climate change that older generations will not see. Therefore, younger age groups can feel more intense fear for the future. Others are encouraged by their heightened anxiety to act before it's too late. Based on one's inclination, to be hopeful or despairing, eco-anxiety can yield different results.

Surprisingly, anger is another very plausible response to heightened climate awareness, and it may in fact be essential to promoting action. According to two sociologists, Jochen Kleres and Åsa Wettergren, a combination of guilt, fear, hope, and anger is required for climate activism to occur. Therefore, contrary to public images, anger surrounding the climate crisis isn't reductive or immature, but rather it's critical to a progressive future. For the youth, frustration with climate change is due to intergenerational injustices that often force the burden of a brighter tomorrow on the youngest generation. This cycle of placing responsibility elsewhere angers those stuck with the problem and damages the efficacy of climate change solutions. While anger has a negative connotation, in terms of climate-consciousness, it is actually a productive form of self-expression that encourages strides in the right direction.

Fortunately, climate-conscious individuals emerge from this emotional rollercoaster with the intention of creating change. Inspired by a troubling mixture of fear, anger, guilt, and hope, action can occur. Though unpleasant, an oscillation between various emotional standings is necessary to become a productive activist.
To avoid an outright climate catastrophe, people must first be willing to become aware of the situation at hand. Instead of hiding behind a veil of ignorance, all must undergo the ups and downs of climate-related emotions. Only after this may true change take place.

The Dark Side of Carbon Capture

Anusha Kumar

Carbon Capture, Sequestration, and Removal are all vital technologies we need to utilize to achieve net-zero carbon emissions. The difference between these technologies is that removal removes carbon that has already been emitted into the atmosphere, sequestration attempts to take carbon away at its source, such as from flue stacks, and carbon capture essentially encapsulates all of these different technologies. Regardless of the use or method of carbon capture used, this carbon can have a few different destinations. It can be sold for other uses, stored underground, or used for chemical processes.

Carbon capture can be used for all these brilliant things, and it is definitely a crucial tool to get us to a sustainable world, however, it does have a dark side. Just from an environmental standpoint, carbon capture can exacerbate environmental issues of oil drilling and fracking, pose health threats to nearby communities, and worsen the climate crisis.

When fossil fuel companies drill a well and extract the resources from it, at the very end, there is still a little bit left, which they want to get. These companies purchase carbon from carbon capture companies and use this carbon dioxide to pressurize the wells, concentrating the dispersed oil, allowing them to extract it. This means of extraction allows the companies to profit more off the same oil well, encouraging them to create more wells and do the same thing, allowing them to mine more fossil fuels. In other words, fossil fuel companies are some of the biggest funders of carbon capture as it allows them to profit and make the most out of their business.

On this point, carbon capture can actually encourage fossil fuel usage and exacerbate the climate crisis. Carbon capture is what allows companies to say they are going to "net-zero"; in fact, this technology makes up the "net" part of "net-zero". It allows companies to emit CO_2 as long as they utilize carbon capture to take it out of the atmosphere. Companies, namely fossil fuel and oil companies, can and will continue to emit carbon dioxide and can still call themselves "net-zero" companies. Further, companies will hesitate to shift from fossil fuels to re-

newable sources, since it is so expensive and such a drastic change when they can continue to use non-renewable sources as long as they use carbon capture.

In addition, carbon capture technology results in more emissions than it will probably capture in its lifetime. When carbon is sequestered, the means of storing it are often unreliable. Meaning, there is a lack of viable space, unpredictable storage methods and simply because it is unlikely that the carbon dioxide will stay in the ground once it is put there, due to cracks and leaks in the rocks, making it even worse for the environment and atmosphere. In fact, Mark Jacobson, a professor at Stanford University, found that over the 20 years, carbon capture only removed 10-11% of the emissions produced. Furthermore, its practices are extremely similar to those of fracking as carbon capture requires holes being drilled into the ground for storage and large carbon pipelines to get to these holes, just like oil companies.

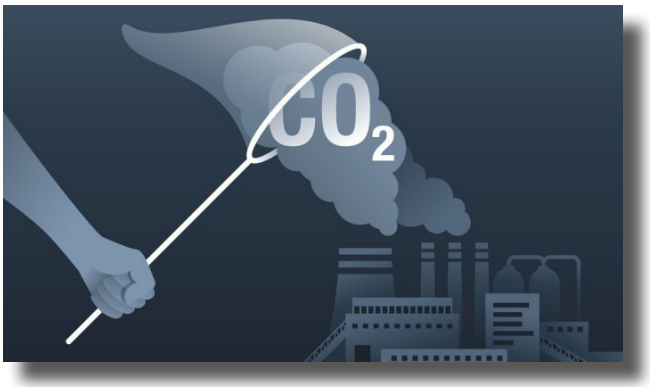
Lastly, carbon capture is bad for local communities and causes health concerns. In 1986, a lake in Cameroon released a massive bubble of CO_2, turning the lake a deep-red, forming volcanic activity and suffocating and killing around 1,800 people. These people described the aftermath as the equivalent to seeing a neutron bomb dropping. During the event, survivors could not breath, think, or even move. When introduced in small amounts, carbon dioxide is known to have hallucinogenic effects, however, at this large scale, the effects were devastating. This event proved that, similar to an oil pipeline, if a carbon pipeline leaks, it can have devastating effects on the local population and has resulted in people being hospitalized in the past.

In conclusion, carbon capture seems like a vital technology to achieve our net-zero future. However, to get there, we need to ensure a few things: it is not profiting oil companies, it is not discouraging companies to shift to renewables, and that it is securely stored and does not pose a threat to the public.

Geological vs Biological Carbon Sequestration

Kayden Hansong

In the battle against climate change, geological carbon sequestration is a new technology on the rise that can serve to aid the global pursuit of reaching net zero carbon emissions. Scientists have realized that unless we achieve net zero, the heightened surface warming caused by CO_2 is anticipated to prolong for decades to centuries. Carbon sequestration represents a headstrong strategy to combat the increasing CO_2 levels and climate change, emphasizing the need to actively extract carbon dioxide from the atmosphere. This article will delve into the basics of the short and long-term carbon cycle, analyze different types of geological carbon sequestration, and examine how they can be applied to different regions with diverse terrain.



The Earth's carbon cycle involves both a short-term cycle and a long-term cycle that operate on significantly different time scales, with most of its carbon being stored in the ground. The short-term carbon cycle involves rapid (meaning processes that range from a year to roughly ten or so years) interactions between the atmosphere, oceans, and biological carbon. This includes processes such as how plants take in atmospheric CO_2 through photosynthesis and transfer it to other living organisms. The long carbon cycle unfolds over hundreds of millions of years and involves atmospheric carbon dioxide being slowly absorbed into rocks, oceans, and sediment. These processes mainly involve transforming carbon into calcium carbonate through chemical weathering, solidification under pressure, tectonic plate movements, and eventual remelting into the Earth's magma. While short-term carbon cycles are almost impossible to use in measuring differences in atmospheric CO_2, long-term carbon cycles can show immense changes due to the sheer scale of time. The problem lies in humanity's extraction and use of fossil fuels, which has created a huge short-term CO_2 surplus well beyond the ability of the Earth to offset. This influx of atmospheric CO_2 poses a significant threat to the world we live in--whether that be contributing to increased global temperatures or ocean acidification--and we need to counteract it soon.

To combat the long-term problem of consistently high short-term carbon cycle emissions, scientists have been coming up with new technologies and ideas for a long-term solution: geological carbon sequestration. Geological carbon sequestration involves two primary methods: carbon capture and storage (CCS) and carbon dioxide removal (CDR). CCS primarily "involves capturing CO_2 from stationary emission plants, transporting it through pipelines or ships, and storing it in underground geological formations such as depleted hydrocarbon reservoirs, saline aquifers, coal seams, and unconventional shale formations" and is considered carbon-neutral (). However, the main criticism of CCS lies in the huge amount of energy required for the method to have a significant impact on CO_2 levels--and if this energy does not come from green sources, it risks further exacerbating the problem it is trying to solve. CCS can also enable coal and oil companies to continue using fossil fuels whilst simultaneously using the label "carbon neutral." CDR, on the other hand, strives to remove legacy CO_2 directly from the atmosphere and to displace it elsewhere. One of the most promising methods, in-situ sedimentary basin storage, revolves around storing and injecting carbon back into the ground. Carbon naturally mineralizes in the long-term carbon cycle, but this cycle takes over hundreds of thousands of years--this process can be significantly expedited through CDR, which companies like Carbfix in Iceland do by injecting pure liquid CO_2 into porous rocks like basalt with a caprock seal, ensuring long-term containment at a relatively low economic cost. Unlike biological carbon sequestration, which will eventually dissipate carbon stored back into the atmosphere, geological carbon storage can essentially store carbon "forever." While geological carbon storage shows a lot of promise, it still requires a substantial amount of energy to perform and, if not readily monitored, can leak and cause geological disturbances. With properly monitoring for risks and otherwise, geological carbon storage could be a promising aid in the fight against climate change.

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