FEDERAL RESERVE BANK *of* NEW YORK

Journal of Future Economists

Economics of Climate Change

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Economics of Climate Change
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2021

VOLUME 2

Contents

Students' experiences provide invaluable insight to help develop policy

As we enter our second publishing year of the Journal of Future Economists, *a variety of global issues have affected how we live and the outlook for our economic future. One of those challenges is climate change, which has fundamentally affected all our lives. As a result, policy makers are wrestling with how to best protect their communities from these challenges.*

High school students are the policy makers of the future, the ones who will influence and shape our economy decades from now. During the pandemic, students have demonstrated a remarkable ability to adapt and act in a fast-changing world. Reading this year's entries gave us reason to hope students can draw from those lived experiences to help develop policy to create a resilient and

better economy for all.

While the format of the 2022 Journal of Future Economists *is different from last year's, the purpose remains the same: To inspire students' interest in economics and amplify their voices on policy issues. This year's podcast script format allowed students to share their research in a unique way. Students were able to inject their personalities into their academic work and share it in an accessible format. We saw their originality, humor, and academic rigor displayed. We believe that students' experiences and perspectives provide unique insight into how they analyze the economy and propose solutions regarding issues that matter the most to them.*

The second volume of the Journal of Future Economists *contains fifteen student podcast scripts on the economics of climate change. The topics, which range from the coffee industry to electric vehicles to agriculture, reflect the interests of these students and demonstrate their abilities in research, evaluating data, writing, collaboration, and communicating complex topics.*

Sixty-nine school teams submitted entries, all of which demonstrated creativity and commitment. We thank everyone who participated in this year's High School Fed Challenge. The schools, student authors, and advisors are acknowledged on pages 15-23.

We want to congratulate once again these student authors and their teachers for their hard work. As you read these podcast scripts, we hope you will find them captivating and insightful.

Dear Future Economists,

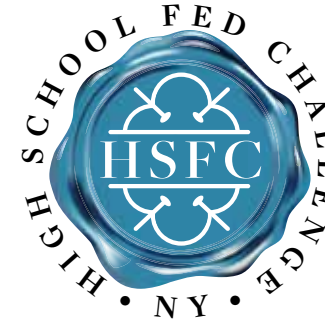
JOHN C. WILLIAMS
President and Chief Executive Officer of the Federal Reserve Bank of New York

Congratulations on your outstanding contributions to the Journal of Future Economists*! The hard work and team effort that you displayed show the talent and commitment you have to take on critical challenges facing the world today and in the future. Climate change is one issue that touches so many facets of our economy and our lives. Your work demonstrates remarkable expertise at research and analysis—one day it could inform policy, action, and change.*

Everything that you've done throughout this process is what economists should do every day. Asking questions, studying problems, and devising solutions will always be at the heart of

our profession. Economics is a challenging and rewarding field, and if you enjoy this work, I encourage you to consider it as a future career. The Federal Reserve is one of many institutions that offer fulfilling opportunities for people with your interests and skills. Wherever you land, I know you will have a successful future ahead of you, and I am excited to see what you do next.

JOHN C. WILLIAMS



congratulations!

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Simon Cvercko
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Franco Rea, *Advisor*

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Michael Kulpa
Morgan Lentino
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Samuel Gioffre
Elijah Ackerman
George Hahn
Aditya Mital
Jackson Duncan
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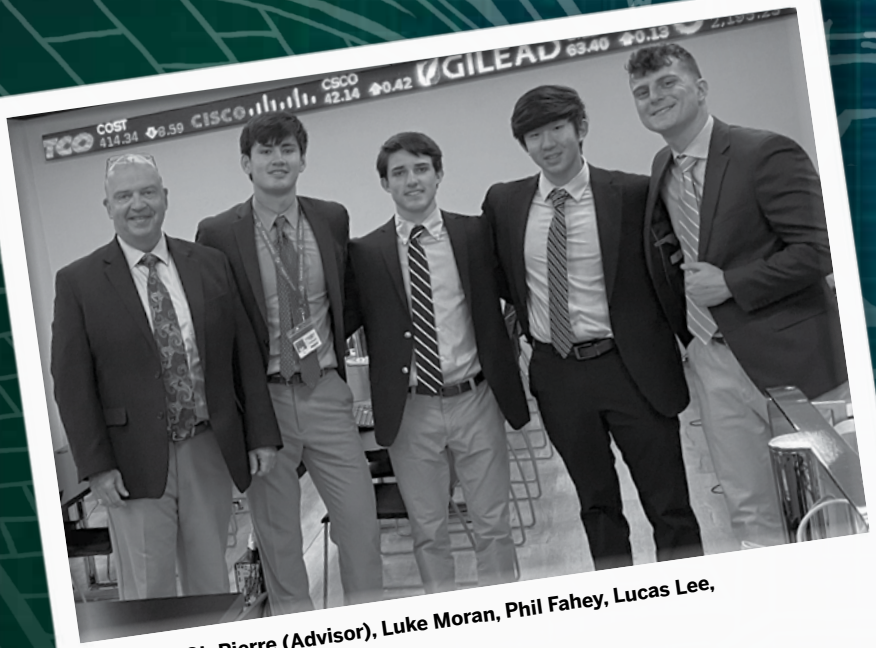
We had

69

Entries in Total!

THANK YOU TO ALL PARTICIPANTS!



L-R: Kevin St. Pierre (Advisor), Luke Moran, Phil Fahey, Lucas Lee, GianLuca Moscheni

Chaminade High School

Mineola, NY

The Drowning Effect of Climate Change: Real Estate Prices & Mortgage Volume Plummet as Sea Levels Rise

STUDENT AUTHORS

Lucas Lee
Philip Fahey
Luke Moran
GianLuca Moscheni

FACULTY ADVISOR

Mr. Kevin St. Pierre

CITATION STYLE

APA 7th Edition

HOST Good morning! Welcome to The Economics Exchange, a podcast about economics, financial literacy, and real estate. I'm your host, Thomas Cooper, and I'm really excited to dive into today's topic with you!

As we all know, climate change has a real, significant impact on economics, and so we'll be joined today by economist Alexandra Brown, who is well-known for her evaluation of trends in the markets of the Long Island/New York area, to discuss the various and nuanced economic impacts of climate change.

ECONOMIST Thanks a lot for having me, Tom. I'm really excited to dive into the topic of climate change with you. I hope that our conversation will inform your listeners as they try to understand the economic and financial consequences of climate change.

HOST Yes, I'm sure it will! Let's dive right in: Could you please describe the most significant environmental problem with major economic implications in the Long Island (LI)/New York City (NYC) area? How do these environmental problems impact the local communities of these areas?

ECONOMIST Over the past few decades, I, a Long Island resident,

have observed the general housing market transform into an unpredictable environment. Our local market has adopted a rather eccentric trend where even the slightest of factors are now reasons to decrease prices. For example, high risk assessments of homes, short sales, a decrease in demand, and even the COVID-19 pandemic could all be potential justifications for a decline in value.

Though all of these factors vary per geographic area, they also occur on the national level, allowing us economists to track the macroeconomic trends consistent to all areas of the United States. However, certain regions are uniquely impacted by specific factors; for example, LI and NYC are most significantly impacted by the climbing sea level. Here's an alarming statistic: By 2050, the sea level on the East Coast is expected to rise by 10-14 inches, per research from the National Oceanic and Atmospheric Administration (NOAA). This increase is the outcome of our current rate of high tide flooding accelerating at nearly double the rate of what it was in 2000. There are no signs of the rate contracting, and in fact, it is expected to double again by 2030 (Sweet, 2022).

These environmental changes are not a good indication for the future: I'm most anxious to see how the market will adjust itself due to the economic and physical dilemmas that rising sea tides can potentially generate.

HOST Yes, that makes a lot of sense. As a Long Island resident as well, I've witnessed these trends in specific parts of the Island, yet never fully understood their effects. It seems as though the market, as it has in the past, will have to conform to the negative nature of such supernatural events.

You mentioned your particular concern for how the housing market will adapt to sea level rise: Since disruptions in the housing market never recover consistently and since climate change is a permanent issue, how will the market fare if the trend of rising sea levels isn't any different from other historical events?

ECONOMIST The real estate market fluctuates based on factors that sustain economic impediments. Sometimes, these factors, such as location and demographics, have expected outcomes: For example, an increased number of buyers in spite of property value appreciation. However, the actual outcome has historically been the total opposite: The market reacts not just to how buyers and sellers act but also to how banks, corporations, and developers become involved in the process of purchasing homes. And that's precisely the case for the impact of

rising sea levels on coastal real estate: One would think that there is no correlation between rising sea levels and home prices because the year-to-year increase in sea levels is minimal.

However, the actual repercussions are far more substantial, as the value of homes likely to be impacted by climate change promises to depreciate considerably. As inundation, when a dry area becomes submerged under water, instills uncertainty amongst potential buyers for a coastal house, sellers will continue to face difficulty listing their properties with increased value or even their original price. Think back to the basic economic principle of Supply and Demand: As the demand for coastal houses decreases, buyers are forced to lower prices in order to sell their homes. In a recent study performed by the University of Colorado, researchers affirmed this reality, finding that homes in areas plagued with climate change-related issues sold for 7% less than comparable houses in other areas (Dehan, 2022). And this is reasonable: People don't want to move into high-risk areas where it's likely that their house will flood and sustain damage.

As the demand for these houses in high-risk areas decreases (Tyndall, 2021), fewer houses will be sold, and property taxes in these areas would also increase. Due to many families leaving the coastal areas and fewer families moving in, the tax base of coastal areas is minimizing. As a consequence of these coastal areas receiving a lesser amount of tax revenue, less funding is able to be used to support and manage community properties. Thus, property taxes for residents who are still in that region would have to increase in order to pay for these wish list items such as infrastructure (Dehan, 2022).

The market will unfortunately continue its current trend due to the effects of climate change showing no signs of slowing down, as the sea level keeps rising at an accelerating rate.

HOST Yes, it is truly a bizarre and unwanted problem that all Long Island residents may have to cope with.

In addition to those nuanced factors, you previously mentioned the effects of the rising sea levels on the value of homes and property taxes. However, whenever one thinks of the housing market, mortgages are always a particular concern for property owners and potential buyers. Has the recent rise in sea levels and projections for sea level rise in the near future affected the mortgage market at all? If so, to what extent?

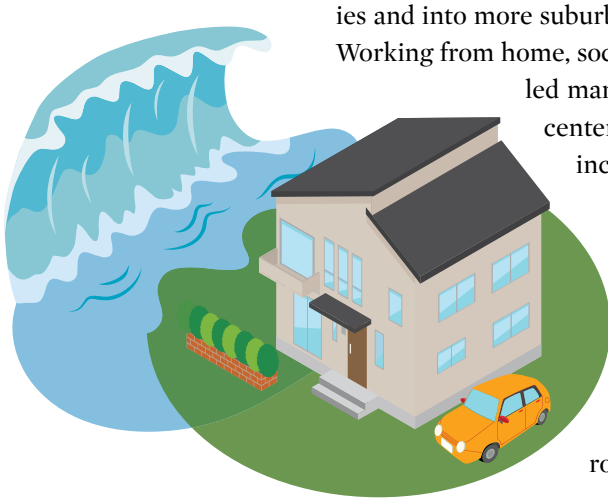
ECONOMIST The mortgage market on Long Island has seen great volatility and transformation recently. However, it is not just on Long Island that I've noticed this change: Research from leading economists

indicates that this is a much broader trend affecting coastal areas across the nation. In a recent study from the National Bureau of Economic Research, economists attributed the decrease in mortgage volume, approximately 20% as of 2020, in Florida coastal areas to uncertainty regarding future sea level rises. Homes in Federal Emergency Management Agency (FEMA) designated flood zones pose a risk to lenders, as rising sea levels generally result in a decrease in real estate value over time. It's quite ironic that the most liquid areas have seen the most illiquid mortgage markets (Keys & Mulder, 2020).

While this particular study was conducted in Florida, Long Island has its fair share of FEMA flood zones as well, and thus we project a similar effect on the mortgage market. Recent climate projections from the NOAA project a 344.44% increase by 2050 in NOAA defined "moderate" flood events for the Northeast Atlantic region, which includes Long Island (Sweet, 2022). So, we can expect to see less liquid mortgage markets on Long Island, as climate change will continue to pose a risk for lenders and be factored into mortgage prices, save any drastic climate change prevention measures.

HOST You bring up some great points. I didn't realize how flooding could so significantly affect the mortgage market.
I'm a bit confused on one of your points, though: You stated that real estate prices in coastal regions are falling due to rising sea levels; However, I've seen a significant increase in home prices on Long Island recently – why?

ECONOMIST You're right. While we've observed coastal home prices dropping, the dawn of COVID-19 in 2020 significantly skewed this trend. There has been a large migration of people out of large cities and into more suburban and rural areas throughout the pandemic. Working from home, social distancing concerns, and virtual education led many people out of New York City, once the epicenter of the virus, and into less populated areas including Long Island. With a great increase in demand understandably came a rise in home prices on Long Island. In particular, luxury real estate in coastal areas saw a surge in prices, as wealthy New Yorkers flocked to the Hamptons and other illustrious locations on Long Island's North Shore and East End (Kussin, 2020). Accordingly, as demand rose, the median home sale prices in the Hamp-



tons increased by 27.1% in 2020 according to a Douglas Elliman market report (Bourgard, 2020).

Thus, COVID-19 caused a reverse in the aforementioned trend of falling home prices, as homeowners seemingly accepted the increased risk of flooding and other climate change-caused perils to protect themselves from the virus. However, as people return to work and many move back to New York City, we expect to see prices fall in coastal areas since sea levels are projected to gradually rise and flooding to continually increase.

HOST Well, let's hope COVID won't turn the markets upside down again. In 2012, Hurricane Sandy, another unpredictable event akin to the COVID-19 pandemic, destroyed the coastal areas of Long Island, NYC, and New Jersey. What exactly happened after, and how does this event compare to the typical trend you described before?

ECONOMIST Hurricane Sandy left most of the impacted areas in devastation physically, economically, and socially. The Hurricane was truly a tragic event, as houses, businesses, and infrastructure were destroyed and economic activity was lost. For those properties that were either destroyed or severely damaged, many homeowners had to finance the requisite repairs independently, as flood insurance and other forms of home insurance covered only a portion of the damages.
According to the RAND, a research and analysis cooperation that evaluates national flood insurance, flood insurance rates rose from $3,000, the median for structures in the 2007 Flood Insurance Rate Map (FIRM), all the way to $5,600, based on the 2015 FIRM, marking an 87% increase. These increases led to around 33% of impacted households becoming income-burdened (as opposed to 25% burdened beforehand) in a time of economic crisis (Kunreuther, 2018). Such a factor, when coupled with the various additional financial strains placed on homeowners due to Hurricane Sandy such as higher local prices for gas, led to some even abandoning their homes (Hoffman & Bryan, 2013).

After Hurricane Sandy, property values in impacted areas were expected to fall anywhere from $10,000 to $100,000 if these insurance rates held. This also meant that tax revenues would decrease. The RAND suggested a decline by $22 million (Kunreuther, 2018). To reaffirm, this incidence that as property value decreases, tax revenues could decline.

By 2050, the sea level on the East Coast is expected to rise by 10-14 inches, per research from the National Oceanic and Atmospheric Administration.

The combination of these issues increased speculation amongst potential buyers of these houses near coastal bodies of water, thus decreasing the prices of those homes. Properties that were damaged saw an immediate drop in price by over 15%. In addition, properties that merely possessed a risk of being impacted by rising sea levels experienced a 7% decrease in value (Ortega and Taspinar, 2017).

To sum up, we can expect natural disasters and other negative climate-related events, such as Hurricane Sandy, to lead to increased insurance premiums and a decrease in property value, as the aggregate economy will suffer.

HOST Absolutely right. We, Long Islanders, witnessed that with our own eyes. To summarize for our listeners, though we tend to try to forget the impacts that unpredictable occurrences have on us, the events always leave overwhelming marks on the market, which can clearly be seen through the example of Hurricane Sandy.
Considering all said impacts of rising sea levels on coastal economies and their real estate markets, what should I, a Long Island homeowner, be cognizant of in the next thirty years regarding the Long Island real estate market?

ECONOMIST While I have stated that rising sea levels decrease coastal real estate prices and lower mortgage volume, it should be noted that this is not always the case. Rising sea levels and climate change as a whole generally cause market uncertainty and volatility. We can project the future of our climate, but no model can accurately predict the future of climate change. Similarly, economists certainly cannot perfectly measure the direct impact of climate change on financial markets; however, one thing is for certain: Climate change will play a lasting role in our economy and will continue to transform the way we value real estate assets. With that said, my advice to Long Island residents is to keep an eye on sea rise projections and be mindful of areas with increased risk of floods such as barrier islands.

HOST Great, I'm sure our listeners will really appreciate the advice. That is a great idea to keep in mind: Climate change causes market uncertainty. Alexandra, thank you very much for joining us. I speak on behalf of our listeners in saying that your knowledge and research was extremely informative and helpful! That is it for us today, everyone! Thank you very much for tuning in, and remember: Keep your economic standards high. You never know what the future holds!

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Back row L-R: Grace Jerred Scott, Ximena Cruz, Ata Erdal, Jasmin Garcia Nareg Kassardjian (Advisor)
Front L-R: Doa'a Khalil, Kylie Jung, Irene Raftopoulos, Chris Catalan, Candice Rowan (Advisor)

Cliffside Park High School

Cliffside Park, NJ

The True Cost of Tourism

ERDAL Hello! I'm Ata Erdal and today the students of Cliffside Park High School will focus on exploring the true cost of tourism.

Tourism is a vital source of revenue for countries' economies, allowing developing countries to better the overall living standards for their citizens and to become competitive world economies. However, tourism perpetuates the negative effects of climate change by increasing the severity of natural disasters and the deterioration of current tourist hot spots.

We've developed a clear equation here at Cliffside Park High School. It goes as follows: Tourism simultaneously increases employment and climate change, while climate change simultaneously diminishes tourism and the global economy.

In regards to the global economy, air travel is essential as it connects people around the world, increases competition amongst aviation companies, and allows tourism to be a main reason for travel. According to the Air Transport Action Group, "40% of international tourists now travel by air" (ICAO 4).

Developing countries also benefit greatly from air travel, through job creation and increased revenue sources.

Social and economic benefits aside, air travel is becoming more concerning. Studies show that "Greenhouse gas emissions from commercial flights make up around 2% of the world's total carbon emissions, and are expected to triple by 2050" (Pruitt-Young 2).

Essentially what happens is heat gets trapped in the Earth's atmosphere, causing the planet to gradually warm up over time. And, as traveling by air becomes easily accessible, tourists' utilization of air travel leads to increased global warming.

RAFTOPOULOS Some groups are protesting air travel as a whole by simply not traveling by air. I mean can we blame them?

ERDAL I'll turn it over to Irene now. She'll be going much more in

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depth about the effects of tourism and climate change on the global economy.

RAFTOPOULOS Irene here, a big part of tourism is the aesthetics and stability of each attraction's environment. Think about it, tourists travel to have fun and whether they admit it or not, take some nice pictures. If the environment isn't comfortable, it loses its appeal. As climate change harms tourism-dependent locations, the economy has been impacted as tourists travel to other destinations. Increasing temperatures have substantial effects on the environment of tourism-reliant countries. Turkey and Greece are popular summer attractions for tourists, yet as the temperature rises, heat waves have become worse and more common. Though August is the most popular month for tourism in these countries, rising temperatures have deterred visitors from visiting during this month, putting the tourism industry in these countries at risk (Agnew). To emphasize the importance of tourism in these areas, it is worthy to note that tourism accounts for 18 percent of Greece's GDP and employs nearly 900,000 people (Agnew 44). If global tem-

Tourism simultaneously increases employment and climate change, while climate change simultaneously diminishes tourism and the global economy.

perature continues to rise, it could cause a domino effect, threatening major sources of revenue for several countries. For example, tourism in the Alps brings about 50 billion euros annually, yet with the reliability of snow dropping as temperature rises, tourist attractions diminish (Elsasser 253). These effects of climate change are threatening as nearly 18.3%–20.7% of winter tourism relies on the alps, meaning losing snow equates to losing money. Doa'a, I know you've done a bit of research on that.

KHALIL Well hey I'm Doa'a and believe it or not the 2022 Winter Olympics is expected to use 100% artificial snow, which resulted in over 60 million dollars spent on snow machines (Mak 1). Hey Kylie, didn't you learn about how climate change affects businesses?

JUNG Hi, I'm Kylie Jung and that's right. Climate change does seriously affect businesses. Marine tourism is a sizable industry and if it is affected, many others are affected as well. The Caribbean Islands' tourism makes up for more than 50 percent of the Islands' GDP. Those vacation spots were then "severely damaged by Hurricane Irma, and some were completely annihilated", ("Island Communities and Coral Reefs Face Weather Events and Rising Waters in Twenty-First Century"). In a marine environment it significantly affects temperature, weather, sea levels, and water circulation.

GARCIA Hi Kylie, I'm Jasmin Garcia. I have also noticed how climate change has impacted hotel industries in Mexico! If you did not know yet, Mexico also has a travel and tourism contribution to GDP by 15.5 % which is being negatively affected by climate change (Neufeld). The hotel industry near the coastal zones is being impacted by rising sea levels, as maritime currents would behave differently, affecting the coastal areas and sand dynamics on the beach – something that is already happening in different parts of the country. (*sighs*) The impacts that climate change has on these resort-packed beaches are part of Mexico's $100 billion tourism industry!!! To put the cherry on top, according to the Sustainable Hospitality Alliance, "The consequences are an increase in water-related problems, shortages, reductions in the quality of the water supply, deterioration of the water supply, etc. These negative effects directly affect the success and sustainability of the destination" (Deya-Tortella, Garcia, Nilsson, Tirado 1). So basically, the tourism industry in these tourist destinations is suffering!

RAFTOPOULOS Another impact on the hotels' income are the attractions that surround them, one being coral reefs. Interesting fact,

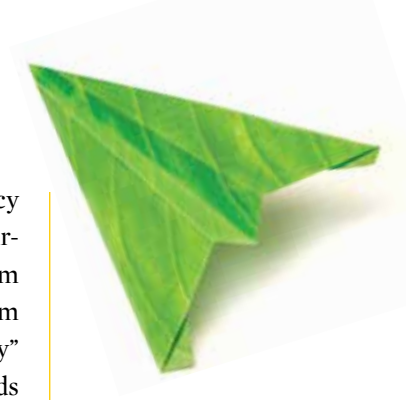
warming of the ocean causes a reaction called coral bleaching resulting in the coral turning white. As coral reefs lose their unique color, they also lose their natural attraction which draws tourists in. If it's not picture worthy, it's not worth visiting. This negatively affects profit made from coral reefs because 90% is generated from tourism. As coral reefs gain around $36 billion per year in the tourism industry, climate change impacts not only the reefs themselves but also the profit made from them (Hagen). Now Chris, I believe you know a bit about the effects of rising temperatures.

CATALAN Hello, I'm Chris Catalan. Another situation our group has noticed is with global temperatures rising, natural disasters have grown frequently over the years affecting not only major tourist destinations but local communities that rely on traveling. These drastic measures have caused irreversible changes to the tourism industry with many closing down or taking other countermeasures to combat natural disasters in their regions. My colleague, Ms. Cruz, can take it from here.

CRUZ My name is Ximena Cruz and to branch off from what Mr. Catalan said, on the surface, ecotourism appears to be a solution to the problem. By definition, ecotourism is a form of responsible travel to natural areas with the objective of studying and admiring the environment. It serves as a way to spread awareness and promote environmental education. However, ecotourism is partially dependent on climate change due to nature-based attractions. It is ironic how the countries most vulnerable to climate change are considered ecotourism hot spots. Tourism is a growing industry and overall, a very resilient factor of the economy. Furthermore, carbon emissions from the usage of transportation to get to the tourist locations are a major contributor to pollution which as a result helps increase global warming. I think my colleague, Grace Jerred Scott, has an interesting take on another aspect of this issue. Grace, do you care to elaborate?

JERRED SCOTT Yes, Ximena. Thank you. My name is Grace Jerred Scott, and I have done extensive research on the economics of "doomsday" tourism. So, the growth of ecotourism has led to another set of issues, specifically in regards to "doomsday" or "last chance" tourism.

CRUZ This new branch of the ecotourism industry promotes the "see it before it's gone" mentality by encouraging and capitalizing off of tourists' desire to see disappearing landscapes before climate change takes its toll.



JERRED SCOTT "Doomsday" tourism creates a sense of urgency to see disappearing landscapes, but neglects the importance of ensuring that these landscapes are never truly gone. This neglect stems from tourist agencies, and national and local governments profiting from worsening climate change. The economic interests in "doomsday" tourism ensure that to address climate change and to work towards limiting its impact would be to drastically reduce the amount of money governments and corporations bring in.

CRUZ Ecotourism already accounts for 7% of the global tourism industry, and the demand for ecotourism destinations is only expected to increase as urban congestion, pollution, and public concern for the environment increase as well (PRB). National governments and gateway cities see great economic and developmental benefits because of their role in Antarctic travel (Hall). The local economy of Hobart, Australia, one of only five recognized gateway cities, receives approximately $159 million each year, that's $38.4 million more than two years ago (Department of State Growth).

Ecotourism already accounts for 7% of the global tourism industry, and the demand for ecotourism destinations is only expected to increase as urban congestion, pollution, and public concern for the environment increase as well.

JERRED SCOTT Due to economic interests, national and local governments, and tourist agencies promote "last chance" tourism as a sustainable way to see the world before climate change takes its toll. Coined "greenwashing," this kind of advertising disregards the amount of carbon emissions and environmental harm that is associated with such travel, placing greater importance on sustaining tourism, rather than tourism through sustainable means (Lansing). Over to you, Ata.

ERDAL I just want to add on and conclude our thoughts. What we really have is a double-edged sword as the tourism-dependent components of the economy grow, the environments on which they rely continue to deteriorate. This essentially creates a paradox as tourism both increases economies but harms the environment, leading to long-term economic repercussions. In the long run, this shows that no amount of money is worth the damage and even to some extent, no amount of money can fix the damage already done.

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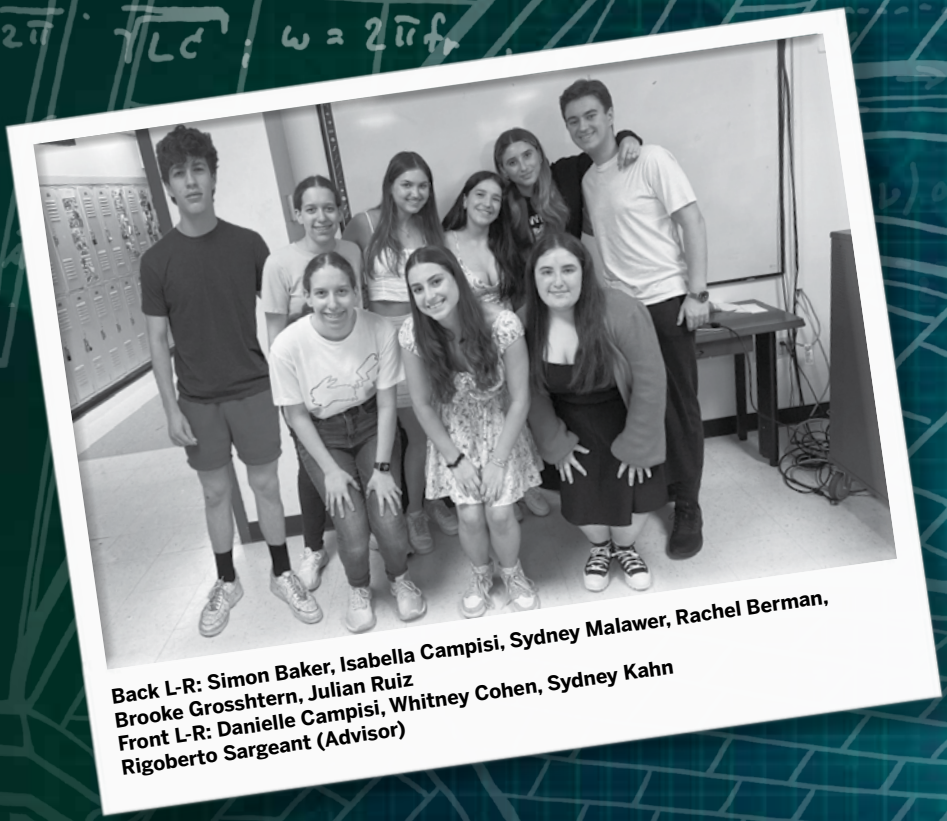

Back L-R: Simon Baker, Isabella Campisi, Sydney Malawer, Rachel Berman, Brooke Grosshtern, Julian Ruiz
Front L-R: Danielle Campisi, Whitney Cohen, Sydney Kahn
Rigoberto Sargeant (Advisor)

Eleanor Roosevelt High School

New York, NY

Eek!onomics Episode #302: The Economy Is Melting!

WHITNEY COHEN Welcome back to Eek!onomics, the economic podcast designed for teenagers, by teenagers. I'm one of your hosts, Whitney Cohen, and I'm joined by my peers Rachel Berman, Sydney Malawer, Sydney Kahn, and Simon Baker. Here at Eek!onomics, we break down complex, sometimes intimidating, concepts and developments in the world of economics in a way that is understandable to our fellow members of Gen Z. We believe that all teenagers are capable of understanding the economics that shapes our world and ultimately, our future.

RACHEL BERMAN Today's episode is titled "The Economy Is Melting!" because we will be discussing an issue that is close to many young people's hearts: climate change. We'll aim to disprove the popular myth that climate reform and economic prosperity are mutually exclusive, specifically through the lens of human health.

SYDNEY MALAWER We are joined by two renowned guests. The first of which is an esteemed American economist, professor of Economics at Yale University, and recipient of the 2018 Nobel Memorial Prize in Economic Sciences, Dr. William D. Nordhaus.

WILLIAM NORDHAUS Good evening, and thank you for having me! It's very inspiring to see young people eager to dive into the world of economics to ensure a greener future. Today I will talk about my analytical findings on the long-term impacts of climate change on the U.S. economy.

SM Thank you Dr. Nordhaus. Our second speaker is a fellow member of Gen-Z, a 19-year-old Swedish climate activist, and TIME magazine's youngest person of the year: Greta Thunberg.

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The interview portrayed in this paper is a product of the authors' imagination. While the interview may reference actual people, the subject matter and language attributed to those people is entirely fictitious.

GRETA THUNBERG Thank you for having me on your podcast! It's an honor to be able to connect with fellow young people on this platform.

WC Now Eek!onomists, let's begin, and remember: "Have no fear, Eek!onomics is here!" First, we'll talk about two major effects of climate change: rising temperatures and rising sea levels. Ms. Thunberg, can you tell us more about these two issues?

GT Of course! To begin, NASA[1] has found that the average surface temperature of the Earth has risen about 2°F (1°C) since the late 19th century. This is a direct result of human activities like burning fossil fuels and releasing chemicals into the atmosphere, which have increased carbon dioxide emissions. Additionally, extremely high-temperature events in the U.S. are on the rise and extremely low-temperature events have been on the decline since 1950. This, coupled with an increase in the number of intense rainfall events, has resulted in more natural disasters such as wildfires and floods worldwide. This warming has occurred mostly in the past 40 years, with the past 7 years being the warmest in recorded history. Much of this heat has been absorbed by the ocean. In fact, the top 100 meters of the ocean have warmed about 0.6 °F (0.33 °C) since 1969.

RB Thank you for that insight, Ms. Thunberg. As we know, rising sea levels are another major effect of climate change. Would you please elaborate on that?

GT Yes. Rising sea levels should be a huge concern. Between 1993 and 2019, Greenland lost an average of 279 billion tons of ice annually, and Antarctica lost around 148 billion tons of ice annually, resulting in a rise in the global sea level of about 8 inches (20 centimeters).[2] In the past two decades, sea levels rose twice as fast as they did in the last century.[3]

[1] "Climate Change Evidence: How Do We Know?" *NASA,* NASA, 8 Feb. 2022, climate.nasa.gov/evidence/.

[2] Velicogna, Isabella, et al. "Continuity of Ice Sheet Mass Loss in Greenland and Antarctica From the GRACE and GRACE Follow-On Missions." *Geophysical Research Letters,* vol. 47, no. 8, 2020, doi:10.1029/2020gl087291.

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SYDNEY KAHN Although we know these facts to be true, Americans are still divided in their opinions about climate change. Fortunately, most do acknowledge its negative consequences. A 2020 survey conducted at Yale University[4] showed that 72% of U.S. adults believe that climate change is a relevant issue. However, only 35% of U.S. adults think that addressing climate change would benefit the economy. Dr. Nordhaus has committed his life's work to answering this question. Let's turn to him for some clarity on this issue.

WN Unlike most other factors that impact our economy, climate change's economic impact cannot be measured quarterly. That is why I came up with the Dynamic Integrated Climate Economy Model, otherwise known as DICE, to measure the cost of climate change over time. With this model, I was able to examine various factors –such as the change in carbon dioxide concentration and global temperatures– and their effects on output, price levels, interest rates, and other economic indicators.[5] I found that as the global mean temperature increases, the damages as a percent of economic output also increase. Additionally, increasing global temperatures correlate with decreasing global GDP.[6] DICE showed that if no major actions are taken to address climate change, it would cost the world over $22 trillion.[7] I deduced that while certain climate policies – including methods to limit global temperatures and carbon emissions – are more costly in the short run, these costs would be offset by their gross benefits. Overall, I found that the cost of action towards climate change greatly outweighs the price of inaction.

SK Thanks for that, Dr. Nordhaus. Now, let's move on to our focus for today: the costs and effects of climate change on human health. We will begin by looking at asthma and other respiratory diseases. Ms. Thunberg, would you start us off?

GT Of course. A study conducted at Harvard University found that

Currently, around 5% of the U.S. population, or roughly 16 million people, is expected to experience over 100 days per year with a daily maximum temperature over 90° F (32° C).

[4] "Yale Climate Opinion Maps 2021." *Yale Program on Climate Change Communication,* 23 Feb. 2022, climatecommunication.yale.edu/visualizations-data/ycom-us/.

[5] Nordhaus, William, and Paul Sztorc. DICE 2013R: *Introduction and User's Manual.* Yale University, Oct. 2013, http://www.econ.yale.edu/~nordhaus/homepage/homepage/documents/DICE_Manual_100413r1.pdf.

[6] Nordhaus, William. "Projections and Uncertainties about Climate Change in an Era of Minimal Climate Policies." *American Economic Journal: Economic Policy,* vol. 10, no. 3, 2018, pp. 333–360., doi:10.1257/pol.20170046.

[7] Murphy, Robert P. "Rolling the DICE: William Nordhaus's Dubious Case for a Carbon Tax." The Independent Review, vol. 14, no. Fall 2009.

climate change directly worsens the existing respiratory diseases of those who are exposed and increases people's risk factors. The usage of fossil fuels produces carbon pollution such as Particulate Matter (PM), which is detrimental to human health.[8] Prolonged exposure to black carbon, a PM constituent, was found to correlate with the development of asthma in early childhood. These pollutants also increase the number of asthma attacks in those who are infected.[9]

Elevated ground-level ozone due to an increase in carbon emissions and rising temperatures leads to airway inflammation and damaged lung tissue. This is especially detrimental for those with asthma and can lead to an increase in emergency room visits and hospitalizations for those with respiratory conditions. Young children are at the highest risk of developing asthma due to increased ground-level ozone.[10]

SIMON BAKER Now that we understand how climate change exacerbates the development and severity of respiratory diseases, Dr. Nordhaus, could you explain the effects of these trends on our economy?

WN Absolutely! Cases of asthma are on the rise in this country and their economic effects are only expected to worsen. In 2018, the CDC estimated the economic burden of asthma to be over $80 billion. This number was composed of direct costs, such as medications and hospitalizations, as well as indirect costs, such as days missed from work and school. In fact, asthma is one of the leading causes of disease-related absenteeism from school. More than half of all kids with asthma have missed school for asthma-related reasons.[11]

SB Thank you for your expert insight. Now let's move on to vector-borne diseases. Ms. Thunberg, would you begin?

GT Sure. Climate change accelerates the transmission of vector-borne diseases – which are carried by mosquitoes, ticks, and other insects – for a plethora of reasons. In the case of Lyme disease, studies show

[8] "Asthma." *C-CHANGE* | Harvard T.H. Chan School of Public Health, 6 Oct. 2021, www.hsph.harvard.edu/c-change/subtopics/climate-change-and-asthma/.

[9] Rice, Mary B., et al. "Lifetime Air Pollution Exposure and Asthma in a Pediatric Birth Cohort." *Journal of Allergy and Clinical Immunology,* vol. 141, no. 5, 2018, https://doi.org/10.1016/j.jaci.2017.11.062.

[10] "AAFA." *Asthma and Allergy Foundation of America,* www.aafa.org/climate-and-health/.

[11] Inserro, Allison. "CDC Study Puts Economic Burden of Asthma at More Than $80 Billion Per Year." *AJMC,* AJMC, 30 July 2020, www.ajmc.com/view/cdc-study-puts-economic-burden-of-asthma-at-more-than-80-billion-per-year.

that its vector, ticks, thrive in at least 45°F (7°C) and 85% humidity.[12] As global temperatures rise, more ticks will be able to survive and spread Lyme disease during previously uninhabitable seasons. Lyme disease can cause a wide range of health implications, such as inflammation in the heart or nervous system and joint disease. Additionally, people who are diagnosed with Lyme disease tend to return to the doctor with persistent symptoms, in need of additional tests and treatments.[13]

A similar situation is occurring with Zika virus. The mosquitoes that carry and spread Zika thrive in temperatures of approximately 82.4 to 93.2° (28 to 34°).[14] As a result of climate change, regions that were once suitable for the mosquitos that carry Zika virus may become too warm, causing those mosquitos to migrate to newly inhabitable regions. It is projected that by 2050, 1.3 billion people that previously did not live in high-risk areas for Zika will live in places where Zika can incubate and thrive.[15]

In the case of Neuroinvasive West Nile virus, mosquitos can become vectors by feeding on infected birds. Higher temperatures due to climate change can speed up mosquito development, feeding rates, the incubation of the disease within a mosquito, and affect the migration patterns of infected birds. The complications of Neuroinvasive West Nile virus include meningitis, encephalitis, and acute flaccid paralysis, which can be incredibly detrimental to infected individuals.[16]

SM Not only do these vector-borne diseases infect the body, but they also put the economy at risk.

WN Indeed they do. As individuals affected by these diseases are often unable to go to work due to symptoms or frequent doctor's visits, the economy will experience a decrease in productivity and consumption. Lyme disease alone costs the U.S. healthcare system between

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[12] Dunseith, Les. "High Temperatures Increase Workers' Injury Risk, Whether They're Outdoors or Inside." *UCLA,* UCLA, 17 July 2021, newsroom.ucla.edu/releases/high-temperatures-worker-injury-risk.

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$712 million and $1.3 billion yearly. Studies show that individuals who contract Lyme disease cost the health care system $2,968 more than those who do not, with 87% more visits to the doctor and 71% more visits to the emergency room.[17]

A study at Johns Hopkins University found that a hypothetical Zika outbreak with an attack rate of 0.01% would cost the U.S. $183 million in healthcare costs. This figure is projected to increase to $1.2 billion at an attack rate of 1%. The largest contributor to this number would be cases of central nervous system diseases caused by Zika when giving birth while infected. The total lifetime costs of these disorders were estimated to be over $4.1 million per case. The productivity loss per case was $3,516,025.[18]

In the United States, the annual cost of West Nile virus cases is $56 million, and the cumulative cost in health care expenditures and productivity losses is $778 million.[19] Studies conducted on a West Nile virus outbreak in California in 2005 found that 163 cases cost approximately $2.28 million due to the price of medical treatment and patients' productivity loss.[20]

RB Wow, change is imperative! Ms. Thunberg, would you please explain the effects extreme heat has on human health?

GT Yes. Extreme heat is defined as weather that is much hotter than average, usually with higher humidity as well.[21] Historically the U.S. had faced periods of extreme heat, and with climate change, these periods are expected to become more frequent and severe. Currently, around 5% of the U.S. population, or roughly 16 million people, is expected to experience over 100 days per year with a daily maximum temperature over 90° F (32° C). If precautionary measures are not taken this figure

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[17] Adrion, Emily R., et al. "Health Care Costs, Utilization and Patterns of Care Following Lyme Disease." *PLOS ONE,* Public Library of Science, journals.plos.org/plosone/article?id=10.1371/journal.pone.0116767.

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[20] Barber, Loren M., et al. "Economic Cost Analysis of West Nile Virus Outbreak, Sacramento County, California, USA, 2005." *Emerging Infectious Diseases,* vol. 16, no. 3, 2010, pp. 480–486., doi:10.3201/eid1603.090667.

[21] "Climate Change and Extreme Heat: What You Can Do to Prepare." *United States Environmental Protection Agency,* Oct. 2016, https://archive.epa.gov/epa/production/files/2016-10/documents/extreme_heat_guidebook_0.pdf.

could increase to 30% of the population by 2050. It has been found that on days with the stated maximum temperatures, the risk of injury for workers increases by 6% to 9%, compared to days with maximum temperatures of 50º F (10 ºC) to 60 ºF (15.6º C).[22]

SK Thank you, Greta. Dr. Nordhaus, can you explain the effects of heat-related injuries on the economy?

WN Sure. In 2020, the estimated health costs due to extreme heat were $263 million. In California alone, heat-related injuries are projected to cost between $750 million and $1.25 billion annually in the form of health care payments, lost wages, loss of productivity, and disability claims.[23] Given our current environmental conditions, the U.S. could lose up to $100 billion annually from lost labor productivity caused by heat-related injuries alone. If no action is taken to reduce extreme heat, labor productivity losses could double by 2030 to approximately $200 billion and increase to $500 billion by 2050. Mortality rates due to extreme temperatures are also expected to sharply increase if climate change is not mitigated. In Wisconsin in 2012, extreme heat led to $264 million worth of damages caused by mortalities alone.[24] As extreme heat-related mortality rates continue to increase, these costs are expected to increase nationwide as well.

The effects of climate change on human health ultimately leads to a decreased labor force and less productivity. Additionally, with higher medical bills, consumers will have less disposable income and will spend less, thereby causing a decrease in overall consumption. A decrease in productivity leads to a decrease in aggregate supply, and a decrease in consumption leads to a decrease in aggregate demand, both of which will directly cause a decrease in real GDP.

WC Eek!onomists, we hope that today's episode has clearly emphasized the urgency of addressing climate change, not only for the health of our planet but also for the health of the economy and our bodies. We would like to extend a special thanks to our two incredible guests: Dr. Nordhaus and Greta Thunberg. See you next time and remember, "Have no fear, Eek!onomics is here!"

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L-R: Iris Chung, Edward Quvus, Alyssa Serebrenik, Elijah Onik, Kevin McKegney, Una Kearns (Advisor)

Glen Rock High School

Glen Rock, NJ

Spilling the Beans About Coffee: A Forecast of the Effects of Climate Change on the Coffee Industry

GRETA The story begins three decades ago in the 2020s, when we could buy a cup of coffee for less than $5.

AL Now, my espresso is a depresso. Wow... Bob, I sometimes wonder why your generation had to mess the environment up so badly. I wouldn't mind being able to afford coffee every day.

CAMERAMAN-BOB Well Al, why do you think I came out of retirement to tape your internet videos? I need my coffee money.

GRETA Great, that's what we're talking about today.

AL Hello and welcome to the eighth episode of "Looking Back at The Roaring (Twenty) Twenties, 'Spilling the Beans about Coffee.'" Today, GRETA and I will be discussing what exactly happened to the price of coffee – and why.

GRETA I remember when, right up to the pandemic starting in the twenties, 62% of Americans consumed coffee every day ("Our Collective Coffee Craze Appears to Be Good for Us").

AL Coffee had a strong grip on our society. Unfortunately, the climate change beast was beginning to drive coffee prices up; by 2050, half of the arable coffee land became unusable.

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CITATION STYLE

MLA8

GRETA For a while, increasing prices didn't seem to matter. We just paid more and more for our fancy frappuccinos and lattes. The inelastically-priced drink satisfied our caffeine fix.

BOB I never drank any of that disgusting sugar-filled stuff. It was black coffee for me.

AL I'm with Bob on this one.

GRETA Whatever we drank, we drank a lot of it. Back then, consumers drank 3+ cups of coffee a day!

AL I guess the massive economic impact that climate change had on coffee makes sense. The demand kept increasing and increasing, as supply dwindled.

GRETA Especially since coffee played a huge role in the U.S. economy back then: it was an 80-billion-dollar industry ("Coffee Market in the U.S. - Statistics & Facts"), responsible for about 1.7 million U.S. jobs ("How Much Does the Coffee Industry Make a Year?"). Worldwide, it created over 125 million jobs ("Global Market Report: Coffee").

AL Yeah, when we were in high school, you would never see teachers and students without their daily fix. Americans consumed roughly 400 million cups of coffee each day in the twenties ("Coffee Consumption Statistics for 2020/2021 [Research]").

GRETA So, back then, how much were people spending on coffee?

AL It's crazy: the average price for a regular black coffee was $3.28 in 2022 compared to $12.46 today (in 2022 terms).[1] Between those 3+ cups

[1] Final calculation (produced by students) is done in 2022 currency. According to the USDA, global coffee demand in 2021 was 165k bags vs. global pro-duction of 171k bags. Global coffee demand has grown on average at 2% p.a. over the past 10 years. We assume a similar growth rate going forward, driven by continued population growth and higher disposable incomes (and some reputable forecasters assume as much as 4-5% annual growth rates, albeit none project out to 2050). At a 2% CAGR, global coffee demand would thus reach 285k bags by 2050 (+73%). Meanwhile, the IADB forecasts that climate change could reduce coffee production by 50% by 2050, which would result in production of just 86k bags. As there is no significant coffee inventory, the market will need to find a balance that equates demand to supply. To close this 70% gap between projected supply and demand, prices would need to rise to a level that leads to demand destruction of 70% (i.e., from 285k bags to 86k bags). Coffee is a relatively inelastic good (-0.25 elasticity as per Harvard's Anderson et al in '97), which means prices would need to rise 280%. For simplicity, we are assuming stability of share between coffee consumed at home vs. coffee consumed at coffee shops, i.e., both will need to see 70% declines in demand (although in reality, there will likely be greater demand destruction at retail than at home as people shift consumption in response to higher absolute prices). We then apply this 280% price increase to today's average price of a cup of coffee at a shop ($3.28, as per Credit Donkey), which gets us to an implied $12.46 per cup by 2050.

a day, we spent an average of $2,008 a year on the goods.

GRETA There's an interesting paper from 2005 in which Dick Durevall from the University of Gothenburg found that even as coffee became more expensive over time, its demand had not varied.

AL Exactly right, I read that Harvard University estimated coffee's price elasticity of demand to be -0.25. Since -0.25 is greater than -1 and closer to 0 on the price elasticity scale, we know that coffee is highly inelastic. So, even as prices skyrocketed, quantity demanded did not change significantly.

GRETA And, if we think about it, that makes sense, since there are little to no substitutes for coffee. What other drinks have its properties? Energy drinks and tea are definitely nowhere close. What happened to the crazy cheap $5 frappuccino we used to enjoy in the twenties? Now we pay $19 in their terms![2]

AL What happened was that, like many other plants, coffee fell victim to climate change. All of the changes in temperature, rainfall, and wind patterns that we've seen have deeply affected the supply of coffee. When supply decreased, companies were forced to increase prices to keep up with expenses.

GRETA Right. The Brazilian coffee crisis in the early twenties saw many coffee trees first damaged by frosts and then hit with a severe drought. This ensuing supply shortage caused the price of Brazilian beans to rise by 75% ("Your Coffee Is Getting More Expensive due to Bad Weather in Brazil").

AL Interestingly, coffee-growers in countries like Colombia began to try to take measures to offset the supply shortage in 2019. Notably, Colombia's National Federation of Coffee Growers petitioned to increase the price floor to $2 per pound, which was almost double the commodity price at that time. Actions such as these by the farmers caused coffee prices to increase.

BOB A lot of our listeners also have questions about climate change itself: @Coffeecrazed1995 asked, "How has climate change specifically

[2] To get us to the implied price of a frappuccino in 2050, we applied the same process, albeit with a cost of $5 instead of $3.28.

impacted the coffee production of these farmers?"

AL Great question! To give a little background, we don't just have oceans out there full of coffee that we tap into. Coffee starts out as seeds inside cherries on coffee plants. There are two main types of coffee plants: Arabica coffee beans grow best between 59-75°F, while Robusta coffee beans thrive between 71.6-86 degrees ("Where Coffee Grows"). Coffee plants are divas when it comes to temperature.

GRETA When temperatures shot up, photosynthesis rates became elevated, causing the plants to flower too soon. High temperatures and humidity also killed pollinating insects and allowed for diseases like coffee leaf rust to spread quickly.

AL And to make things worse...climate change caused irregular rainfall. As we have seen, flooding and severe droughts have become common, further disrupting ideal growing conditions.

GRETA We just received another question from @cup_o_j0e: "Did climate change cause any other changes in the coffee industry besides price increases?"

AL Yes. Unfortunately Joe, you're not only paying more, but you're also getting less bang for your buck.

GRETA Arabica coffee beans, which are higher quality than their counterpart Robusta, are more sensitive to environmental changes and more prone to disease. Back in the twenties, the Intergovernmental Panel on Climate Change (IPCC) correctly predicted that soon, Arabica coffee beans would no longer be a viable option.

AL And so, the environmental impacts brought about by climate change not only affected the price and taste of coffee but also had a huge effect on the coffee industry.

GRETA Lowered quality and a lack of supply meant less profitability for the coffee growers themselves. These farmers, most of whom were from developing countries, relied on paper-thin margins to stay afloat. Farmers, as well as everyone else at the time, hoped for future innovation to solve these issues, such as possibly moving plants to higher elevations and genetic modification.

AL However, profits remained scarce, the innovation never came, and farmers couldn't continue growing coffee. Consequently, farmers were forced to seek jobs in other sectors to feed their families, meaning there were fewer laborers to handle the crops. This led to a vicious cycle of decreased supply.

GRETA While the overall market suffered, large coffee corporations took more control.

AL Yeah, it's ironic that large coffee corporations like Starbucks were on the forefront of attempts to keep climate change at bay. They were one of the most environmentally responsible businesses, yet benefited the most from the negative impacts of climate change.

GRETA Well, what exactly was Starbucks doing to mitigate global warming?

AL Starbucks donated tens of millions of trees to farmers that were resistant to coffee rust disease ("Starbucks to Provide 100 Million Healthy Coffee Trees by 2025") and committed to save or reuse 50% of the water used in their coffee production by 2030 ("5 Things to Know about Starbucks New Environmental Sustainability Commitment"). Their strategy was to maximize their investments in sustainability and be a thought leader in the industry.

GRETA At the end of the day, massive coffee companies like Starbucks and Dunkin' Donuts had large cushions of cash to fall back on when coffee supply became limited. Starbucks had over thirty thousand stores globally ("5 Things to Know about Starbucks New Environmental Sustainability Commitment"), bringing in yearly revenues of approximately $29 billion ("Starbucks Revenue 2010-2021: SBUX") and profits of $20 billion ("Starbucks Gross Profit 2010-2021: SBUX"). They, along with other major corporations, were able to weather the storm, but small coffee shops ran out of supply, and couldn't stay afloat.

AL Furthermore, large companies enjoyed economies of scale, allowing them to mechanize their coffee making processes and helping to offset some of the rise of coffee prices. This incentivized consumers to purchase their coffee instead of the more expensive alternatives and allowed them to take significant market share from the competition.

GRETA It is similar to what briefly happened during the COVID

pandemic, when 7.3% of coffee shops closed in the US, the majority of which were local ("Say Goodbye to Your Local Coffee Shop in America's Cafe Shake-Up"). Climate change created this effect on a MUCH larger scale, of course.

AL In the twenties there were still many companies selling different types of coffee, forming a monopolistic-competitive market. As supply shrunk, costs went up, and only the larger companies survived, resulting in today's oligopolistic market structure.

GRETA That market structure allows companies to have a much larger control over price, giving them easy ability to jack up prices. This pushed lower and middle income consumers out of the market, as they couldn't keep up.

AL But there have been a few attempts to mitigate the unequal barriers put onto coffee consumers.

GRETA Yeah, what's your opinion on the recent debate about whether the government should begin rationing coffee through slowing price increases and providing more equal access?

AL It's crazy to think we could go back to the rations of the Second World War, when coffee supply declined due to a lack of available ships. But it is an interesting solution to today's supply issues, and the U.S. government going back to rationing coffee would temporarily prevent price spikes.

GRETA Of course, such policies face immense backlash and lobbying from coffee companies that want to keep selling coffee as a luxury good for maximum profitability.

AL Now, a simple question remains: Why didn't we do anything about it back then?

CAMERAMAN Our viewers seem to have the same question. @coffeelover_05 asks: "If we knew climate change would have such devastating effects, why didn't people take action against it sooner?"

GRETA The ironic part is that while many countries pledged to take action, they never successfully carried out these promises. Back in the twenties, there were global climate summits called Conference of the

Parties, or COPs, where countries discussed how to both prevent and mitigate climate change effects.

AL Yeah, I remember COP21 was a big issue back in 2015 because of the Paris Agreement. The goal was to limit global warming by 1.5 degrees and achieve net-zero emissions by 2050.

GRETA But, we all know that aim fell short. During COP26 too many countries pledged to enforce greenhouse gas targets and reduction strategies, but weren't committed to them. Plus, there were other problems like underreported emissions and a lack of funding for those regions most vulnerable to climate change. They were already working on borrowed time.

AL The whole world would have had to cut emissions by 50% in order to achieve net zero by 2070. Keep in mind that during COVID, when people stayed inside and emissions were curbed, they only fell 6.4% ("COVID Curbed 2020 Carbon Emissions — but Not by Much"). To cut emissions by about 8 *times* that amount was a long shot.

CAMERAMAN-BOB Here's another question: "How was the coffee industry involved in the COP26 plans, or any other mechanisms to mitigate climate change damage?"

GRETA Unfortunately, the coffee industry also contributed to climate change. When trees are cut down, they release carbon dioxide into the atmosphere and coffee production causes massive amounts of deforestation over 100,000 hectares per year ("Falling Coffee Prices Mean Falling Forests: U.S. Coffee Czar"). Coffee processing also added to carbon dioxide emissions through the use of gas-powered machines and the air freight to ship it. And finally, as coffee grounds decompose, they release methane gas.

AL Since coffee plants were contributing to the very problem that was killing them, the coffee sector should have shifted to more sustainable practices. But due to the lack of implementation and commitment to the Paris Agreement and COP plans, the coffee industry fell victim to the race against climate change.

CAMERAMAN-BOB We've been talking about coffee so much, but you guys have been forgetting about what happened to beer! I've wanted to grab a cold one for the past hour but I can't afford to.

AL Grain isn't only for beer, Bob...

GRETA Grain fed around 1.2 billion people who live on less than 2 USD a day in 2022 ("Global Poverty: Facts, FAQ s, and How to Help"). Even more, half of the 840 million people in chronic hunger lived in areas dependent on rice for their livelihood and food ("United Nations Launches International Year of Rice - World"). If what happened to coffee happens to these other food staples, this could lead to widespread malnutrition.

AL Right, and even the people who can afford the higher prices already need to spend a disproportionately higher part of their income on it. Their disposable income available for other purchases has been greatly diminished, reverberating throughout the broader economy.

GRETA Don't get too scared, though – it may not be too late. Consumers still have the power to shift the market, and there is plenty the government can do: create a carbon tax, subsidize green investment, invest in clean energy and build out closed loop recycling infrastructure. Hopefully this time they learned their lesson.

AL Jeez... There's so much information about what used to be a simple cup of coffee.

GRETA Alright, that's it for today, so thanks for tuning in! In the next episode we'll talk about why beer tastes different today than back in the twenties and why we can blame climate change...again. See you next week!

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L-R: Ms. Mireya DeLaRosa (Advisor), Loren Gonzalez, Josmiluis Peralta, Mayorie Rozon, Carlos Cabral (not pictured)

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Climate Change, a Threat to Poor Communities' Economic Equality

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CITATION STYLE

MLA Format

HOST Welcome to the Generals podcast. We will discuss the issue of poor communities – the majority of whose businesses are minority-owned not having the financial support necessary to fight climate change. These communities lack the knowledge or information to manage the economics of climate change, specifically Washington Heights in NYC. Carlos, Josmiluis, Loren, and Mayorie will speak on it further.

CARLOS Thank you. Climate change is an issue that affects everyone. Poor urban areas, such as Washington Heights, are not exempt. Those economic effects are worse due to aging buildings, lack of managed and mandated structural maintenance, and lack of financial support to local businesses after extreme climate events.

After reading and investigating, analyzing data, and conducting extensive research, we, as concerned students and residents of one of the poorest districts in New York City, came to the realization that climate change is disrupting the financial progress of our community. As we have just recently experienced a dramatic climate event, it has become evident that our society needs to be educated regarding the challenges that stem from inequalities in budget allocation, in order to safeguard the financial health of businesses affected by climatological events. We learned that we cannot ignore how this neglect impacts citizens' daily lives in those areas.

JOSMILUIS Natural gas should be an alternative to what is used now to supply heat to buildings during the winter. According to the U.S. Energy Information Administration, in the United States 40% of the energy produced annually is dedicated to providing energy to residen-

tial and commercial buildings, the split being 22% for residential buildings and 18% for commercial. *(U.S. Energy Information Administration, How much energy is consumed in U.S. buildings?, E.I.A.)* A significant share of the emissions that accelerate the effects of climate change are due to the large amount of energy necessary to supply the number of buildings in the United States.

We need to reduce emissions produced by residential buildings and commercial establishments, especially during the winter months. We must keep in mind that winters are getting colder due to global warming. A collective solution is needed to address both issues.

Natural gas is a less harmful alternative for the environment. By using natural gas, CO2 emissions are reduced by more or less 50% compared to oil or some of its derivatives. Landlords who do not follow maintenance guidelines should face financial penalties.

According to the Center for Climate and Energy Solutions, the use of natural gas has caused a reduction in greenhouse gas emissions in the power sector, therefore advocating for the use of natural gas to continue reducing CO2 emissions is imperative.

To generate less CO2 emissions, an increase in the percentage of the energy budget should be re-allocated to improve and build new natural gas power plants rather than spending funds to make improvements on already existing generators. (Anne, Ashford)

Unexpected climate behaviors, such as floods, storms and hurricanes, are more likely to cause damage or destruction to aging structures. The citizens of these areas deserve to live in safe living conditions. Maintenance may not prevent flooding or damages caused by hurricanes, but ensuring the buildings are structurally safe reduces the risks associated with it.

We suggest the creation of a federal program that concedes higher grants to minority building owners. The grants must be used to cover repair expenses. Within the same program, partnerships with home-services and utility companies to support the owners of the buildings in those poor affected areas would be implemented. In addition, we propose the fines imposed on those owners who do not comply, to be increased from $100.00 to $1,000.00 per day. This amount will depend on the number of units in the building. The funds collected from the fines could in turn be used to cover part of the costs of the program.

The purpose of this program is to avoid situations similar to those that occurred during Hurricane Sandy in 2011, which destroyed thousands of homes and damaged many buildings in poor neighborhoods, costing hundreds of thousands of dollars in federal money.

HOST Loren, who has done extensive research on specific employment, income, demand, and supply data or indicators, please give us more information.

LOREN We decided to look at several qualitative, quantitative, and narrative data to gather information leading to a better understanding of this topic and support our observations and findings. As indicated on the Economic Snapshot of Washington Heights and Inwood from June 2016, this area had a population increase of 6%. Forty-eight of residents in these districts are immigrants; two-thirds from the Dominican Republic. These areas are primarily residential, whose residents commute to jobs in other regions. The most recent data on employment in the private sector was 28,670 jobs in 2013 with the unemployment rate being 4% higher than the rest of the city.

HOST Mayorie, can you share your take on this?

MAYORIE NYC is one of the most expensive cities in the world. For example, a two-room apartment with a kitchen and a bathroom costs an average of $2,000.00 a month. Families living in these low-income communities fall into the city poverty index. In these communities, specifically Washington Heights, unemployment rate has remained at about 6% during the last couple of years, 4% points higher than the citywide rate. The average income of Washington Heights residents is below $30,000 a year; the median housing income is around $75,000 a year (DiNapoli, Bleiwas). We concluded that residents of Washington Heights can't afford to pay rent at the current housing market rate.

A critical factor is that many Heights residents have limited English language proficiency. As these families face dramatic climate events and its consequences, government guidance on dealing with it is practically lacking in their language. When official information in their native language is unavailable, this population becomes hostage to what they read in social media. Many times it is misinformation.

These families lack access to financial support to deal with resulting consequences. For example, families in these areas get affected if the subway system in NYC is interrupted due to damages caused by unexpected drastic climate behaviors. On September 21st, 2021, after Hurricane Aida, most Washington Heights residents could not access public transportation to get to their jobs, they could not afford an Uber or Lyft. An aftermath outreach program should offer free shuttle services to the nearest functioning train stations.

The term "Post-disaster trauma" defines the emotional and actual consequences of the aftermath and the residual situations these people cannot deal with. According to an article on *Public Health Degrees* it can also "damage the collective psyche of communities by disrupting their norms, values, and rituals that provide the basis for their resilience." ("How Do Natural Disasters Affect Mental Health?").

Our research raises, amongst others, one question: to what extent do low-income Washington Heights residents and small businesses continue to be neglected? As previously indicated, more resources for this and other low-income communities are needed.

Community-based organizations (CBOs) services must be encouraged to become involved. "Community-based organizations are also important because they provide a wide range of services and support. Information about public programs can be embedded" *(Chaudry, Fortuny, Pedroza)*. The information must be timely and bilingual.

To address this issue, we recommend an increase in the budget allocation from the present level of $27 million to $52 million for undocumented residents in need of disaster relief for hurricane Ida (Baldonado). These funds should be dispersed according to the damages incurred. For future disaster reliefs, this figure should not be negotiated as it was.

LOREN A 2016 report of an *Economic Snapshot of Washington Heights and Inwood* stated that from 2009 to 2013, three-quarters of Washington Heights and Harlem buildings have been occupied by small business owners. This constitutes a growth of 10.3%, which was faster than the citywide rate of 6.7%. In November 2013, business data was recorded due to the increasing flow of immigrants establishing and dissolving businesses. About three-quarters of the area's 3,049 enterprises were small, with fewer than five employees. Only 26 enterprises had 100 or more employees, primarily in healthcare and business services *("New York State Comptroller, Economic Snapshot of Washington Heights and Inwood")*.

When climate events occur, these are some of the most affected groups. Possible drawbacks for small businesses due to the lack of availability of resources to face climate events and climate disasters, go from the potential additional costs due to governments charging premiums for non-compliance and increased disaster insurance premiums costs, to the need for many buildings being redesigned and reconstructed to hold out against weather events to keep the employees comfortable and productive as temperatures peak.

CARLOS Carbon dioxide-based greenhouse gas emissions, an is-

sue compounded by the pandemic, has the attention of the federal government. According to a report from *Brookings Magazine,* "while transitioning to a low-carbon economy, the Biden administration's plan for "building back better" underscores the need to support small businesses and advance racial equity." The proposed "Small Businesses Opportunity Fund" has an initial amount of $30 billion. However, a $50 billion cross-cutting policy initiative represents a possible exploit of this unique opportunity presented to small businesses mid-pandemic, which seeks to "promote green innovations and investments among small businesses" that struggle with mitigating climate change effects. The initiative will do this through the implementation of "green loans, green grants, and green bonds," all intended to help small businesses to invest in sustainable innovations *("New York State Comptroller, Economic Snapshot of Washington Heights and Inwood")*.

The same *Brookings Magazine* report noted "just above 28% of small businesses were owned by minorities and 33% by women in 2018, which makes them essential operators of financial inclusion and monetary growth." Most of them work in service industries such as trade, food services, wholesale accommodation, and real estate, where they account for approximately half of the total employment in the US. It is also estimated that small businesses all over the country and, as noted by *Forbes Magazine,* New York City ranks in 6th place on most small businesses accounting for 60% to 70% of the total air pollution, a major concern to be addressed *("Rohit Arora, San Jose Is No. 1 Among Top 25 Cities for Small Business, Forbes")*.

Unexpected climate behaviors, such as floods, storms and hurricanes, are more likely to cause damage or destruction to aging structures.

LOREN *Brookings Magazine* stated that, in New York City, 75% to 90% of small businesses were affected by the "fall of demand when confronted with required business closures and social distancing requirements." As the Small Business Pulse Survey by the U.S. Census Bureau recorded, "In late April 2020, 31% of small businesses struggled to pay bills, 25% were unable to pay rent, 24% could not pay wages, and 23% failed to meet their debt obligations." With the ongoing pandemic, many small businesses find themselves to be economically weakened, and so severely sunk into debt that they are unable to react to the climate transition. And even before, with the fluctuating economy, small businesses had a hard time preparing to deal with the effects of climate change. After having tried to deal themselves with climate change by bringing up innovative solutions which involved the high costs of new technologies and capital equipment, capital businesses are way behind in reaching their goals. With a low capital, small businesses lack the financial history and holdings that could help them with their goals, and this is limiting their access to different types of funds *("Addisu Lashitew, Small Business Green Recovery Fund to Power US Climate Transition, Brookings")*.

CARLOS Small businesses are considered to be non-safe borrowers with higher chances of going into bankruptcy. Things that could increase like loans, and with the close climate transition, the costs of financial initiatives and assessment in sustainability, could lead small businesses to increase the cost of their capital. In contrast to their unending monetary needs and the chance for businesses having to inflate the expenditures, there are no significant federal budget agendas that bestow climate change funding for small businesses and help them avoid an increase in expenditures regarding climate change reforms. Even with the existence of funds for small businesses, both before and during the pandemic such as the Small Businesses Lending Program, the Paycheck Protection Program, etc., they usually have interest rates that most people and most immigrants from these neighborhoods are not willing to take because of the risk of sinking into debt. As reported in an article of the *New York Times,* State representative Stacy Abrams said in an interview how small businesses weren't benefiting from these programs: *"I think it [the payment protection program] was inefficient. I think for certain communities, it was ultimately wholly ineffective. I know that the first run of PPP, if you were a Black-owned business, your ability to secure those loans was almost negligible. And the same thing was true for other communities of color. Small businesses were often outmatched by large companies who had faster access to banks, willing*

to allocate those dollars" ("Andrew Ross, How Stacey Abrams Thinks About Business, New York Times").

LOREN According to the *New York State official website,* Governor Kathy Hochul has presented New York's FY 2022 and 2023 budgets, which provides $1 billion dollars to small businesses in order to help them deal with tax credit for Covid-19 related expenses, but until now nothing has been settled in regards to climate change and sustainability costs. Moreover, as stated in a *Gothamist* article, the program to which the budget will be directed to, involves businesses to present evidence of having lost at least 40% of their income by comparing 2019 and 2020 tax returns, but this only calculates the direct costs related to the decline in operations due to the pandemic, not due to climate change, so when the time comes to totally switch to a low-carbon economy, small businesses will have serious difficulties with it *("Beth Fertig, NY State Budget Includes "Huge" COVID-19 Relief Package for Small Businesses, Gothamist")*.

To solve this problem we have thought of an initiative that will help small businesses adjust to the low-carbon economy the United States seeks to achieve. This initiative will affiliate sustainable suppliers in a non-profit government-funded financial institution which would be intended to help small businesses with expenses regarding the low-carbon transition, and that will support them by offering special incentives and payment plans for small businesses with reduced interest rates. This will be done through the inclusion of institutions that offer services like sustainable energy, environment-friendly office and production materials, insurance covering for post-climate events recovery, and energy-efficient products. The funding of this initiative would be settled for a total of $640 million, which accounts for 7.04% of the $9,237,153,000 that constitutes the Environmental Protection Agency's budget. *("EPA's Budget and Spending, E.P.A")*

HOST Thank you Carlos, Josmiluis, Loren and Mayorie! Thanks to all our listeners.

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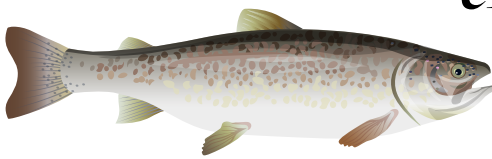
Horace Greeley High School

Chappaqua, NY

Patrick Fang, Alex Friedman, Andrew Seidman, Jake Friedman (not pictured Alexander Baek)

Fishy Business: Climate Risks to the Agriculture and Fishing Industries



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CITATION STYLE

Chicago Author-Date

ANDREW SEIDMAN Welcome everybody, this is FISHY BUSINESS, presented by the students of Horace Greeley High School, and today we will be examining climate risks to the agriculture and fishing industries.

(SOUNDBITE OF MUSIC)

ALEX BAEK Johnny McCarthy, a young lobsterman from Maine, has been in the scene for years. He's been pulling in hundreds of thousands of dollars yearly whereas the average worker in Maine only makes a fraction of that. A few years ago, he even decided to invest in a $650,000 beast of a boat, a token to his belief that the good fishing times would keep coming (Overton and Russell, 2021).

Unfortunately for him, though, the golden age of lobster fishing came to a rearing halt recently, and it's largely due to climate change. Just the year after he purchased the boat in 2019, lobster numbers in Maine were down immensely, reaching record low numbers over the last decade (Overton and Russell, 2021). Many people, fishermen included, have been making excuses, saying that climate change isn't a threat in the present but an issue to be tackled in the future. However, Johnny is facing the issue at this very moment, and it's hitting him hard.

Although the local government in Maine is trying to make policies to help protect the lobster populations and prevent an unfamiliar post-lobster life for Johnny, odds are that things are only going to get worse.

ALEX FRIEDMAN Even on the other side of America on the west coast, John Beardon, a Dungeness crab fisherman is suffering just as much from the warming of the waters as McCarthy (Hasemyer, 2018). Things have gotten so bad that lawsuits are being filed against fossil fuel companies like Shell, BP, ExxonMobile, and Chevron for hundreds of millions of dollars for polluting their air and the oceans, while damaging fish yields. In a quote from an interview, Bearden explains his situation: "The last three years have been really hard. Our community came together and held a fish fry to help our crew members. But fish fries and disaster relief are no solution to these closures we're now seeing year after year after year" (Hasemyer, 2018). With many of the local/state courts rejecting the lawsuits, claiming that they are issued to be left to the executive and legislative branches of the government, local fishing businessmen like John Beardon and Johnny McCarthy are wondering: what's next?

Now, Johnny and John are not the only people to be suffering from the effects of climate change. Across the United States, food sources and food production are under threat from rising temperatures, with the fishing and agriculture industries especially at risk. In this podcast, we will take a look at these two industries—both integral to the United States economy—and how climate change is placing them at risk.

ANDREW SEIDMAN Climate change is doing irreparable damage to the fishing industry in the United States. Increasing ocean temperatures have placed the United States fishing industry at risk. As of 2017, the commercial fishing industry in the United States is valued at $240.99 billion (Berman, 2021) and supports 1.6 million jobs as of 2018 (NOAA Fisheries, 2017). Rising ocean temperatures greatly impact this crucial industry. For instance, in Johnny McCarthy's very own New England, the combination of warming water temperatures and overfishing resulted in very low quotas—limits set by the United States government to regulate the amount of fish a fisherman can fish—for cod in the Gulf of Maine, causing socioeconomic stress in a region where fishing is an integral part of the local economy (Pershing et al., 2015). Similarly, a recent heat wave in the Gulf of Alaska meant that there were difficulties harvesting Pacific cod from 2016-2018 (Barbeaux et al., 2017). In fact, there was a complete inability to harvest the Pacific cod quota in 2016 and 2017. Even worse, the demand for fish products across the nation is on the rise, with the commercial fishing industry projected to be valued at $438 billion by 2026 (Wood, 2019) from the projected increase in demand, placing stress on an already fragile industry. This increased demand will exacerbate overfishing, ultimately leading to even great-

er loss of fish stocks long-term. Without sustainable fishing practices, United States fisheries can expect to see large deficits in employment and revenue. Not only will it affect the fishing industry, but activities that depend on marine life. For instance, Hawaii is a hub for tourism and exploration of marine life, supporting 216,000 jobs and generating a quarter of their annual revenue through tourism (Schaefers, 2020). However, climate change is leading to the bleaching of Hawaii's coral reef, driving out entire species of fish (Ferrario et al., 2014). Without a sustainable ecosystem preserving the state's marine life, related jobs in Hawaii could disappear overnight. This, in turn, places economic stress on the people of Hawaii as a whole, not just those specifically in the fishing industry, due to the importance tourism has on the Hawaiian economy. The same situation is more noticeable in the Florida Everglades and Keys, where rising sea levels threaten marine life through the flooding of local ecosystems. Overall, these regional economies in Florida are expected to lose $9 billion in revenue by 2025 and $40 billion in revenue by the 2050s (Hales et al., 2014).

JAKE FRIEDMAN Climate change also threatens to bring decreased agricultural productivity as a result of temperature and precipitation changes. More frequent extreme weather events have the capacity to severely injure a region's ability to feed its inhabitants. Economically, decreased crop yields paired with higher maintenance costs have the potential to hit industries and consumers hard with greater food insecurity and higher prices. The United States' production of seafood, crops, and livestock contribute more than $300 billion to the economy each year (Hatfield, et al. 2014). This value has come under threat as climate change progresses. It is commonly known that agriculture heavily depends on climate change conditions and can be affected both positively and negatively. In fact, increased carbon dioxide levels and temperature in some cases may even raise crop yields (Gray, 2021). Yet for that potential to be realized, other limiting factors must be met. For example, soil must contain adequate amounts of nutrients and water among other things. Moreover, an increased frequency and severity in floods, droughts, and storm events poses a serious threat to food security (Brown et al., 2015).

Climate hardiness zones are being altered across the planet; almost half of the country was upgraded to half a hardiness zone warmer in 2012's update to the 1990 publication (Jones, 2018). Hardiness zones indicate 10 degrees F belts and are used by farmers and botanists as insight into what plants can survive and flourish. These statistical changes in hardiness zones are representative of the fact that warmer weather is being experi-

enced further North in the United States. Interestingly enough, this level of warming may prove to be beneficial for warm-weather perennials such as orange, kiwi, and almond crops, as their cultivation ranges would be expanded. In the coming decades we may see increasing outputs of these crops and growth in these industries.

However, the United States is not known for its oranges, kiwis, or almonds. The United States supplies roughly a quarter of the world's grain supply (USDA, 2015). The capacity of the United States' breadbasket states to continue producing such large outputs is threatened by the expanding presence of pests brought about by warmer temperatures. Moreover, increased growth of weeds and fungi are often favored with these changes. The reduced crop yields, increased expenditures on pesticide application and innovation will be costs passed down to the consumer. The United States spends $11 billion on weed mitigation (Hatfield et al., 2014). This figure will surely increase with time. In addition, the production and subsequent use of herbicides forms a positive feedback loop. The production of herbicides produces carbon dioxide, nitrous oxide, and methane. This further accelerates temperature rises which then requires more pesticide application.

Climate change is not a distant threat; it is a present issue, and it is affecting the livelihoods of millions across the United States over countless industries, such as the agriculture and fishing industries.

In terms of major crop loss, projections estimate that the United States will experience a 24% drop in the production of maize in the late twenty-first century (Corn Refiners' Association, 2020). Given today's domestic output value, that's nearly a $12 billion loss (Shahbandeh, 2021). Crop losses related to climate change are already occurring around us. Let's take a look at Traverse City, Michigan.

PATRICK FANG Every summer, thousands of visitors flock to Traverse City to check out the National Cherry Festival. At the festival, one may find all things cherry, everything ranging from pit spitting, to pie eating, even to the crowning of the National Cherry Queen. It may seem surprising that people of the region hold such a large festival for fruit, but Northwest Michigan produces roughly 75% of the country's tart cherry crop each year for pies, juices, and preserves (Kransz, 2021). Near Lake Michigan, the ideal climate of the region—a delicate balance between mild temperatures and low humidity in a temperate climate—is essential for the continued growth and production of different varieties of fruits, a product that provides thousands of jobs around the area and thousands more around the country.

However, the productivity that farmers in the region grew to de-

pend on changed in 2012, when a freezing winter was followed by extreme temperature swings in spring, due to the changing climate of the region. Cherry trees remain dormant throughout winter until a spring warming wakes them up, but in 2012, the spring warming happened much sooner (EPA, 2017). Temperatures in March shattered records, reaching the mid-80s; this abnormal warming pushed the trees into an early budding, almost 5.5 weeks ahead of normal (Kransz, 2021). Just as soon as the warm temperature was there, it was gone, followed by a frigid period between April and May where there were 20 nights in which the temperature was below freezing.

Farmers Sara and Pat McGuire of Royal Farms in Michigan can attest to the powerful impact the freak weather had on crops; throughout their years, they've been through a lot of bad weather and minor temperature fluctuations, but they've never faced anything as destructive and wild as this. "It's been a real challenge emotionally and physically," Pat says. "We have no crop. We've had to lay people off. We've had to work extra hours. We did everything we could in the spring to minimize the effects of the freezes that we did have. We felt like we just lost a fight." (de Melker, 2012). They aren't the only ones who have lost income; Don Gregory, co-owner of Cherry Bay Orchards, reports a loss of over 99% of their usual yearly crop, from ten million to less than 100,000 pounds.

And this isn't just happening in Michigan.

Around the country, changing climate conditions due to global warming are making for less productive agriculture seasons, while more frequent freak weather events could completely halt a year's production. This decline in crop returns will in turn cause food prices to rise everywhere; a global index showing food prices released by the UN Food and Agriculture Organization have climbed to their highest levels since 2011, to the point where many experts say that it "wouldn't be an exaggeration" to say we are approaching a global food crisis (Swanson, 2022).

ANDREW SEIDMAN Climate change is not a distant threat; it is a present issue, and it is affecting the livelihoods of millions across the United States over countless industries, such as the agriculture and fishing industries. From Johnny McCarthy of New England to Sara and Pat McGuire in Michigan, climate change is having a direct impact on individuals across the United States. It is imperative for the Federal Reserve and other financial institutions to aid these imperiled industries and people as climate change continues to worsen.

ALL Thank you for listening.

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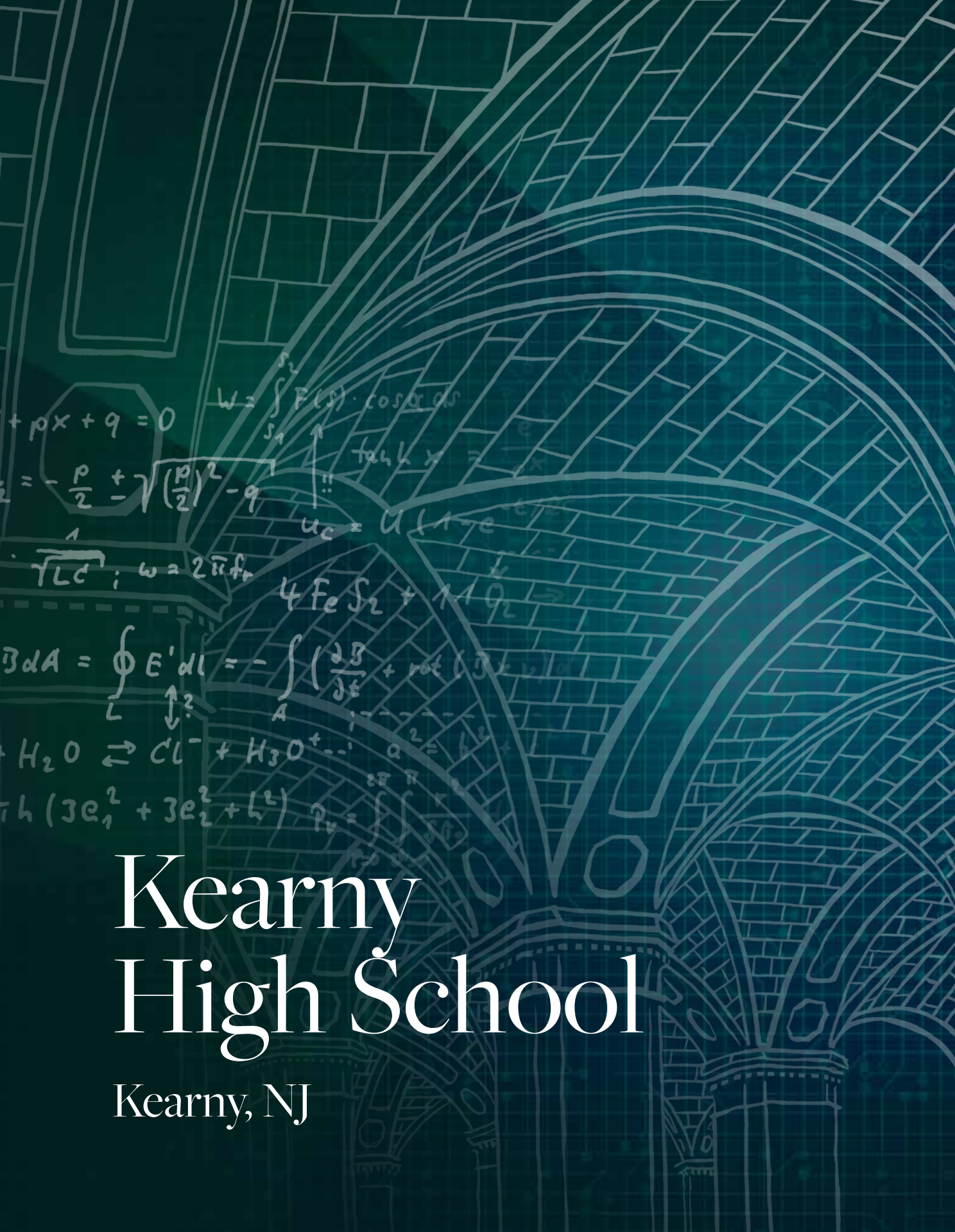

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Money Talks Podcast

Hello listeners. Thanks for tuning in to 106.5 lite FM and welcome to the Money Talks PodCast. We will be talking about how climate change will and has affected our economy. We have brought in six economic experts to talk about the subject. Let's start with you, William.

MODERATOR *Hello, William, being an expert on government policy; could you please explain to us what government policy is being taken to combat climate change and elaborate on its effects on the economy.*

WILLIAM Without a problem. One of the largest multinational government policies put in place to combat climate change is the Paris Climate Accord. The Paris climate Accord is very divisive. Some people believe that the Accord will cost the economy trillions of dollars and many jobs. On the other hand, some people argue that the Paris Agreement will actually boost the economy. Wayne Christian and Donald Trump stated that the Climate Accord would run the United States $3 trillion and around 6.5 million jobs. The U.S. will have to pay $3 billion to support developing countries for the energy transition while also arguing it will hurt the fossil fuel industry. This would in turn affect all the people who work in the fossil fuel industry, effectively lowering America's GDP. The UN claims, however, that the Climate Accords will help the economy. First off, the 310 climate-related disasters in the US since 1980 have cost the US $2.155 trillion. The climate accord will seek to cut that number drastically, along with claims that the accord will create jobs and produce $26 trillion globally in economic benefits. The trillions in subsidies that the fossil fuel industry receives from the government will be cut as well. On top of that, according to the WHO air pollution causes a huge financial burden as air pollution is responsible for 7 million premature deaths a year (more than any other health risk like alcohol for example). The WHO argues that this costs the global

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economy more than $5 trillion in welfare costs and $225 billion in lost income. No one knows for sure the effect of the Paris Climate Accord on the economy. The only thing people can agree on is the fact that a lot is still up in the air and only time will tell how the Paris Climate Accord will affect the economy.

MODERATOR *What about you Sam, I know you're our expert on electric vehicles. Explain the economics of electric vehicles, and its effects on the economy.*

SAM Well as you know electric vehicles are a huge debate in today's society. Some people are truly for it and believe that it will be the next big thing especially with fully autonomous vehicles, while on the other hand there are others who believe there are still too many unknowns including safety hazards as well as the fact that electric vehicles emit more carbon into the atmosphere. Democrats have been pushing for people to purchase electric vehicles, and are also pushing for all vehicles sold by the year 2030 to be electric. To add, President Joe Biden's $1.75 trillion Build Back Better Act, which will soon be revamped by the senate, and according to Reuters, it states that it features several rebates and credits to lower the cost of electric vehicles up to $12,500. Furthermore, the autonomous taxi network is supposed to add around an astonishing $2.3 trillion to our GDP.

MODERATOR *Do you think it makes sense for people to get an electric vehicle now while there are many rebates and tax credits?*

SAM For the time being, it may make sense to steer away from electric vehicles. Electric vehicles, notoriously known for their gas mileage, would force people to spend more time at a charging station and less time at work. This means that consumers will have to keep coming back to the charging stations which could accumulate into a large monthly expense. Some may rebut that gas prices have been drastically increasing recently, and though this may be true, people charging their vehicle saves money, but they would still technically be losing money in the end since the opportunity cost of them charging at a station would mean they would lose the money that could be earned at work. In the future however, as the vehicles improve, people would be able to charge their cars in a much quicker manner, hence they would be able to work and gain more money in the end.

MODERATOR *Let's switch topics for a bit, Alex, you're our expert*

on agriculture in the United States. What are some of the concerns you have about agriculture production, global emissions, and how they correlate to our economy?

ALEX Thank you, the American beef industry is one of the largest industries in our economy as the United States is the largest beef consumer globally. Consumer trends favor high-quality beef, which takes years of development. According to the USDA, the United States requires roughly 90 million cattle to meet the demand of American consumers. On average, one pound of beef requires nearly 1,800 gallons of water and large amounts of pasture for feeding. These statistics display the high economic costs of raising cattle. In addition, the large amounts of water are a threat to an already diminishing global water supply.

Raising large amounts of cattle also presents an unsuspecting contributor to global warming, methane emissions. When cattle belch and have flatulence, they emit methane gas which, according to the University of California, Davis, is roughly 220 pounds of gas per cow per year. With the cattle population exceeding 90 million in the U.S. alone, their methane emissions dramatically increase. Cattle are the most significant contributors to methane emissions globally.

MODERATOR *Do you have any possible solutions to this growing issue?*

ALEX There are solutions to reduce these emissions. From a social perspective, we can stop consuming beef in large quantities, which would bring down demand and ultimately downsize beef production. A shift away from meat has already become a growing trend with U.S. consumers as meat alternatives have gained traction, such as Impossible Foods.

The U.S. government can implement new policies for raising cattle or importing cattle to make a less economic impact. The Australian government has recently implemented food additives to cattle diets to prevent the cattle from producing methanogens and reduce emissions. A similar implementation could drastically reduce the direct emissions of cattle in our environment. The bottom line is that these economic luxuries are a massive contributor to global greenhouse gas emissions and, as the other experts have mentioned, have a signifi-

cant impact on our economy. In addition, the cost of meat will only increase as overhead such as water and pasture become more scarce and expensive.

MODERATOR *Michael, what is stress testing? How could you calculate the stress test? And why is stress testing important for an economy?*

MICHAEL Stress testing is a system of tests that are used to calculate the impact of inferior scenarios on the resilience of financial firms. They involve the use of models and data at the firm or system-wide level and may rely on historical or hypothetical scenario. In the case of climate change, stress testing is used to see what would happen to banks if the climate crisis were to get to an extreme or out of control situation. The way that stress testing is calculated is a measurement called CRISK. CRISK is the expected capital fall of a financial institution in an intense or absurd Climate scenario. According to Troy Segal, these are three steps to conduct a full Stress test.

1. **First, you must measure the climate risk factor, which you can use as a stranded asset portfolio return to measure for a transition risk.**

2. **Next, you must estimate a time-varying climate of financial institutions using the Dynamic Conditional Beta (DCB). DCB is an estimated regression model and graph that shows what would happen to the economy if climate change became an overwhelming problem.**

3. **Third and lastly, you must compute the CRISK, which shows all that would be lost and how it would poorly affect a financial firm.**

After these steps are completed, the stress test is complete and you are done. These tests are beneficial to the economy because they show what would happen if climate change becomes an even more serious problem than it already is. Stress testing helped a great number of financial firms, banks, economies, and reserves to see what would happen if the climate crisis got really out of hand. The stress test helps governments find out lots of things which are the objective of government policies, processes, resources and documentation of stress tests. Overall, stresstesting is a great and confidential way to protect your economy and see the outcomes of climate change.

MODERATOR *Stress testing seems to be a very important topic when it comes to climate change in the economy. Christopher, being our expert on finance and jobs, is there anything you'd like to add?*

CHRISTOPHER Thank you and certainly. When it comes to the outcomes of climate change, those outcomes have financial aspects to it, one of the most important ones being our GDP. Crazily enough, if we don't reduce global temperatures by 2050, our GDP will lose around a whopping "11 percent to 14 percent off global economic output by 2050" according to a report from Swiss Re. A catastrophic event like this could be so devastating to the economy that in order to combat climate change to prevent such a disaster, many companies are switching to alternative renewable energy sources like wind, solar, and hydro.

MODERATOR *Is there a problem or problems that might arise from this change?*

CHRISTOPHER Like any solution, there is always an issue at some point. In this case, the problem many people and politicians seem to have is that a significant amount of jobs are to be lost in the transition to these new industries... but studies actually show the opposite. Renewable energy jobs are on the rise despite the global pandemic in 2020. The transition from nonrenewable energy is going to be difficult, but in the end, it seems to be the most cost effective for the economy. In fact, it actually has more of a net gain on the world rather than a negative one. With multiple forms of renewable energy being available and their jobs constantly rising, the economy actually has room to grow.

MODERATOR *Is there any proof of this opposite effect compared to the doubt of the transition to renewable energy because of climate change in the economy?*

CHRISTOPHER Yes, in fact, an analytical job creation model produced by University of California, Berkely, for the U.S. power sector from 2009 to 2030 was created in order to find the differences in job production between renewable and nonrenewable energy. As a result from the previously mentioned model, the evidence

On average, one pound of beef requires nearly 1,800 gallons of water and large amounts of pasture for feeding.

presented "all non-fossil fuel technologies created more jobs per unit energy than coal and natural gas" (Wei, M., Patadia, S., & Kammen). Not only that, but the same model also measured that over 4 million full-time are to be created by 2030 in the United States as well. To make matters even better for renewable energy, investments into it have skyrocketed. I mean, if you look at the numbers Statista.com put up, in 2019, investments reached "59 billion U.S. dollars compared to 11.3 billion in 2005" (Jaganmohan). Overall, renewable energy is on the rise and the industry is growing; the benefits from it like job growth and reducing climate change is something to take notice of.

MODERATOR *With time running out, what can be done to help the effects of climate change and the everlasting consequences it will have?*

ABBY With the climate change issues being on the rise and time seemingly "running out" it is now more than ever important to educate everyone about the ongoing issue. With climate change being a problem veering toward major issues affecting the economy in the near future, it is imperative that upcoming generations are educated on what, how, and why the everlasting effects of climate change can have altering effects on the economy and the world.

It is time to take a push into a better society filled with educated students that can be involved in not only knowing about the changing climate but how it can alter everyday factors such as the economy.

MODERATOR *How can this be done?*

ABBY The diagnostic of strategizing a plan on how k-12 curriculum embodies a clear education source for young minds about not only what climate change is, but action and justice to withhold a better state of living, is in the hands of policymakers to transform the education system to fit these changing times.

As stated in, *How can we implement education for climate action and climate justice?*, "Specific to the incoming Biden administration, these approaches could also help guide U.S. bilateral assistance in education, especially girls' education and gender empowerment, as well as U.S. technical assistance to countries in need of support achieving their own climate strategies." With the new Biden Administration coming into office, it is now a perfect time for change of curriculum to be implemented in schools, as it is time to

take a push into a better society filled with educated students that can be involved in not only knowing about the changing climate but how it can alter everyday factors such as the economy.

MODERATOR *How does the idea of further implementation of climate change education relate to the topics mentioned earlier?*

ABBY William's mentioning of the Paris Climate Accord, is a clear example of a way students should be allowed the opportunity to fully understand what government policies are being placed and enforced and therefore have the opportunity to use that knowledge to create further solutions and the ability to adapt to the changing economy. As well as bouncing off of Christopher's idea of the increasing renewable energy jobs being on the rise, it is just as important for students to understand the many jobs out there that are being created.

MODERATOR *Wow, very informative of you Abby and thank you so much for speaking, as to all of the other speakers as well. It seems that climate change is starting to have drastic effects on the world everywhere we turn, like the environment or the economy. It is imperative that we look forward to advancing into a world where the effects of climate change are truly seen, and that the economy and the world are feeling its impact. Thank you everyone for listening, and make sure to vote on next week's topic. Thank you and stay tuned to Money Talks on 106.5 lite FM.*

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Climate Change Has an Effect So Real, You Can Taste It: The Impact of Climate Change on Small Businesses Within the Apple, Maple Syrup, and Tomato Industries

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CITATION STYLE
MLA 9th Edition

AL LANSING "Small farmers have to be a chemist, a biologist, an ecologist, and an accountant all in one."

ANINA Al Lansing is a small farm owner from Colonie, NY, and he's a prime example of how small farms have struggled to keep up with rising costs associated with climate change.

GRETA Today we are going to examine tomatoes, apples, and maple syrup, and how the people who dedicate their lives to cultivating these delicious products are attempting to tackle the global issue that is climate change.

LUCY We took a hyper-focused look at some of the most beloved products in our community, evaluated how these producers have been impacted and examined how climate change may impact them in the future. We're going to start with maple syrup, which is commonly

found in the northeastern United States, specifically in New York.

ANINA According to the Vermont Agency of Agriculture, Maple Syrup is a $686 million industry in the United States. As any New Yorker knows, Maple Syrup fresh from your local sugar shack beats the store-bought brand any day. Unfortunately, this branch of the agricultural sector is especially affected by changing temperatures and extreme weather patterns associated with climate change.

GRETA Could you tell us a bit about how climate change and changing weather patterns have affected the maple syrup industry?

ANINA Yes. Ideal sap collection times for maple syrup require warm days and freezing nights. This allows for the sap to go through a freeze-thaw cycle suitable for maple syrup. However, due to warmer weather, the regions with these ideal temperatures are steadily growing more north, putting many maple syrup producers south of New York out of business. Earlier, West Virginia used to be a huge producer of maple syrup. However, now their average temperatures are not suitable for wide-scale production.

LUCY I remember seeing a map that shows the change in the Maple syrup production area and how it has changed over time, and it's pretty drastic. I also think maple syrup is something almost every American adores, but I don't think it's an industry that people realize has had to adapt to the effects of climate change.

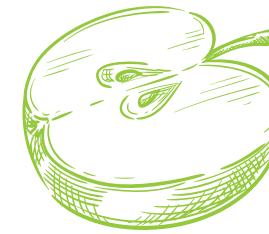
ANINA Yes I agree, and I think learning a bit about how the industry has adapted over time, and how it will need to adapt in the future is important. I interviewed Erich Ruger, the owner of a small local maple syrup farm near me called Sugar Oaks Farm, to get a better understanding of the effects climate change has on the industry. He said that he began his business with his son and that it brought his entire family together, becoming an essential part of his life. Ruger mentioned that the maple sap harvesting season is already short, at around 6 weeks, usually during March to April, but in recent years, due to warmer weather patterns, it has shifted to February and March and the season is much shorter at 3-4 weeks. Other farms around the northeast have experienced the same thing.

GRETA It's really amazing how much climate change can impact a growing season. At your interview did he mention any solutions that

can be used to combat this?

ANINA Yes, Ruger said that larger farms have had an easier time adapting to the effects of climate change because they have the capital to invest in equipment such as the reverse osmosis machine, which makes the sap run for a longer period of time. But smaller farms have a hard time accessing this equipment because it's so expensive. One reverse osmosis machine can cost 30,000 dollars. This is just the raw price of the machine which does not include labor, energy/fuel, land, maintenance, and building equipment costs. For a small farm, it's just not affordable or sustainable. The need to keep investing capital for this expensive technology is a long-term investment. Without huge profits to support this ongoing cost, it is not in the best interest of small farms to maintain this equipment.

GRETA The $343 million New York apple sector (New York Farm Bureau) is experiencing similar trends. While overall harvest amounts are expected to trend upward despite changing temperatures and extreme weather patterns associated with climate change, this data incorrectly reflects the burden that small farms carry.



ANINA What do you mean?

GRETA Well, technology has advanced to help fight climate change but the cost of these solutions is greater than what many small-scale farmers can afford resulting in a poorer harvest for smaller farms. This isn't present in USDA overall harvest predictions because bad harvests in one area are offset by good harvests in another, with large harvests from larger farms that can afford innovative equipment. This figure then cloaks the disproportionate effect that changing weather conditions will have on small farmers.

Well, technology has advanced to help fight climate change but the cost of these solutions is greater than what many small-scale farmers can afford resulting in a poorer harvest for smaller farms.

ANINA The maple syrup industry has noticed the same thing. The industry has been able to keep up with the effects of climate change for the most part; bigger farms, that is.

GRETA Has the industry noticed changes in pricing as a result?

ANINA Maple syrup was already a fairly expensive product. Allison Hope reported to Saint Salbans messenger in 2019, that maple syrup

farms in Vermont had only produced 40%-70% of their usual amount of maple syrup. With the decline in maple sap collection suitable for maple syrup, it will be harder for farmers to meet demands in the consumer market. Every year maple syrup prices have been rising due to the growing scarcity, as well as unmet labor needs.

GRETA Apples are experiencing the opposite trend: production costs are increasing while prices remain consistent. This makes it extremely difficult for small farmers to turn a profit. If they raise prices consumers are more likely to buy the often cheaper imported apples. If they keep prices the same there is only a limited profit. It is not a feasible system in the long term. I interviewed Isabel Prescott, the owner of Riverview Orchards which has been in her family since 1944, and she summed it up perfectly, saying, "There has often been a very slim margin between profit and loss, and any additional risk, climate change or otherwise, can put farms in jeopardy."

By 2050 due to the 1.5-degree Celsius global increase in temperature, seven of the top 29 tomato-producing countries will become 30 to 100% unsuitable for tomato growing.

LUCY It's disheartening how much climate change threatens the livelihood of small-scale farmers.

ANINA It really is. In a study that highlights the disproportionate struggles that smaller farms face, a report on the economic contributions of the maple syrup industry, from the University of Vermont, found that smaller farms experienced the largest overall decrease in production out of maple syrup farms in Vermont. Maple syrup farms that have 0-499 sap taps, reported that they, on average, saw a 22.7% decrease in production annually. On the other hand, bigger farms that have 5,000 taps or more, saw an average decrease of production of only about 4-5%.

GRETA Over two thousand New York farms with apple orchards closed from 2012-2017, a 6 percent decline in the state (Newburger). This decline was accompanied by a 71% increase in the number of extreme weather events that occurred in the Hudson Valley, the area where 22% of New York apples are produced (Newburger).

LUCY What weather events have harmed the apple industry and what can be done to protect crops?

GRETA Not much can be done to protect against extreme weather events like hurricane-level winds, or massive thunderstorms. However,

the silent killer of a good percentage of the apple harvest is frost. According to Mark Longstroth from the Michigan State University Extension, one day with a freezing temperature of 28 degrees Fahrenheit after budding can result in a 10% loss of the crop. A freezing temperature of 24 degrees Fahrenheit can result in a 90% loss. A variety of combative strategies proposed to limit the damage all require different amounts of investment capital which results in varied feasibility for different levels of farmers.

LUCY Al Lansing, who you heard at the beginning, transitioned his farm from growing vegetable crops in-ground to growing them in semi-permanent greenhouses called high tunnels. What specific strategies have been proposed to fight problems caused by extreme weather in the apple industry?

GRETA To insulate the blooms from record-high temperatures it is recommended to spray water during high-risk times. This option is limited for many farmers due to the need for large water tanks and spraying equipment. Costs of these tanks range from $200 for a 275-gallon tank to $40,000 (Isabel Prescott) for a 50,000-gallon tank (National Tank Outlet). Depending on the size of the farm, this just isn't sustainable for a long-term investment. The same is true for cold temperatures; Isabel Prescott had no harvest in the fall of 2012 after early warm weather led to early blooms that were killed by a series of frosts. Many large farms purchased wind machines after the event to ward off future losses but haven't used them enough since to recoup the cost of their investment. Here are her own words: "Even though I feel great concern for the possibility of another year without apples, with its exorbitant price tag, it has not been practical for me to purchase a wind machine"

ANINA Yes, hearing that from a small farm owner really exemplifies how much of a trade-off there is between an economically sustainable lifestyle or affordability for small farmers. It demonstrates how not being able to purchase this expensive equipment to combat the effects of climate change, can put small farms in a constant state of worry as to how much product they will yield.

LUCY Are the limited number of apples that survive these temperature changes affected in any way?

GRETA Yes, often the central flower of an apple flower cluster is

called the king bloom. These buds usually create the largest and most desirable fruit but they are also the most vulnerable to frost. A frost of 28 degrees will most likely affect the king blooms and leave the smaller blooms. This still results in a decent yield and a reasonable profit for the farmer in question but means that the most flavorful apples will not be for sale.

LUCY Tomatoes have similarly suffered. Higher CO2 levels have messed with tomatoes' sucrose, organic acid, and ascorbic acid concentrations. Harvesters determine if a tomato is ripe based on its color. Since the usual concentrations of these components have changed, the normal color used to judge if a tomato is ripe no longer corresponds with its maturity. So, harvesters are now picking tomatoes later than they need to, changing their flavor.

Simultaneously, the length of the growing season for tomatoes has shortened. A study based in California, which produces 95% of the United States' tomatoes, found, "a significant decrease in the number of days between transplanting and maturity, with an expected harvest 2-3 weeks earlier than normal under current conditions" (Pathak).

ANINA How will climate change affect small farmers across the world?

LUCY By 2050 due to the 1.5-degree Celsius global increase in temperature, seven of the top 29 tomato-producing countries will become 30 to 100% unsuitable for tomato growing (Litskas). Devastating effects will notably be felt in India, Pakistan, Iraq, and Mexico, which all primarily produce tomatoes using small-scale agriculture. While larger farms will be able to adapt to the new reality with new technology, small farms will be left to work it out on their own. "Tomato processors have very expensive facilities that can only do one thing," says Michael Swanson, Wells Fargo's chief agricultural economist, "If they don't want to be out of business, they will have to bid up tomatoes rather than leave facilities idle."

GRETA Just like with Isabel Prescott! Farmers have to make the tradeoff about whether to keep and purchase expensive machinery to withstand the effects of climate change or to potentially sacrifice their financial stability.

LUCY We spoke to one local family farmer, Al Lansing, about his efforts to combat climate change while still growing his business. Al

Lansing frequently takes the bet when it comes to investing in new technology.

AL LANSING When I first started, July to Halloween was my window of making money...This was 1968....we can't live from July to October on [that] income. So, I said, we can back up and we'll start in June... raising strawberries, so now [we sell from] June to October...[but] I had old equipment, so [I had] to upgrade, [I had] to keep reinvesting. So I looked at the equipment, I looked at the cost of new equipment, and I said it's not going to cut it. So we started with one greenhouse for flowers, thinking, oh, well, now May! Now we're from May to Halloween trying to support a family. And that money just didn't stretch. So then, you keep thinking, because farmers are always thinking...We started putting up high tunnels...[which] allow us to extend our growing season. Now we start harvesting in April, lettuce, and things like that. We [started] planting tomatoes indoors [in high tunnels]. With the high tunnels [we've] now extended our growing season to Thanksgiving. So that puts us now opening the week before Mother's Day and we close the day before Christmas.

Our examination of the effects of climate change on the maple syrup, apple, and tomato industries can serve as a broader example of the effects of climate change on the agricultural sector and how smaller businesses and farms have had to fight the economic burdens that come along with climate change.

LUCY Al Lansing's commitment to maintaining his family farm, a local institution since 1788, has been uniquely shaped by his own desire to remain at the forefront of cutting-edge technology. This approach is admirable but not feasible for all farmers. While other farmers may be taking other approaches, all exemplify the drive that small business owners have to continue to fight for their livelihood and position in their communities, while battling changing growing seasons and extreme weather patterns.

GRETA The struggle of small farms due to climate change is often overshadowed by the success of the larger agricultural industry as a whole. Here's Isabel Prescott: "The overall concern as illustrated in New York State alone, is that over a quarter-million acres of farmland were lost to development between 2001 and 2016 as New York farmers were unable to stay in business. As climate change becomes [our] reality, the impact on our nation could become devastating."

ANINA The maple syrup industry could lose up to $2 trillion per year

at the end of the century (Conte); a large portion of that loss coming from smaller businesses. It is crucial that smaller farms are protected because their decline would be a huge loss to the industry as a whole as well as local communities that rely on them.

LUCY Our examination of the effects of climate change on the maple syrup, apple, and tomato industries can serve as a broader example of the effects of climate change on the agricultural sector and how smaller businesses and farms have had to fight the economic burdens that come along with climate change.

ANINA We hope that the next time you go out grocery shopping, you choose to support your local small farm. Engaging with local businesses as they host educational events, festivals, or even just picking up tonight's dinner, all help farmers contend with the economic burdens associated with the climate crisis.

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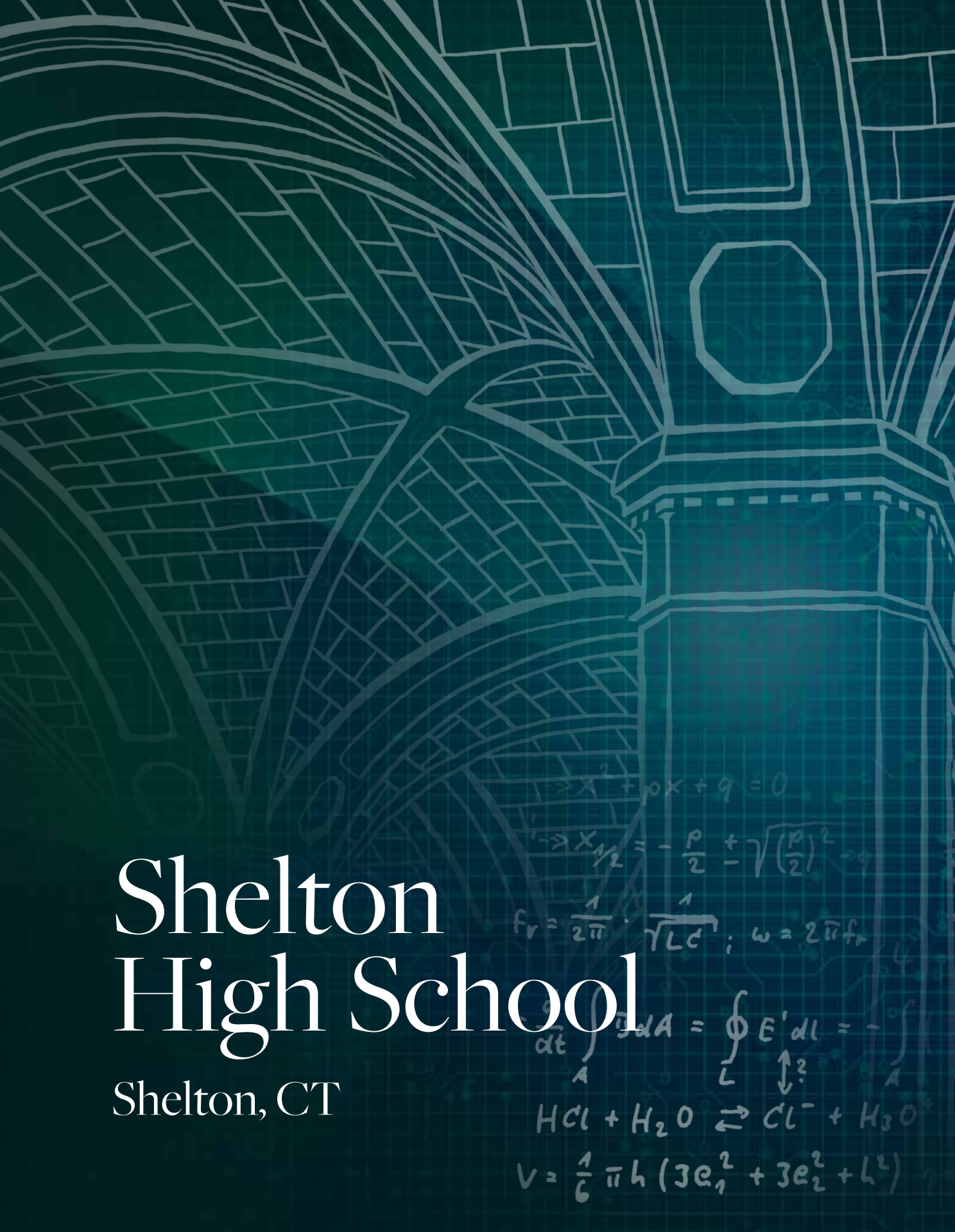

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Making It Rain: How a Green Future and Healthy Economy Can Coexist

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CITATION STYLE

MLA9 Format

EILEEN Hey, I'm Eileen.

RIA Hi, I'm Ria. Welcome to Making It Rain—

EILEEN —How a Green Future and a Healthy Economy Can Coexist

RIA Today we'll be talking about an extremely relevant topic: climate change. Or, more specifically, the economics surrounding it.

EILEEN That's right. We'll be delving into the current impact climate change is having on our economy and some potential solutions.

RIA Is a sustainable environment and productive economy possible? Let's find out.

EILEEN So as a society it is very clear that we are heavily dependent on fossil fuels. We use them in our cars, to heat our homes, provide electricity, power manufacturing, and so much more.

RIA And so the question is, what happens when we run out of fossil fuels?

EILEEN Once they run out and we don't know when this will happen our demands for energy will be unmet. The amount of renewable energy the U.S. has right now is not enough to fulfill the role of fossil fuels if they were to run out.

RIA That would be devastating to the economy.

EILEEN Exactly and the economy will be hurt by fossil fuels even before we run out.

RIA Would that be because of climate change?

EILEEN Yes, if we keep using fossil fuels at the rate we are now, the resulting climate change will be very devastating. With warmer temperatures, there will be lower crop yields, more extreme weather, and rising sea levels. The lower crop yields would deal a huge blow to the economy. Not only would the farming industry be hurt, but everybody would be hurt from the lower supply of food. The extreme weather and rising sea levels would damage houses, roads, and other infrastructure.

RIA This extreme weather would hurt the human population as well, right?

EILEEN Exactly! The World Health Organization estimates that climate change results in 150,000 deaths per year with that number increasing significantly as temperatures continue to increase. This loss of human life would lead to many jobs remaining unfilled for an uncertain amount of time until people can be hired to fill them.

RIA It would be very difficult to run an economy when there are significant job losses. Is climate change the only reason that fossil fuels are unsustainable?

EILEEN Climate change is not the only reason that fossil fuels are unsustainable. The dependence the U.S. has on other countries is a huge issue.

RIA The U.S. relies on OPEC nations like Saudi Arabia, Iran, and Iraq for a significant portion of our oil.

EILEEN Yes, they supply about 11% of U.S. oil (U.S. Energy Information Administration – EIA – Independent Statistics and Analysis) and the issue with that is these countries tend to be politically unstable. This instability as well as possible links to terrorist organizations raises national security concerns which makes it risky to depend on them for oil. If issues arise and the OPEC nations no longer export oil to the U.S., the amount of oil in the U.S. would take a huge hit.

RIA If the U.S. has less oil, it would be more difficult to fulfill all of its roles in the economy. Prices in the economy would also increase significantly.

EILEEN Yeah, that is an issue. However, maybe the real issue is our reliance on nonrenewables in the first place. If our economy did not rely so much on using up resources, then it could potentially avoid all of these issues. I was reading about how Sweden is one of the leaders in the fight against climate change—they actually passed the first environmental protection act—and I saw something about how they are currently in the process of switching to a circular economy.

RIA A circular economy? What's that? I'm not sure I've ever heard about that.

EILEEN Well, I'm glad you asked that since that is the same exact question I had upon reading that. So, I then went down an hour-long rabbit hole, as you do, on what a circular economy really is. Basically, a circular economy differs from our current economy in that nothing is wasted. Instead of throwing a product out, its materials are put right back into the economy and it is used to make a new product. For example, rather than throw away old clothes, they may be ripped up and used to create insulation.

RIA Oh, so kind of like reduce, reuse, recycle?

EILEEN Exactly! A lot of circular economy stems from those ideas. In fact, there are three main principles of what makes a circular economy: make sure waste is not part of the production process, keep materials cycling through the economy, and support nature's own systems. About 7.6 billion tons of industrial waste are produced annually in the United States alone according to the EPA's Guide for Industrial Waste Management. That's a lot of trash and that trash is not doing any favors for the environment. Waste has the potential to pollute the environment, causing species to die out due to contamination. These toxins can even bioaccumulate through the food chain, possibly even eventually poisoning humans as with mercury. So, if the process from the beginning is designed in such a way as to minimize or eliminate any waste, these sorts of problems will start to disappear.

RIA Okay, that makes more sense. I think you explained the next principle a little earlier. If the first principle is like the "reduce" part of the three R's, then the second principle is akin to the "reuse" and "recycle" parts.

EILEEN Yeah, you are totally right. In a circular economy, there is a slight change in vocabulary that makes all of the difference. The word "user" is used in place of "consumer." This small distinction reflects the very ethos of the circular economy. People should not consume products, meaning that they throw them out after they are finished with them, rather products should move through the economy with people using them for limited amounts of time when they have a need. There are two main cycles of the circular economy: the technical and biological flows. The technical flow contains materials that don't biodegrade easily and have to continue to cycle through the economy. With the biological flow, products derived from organic materials are continuously used to make other goods until they deteriorate down into their base nutrients, at which point they are used to fertilize the ground.

RIA I suppose that is a bit like composting where what would just be thrown out is instead used to enrich the soil.

EILEEN Yeah, I didn't really think of it that way. Only, instead of just food, its old fabric and wood products that are also being composted. That segues nicely into the last point: helping to restore nature and its systems. According to the Ellen MacArthur Foundation, around the world, land degradation costs forty billion dollars every single year. A circular economy aims to fix that by reintroducing nutrients into the soil, creating acres and acres of land that can be used for other purposes, like farming.

RIA One question I have hearing this is just how is this type of economy better than one we have now, aside from its environmental impacts?

EILEEN Unlike our current linear economy, a circular economy tends to have lower production costs as companies are not relying on virgin materials. Virgin materials, of course, being any resource harvested straight from the environment. Products that people tend to throw usually still have working parts that can be used to make new ones. If these parts are reused, manufacturers will theoretically save money as they do not have to pay the costs required to harvest all of

the materials from the Earth. In addition, new jobs will be created as there will be a whole industry needed to handle the logistics of sorting through used materials and sending them to the correct factories to be put into new goods.

RIA If the circular economy is so great, are there any countries that have currently adopted it? Why am I only hearing about it now?

EILEEN There are quite a few European countries currently trying to transition to a circular economy, like Sweden and the Netherlands; however, no country is a pure circular economy. One reason for this is that in order for this sort of economy to succeed, there has to be a systematic change to how a country works. This sort of process takes time and countries have only recently begun adopting these environmental principles. Another issue is that the circular economy is very idealistic at the moment.

RIA Yeah, while it does sound great at first, I just don't know how it would be realistically implemented, especially in a country like America. I mean, we really love to consume goods and I doubt that people would be so willing to accept such a drastic change to their lifestyle, even if it was for the environment.

***About 7.6 billion tons of industrial waste are produced annually in the United States alone according to the EPA's* Guide for Industrial Waste Management.**

EILEEN I do agree with that point. Additionally, there is a substantial lack of information surrounding the circular economy. For example, the increased prevalence of fracking in the United States has gone a long way towards decreasing the price of oil. Since a lot of resources are still required for recycling, this means that making plastic from virgin materials tends to work out to be cheaper than recycling it. How exactly would recycling everything entice companies if it costs more money? Then again, perhaps a more efficient recycling system could be devised.

RIA But, recycling is still better than just throwing it out as trash for both the economy and the environment. After all, recycling creates seventy times as many employment opportunities compared to landfills and incineration, which can end up polluting the environment. Anyways, as much as the idea of a circular economy is appealing, it seems like the idea still has a while to go until it can be the answer to all of our environmental problems.

EILEEN I guess we'll just have to see how it plays out in Europe first.

RIA In the meantime, let's talk about some possibilities for a green future that doesn't require reworking our entire economic system. Ideally, the most effective environmental policy would be easy enough for the majority of the country to adapt. A popular suggestion has been taking advantage of the myriad renewable resources available to us. However, renewable resources being available is only half the battle; incentivizing these sources is important.

EILEEN It's all about getting systems in place that work!

RIA Something like cap and trade can help regulate and manage carbon alliances and emissions. Having companies need to "trade" stock in carbon emissions serves as an incentive to lower emissions to save money. The "cap" only will allow a fixed and controllable amount of carbon into the atmosphere.

EILEEN Slowly lowering the cap over time can also help lower and manage carbon emissions altogether.

RIA Lowering greenhouse gas emissions like carbon is vital for both the atmosphere's and the ocean's health. A company that does environmental impact data for companies, the Carbon Disclosure Project, found that of most greenhouse gas emissions, excluding some sources of agricultural methane between 1988 and 2015, 71% came from 100 fossil fuel producers, including emissions used from those companies by consumers. We are actively damaging the ozone and the ocean with these high levels of carbon dioxide we produce. Regulation is a start we need to take to have responsibility for environmental destruction.

EILEEN Wow, that really shows how much of a change can happen if we start to truly regulate emissions and encourage the use of alternate and sustainable power sources.

RIA The heart of the matter is that the carbon regulating process leg cap-and-trade is not possible without having alternative power in the form of renewable energy.

EILEEN Renewable energy sources like solar, onshore and offshore wind, geothermal power, and low-impact hydroelectricity can greatly

defer the reliance of fossil fuels. Not only will switching to fossil fuels create a more green sustainable future, they will also provide more infrastructure and jobs now.

RIA The benefits of going sustainable connect in a couple of ways first, building new renewable energy is cheaper than running existing coal plants, and second, research from Energy Innovation and Vibrant Clean Energy (VCE) shows that America has reached a turning point. Their data show that by 2025 almost every existing Coal Energy plant will cost more than building and operating replacement solar and wind powered energy within 35 miles of each plant. It's inevitable that sustainable resources will become the most affordable resources.

EILEEN Renewable energy is also helping the workers. E2's clean jobs America report found almost 3.3 million Americans working in renewable and clean energy. Clean energy workers outnumber fossil fuel workers 3 to 1. Especially since green energy is only expanding, job opportunities will also continue to expand.

RIA So, in the long-term, going with clean, renewable energy is only going to help the economy as a whole?

EILEEN Yes! While some industries will be disrupted during the shift, our economy and our environment will be much healthier.

RIA Not only will a focus on green energy help our economy, it will frankly mitigate a quickly approaching humanitarian crisis with the changes in weather and sea level. I would imagine a worldwide crisis will do much more harm to the economy than switching our main fuel provider.

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Metaverse Virtualization As a Solution for Climate Change

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CITATION STYLE

MLA Handbook, 9th ed.

JULIAN What if I told you that you can help save our warming planet, just by staying home? Welcome back to Economic Issues Crystallized, a podcast concerning the most pressing issues in society and potential economic solutions. I'm Julian Weng, your host, and I'm here today with climate change expert Peeta Thunberg and metaverse engineer Tom Bowie. Today, we're going to be discussing how the metaverse can help stop climate change.

PEETA Hi Julian, thanks for having me.

TOM Same here.

JULIAN Let's get started. Climate change is obviously a serious threat to our world as we all know. Can you briefly reiterate what's at stake if we don't find a solution?

PEETA As you might know, climate change represents an existential threat to humanity. Man-made carbon emissions lead to global temperature increases, which directly cause rising sea levels and an increase in the frequency of natural disasters.

JULIAN Tell me more about rising sea levels. Why would it be a bad thing if my upstate New York residence turns into a waterfront property?

PEETA Not funny. According to the National Oceanic and Atmospheric Administration (NOAA), coastal counties in the U.S. produce over

$9.5 trillion annually in goods and services, employ 58.3 million people, and pay $3.8 trillion in wages ("Economics and Demographics"). For reference, the 14% of U.S. counties bordering the coast produce 45% of the nation's GDP ("How Important"). Of course, these counties are at greater risk of flooding due to climate change.

JULIAN Okay, okay, I got it. What about natural disasters in general?

PEETA Extreme floods, droughts, and hurricanes will significantly increase in frequency. According to NOAA, the average number of disasters with costs exceeding 1 billion dollars in direct damages per year increased from 2.9 in the 1980s to 18.7 between 2019 and 2021. ("Billion-Dollar Weather").

JULIAN But how severe are the economic impacts of a changing climate beyond property damage?

PEETA We can use flight delays as an example of what disruptions to all forms of transportation might look like. The Center for Aviation predicts that changes in precipitation and storm severity will increase disruptive delays and cancellations. A 2013 study claims that these flight delays have the "indirect effects of lost labor productivity for business travelers, an opportunity cost of time for leisure travelers, and changes in consumer spending on travel and tourism goods and services" (Peterson et al. 109). Reducing flight delays by 10% would add $17.6 billion in utility to the economy, and $38.5 billion given a 30% reduction (Peterson et al. 120). For reference, $38.5 billion is more than the annual net profit of every commercial airline in every year since 2006 (Mazareanu).

JULIAN Cool. Now that we know a little bit about the stakes here, what are some major sources of carbon emissions?

PEETA The transportation sector is massive. It's the single largest contributor to U.S. greenhouse gas emissions according to the Environmental Protection Agency (EPA), making up 29% of all emissions in the nation and 16.2% globally, with 70% of that coming from road transportation ("Sources Greenhouse Gas Emissions").

JULIAN Interesting. So why not just use solutions such as electric vehicles, for example? Wouldn't making physical transportation greener be enough?

PEETA To be frank, these solutions don't solve the issue.

JULIAN Hi Frank, I'm Julian
Frank/Peeta: ...

JULIAN Sorry, go on.

PEETA Anyway... There's only so much we can do to make physical transportation more efficient. Electric vehicles, for instance, represent a step in the right direction. However, it's simply not viable to replace all gas cars, which make up 97% of all cars on the road in America (Domonoske). This would be even harder in emerging economies, with their growing middle classes becoming able to afford more gas cars.

JULIAN Okay, let's say, theoretically, electric vehicles become as cost-efficient as gas-powered vehicles. Then what?

PEETA Well, no matter how many advancements are made in fuel efficiency, you would always need a certain amount of energy to move a heavy object from one place to another. This energy would most likely come from burning fossil fuels. A New York Times article predicts that our electricity usage would increase by 25% if everyone drove an electric car (Plumer). Currently, 80% of all electricity is produced by nonrenewable means, which might only increase if we are suddenly required to produce that much more of it ("Frequently Asked Questions").

JULIAN Thanks for your input. Do you think that an emerging technology like the metaverse would be any different?

PEETA I'm no expert, but I would think that it is certainly more realistic for people to use electronic devices they already have and small add-ons like VR headsets than to buy a Tesla. The electricity needs of the metaverse's computations can be optimized extensively over time, computation doubling in electrical efficiency since the 1940s, while there is little evidence of any physical car being optimized to the same extent (Koomey).

JULIAN Speaking of a metaverse expert, let's turn to you for a second, Tom. What is the metaverse anyways?

TOM Its textbook definition is a "vision of an immersive Internet as a gigantic, unified, persistent, and shared realm" (Lee et al. 1). Essentially, the metaverse allows what are typically seen as in-person activities to instead be done virtually in an all-inclusive, second digital world.

JULIAN So... what can we do on it exactly? Have we seen this sort of thing in action yet?

TOM Yeah, this question has become increasingly relevant over the last two years. Conducting social activities from home has been a phenomenon for far longer in the form of immersive massively multiplayer online video games. However, the pandemic has pushed many more parts of our lives into the cloud. We saw remote working in record amounts, where many saw the potential for a richer and more productive workday in a daily commute from their bedroom to their home office or living room. Concerts, college tours... as well as any sort of recreational activity that could be virtualized turned virtual over the last two years, not to mention schooling by Zoom video calls.

JULIAN This all sounds very interesting. What do you think the future economic implications could be for this?

TOM The metaverse is the next step in this existing trend of virtualization. As technology becomes more and more immersive and convenient for the average consumer, it will start to replace expensive, inconvenient, and carbon-intensive physical activities as part of what we call the "experience economy," the buying and selling of experiences (Yaffe et al.). For instance, someone might choose to experience a virtualized, realistic tour of Rome rather than traveling to Europe, or attend a virtual concert instead of going to see Travis Scott live. Obviously, using electronic devices uses electricity, but we can measure the emissions that would be saved through the replacement of physical commuting and recreational travel, which have massive carbon footprints, to see if virtualization would be worth it.

JULIAN Thank you. So, you've brought up this notion of virtualizing leisure activities such as concerts on the metaverse. Can you elaborate on how that would work, and more importantly, how that would tie back into solving climate change?

TOM Definitely. Right now, tourism contributes around 8% to the world's carbon emissions, which is a staggering figure for an activity

that is purely recreational. However, physical tourism and other recreational activities, such as concerts, can be virtualized. This past November, pop star Zara Larsson performed a virtual in-game concert in Roblox, a video game platform oriented towards younger children, attracting about 1.7 million users and making more than one million dollars in profit from merchandise (Savage). Similarly, rapper and singer Travis Scott performed to 12 million fans in a virtual concert hosted on the popular shooter video game Fortnite.

JULIAN So you mention this 12 million fan figure. It takes electricity to host and access these virtual concerts, particularly in powering your computer, video game console, or phone to be able to render them. How much would a concert like this really save in carbon emissions?

TOM Obviously, we can't say that these 12 million people would have all gone to see an equivalent in-person concert if they couldn't access one virtually. However, this concert still ultimately replaced the leisure

As technology becomes more and more immersive and convenient for the average consumer, it will start to replace expensive, inconvenient, and carbon-intensive physical activities as part of what we call the "experience economy," the buying and selling of experiences.

times of these millions of people.

JULIAN Well, what do you mean by this exactly?

TOM Well, let's extrapolate from this relatively short performance and say that Travis Scott does a follow-up virtual concert the same length as an in-person one, with multiple acts and all those perks as well. Most people who didn't spend their weekend attending this in-person concert would have done something else. Let's do some heuristic calculations.

JULIAN OK.

TOM Let's assume a solid half of these people would have done something out of the house if they were not preoccupied with this concert, a relatively conservative estimate given that it would happen during a weekend and function as an all-day event. This is 6 million people. Now, they most likely wouldn't all be doing something huge, like going to another concert per se. Let's say that the average distance traveled round-trip per person to go to this alternative activity is 20 miles, with some people taking far longer rides to attractions such as amusement parks or making multiple excursions around town while others being able to walk a couple of blocks to their destinations. These people would largely take cars, a mixture of small cars and SUVs averaging perhaps 0.60 pounds of CO2 per mile per person ("Carbon Footprint"). All in all, this would result in 72,000,000 pounds of CO2 being emitted.

JULIAN That sounds like a lot of emissions. Now, how does this compare to a virtual concert?

TOM I'm glad you asked. A computer with the requirements to power an Oculus Rift VR Headset takes 346 watts per hour to function (Binstock; "Power Supply Calculator"). While this level of computation is unnecessary to access a concert in Roblox or Fortnite for instance, we can be conservative and assume that in the future, virtual reality must proliferate to make the metaverse worth it to consumers. With an average concert being maybe two or three hours, let's round up the length to four hours including the opening act and other festivities. 12 million people using 346 watts per hour for four hours will use up to 16,608 megawatt-hours of electricity. I know, this sounds like a lot. However, given that it takes on average 1,562 pounds of CO2 emissions to produce one megawatt-hour of electricity, this adds up to only 26,000,000 pounds of CO2 total produced by the virtual concert ("Greenhouse Gas

Equivalencies Calculator").

JULIAN And this is compared to 72 million pounds of CO2 if this virtual concert didn't take place, right?

TOM Yep. This is roughly a 64% reduction in emissions. This model also doesn't take into account the electricity costs at in-person recreational venues as well as those from the gaming or other activities the people who would stay at home anyway would do.

JULIAN Wow. That's major. However, thinking of all the times I drive, it's mainly just commuting to and from work. I'm thinking about having to keep my computer on almost 24/7 on Zoom meetings and those electricity bills it entails. Would we really save enough on carbon emissions to justify this electricity usage?

TOM I'm glad you mentioned work. It's another area where the metaverse will have a hugely positive impact on the climate, especially as 91% of remote workers in the U.S. wish to continue to work remotely after the pandemic is over (Saad and Wigert). According to a Canadian study, the average commute distance is around 40 kilometers or 25 miles (Kwan). Let's once again assume that people would drive to work, since it is the most common form of transportation by far in the U.S. and feasible alternatives such as trains are not substantially more carbon-efficient than cars (Kwan).

With cars averaging 0.60 pounds of CO2 per mile traveled and planes averaging 0.82 pounds of CO2 per mile, this averages out to roughly 367 pounds of CO2 emitted per year per worker solely from business travel.

JULIAN Seems reasonable enough.

TOM Yep. Similarly, assuming 0.60 pounds CO2 per person per mile, a 50-mile daily round trip, and 261 working days in a year, a typical worker's commuting would emit 7,830 pounds of CO2 in a year. In addition, many workers frequently take business trips via car or air travel as part of their jobs. The Bureau of Transportation states that there are at least 405 million business trips per year, with air travel accounting for 16% of trips and personal vehicle travel accounting for 81% of trips ("U.S. Business Travel"). A typical employee takes around 0.51 trips via air and 2.58 trips via car per year, with around 127 million full-time employees in the U.S. This source indicates that the median one-way distance for business trips via cars is 100 miles while the median one-way distance for business

trips via plane is 507 miles. With cars averaging 0.60 pounds of CO2 per mile traveled and planes averaging 0.82 pounds of CO2 per mile, this averages out to roughly 367 pounds of CO2 emitted per year per worker solely from business travel ("Carbon Footprint").

JULIAN Woah. So, you're saying that the average American worker emits about 8,197 pounds of CO2 per year through work alone?

TOM Yes, though I wouldn't put it that way. Anyway, you're probably thinking about how much CO2 emissions we can save through the metaverse.

JULIAN Definitely...

TOM Assuming a typical eight-hour workday and the statistics regarding electricity usage I mentioned earlier, and that a worker clocks in the full eight hours on their virtual reality device, this would be 722,448 watt-hours in a work-year, which requires 1,128 pounds of CO2 emissions to generate currently.

JULIAN You're saying that we can cut 86% of a worker's energy consumption through the Metaverse?

TOM Of course, these numbers are mostly approximations, but if we as a society can even get close to these sorts of savings, the metaverse is definitely worth pursuing. In fact, since we didn't even factor in energy consumption at the physical workplace, savings can be even greater than what has been presented.

JULIAN I'm astounded. Thank you, Tom, thank you Peeta... I'm sure our listeners have learned a lot about how the metaverse can help fight climate change, I sure have.

TOM No problem.

PEETA You're welcome.

JULIAN *[Addressing audience]* So, what have we taken away from this? The metaverse provides a promising way to preserve the essence of our experience economy, the buying and selling of consumer experiences while decreasing climate-related negative externalities, greatly decreasing daily carbon emissions in the long run.

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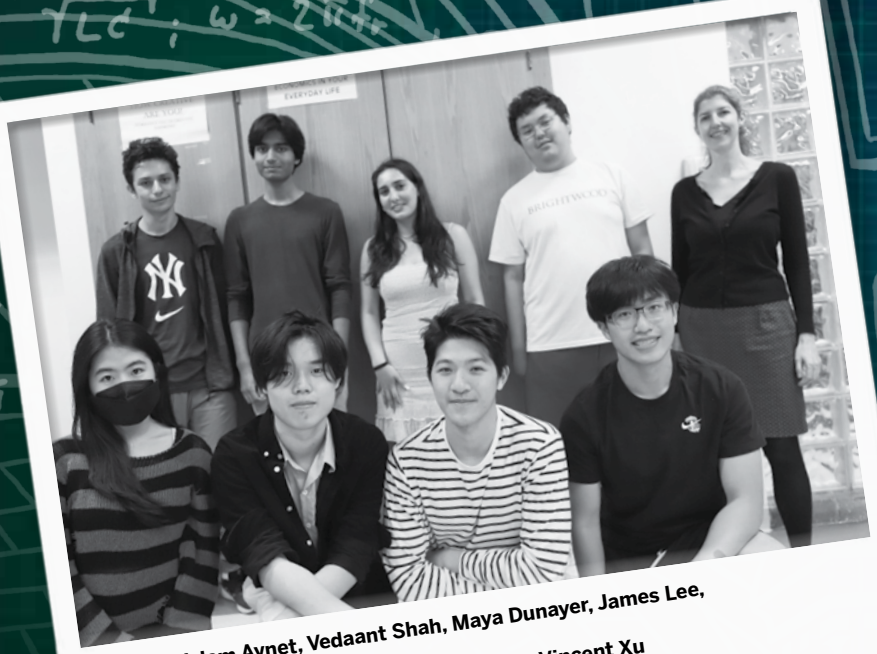

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Green Investment and Its Impact on Climate

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Introduction to Green Investment

DANIEL Welcome to our podcast episode, *Green Investment and Its Impact on Climate Change*. I'm your host, Daniel Yu, and with me is my team, Vincent, Maya, Vedaant, Priscilla, Adam, and James, to present our findings.

[pause]

DANIEL Once-in-a-century droughts, historic flooding, biodiversity loss, and the possibility of human extinction, of course, we're talking about climate change! As the public has become more and more conscious of climate change, there has been mounting pressure on governments, banks, and even Wall Street to pivot towards environmentally focused investment, aptly named "Green finance" or "Green investment."

VINCENT I have to admit, I'm a bit skeptical. Reformers have been trying for decades to change Wall Street's insatiable focus on profits and their shareholder maximization model of short-term profit and quarterly revenues. Now, you're telling me that companies have finally learned to put something else before profits?

DANIEL Well that's the question here today. Is "green" investment a cynical rebranding of the same old investment techniques, or a dedicated effort to reform Wall Street and save us all from extinction? James, I know you have a lot to say about this.

Private Investors

JAMES So, first off, there is definitely progress being made. The Climate Action Group 100, an organization of mutual funds, pension funds, university endowments, and sovereign wealth funds, has a combined 32 trillion in assets pledged to meet "green" standards. In Asia, Green investing constitutes 26 percent of the professionally managed assets. Even the E.U. has imposed sustainability and green investment guidelines ("Green asset classes are proliferating", 2018) .

VINCENT It seems there's been progress, but how exactly are green standards defined?

JAMES Good question. Firms are measured on their environmental, social and governance metrics, known as an ESG scale. They perform what is known as Socially Responsible Investment (SRI), investing only in firms that are profitable *and* advantageous to society. Many SRI's adhere to ESG standards. An example of a passive index with ESG standards is the MSCI World SRI Index, which ranks firms based on how high or low their ESG scores are. However, there is no set standardized measurement scale, so companies can select whatever ESG system they like.

DANIEL This can obviously be problematic, with different metrics scoring the same company differently. For example, Tesla, the electric car company, was rated at the top in one ESG scale, but at the bottom in another, depending on if the carbon emissions from the car factories were included with the carbon emissions from use of the cars themselves.

JAMES And that's only one of many issues with "green investment." In order to really understand what's going on, we have to look at firms' rates of return for shareholders. Taking a cynical look, the shift towards investment in environmentally friendly firms yields high returns for shareholders, as labeling a firm as ESG can make it more attractive to investors, employees and customers. Recently, the platform Goby did a survey of over 500 LP investors, and more than 450 said that ESG funds perform equally well or better than non ESG funds.

DANIEL By the way, LP investors means "limited partner" investors: investors that share ownership of a firm, but have no management power making them reliable outside sources.

JAMES Right. And it's not just LP investors. The MSCI World SRI Index has actually outperformed the MSCI World Index in Annual Performance (as a percentage) since 2007. So "green" assets appear to perform just as well or better than traditional assets.

VINCENT Sure, so the firms have better returns on investment, but what about their environmental impact? Isn't the point of climate consciousness and "green finance" to pressure companies into reforming? Not make them more money?

DANIEL You hit the nail on the head! That's the crucial issue of today's podcast.

JAMES This is a tricky question to navigate, partly because of how finance works. Let's illustrate with an example: BlackRock, Vanguard, and State Street are major firms with active investments meeting ESG standards. However, they also passively invest in indices, which are an asset bundle of shares of various firms. When a firm invests in an index, index providers have control over their investments. Many indices

include high performing companies from oil, gas, and other fossil fuel companies. However, BlackRock wants to divest from firms that get 25% or more of its profit from coal, so its passive indices don't follow this rule. For example, the S&P Global Clean Energy Index contains multiple firms (out of a target range of 100 firms) that have low ESG ratings that rank within the bottom 45th percentile ("S&P Global Clean Energy Index", 2022).

VINCENT Is there any conclusive evidence on their total impact?

JAMES On their actual environmental impact, the data is less clear. Partly, this is because of a lack of disclosure. According to the 100% Club, a nonprofit dedicated to monitoring carbon footprints, only 21 companies disclosed their full environmental impact in 2016. Furthermore, most scoring systems combine environmental, social, and governance factors into one single ESG score, so a polluting firm with stronger social policies could have a higher ESG score than a comparatively "greener" firm.

DANIEL Finally, there's the political factor. While China labels clean coal as a green product due to their dependence on fossil fuels, the EU doesn't. Also, consider the importance of state-owned enterprises, which could be substantial parts of a country's GDP and defined as a national security resource. These companies like Coal India or Saudi Aramco answer only to the government, not private investors. In fact, about 5% of firms account for about 80% of emissions ("The Uses and Abuses of Green Finance", 2021).

[Turns to audience]

DANIEL Can "green" investors really sway these monoliths? Stay tuned for the last part of this podcast where we'll cover the actions of famous firms like Chevron, Shell, and ExxonMobil. But first, let's take a look at how the government is addressing this issue.

Green Investment Banks

DANIEL We've just learned how firms can be involved in green investment and promote a cleaner and greener Earth. But how do governments help entice the private sector to invest in energy-efficiency measures and renewable energy initiatives? Let's hand over the next segment of our podcast to Maya and Vedaant, which covers green in-

vestment banks. Hey, Maya!

MAYA Hey Daniel! Governments can use publicly-capitalized green investment banks to help spur investment by private firms. A green investment bank (GIB) is a public entity that specifically facilitates private investment into low-carbon, climate-resilient infrastructure. GIBs in different nations around the world have specific goals they aim to achieve, including reducing carbon emissions, lowering energy costs, developing sustainable green technology, and other environmental objectives.

VEDAANT What kinds of projects do GIBs invest in?

MAYA GIBs generally invest in technologies that have less attractive risk-return profiles, or in companies that are on the verge of commercial viability. The State of Green Banks 2020 report found that GIBs have invested $24.5B of their own capital since their respective inceptions, and have attracted $45.4B of private co-investment. In addition, nine of these banks attracted over $2 of additional private capital for every dollar invested.

VEDAANT What do you think the benefits of GIBs are, and how can they help us promote greener investment strategies?

MAYA Though the GIB model is still a relatively new innovation, its ability to garner private co-investors has the potential to help governments and firms invest in new energy saving technologies, improving infrastructure in nations around the world, and moving us towards a more sustainable Earth.

Socially Responsible Investing of University Endowments: Trends and Impacts

DANIEL Okay, so governments use GIBs to help with the movement. What about younger generations and activist groups? Let's ask Kevin and find out. Hey Kevin!

KEVIN Hey Daniel. This is definitely an interesting phenomenon because younger generations have an often underappreciated but enormous impact such that even universities are altering their practices based on student activism.

DANIEL Can you tell us a bit more about what universities are doing?

KEVIN The U.S.'s higher education institutions have approximately $600 billion in endowment funds ("Intentionally designed endowments primer", n.d.). As a result of the "Green" movement, these university endowments have increased their focus on socially responsible investing (SRI) over the last decade.

DANIEL How so?

KEVIN Researchers analyzed over 1,000 university endowments from the National Association of College and University Business Officers surveys and found that the percentage of endowments adopting SRI policies rose from 30% in 2009 to 46% in 2017 (Aragon, Jiang, Joenväärä, & Tiu, 2019).

DANIEL That's a significant increase!

KEVIN Indeed, such an increasing trend is primarily due to student campaigns calling for fossil fuel divestment. In 2012, Divest From Fossil Fuels – Fossil Free Campaign launched a campaign calling for endowments to, quote, "immediately freeze any new investment in fossil fuel companies, and divest from direct ownership and any commingled funds that include fossil-fuel public equities and corporate bonds within 5 years." There are student-led fossil-fuel divestment campaigns on hundreds of campuses in the United States and abroad.

DANIEL What does this mean for endowments?

KEVIN A key finding is that more than 80 percent of the endowments have added environmental, social, and governance (ESG) factors to their investment policies. This is in contrast with the 2018 NACUBO-TIAA Study of Endowments, in which 249 out of 802 respondents (31 percent) applied responsible investing policy to portfolio holding.

DANIEL What's the difference?

KEVIN Before, just 26% of respondents said that they believe an SRI approach can be a source of "alpha," i.e., performance in excess of the market return. However, NACUBO found no performance difference in 2019 between those that employ SRI strategies and those that did not. I think this conclusion is what really sparked the increase in investment.

DANIEL Well, you've certainly convinced me of the power of activism to create change, but still the question remains, is this genuine?

Green Investment by Firms

DANIEL Let's see if Adam can finally answer this question through his case-specific analysis on firm behavior. Take it away, Adam.

ADAM The three largest nongovernment-owned energy firms by market capitalization are ExxonMobil, Chevron, and Royal Dutch Shell ("Largest energy companies by Market Cap", 2022). While these firms all pledge to become net-zero GHG emitters by 2050, natural gas and oil are still their overwhelming focus. Nonetheless, ExxonMobil is trying to change its reputation, with GHG emissions-reducing investments of $10 billion since 2000 and promising another $15 billion over the next six years (ExxonMobil, 2021).

PRISCILLA Doesn't this mean ExxonMobil is becoming more environmentally friendly?

ADAM While these numbers seem impressive, they're insignificant for such a giant corporation. From 2013 to 2020, ExxonMobil invested an average of $29.04 billion dollars per year in its core oil and natural gas-related operations. ExxonMobil's GHG emissions remained steady and as coal use declines dramatically, ExxonMobil sees an increase in the markets of natural gas and oil (ExxonMobil, 2021).

PRISCILLA Why does ExxonMobil produce so much gas and oil?

ADAM The argument is that world energy demand will greatly increase in the future, and that the renewable energy sector can't fulfill this greater demand. Unless incentive structures or profitability changes, energy firms will continue to produce oil and natural gas, and the world will continue to rely on fossil fuels.

PRISCILLA What about other major energy firms?

ADAM While Chevron and Royal Dutch Shell have both decreased investment, Chevron's emissions have been steadily increasing from 2011 to 2018. The brief decline in GHG emissions from 2018 to 2020 is promising, but largely due to COVID. On the other hand, since 2013, Shell has followed its promise of decreasing oil production 1-2% per

year for the foreseeable future (Shell, 2021).

PRISCILLA Why was Shell, but not Chevron or Exxon, able to divest?

ADAM As a significantly smaller company than Exxon or Chevron, Shell can more easily pivot to producing different forms of energy. So it seems each firm's actions are case-specific, but on the whole, their actions are resistant to change, likely because they want to maintain profit.

Conclusion

DANIEL Truly, this has been fascinating, but what's the takeaway?

PRISCILLA "Green investment" covers a wide range of actors, including private investors, green investment banks, university funds, and firms themselves. At the very minimum, green investment has been profitable and is soaring in popularity.

We hope that more research and data on green ESG standards will be collected to better understand the environmental impacts of investors, green banks, university funds, and firms.

VINCENT While ESG strategies may not have negatively impacted returns, this is no guarantee that they've had a measurable impact on emissions.

ADAM With the rise in popularity of investment indices and increase in demand for oil and gas, a world in which large firms and indices invest and produce in environmentally friendly ways seems unlikely in the near future.

MAYA While this is true, not all hope is lost. Many smaller firms and universities are profiting from socially responsible investment.

VEDAANT We hope that more research and data on green ESG standards will be collected to better understand the environmental impacts of investors, green banks, university funds, and firms.

DANIEL Ultimately there's no time to waste. While collecting data is critical, it's imperative that policymakers and individuals help in the implementation of greener technologies and initiatives as we're all players in the war against climate change. If we take too long,

no amount of green investment would reverse the impacts of climate change. Therefore, regulations are needed to force companies to back-up their talk with action. This is Daniel and the crew, signing off.

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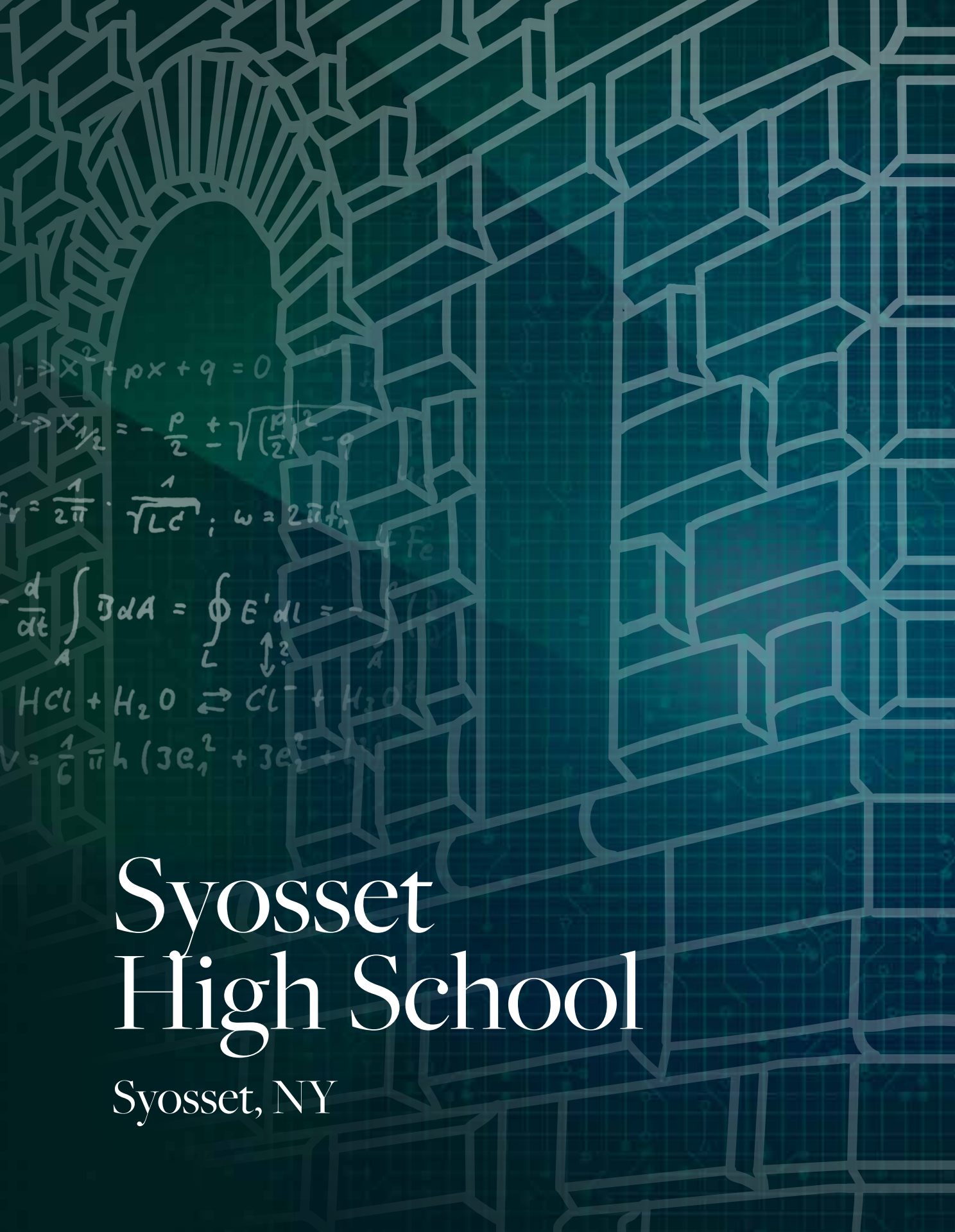

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Overcoming the Challenges of "Greenwashing" to Promote a Sustainable Economy

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CITATION STYLE

APA, 7th edition

HOST Hello and welcome to *Econ Teen Talks*. I'm your host, Mr. Green. In today's episode, we will be talking about overcoming the challenges of "Greenwashing" to promote a sustainable economy. What is "Greenwashing"? Stay tuned and you'll find out soon... Our first guest is Gro Harlem Brundtland from Norway. She is well-known for chairing the Brundtland Commission, which was an organization created by the United Nations in 1983 to identify worldwide environmental problems. Ms. Brundtland, can you please share a little about your work?

BRUNDTLAND The Brundtland Commission published "Our Common Future" in 1987, which was an extensive report created by experts around the world to highlight the conflict between global economic growth and increasing ecological degradation. The Commission is known for establishing the most commonly used definition of sustainability. The report states that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Hinrichsen, 1987).

HOST Thank you Ms. Brundtland for providing us with an explanation of sustainability. I would like to invite our next guest to talk about one of the biggest environmental problems that the world faces today, which is climate change. Let's welcome world-renowned scientist Michael Oppenheimer, a pioneer in climate research.

OPPENHEIMER Since the mid-19th century, scientists have observed a global warming trend attributed to the "greenhouse effect,"

The interview portrayed in this paper is a product of the authors' imagination. While the interview may reference actual people, the subject matter and language attributed to those people is entirely fictitious.

which results when certain gases accumulated in the atmosphere block heat from escaping, resulting in climate change. On Earth, human activities such as transport, agriculture, and power generation burn fossil fuels, which causes massive gas emissions. 2018 IPCC special report, *Global Warming of 1.5°C,* assessed that current emission patterns could lead to warming to 1.5°C by 2040. The report highlighted the serious risks of global warming beyond 1.5 degrees, which include "intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity." And the latest 2022 IPCC Sixth Assessment – Working Group 2 special report concludes "that enough measures are not being taken to halt global warming and the adverse impacts of climate change are far more widespread and negative than expected." The assessment confirms that climate impacts will become irreversible unless the global emissions are reduced rapidly.

HOST Thank you very much for your warning on climate change. Next, I would like to introduce our next guest, William Nordhaus, a professor at Yale University who received the 2018 Nobel Memorial Prize in Economic Sciences. Can you please talk about the effects of climate change on the economy?

NORDHAUS A report published in 2018 called the Fourth National Climate Assessment gave a serious warning that global warming would seriously disrupt the US economy. Cho (2019) states that the "physical effects of climate change such as an increase in natural disasters and rising sea levels would damage property, weaken essential infrastructure, impact human health, and limit productivity." Droughts would make water more expensive, which would in turn affect the cost of raw materials and production. There would be a negative effect on sectors such as manufacturing, power generation, agriculture, forestry, fisheries, and tourism. Damage in other countries would also affect the US economy as there would be a disruption in trade and supply chains (Reidmiller et al., 2018). According to Morgan Stanley, extreme weather changes have cost North America $415 billion dollars in the last three years (Cho, 2019).

HOST Thank you for highlighting the potential dire effects of climate change to the economy. However, some people believe that the economic costs of transitioning from fossil fuels to renewable energy are too great.

NORDHAUS Well, some people may make this argument, but a recent study published in Environmental Research Letters finds "if nothing is done to alter the course of climate change, then ultimately the economic cost would be 15 times greater than the cost to move away from fossil fuels" (Kikstra et al, 2021). In addition, climate change adaptations can create more business opportunities in areas such as renewable energy development and construction of green infrastructure (Cho, 2019). In 2018, The Carbon Disclosure Project reported that 225 of the world's 500 biggest companies believe climate change adaptations could generate over $2.1 trillion in new business prospects.

HOST It is becoming increasingly clear that there is great benefit for the world to move towards a more sustainable economy. What measures have been taken to facilitate this transition?

NORDHAUS The international community has a long history of negotiating many agreements on climate change. In 2015, there was a historic turning point for international climate action. At the UN Climate Change Conference in Paris, a landmark international accord, called the Paris Agreement, was signed by nearly every nation. The agreement aimed to cut global emissions by creating a framework for climate goals and established a path for developed nations to financially help developing nations with climate change adaptations (Denchak, 2021). In addition, more than 5000 global companies, representing over $38 trillion dollars in revenue, made commitments to restructure to meet climate goals (Muneer, 2016).

HOST It seems like the world has been moving towards a more sustainable economy over the past few decades. Is there evidence showing this to be true or is it just a false assumption?

NORDHAUS Well, over the past few decades, there has been a rapid rise in the number of firms claiming the "eco-friendly" merits of their products and their sustainable operational business practices. This has been driven by increased public awareness and societal concern around environmental issues. Investors have also sought to make more socially responsible investments. Consequently, many firms have been intentionally or unintentionally misleading consumers and investors about the environmental benefits of their products, services, or mission, which is a condition called "greenwashing." Examples of greenwashing include rebranding or repackaging a product to make it look "more green" with eco-friendly imagery and keywords. Another tactic is for a

company to magnify a small change in eco-friendly practices with the majority of the company's practices harming the environment. These deceptive tactics undermine companies that actually use sustainable practices and make it harder for conscious consumers or investors to make eco-friendly decisions (Yonkers, 2021).

HOST Wow, that seems pretty deceptive. But are there negative consequences to greenwashing? Why do companies decide to go this route?

NORDHAUS Most companies that are engaging in "greenwashing" are looking at the short-term benefits. They believe they are saving money by marketing their company better, instead of restructuring it. However, "greenwashing" can have devastating effects on employment engagement and stakeholder trust. Ultimately, "greenwashing" hurts a company's finances and credibility.

HOST It seems that "greenwashing" can really hurt a company's future. Thank you so much for coming on the show Mr. Nordhaus. I would like to welcome our next guest, Michael W. Toffel, Professor of Environmental Management at Harvard Business School. Can you please explain how prevalent "greenwashing" is in today's business industry?

TOFFEL The trend for "greenwashing" is quite prevalent in today's business world. Terrachoice Environmental Marketing conducted a study in 2010 analyzing 5,296 home and family products. They found that 95% of the products made false or misleading environmental claims (Terrachoice Report, 2010). Another study examined the records of ExxonMobil, Chevron, Shell and BP from 2009 to 2020. The researchers found a sharp increase in environmental keywords like "climate", "low-carbon," and "transition" in their annual reports, but concrete actions to transition to clean energy were lacking (Li et al, 2022). In addition, in recent years, many large corporations have been found to be greenwashing such as General Electric, General Motors, Walmart, McDonalds, and Mattel (Bender, 2011). Another big area of greenwashing is taking place by ESG fund managers. The demand for investors looking to put their money into sustainable funds has increased, but questions have risen about their true commitment to climate change. A research study done by InfluenceMap found that "55% of funds marketed as low carbon, fossil-free and green energy exaggerated their environmental claims and 70% of funds fell short of their target ESG goals" (Quinson, 2021).

HOST Unfortunately, it seems increasingly evident that greenwashing is highly prevalent in the US. Mr. Toffel, thank you for giving us a better understanding of the greenwashing trend. Our next guest is from the Bureau of Economics at the Federal Trade Commission. Let's please welcome, Ms. Alison Oldale. Can you please explain the measures the government has taken to stop this deceptive tactic?

OLDALE One of the biggest initiatives to tackle greenwashing is the Federal Trade Commission's Guides for the Use of Environmental Marketing Claims, which is known as the "Green Guides." It was originally created in 1992 and its goal was to prevent fraud, deception, and unfair business practices. The guides have detailed descriptions of acceptable environmental claims that companies can use in their marketing and advertising campaigns. These guides also help the public understand the limits of legitimate eco-friendly claims. (Bender, 2011). Under Section 5 of the FTC Act, the agency can bring suit against companies for deceptive advertising and marketing and administer fines. Unfortunately, the FTC has not taken action on many environmental cases. From 1992 to 2021, over a span of 30 years, the FTC has made only about 80 environmental claims (Fischer, 2021). In addition to government efforts, many independent campaigns have formed to investigate, document, and expose corporate greenwashing. Most recently, 3 grassroot organizations: Greenpeace, Global Witness, and Earthworks filed a joint false advertising complaint to the FTC against one of the largest oil companies, Chevron, for overstating its investment in renewable energy and climate actions (Volcovici, 2021).

HOST Thank you for giving us an overview of some of the major methods to combat greenwashing. It is becoming apparent that more needs to be done to stop deceptive company tactics. Today, we have 4 special guests from Syosset High School who have extensively researched the topic of greenwashing. These junior economists will be discussing their ideas for overcoming greenwashing to promote a more sustainable economy.

STUDENT 1 Hello, my name is Vatsal Kalola and I am very happy to be part of this podcast. From our research, we have found that there is an urgency for the US Federal Government to take strong steps to regulate greenwashing in order to achieve a more sustainable economy. Since being elected, the Biden administration has kept environmental initiatives at the forefront. New climate change units are being created at various financial agencies in the US government. In March 2021,

the SEC developed the Climate ESG Task Force Agency to identify ESG (Environmental, Social, and Governance) related misconduct (Ebbs & Schulze, 2021). The agency recently distributed letters to public businesses to increase ESG disclosures to the SEC. However, this is just a small step in impacting businesses, but a universal standard must be created to measure, monitor, and enforce environmental initiatives. More federal funds need to be allocated to create such universal standards. Companies need to have clear guidelines of their ESG impact in order to generate valid and reliable sustainability reports. In these reports, they would need to disclose climate risks and costs, as well as provide documented metrics of gas emissions, water usage, and plastic consumption. Companies that fail to comply would have steep consequences and could face securities fraud with penalties (White, 2021). Mandating such reports is essential to create more transparency in public companies and investment firms, eliminating chances of greenwashing.

HOST Can strict government regulation of company environmental disclosures really help to limit greenwashing?

STUDENT2 Hello, my name is Devin Awatramani and I would like to add that too many companies are not taking the moral high ground and are cutting corners to seem like they have good environmental consciousness. Therefore, a higher authority needs to intervene and establish consequences for failures in sustainability. A 2019 study published in the Journal of Cleaner Production used game modeling theory and determined that government punishment mechanism is an excellent inhibitor of greenwashing (Sun & Zhang, 2019). And in March 2021, the European Union led the movement of government regulation by passing the Sustainable Finance Disclosure Regulation (SFDR), which mandates all financial market participants in the EU to disclose their sustainability risks and practices. And most recently, the EU has produced the first rulebook, called the EU Taxonomy, which uses science-based criteria to establish a list of sustainable economic activities (Quinson, 2021). A qualitative study was conducted in 2021 which concluded that the EU Taxonomy showed great potential in increasing transparency within the sustainable financial sector which could decrease greenwashing methods (Letner et al, 2021).

HOST It does seem that government regulation of ESG disclosures will be a very effective way to stop greenwashing. What else can the government do to limit greenwashing?

STUDENT3 Hello, My name is Shiv Khazanchi and I am also very happy to share my thoughts. In addition to penalties imposed for non-compliance of disclosure mandates, governments can also provide tax credit incentives for those companies that are trying to implement better environmental business practices. A point system can be set up that measures a company's sustainability and as they gain more points they would acquire more tax benefits. This way companies have a financial incentive to become more sustainable. In addition, the government can issue special seals of sustainability for companies that have reached a certain sustainability score. This universal system would boost a company's reputation and allow investors and consumers to easily identify companies that truly are committed to helping the environment.

HOST That sounds like a great plan. Is there any way the government can help consumers understand the importance of a sustainable economy?

STUDENT4 Hello, My name is Samir Panchal and I would be happy to answer that question. As mentioned previously, the Federal Trade Commission has created the "Green Guides" for consumers to understand the legitimacy of eco-friendly claims. However, more needs to be done to educate the public about the importance of sustainable investments. As more people look to invest in sustainable companies, there will be a faster shift to a more sustainable economy. Financial literacy programs with an emphasis on ESG investing should be available to the public. The Federal Reserve has 12 Community Development Teams across the US. These teams help to promote economic growth and financial stability in communities across the country. With proper funding, they can educate the public to spend and invest their money in a more sustainable manner. There should also be special programs to educate the youth of this nation to raise a more socially and environmentally conscious generation.

HOST Wow! For such young economists, you all gave us some really thought-provoking solutions to eliminate greenwashing. I would also like to thank our highly specialized panel of guests today for their contributions to this podcast and to their fight for climate change. Let's hope the US government becomes successful in its mission to stop these deceptive tactics and to promote a more sustainable economy.

(music end)

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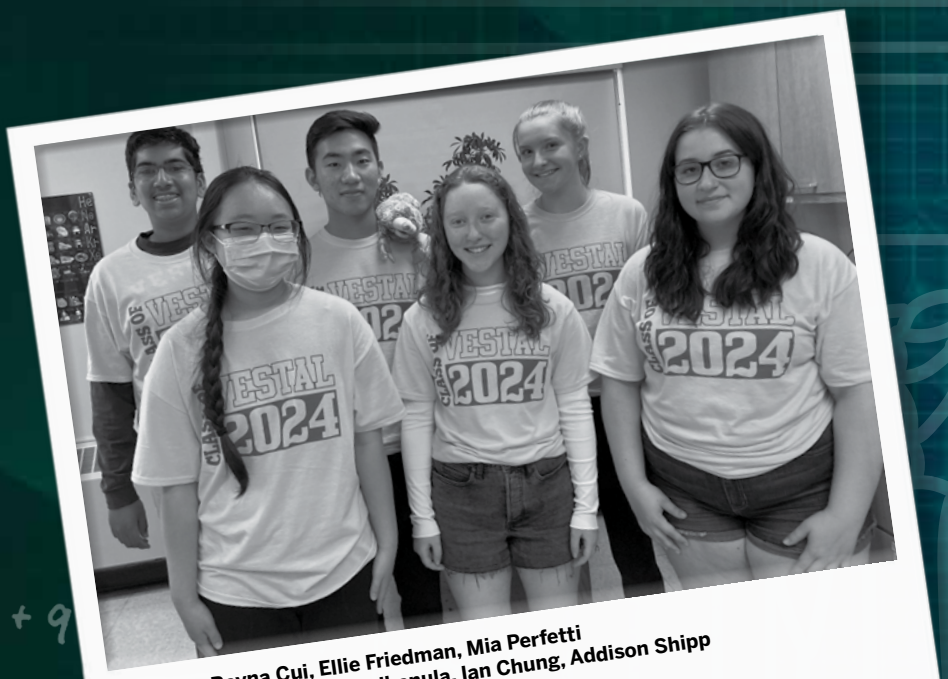

Front L-R: Rayna Cui, Ellie Friedman, Mia Perfetti
Back L-R: Sriram Chakravadhanula, Ian Chung, Addison Shipp

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Crypto's Climate Crisis

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CITATION STYLE

MLA Handbook, Edition 9

MIA PERFETTI Wild speculation never comes without risks. In 1929, Wall Street crashed and contributed to the worst depression in American history. In the 1990s, the dot-com bubble popped and forced tech companies out of business. In 2007, the housing market collapsed and forced the United States into a recession.

RAYNA CUI Now, investors are rallying around an entirely new sector of the economy: cryptocurrency. Its value soars, plummets, then soars even higher in a gut-wrenching rollercoaster ride. Concerns constantly rise about the risks involved in this latest spat of speculation. Only this time, the danger isn't an implosion of financial institutions or a loss of consumer confidence: it's catastrophic climate change.

MIA PERFETTI There's no denying climate change is one of the most pressing issues facing humanity today. An average global temperature increase of only 2°C from pre-industrial levels is predicted to cause a 1.18-2.85 foot rise in sea levels, a total ecosystem transformation of 4% of Earth's land, and a near complete loss of coral reefs (Lieberman).

RAYNA CUI One main cause of global warming is increased emissions of greenhouse gases due to overuse of energy. With this in mind, the recent rise in cryptocurrencies—especially Bitcoin, by far the most popular—becomes particularly worrisome. Per one Bitcoin transaction, an estimated 707 KwH of energy is consumed (Cho). As a result, Bitcoin's carbon emissions are virtually equal to those of Hong Kong each year (Calma). The implausibility of this statistic raises the question: how could Bitcoin transactions consume so much energy?

MIA PERFETTI To prevent fraud and ensure fairness, all transac-

tions must be verified by Bitcoin "miners" before they can be added to the public ledger of transactions, called the blockchain. To verify these transactions, miners compete to solve a complex mathematical equation. These equations are much too complex for miners to complete themselves, so they use computers to guess the answer, often making trillions of guesses before the correct one is found.

RAYNA CUI Bitcoin protocol adjusts the difficulty of the equations so that it generally takes around ten minutes to find the answer. The miner who finds the answer first and verifies the transaction is rewarded with Bitcoin, creating competition amongst the miners.

MIA PERFETTI This validation process is known as proof of work, which prevents counterfeiting or double-spending. To benefit from the system and earn money, miners aim to process more transactions, requiring more energy-intensive computers. In fact, mining of Bitcoin alone consumes more energy per year than Google, Apple, Microsoft, and Facebook combined. This translates into an estimated 22 to 22.9 million metric tons of CO_2 emissions annually, matching the emissions from the energy use in 2.6 to 2.7 billion homes for one year (Cho).

RAYNA CUI It's not just individual miners contributing to greenhouse gas emissions. Greenidge Generation, "a former coal power plant in Dresden, New York" that converted to natural gas and began mining for Bitcoin, intends to expand its operations. Upon becoming a major Bitcoin mine in the United States, "greenhouse gas emissions increased almost ten-fold" within the span of a single year (Cho).

MIA PERFETTI The growing prevalence and popularity of cryptocurrency is attracting more and more miners, which may render attempts to curb climate change futile. Bitcoin consumed a staggering 62 times more energy in 2021 than in 2015, with only 39% of that energy coming from renewable sources (Cho).

SRIRAM CHAKRAVADHANULA Can cryptocurrency and the fight against climate change coexist? Is there any hope for a solution to the excesses of proof of work?

ELLIE FRIEDMAN One possibility is the proof of stake model. Tezos, an open source blockchain that uses proof of stake, is over two million times more energy efficient than Bitcoin (Tezos). The second largest cryptocurrency company, Ethereum, is following suit. Ethere-

um is based on proof of work, but it plans on making a complete shift to proof of stake by 2025, aiming to cut down emissions and energy use by 99.95% (Helman).

SRIRAM CHAKRAVADHANULA So how is proof of stake substantially more energy efficient than its counterpart?

ELLIE FRIEDMAN The difference can be witnessed in their respective processes. In proof of work, every miner attempts to solve an equation in order to verify a transaction, expending unimaginable amounts of hardware computational power.

SRIRAM CHAKRAVADHANULA Proof of stake removes all of this unnecessary energy. Users instead create a node, or server, and stake their crypto into the network. They can then become "validators," nodes that verify transactions. Validators are selected based on how many native coins from that node are locked away in a stake. If a transaction is publicly deemed trustworthy, the validator that verified the transaction will be rewarded with crypto coins. However, if it is deemed fraudulent, the node's staked crypto coin is lost. This risk and reward peer review system allows crypto systems to be secure while still being decentralized. Proof of stake decreases computational power because only one node is acting as a validator for each transaction, instead of an enormous mining community wasting energy in a cryptocurrency gold rush (Nibley).

Per one Bitcoin transaction, an estimated 707 KwH of energy is consumed. As a result, Bitcoin's carbon emissions are virtually equal to those of Hong Kong each year.

ADDISON SHIPP Despite the availability of these solutions, cryptocurrencies and their miners continue to devour energy at unbelievable rates. Although a growing proportion of companies have begun to integrate the effects of rising temperatures into their risk assessments, the focus is not on reducing energy usage and emissions but instead on protecting profits. For example, an increase in carbon-related taxation—a positive for the environment—is now often calculated as a climate change-related threat (Plumer). One may wonder why companies don't cut back on high-emission practices when faced with these dangers; after all, they will incur significantly increased costs due to the effects of global warming. The reason is as simple as it is tragic.

IAN CHUNG The total greenhouse gas emissions that could be

emitted before causing catastrophic damage is viewable as a common-pool resource. Common-pool resources are both rival, as consumption by one polluter decreases the amount remaining for everyone else, and non-excludable, as preventing others' usage is impossible. When these two conditions meet, the Tragedy of the Commons arises. Working to avoid the emission limit means others will just reach it first, so reducing energy usage and emissions in exchange for lower profits is not a rational decision to make from a company's perspective. Competitors would continue polluting at the same rate, forcing the company to deal with the effects of warming temperatures in the end. This would imply a necessity for the government to intervene in the market and prevent climate change's terrible consequences upon the world.

ADDISON SHIPP But does this have to be the case when it comes to digital finance? What if, for example, cryptocurrency companies had a rational incentive to change their mining mechanisms and decrease their emissions? In other words, what if it was profitable for cryptocurrencies to use less of the commons, making government intervention unnecessary?

IAN CHUNG Take Bitcoin, for example: by far the most popular cryptocurrency in existence. Given the increasing usage of proof of stake, underlined by Ethereum's planned transition away from proof of work, some big names in the crypto industry have predicted that Bitcoin will shift towards proof of stake and therefore achieve much higher energy efficiency (Huillet). After all, Ethereum's switch to a new cryptographic proof method is not based purely out of concern for the environment; on the contrary, as with the decisions of all rational corporate actors, it is profit-driven. The increased efficiency that comes with proof of stake is projected to significantly reduce transaction fees for Ethereum, attracting more consumers and investors and driving competitors out of business (Chambers). If it will increase the profitability of Ethereum, why wouldn't it do the same for Bitcoin?

ADDISON SHIPP The ultimate decision on proof of work versus proof of stake for Bitcoin lies with its community. Unlike other cryptocurrencies, Bitcoin doesn't have any central management or development team. Instead, proposed changes to its code must reach "network

consensus" to take effect (Acheson). Claims that miners have a stranglehold over the Bitcoin network and its governance are exaggerated. However, they do have significant influence that's able to counter the wishes of developers and investors.

IAN CHUNG In 2017, a proposed increase in the block size of Bitcoin to decrease exorbitant transaction costs was rejected by the community. As Investopedia puts it, "The only constituency that benefited from high transaction fees were miners" (Frankenfield). If proof of work is put on the chopping block, the objections of miners will be even louder and angrier. After all, a switch to proof of stake would render all of the expensive, specialized computing hardware that miners use practically worthless. Directly incentivizing miners to shift to renewable energy isn't viable either, given that "it's difficult to know exactly which Bitcoin miners use renewables" (Howson). These factors make it extremely unlikely that Bitcoin will adopt a proof of stake system or make any other meaningful strides towards a reduction in emissions.

ADDISON SHIPP Despite this, for those seeking to make cryptocurrencies more environmentally friendly, the skies are not entirely bleak. For example, proof of stake will likely become increasingly advantageous in the future market. Ethereum's transition away from proof of work has an explicit goal of reducing transaction fees to outperform competitors, but the ability to process more transactions in a short time also increases scalability and future profitability for any cryptocurrency seeking to grow (Reaume).

IAN CHUNG Additionally, there are growing signs that climate change, which has been on the public's radar for decades, is finally causing monumental shifts in consumer and investor attitudes. Larry Fink, the influential CEO of BlackRock, predicted that: "...because capital markets pull future risk forward, we will see changes in capital allocation more quickly than we see changes to the climate itself" (Meredith). Demand for green firms and their products is rising, and even employees are getting involved.

ADDISON SHIPP Research suggests that adopting higher environmental standards allows companies to enjoy at least a 16% increase in worker productivity (Delmas and Pekovic). Given the increased loyalty of employees and investor enthusiasm, no wonder companies that emphasize "corporate social responsibility" in "resource allocation and business structure" enjoy an "enhanced business environment and

greater financial returns" (Wang and Sarkis 24). For cryptocurrencies with less governance power held by the miners than Bitcoin, therefore, pursuing a meaningful reduction in emissions could be a successful strategy.

SRIRAM CHAKRAVADHANULA For example, stakeholders in Tezos, the proof of stake blockchain, have a voting system in which they can propose and ratify upgrades with 80% majorities. After it is deemed viable, the upgrade undergoes testing. It is then voted upon again to be implemented. This allows Tezos to be self-sufficient on a completely decentralized level while being eco-friendly (Nambiampurath).

Over the past few years, cryptocurrencies have been a major contributor to climate change. Fortunately, cryptocurrency is undergoing a transformation that proves there is hope for the future market to be eco-friendly through transparent processes and clean energy markets.

ELLIE FRIEDMAN Multiple innovations have ventured to "greenify" the crypto industry over the past five years. Smart contracts are systems of rules and rewards for blockchain users that incentivize sustainable practices like regenerative agriculture, carbon offsets, and crop insurance. They're programmed to reward people with crypto for going green. If a user completes a smart contract for reforestation, they'd be paid in tokenized carbon credits. These credits would then be recirculated into the market, perhaps to support green companies or charities (Zhou).

SRIRAM CHAKRAVADHANULA The most substantial shift towards greenhouse gas emission reductions in the past few years has been the Crypto Climate Accord. The Crypto Climate Accord is an agreement formed by three companies to shift all blockchains and some crypto companies to net zero emissions by 2025. It aims to implement verification methods that determine how much renewable energy is used by a blockchain (Calma).

ELLIE FRIEDMAN In addition to scrutinizing energy usage, the Accords intend to utilize technology that can actively remove greenhouse gasses from the atmosphere ("Here's Everything You Need to Know about the Crypto Climate Accord — the Push to Make Cryptocurrencies 100% Green."). Support has been continuously rising, and more than two hundred and fifty companies and individuals are now involved ("Supporters").

ADDISON SHIPP Over the past few years, cryptocurrencies have

been a major contributor to climate change. Fortunately, cryptocurrency is undergoing a transformation that proves there is hope for the future market to be eco-friendly through transparent processes and clean energy markets.

ELLIE FRIEDMAN Success is not guaranteed for Ethereum and other environmentally conscious cryptocurrencies. Decentralized digital finance is an extremely new and unpredictable industry, and there are innumerable factors that will affect its future. For example, concerns have been raised that a switch to proof of stake would lessen some of the "sizzle and crazy volatility" that excites cryptocurrency investors, hurting value as a result (Chambers). That said, the future of emission reduction and energy efficiency in the crypto industry overall appears bright, and currencies that do not adapt to an increasingly green market—perhaps even Bitcoin—will likely fall behind.

RAYNA CUI Free-market competition generates not just enormous growth and prosperity, but negative externalities as well. This reality manifests in industrial waste that flows into rivers and oceans, particulate matter that chokes up once-healthy lungs, and greenhouse gasses that relentlessly belch into the atmosphere. While market forces may induce cryptocurrencies to begin curbing energy usage on their own, their progress must be closely monitored.

IAN CHUNG Although government intervention to curb externalities may hurt efficiency, it's a necessary evil when the stakes are so high. The crypto industry will likely shift towards environmentalism, but governments around the world should assess the impact of various other industries on the climate and consider measures such as Pigouvian taxes on a case-by-case basis. The future of humanity may depend upon it.

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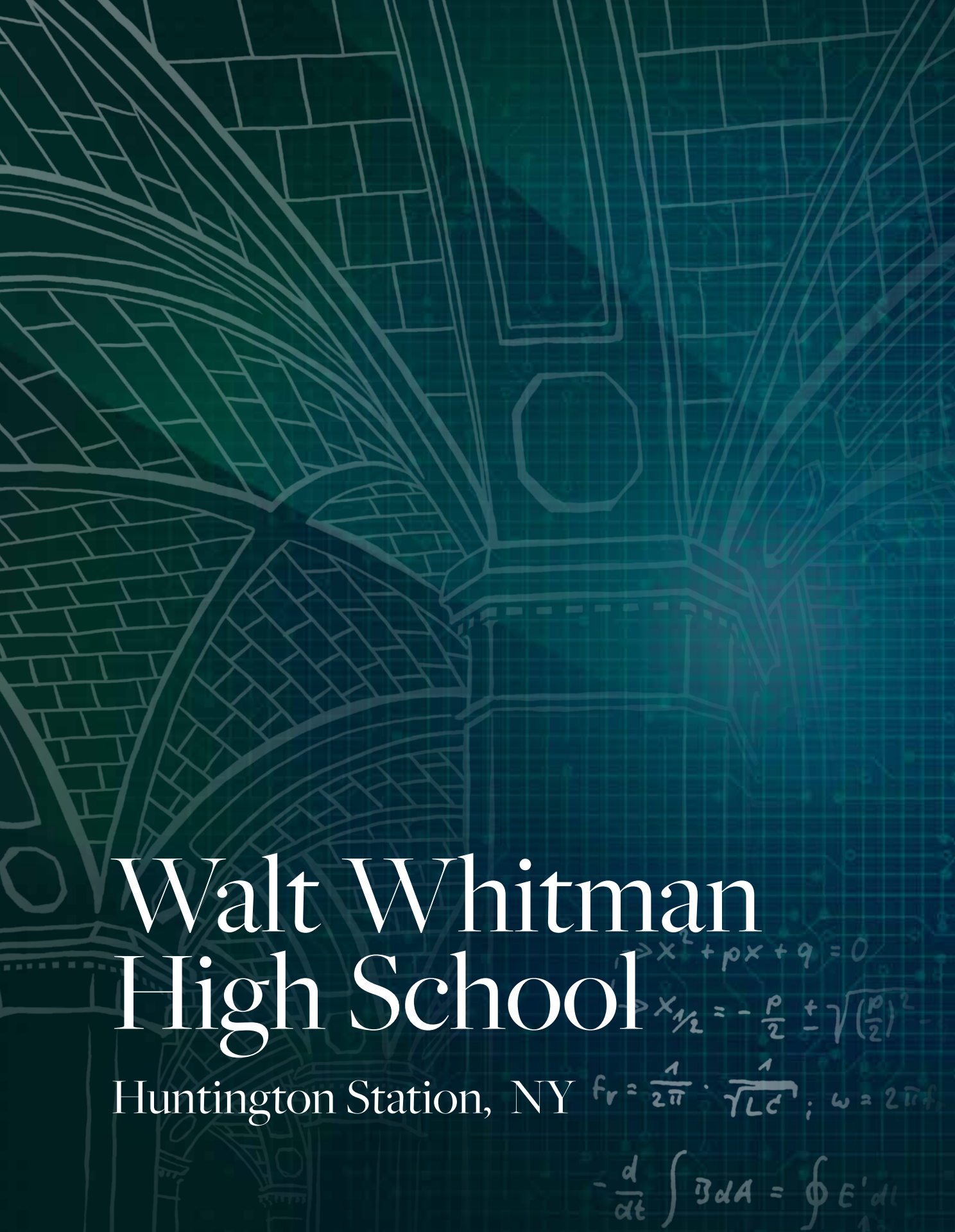

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Climate Conversations: A Discussion on the Circular Economy

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CITATION STYLE

APA 7

LIAM Welcome to Climate Conversations; where we talk about the ongoing climate crisis and the methods we can use to solve it!

NEIL Today, we're talking about the idea of a "circular economy," and how it can help with the climate crisis. Liam, can you start by defining the circular economy for us?

LIAM The circular economy, or CE, is a hypothetical system in which "waste" is recontextualized not as such, but as a resource in and of itself. The idea of waste is removed from the economy as entirely as feasibly possible as the system aims to reuse all byproducts in an enclosed system. This is contrasted with the generally accepted "linear system" in which resources are gathered, consumed, and byproduct disposed of in various (and generally not "environmentally friendly") ways (Ellen MacArthur Foundation, 2021, 1).

NEIL Now how is that different from current recycling methods, and where do those fail in our society today?

LIAM Instead of simply "recycling more," the CE instead frames every step of the production process within the goal of reusing resources and byproducts, as opposed to the current system's idea of recycling as an afterthought, with little effectiveness. We can clearly see the lack of efficacy in current linear economies, where recycling is tacked on with

little forethought, in the plastics industry. Being a subset of the fossil fuel industry, the procurement of material alone produces an obscene amount of pollution, not to mention the refinement process and eventual permanent waste produced by every plastic product. Recycling, as it is currently done, attempts to mitigate some of the pollution by allowing plastics and other waste products to be reconstituted into other products. Unfortunately, the current system accomplishes this at a woefully small scale compared to what is regarded as necessary to correct the present course of global pollution. Due to various loopholes and misinformation regarding the recycling process, an incredibly low amount of products are actually reused, mostly ending up in landfills instead. (Ellen MacArthur Foundation, 2021, 1).

NEIL Given that, why don't you explain what a CE model could do differently?

LIAM The CE attempts to correct these failures in the current system by essentially removing recycling as a phase added onto the end, and instead using it as a systemwide policy, with every step of the production process being geared towards the reuse of material. This recontextualization of waste as a resource is what makes a CE so ideal, especially in the case of the plastics industry.

NEIL Thank you for your insight, Liam. Now we turn to our guest, industry expert Gabe Gonzalez, to give us some insider knowledge on what specifically could be done to transition to a CE.

GABE Of course. There are three primary principles in creating a CE. The first is to eliminate waste and pollution. Here's an example: a bag of potato chips. An average consumer enjoys them for about five minutes, then throws the bag away without a second thought. That bag is then tossed into a landfill or burned. This is a result of how the package, and many other types of consumer items, are designed. The only option is to dispose of them in this way. Producers must design their products in an innovative fashion that treats waste as a design defect, not as a necessity. Some companies have already begun this arduous process, such as Apeel, which uses an edible coating of plant-based substances in place of plastic packaging that enhances the natural protections of produce. The second primary principle is the recycling and reusing of all products, or at least their materials, which ties in closely with the previous point. There are two different cycles to achieve this. First, the technical cycle involves maximizing the longevity of a product so that

it can continue to be used over and over again, whether through resale, the ability to be easily repaired, etc. When its life finally comes to an end, the parts must be remanufactured or recycled as the absolute last resort. Second is the biological cycle, which involves biodegradable materials at the end of their life being propagated back into the environment through processes such as composting or anaerobically digesting organic materials. This allows for must-needed, precious nutrients to return to the environment (Ellen MacArthur Foundation, 2021, 1).

NEIL This all sounds incredibly logical, but Liam was just discussing how the process of recycling was flawed. What would have to be done differently in a CE?

GABE The issue is that most products aren't designed with these cycles in mind—they're created to end up as waste. Companies have to start making their products in ways that fit into these cycles. It should be easy to separate the technical materials of a product, like metal for instance, from biodegradable materials, like wood. For example, Ecovative makes compostable packaging from agricultural byproducts and mycelium. Mycelium actually grows quite quickly and easily, with light

The circular economy, or CE, is a hypothetical system in which "waste" is recontextualized not as such, but as a resource in and of itself. The idea of waste is removed from the economy as entirely as feasibly possible as the system aims to reuse all byproducts in an enclosed system.

and water not even being needed. Once used, it can be safely composted and returned to the soil (Ellen MacArthur Foundation, 2021, 1).

NEIL Quite impressive! What's the final principle?

GABE Restoring our environment. The linear economy, persisting for centuries, has done considerable damage to our planet. But it's not too late to turn things around! The circulation and renewal of materials will cut the need for performing practices that harm the environment, such as mining or the reliance on synthetic resources, such as pesticides and fossil fuels, in the food industry. Doing so improves soil health, allows nature to flourish in areas previously used for finite resources, and reduces greenhouse gas emissions, and that's just scratching the surface of the possible benefits (Ellen MacArthur Foundation, 2021, 1).

NEIL What if scientists found a completely renewable energy source? Would it still be worth it to switch to a CE?

GABE Of course! Actually, only half of total greenhouse emissions can be dealt with by switching to a renewable energy source. Yet, if we were to switch to an economy that followed these principles, projected greenhouse gas emissions of the food industry could be halved by 2050 (Ellen MacArthur Foundation, 2021, 1).

NEIL That's definitely a strong argument in support of a CE! Thank you for your time, Gabe.

JOSH Thanks! Now we're going to discuss the recent history of CE efforts and the practical implementations. Namely, we're going to dive into such implementations in Europe and East Asia.

DYLAN Sounds great! How successful has the CE been in these regions so far?

JOSH Environmentally speaking, both of these regions have seen progress from the adoption of CE efforts. Europe's efforts have yielded notable results, with a 79% jump in recycling, a 61% increase in energy recovery, and a 43% drop in landfill waste (Baran, 2020, 14). While these developments still have a long way to go before achieving true resource sustainability—given the energy recovery rate still exceeds the recycling rate which barely exceeds the landfill rate—the EU is on track to reach a remarkable 65% recycling rate and a mere 10% landfill

rate by 2030 (Baran, 2020, 15). In East Asia, China has been the powerhouse in moving toward a CE. Eco-industrial parks, localized efforts that integrate renewable and recyclable materials into companies' supply chains, were responsible for the elimination of 14 million tonnes of greenhouse gasses in 2016 (Su, 2013, 13). On a national level, key pilot cities of Beijing, Shanghai, Tianjin, and Dalian saw uniform improvements in environmental indicators amidst CE efforts, with a notable reduction in water and energy consumption per unit GDP. Similarly, waste management efforts proved effective as rates of solid waste reclamation and safe disposal of solid wastes increased in all cities (Su, 2013, 15).

DYLAN Does this mean the CE has already been fully proven to be effective?

JOSH Not exactly. Regardless of nominal improvements to environmental standards throughout Europe and East Asia, a holistic understanding of the CE adoption in both of these regions remains impeded by a lack of clear, standardized metrics for CE goals. Zooming out, the aforementioned efforts have been too little to thoroughly upend the colossal resource management concerns on the global level. The real issue regarding the transition to a CE is creating a globalized effort. More collaborative efforts between researchers, governments, and communities are necessary to establish the baseline for more efficient resource consumption throughout the global economy (Baran, 2020, 16).

DYLAN I will be interested to see how researchers can provide new insights into the CE in the near future! Now, to discuss the economic measures of the CE, we have Josh.

JOSH Of course. The primary economic hesitation surrounding the transition to a CE lies in the cost of reworking infrastructure and physical capital during this transition period. Transitions like the overhaul of production processes or organizational structures are assumed to be negligible in many research models but can be the root of opposition from businesses subject to these changes (Geng, 2019, 1).

DYLAN Does this mean the transition to a CE is simply not worth it?

JOSH No, the switch to more sustainable resource consumption bears longer-term macroeconomic benefits. For example, goods produced from reworked plastics see prices about 80% cheaper than those

Europe's efforts have yielded notable results, with a 79% jump in recycling, a 61% increase in energy recovery, and a 43% drop in landfill waste.

from new materials. Moreover, the switch to a CE is expected to spark private investment associated with the transition, gross value added by efficiency in the CE, and new employment opportunities within this new system. A large component of the CE model's economic efficacy can be viewed through the lens of sustainable growth and development.

Analysis of the proposed economic benefits of the CE revealed a positive impact on economic growth in the EU. This same study also linked environmental factors like recycling rate, environmental innovation, and resource productivity to the growth of GDP for EU countries (Geng, 2019, 1).

DYLAN What does the CE mean more directly for the people?

JOSH Broadly speaking, existing literature tends to point towards an overall improvement in employment rates upon the transition to a CE. Studies suggest that the switch to sustainable infrastructure could yield employment gains in the realm of 1% to 2%, on average, with very few models predicting a negative impact on employment. The impact on employment, however, is anticipated to vary significantly across sectors and regions––a notable concern in evaluating the equality end when the CE is introduced (Laubringer, 2020, 14).

DYLAN I like what I'm hearing. Do you have any final thoughts on how effective the CE really is?

JOSH Ultimately, the CE shows considerable promise in improving environmental circumstances while simultaneously promoting economic growth and employment opportunities in the long run.

Regardless, we need more defined and standardized metrics for both the implementation and results of this transition.

DYLAN I am excited to see how the implementation of these ideas and further research on their effects develop. We now turn to Ryan who is looking forward to discussing future approaches to the CE model!

RYAN Thanks, Dylan! Now, if there is any real chance for the CE to have an impact, it'd probably be in large cities. Not only do they have most of the population, but they house most of the consumption. As such, without them, what's really the point? This is why I want to move to talking about a potential future implementation, in good ole New

York City. We've already discussed how the CE can have significant impacts but to bring that closer to home requires much effort (Van Heel et al., 2020, 7).

JOE What about it is so hard? If we just highlight to New York the good this economic model can do, then they'll want to change themselves.

RYAN Not exactly. Even if we show all the good it could do, a complete shift of economic models is neither appealing nor easy. There are many factors that have to go into such a transition. First, we would need considerable planning. A discussion between stakeholders, from producers, city management, and consumers needs to occur. All parties involved need to be educated on what is changing. Producers may be the strongest opponents to this change, so government and urban policy may need to be enacted (Van Heel et al., 2020, 13).

Research specifically for an NYC CE shows there will be growth of businesses, costs will be reduced with greater resource efficiency and productivity by maximizing the value of the goods created.

JOE What sorts of policies would change their mind?

RYAN The policy wouldn't be to change producers' minds about the CE—they can believe whatever they want—but with extended producer responsibility policies, they will be required to be accountable for their own waste. The collection of their end-of-life products will make them consider the designs and circularity of their products to maintain their own businesses while also aiding the environment (Van Heel et al., 2020, 13). As Josh discussed, that may be what producers think. However, having products with greater end of life value provide new revenues and more positive impact than short-term losses.

JOE I understand. Can you dive further into a New York City CE?

RYAN Yes! Research specifically for an NYC CE shows there will be growth of businesses, costs will be reduced with greater resource efficiency and productivity by maximizing the value of the goods created. Additionally, with these changes, there will be an increase in jobs available (Van Heel et al., 2020, 11).

JOE That sounds like a strong plan—why is changing so hard?

RYAN The planning process and implementing regulations is no easy

feat. The communications are complex and getting people to understand the CE will take time. An incentive for businesses to communicate nonetheless lies within Eco-industrial parks, which if implemented like in China will not only have environmental benefits but will also accelerate the development of technology through competition among nearby businesses. The project also needs to be financed (Van Heel et al., 2020, 13). Even though this may be expensive and difficult, if done right, the economic sustainability coupled with the environmental benefits are worth it.

JOE So if NYC creates a CE over the next decade, the increasing risks of climate change will be mitigated?

RYAN Not necessarily. Just one city, no matter how big, won't turn the tides for climate change. Executing these steps in NYC or in another large city is really the next big step for the US and the CE to make sure its impacts are more quantifiable. But we need to look at the big picture. We need to look all over the world. International policy to integrate circular economies in countries worldwide may actually make a dent in climate change's growing effects. This should be done through a global platform where knowledge is shared, alliances are formed, and standards are created to then finally implement a massive world shift (Geng, 2019, 1).

JOE So this discussion on New York City CE, if applied on a more grandiose scale, you believe may have major environmental impacts?

RYAN Yes I do. I'd like to thank you for being on the show with me as well as all our previous speakers.

JOE Of course! Glad to have learned something new. See you all next time!

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Geekonomics Episode nº. 2022: The Federal Reserve System and Climate Change

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CITATION STYLE

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MONEYSHA Welcome back, EconGeeks! I'm Moneysha and this is Geekonomics, the go-to podcast to learn about economics. Every week, we tackle the connection between economics and various social issues; for this episode, we've partnered with the Federal Reserve to discuss a topic that affects us all: climate change. Today, I'll be commenting on a few segments from the Federal Open Market Committee's (FOMC) special forum on climate change. Without further ado, let's get geeky with economics!

First, let's talk about climate change. Climate change encapsulates long-term shifts in weather and temperature patterns (United Nations 2022). While it's a natural phenomenon, climate change has been accelerated by human activities such as burning fossil fuels, manufacturing, deforestation, and overconsumption. The National Oceanic and Atmospheric Association reports that land and ocean temperatures increased at an average rate of 0.13° per decade since 1880, but have jumped to 0.32° per decade since 1981 (NOAA National Centers for Environmental Information 2021).

The proliferation of global warming conditions in the 21st century poses severe economic consequences. Since 1980, the U.S. has suffered 310 major weather and climate disasters costing over $2 trillion in total (A. B. Smith 2020). It's important to note that the costs of climate change are unevenly distributed across the United States. The South has incurred far more climate damages because of higher regional temperatures, which cause heat-wave-induced decreases in labor pro-

ductivity and higher adaptation costs related to infrastructure capacity (Plumer and Popovich 2017).

Fiscal climate policies have been effective at reducing greenhouse gas emissions; in fact, California's cap and trade program contributed heavily to a 13% state reduction in greenhouse gas emissions from 2004 to 2016 (Pfeifer-Rosenblum 2020). However, the FOMC has concerns about the side effects of fiscal climate policy. Let's hear their thoughts.

Ultimately, I've realized that the Federal Reserve is more than green—it's red, white, and blue. To create lasting and meaningful change, we all must be part of the solution.

GOVERNOR DOVELY *Our government has looked to limit corporate greenhouse gas emissions, but I'm worried about their effects on employment. The EPA's NOx Budget Trading Program significantly reduced NOx emissions from 2003 to 2018, but decreased employment in energy-intensive industries by up to 4.8% (Curtis 2018). I'm also troubled by underlying climate uncertainties.*

MONEYSHA As Governor Dovely alluded to, uncertainty hinders the policy-making process. Federal institutions aren't equipped with the necessary tools to accurately factor climate change into models, specifically flood-risk models (Federal Reserve Bank of San Francisco Community Development 2019). An investigation by the Department of Homeland Security in 2017 revealed that 58% of the Flood Emergency Management Agency's (FEMA) flood maps were inaccurate or out-of-date (Office of Inspector General 2017). Current data is unreliable and future data is scarcely available; these factors keep FEMA and other governmental agencies from making informed policy decisions, damaging efficacy. Uncertainty surrounding energy pricing and asset liquidity have also deterred investments, slowing the green transition.

Now that we've briefly discussed climate change and its ramifications, let's tune in to the FOMC's policy discussion. As a reminder, the special forum focuses on the Fed's role in climate change—if they have one at all and how it would intersect with their monetary policy objectives. We'll first hear from President Bear, who'll summarize what the Fed has already done to combat climate change.

PRESIDENT BEAR *The Federal Reserve is a part of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), an international group of central banks that promotes the environmentally sustainable development of green financial practices (NGFS Secretariat 2019).*

CHAIRMAN GREENE *I also have a place on the Financial Stability Oversight Council (FSOC), which identifies risks to our nation's financial system and markets. In our 2021 report, we identified climate change as an emerging risk and issued 30 institutional recommendations, including improving climate-risk disclosures and closing climate-related data gaps (Financial Stability Oversight Council 2021).*

PRESIDENT BULLMAN *The Federal Reserve has recently created two distinct climate committees, the Supervision Climate Committee (SCC) and the Financial Stability Climate Committee (FSCC). The SCC and FSCC work to identify micro and macroprudential risks related to climate change, respectively (Brainard 2021). Climate change is an interrelated issue—which is why the SCC and FSCC also collaborate with regulatory agencies, central banks, and international bodies like the global Financial Stability Board.*

MONEYSHA The Fed has taken preliminary action to combat climate change via the NGFS, FSOC, SCC, and FSCC, but how do they feel about expanding their role? Let's hear what they have to say.

CHAIRMAN GREENE *We must now ask ourselves how to create and improve climate policies. Would we like to consider—*

GOVERNOR PIDGEY *Respectfully, Chairman, I don't believe we should continue this discussion at all. Since the 1977 Federal Reserve Reform Act, the Fed has created policies under the guidance of the dual mandate; climate change clearly does not fall in the Fed's responsibility to maintain maximum sustainable employment and price stability (United States Congress 1977).*

PRESIDENT BULLMAN *I agree. Numerous jobs rely on the brown-energy sector; according to the American Petroleum Institute, 9.8 million people are employed by the fossil fuel industry, accounting for approximately 5.6% of total employment in the Unit-*

ed States (PricewaterhouseCoopers and American Petroleum Institute 2013). If we address climate change, we'll be contributing to a structural unemployment risk. To stay true to our dual mandate and maintain a sustainable unemployment rate, it would be best not to intervene.

GOVERNOR DOVELY *Although we should consider jobs lost by the fossil fuel industry, the green transition is inevitable. The U.S. oil industry is expected to contract by 20% in the next decade and by 95% between 2031 and 2050 (Rosenbaum 2021). Other fossil fuel industries are expected to do the same. We must anticipate job losses in fossil fuel sectors and facilitate the transition of workers into green sectors to reduce unemployment risks.*

MONEYSHA In my opinion, the Fed could very well fulfill the unemployment part of their mandate by fighting against climate change. But what about price stability? Let's hear from the FOMC.

PRESIDENT BEAR *Climate change poses substantial physical risks through both gradual global warming and the threat of severe weather events. As we've discussed, global warming could decrease labor productivity, potentially creating supply-side inflationary pressures; a 2014 study found that productivity declines roughly 1.7% for each 1°C increase in daily average temperature above 15°C (Deryugina and Hsiang 2014). Severe weather events could also create negative supply shocks that increase volatility in headline inflation, especially if exporting countries resort to protectionist measures to stabilize domestic prices. In 2010, for example, Russia banned wheat exports after droughts and wildfires ravaged over a third of arable land, increasing international wheat and foodstuff costs (Kramer 2010).*

GOVERNOR HAWKINS *There are also significant transition risks associated with climate change, especially as new carbon cap and trade programs, taxes, and border adjustment mechanisms are introduced. According to a 2014 study in Spain, the EU's Emissions Trading System passed 86.2% of emissions costs down to consumer electricity prices (Fabra and Reguant 2014). The abrupt introduction of these new fiscal policies clearly has the potential for transitory greenflation.*

MONEYSHA Let's pause for a moment. Greenflation is inflation

specific to increases in energy prices stemming from a green transition (Sharma 2021). To incentivize development in green sources, the government increases production costs for fossil fuels that get passed onto consumers. Now, let's get back to the meeting and see what the others think about greenflation.

GOVERNOR PIDGEY *It's absurd to act on this line of reasoning! Inflationary pressures from physical and transitional risks tend to be temporary and concentrated in the energy and food sectors; therefore, we should NOT adjust our rates or expectations. Although these risks could cause short-term volatility in the headline inflation rate, the FOMC has long preferred the core Personal Consumption Expenditures price index, which provides a better view of underlying inflationary pressures.*

GOVERNOR HAWKINS *While it is true that many of the inflation risks Governor Pidgey mentioned are transitory, some of the risks may have medium-term macroeconomic consequences if severe enough. I'd also like to emphasize that volatility in headline inflation may affect household and firms' expectations of future economic outcomes, creating sustained inflationary pressures.*

CHAIRMAN GREENE *I agree with the majority; it is our duty to moderate these potential risks to ensure price stability. Doing so, however, risks politicizing our institution.*

PRESIDENT BULLMAN *I concur; climate change should be an issue solely designated for elected officials. Unlike the European Central Bank (ECB) and the Bank of Canada, we are not responsible for supporting fiscal policies. We should steer clear of this issue and let Congress take the lead.*

PRESIDENT BEAR *But the Fed is inherently politicized because it relies on political support to advance its agenda. Sarah A. Binder, senior fellow at the Brookings Institution, noted in 2016 that, "institutions are political not because they are permeated by partisan decision-making but because politicians endow them with the power to exercise public authority on behalf of a diverse and at times polarized nation." (Binder 2016)*

GOVERNOR PIDGEY *Regardless, we simply cannot dictate winners and losers within today's market through the biased alloca-*

tion of resources. Moreover, the "greening" of our current approach would starve fossil fuel companies of capital, making banks prone to defaulting and increasing credit risk if business models are not properly adjusted to a low-carbon economy.

GOVERNOR DOVELY *I beg to differ. Climate change poses systemic risks that will restrict our ability to properly support the economic health of our nation. The Fed must uphold its dual mandate and ensure the proper functioning of these financial institutions.*

MONEYSHA The Fed's involvement in climate change is clearly contentious, but the FOMC later agreed that discussing potential policy solutions was crucial to the purpose of their forum. We'll now segue into their policy discussion.

GOVERNOR HAWKINS *Climate change certainly has the potential to cause our next recession; instead of reacting to future crises as we did in 2008 with the Dodd-Frank Act Stress Tests, we should be proactive and incorporate new climate scenarios.*

MONEYSHA For reference, the Dodd-Frank Wall Street Reform and Consumer Protection Act was created after the 2008 Financial Crisis to improve the security of our financial system by preventing excessive financial risk-taking and consumer exploitation (The White House 2008).

PRESIDENT BULLMAN *Unfortunately, our lack of data concerning the physical and transitory risks of climate change undermines our ability to create accurate climate stress tests.*

PRESIDENT BEAR *But we've already begun to bridge data gaps through research with the NGFS. I'd also like to note that climate stress tests have allowed the ECB to more accurately assess their transition risks, improving their data-driven monetary decision-making process. We should follow in their footsteps by expanding and implementing our current climate test model, CRISK. Developed by the New York Fed, CRISK outlines a three-step process: first, measuring the climate risk factor, then estimating a time-varying climate beta of financial institutions, and ultimately using those values to compute the CRISK, or systemic climate risk, value (Jung, Engle, and Berner 2021).*

CHAIRMAN GREENE *Absolutely. We should improve the accuracy of the CRISK model through research and development to eventually incorporate it within our monetary policy toolbox. Any other suggestions?*

GOVERNOR DOVELY *We should also promote community projects amongst regional Federal Reserve Banks. Current initiatives focus on improving climate infrastructure and resilience through flood mitigation investments and sea wall construction in flood-prone areas. The NY Fed's Community Development Team, for example, provided crucial analysis on the impact of natural disasters on small businesses following Hurricane Sandy—informing nationwide disaster recovery efforts (Battisto et al. 2018).*

GOVERNOR HAWKINS *Expanding these research efforts would not only bridge community data shortages—improving local policy—it would also fulfill our community development function.*

MONEYSHA For context, the Federal Reserve's community development function aims to support the economic development of low- and moderate-income communities. They have also recently sought to address racial inequities through the FedCommunities project (Board of Governors of the Federal Reserve System 2021).

GOVERNOR HAWKINS *I'd also like to discuss greening our investment practices. The Fed cannot directly purchase green corporate bonds without the Treasury Secretary's approval of Section 13(3) emergency lending powers under the Federal Reserve Act. We could, however, create a climate discount window with lower interest rates than the federal funds rate and discount rate to stimulate green investments (Greene 2021).*

GOVERNOR DOVELY *By requiring that banks pass down a specified portion of the climate discount rate subsidy directly to the end-user, we can also ensure that designated climate projects receive favorable funding (Greene 2021). Additionally, we can collaborate with institutions, like the Federal Housing Finance Agency or the International Capital Market Association, to create a revised set of green bond standards for a wide range of asset classes.*

GOVERNOR PIDGEY *That's unacceptable! This would clearly politicize our institution as we would prioritize partisan social ob-*

jectives over our monetary policy guidelines. Since you also haven't specified green asset standards, how can we be sure this discriminatory lending would result in any tangible climate benefits?

PRESIDENT BEAR *If we can't implement a preferential discount rate, let's look at "brown haircuts." By imposing higher collateral requirements on carbon-intensive assets, haircuts would account for the differences in transition risks between high and low-carbon assets. Haircuts would therefore create unfavorable financing conditions for investors, incentivizing them to shift to more sustainable assets. I believe these adjustments in asset valuation are crucial to our green monetary agenda.*

PRESIDENT BULLMAN *That's bull! Following the Great Recession, the Fed lowered interest rates to promote a recovery; the fracking industry was one of the only sectors that took advantage of the Fed's cheap financing to invest in jobs and reduce prices (K. W. Smith 2022). If we now punish the same sectors that propelled our recoveries, how will we be able to incentivize future spending and investment during economic downturns? (K. W. Smith 2022)*

Climate change is a complex, dynamic issue that requires an empathetic, flexible approach.

GOVERNOR DOVELY *Well, President Bullman, following the Great Recession, the technology and healthcare sectors also boomed (Dolfman, Insco, and Holden 2018; Gascon and Karson 2017). They, however, aren't being similarly penalized because of their lower social costs. Moreover, by gradually implementing our haircut policies, we disincentivize investment in brown assets while propelling the development of renewable energy, expanding green sectors that could support us in times of crisis. It is high time we greened our investments—setting a precedent for future lenders, investors, and institutions alike to follow!*

CHAIRMAN GREENE *Well stated, Governor Dovely. I'd like to conclude by clarifying our intent for this special forum. We, as the FOMC, want to engage in greater forward guidance; in other words, we hope to better communicate our monetary policy objectives to the general public in order to ease uncertainty surrounding climate change and the overall economy. Climate change is a complex, dynamic issue that requires an empathetic, flexible approach. We shall prioritize our vested interest in serv-*

ing the American public to prudently address climate change.

MONEYSHA And that's it for this episode, EconGeeks! Ultimately, I've realized that the Federal Reserve is more than green—it's red, white, and blue. To create lasting and meaningful change, we all must be part of the solution.

Thank you for tuning in! Subscribe to be notified of future episodes; next week, we'll be tackling economic inequality! As always, feel free to share any comments or questions on our website: geekonomics.com. Stay geeky!

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