Ecological Economics: Capturing its Notable Trajectory Through a Podcast

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Table of Contents

List of Tables and Figures

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Title: **Ecological Economics: Capturing its Notable Trajectory Through a Podcast**

This senior project looks to answer one question: building on the history of ecological economics and its main objectives, what is in store for its future? To answer this question, I created a four-episode podcast series based on different aspects of the ecological economics field: its history, its two main areas of controversy, and its future. Each podcast episode is based on an extensive literature review for each chapter of the written portion, corresponding to these four topics mentioned above. At its very core, ecological economics is a profoundly radical field that could offer solutions to reducing the irreversible impact that humans have left on the planet. However, it would essentially reject the economic behaviours that have become so accepted by policymakers and businesses, but also by many individuals across the globe in their daily lives. Therefore, does ecological economic thinking bear an opportunity to become commonplace in the near future? By examining ecological economics writing since its inception as a field to the present, it is clear that the field is at a crossroads. Ecological economics has identified what has been going wrong, yet a straightforward path towards an achievable solution has yet to be discovered. Identifying this disconnect is the goal of my senior project.

Introduction

The Intergovernmental Panel on Climate Change (IPCC) has released yet another assessment report, detailing the continuing rise in average annual Greenhouse Gas Emissions from 2010-2019. These emissions were higher than any previous decade, confirming the fact that global warming will likely exceed 1.5 C degrees during the 21st century, effectively transforming the fragility of the world (*IPCC* 2022; *World Economic Forum* 2022). Although they are unfolding at an extremely slow pace, with this increase in emissions, there is not one aspect of natural life that will remain unchanged and unaffected by these transformations. For example, climate extremities will become more and more common, such as stronger hurricanes, rising sea levels, droughts and heat waves, longer wildfire seasons and changes in precipitation (Carson et al., 2015; Knox-Hayes, 2021; Lindsey, 2022). Other species will suffer due to these changes, with a projected decrease between 14% and 35% of the fraction of remaining area and remaining species, representing adverse effects on global biodiversity (Mulhern, 2021; Nunez et al., 2019; Shah, 2014).

While the world's diverse ecosystems are suffering with extreme magnitude, Gross Domestic Product (GDP), the ultimate measure of global and national economic growth, is still showing a 3.0% projected world increase in 2023, clearly demonstrating an increase in the activity of the world's economy (*World economic outlook* 2021). How could the economy and its widely accepted growth measures be showing immense progress when the environment and its natural systems are struggling more and more each day? Reframing this disconnect between the environment and the economy in terms of societal well-being is the basis for the field of ecological economics.

The field of ecological economics was first given the opportunity of formal conceptualization during the 1960s. A vast increase in population questioned food and resource security worldwide, while a turbulent period of environmental public awareness was escalating rapidly (Røpke, 2004). The groundbreaking publication of Kenneth Boulding's "The Economics of the Coming Spaceship Earth" created a powerful metaphor contrasting the current "cowboy economy" of unlimited growth, with the more ecologically sound "spaceship economy" in which material constraints are actively present and represented in the inputs and outputs of the world's

socioeconomic system (Røpke, 2004). This radical reconsideration of Earth's processes generated the foundational principle for the field of ecological economics: Earth's economy is fully embedded within nature, and these complex interactions require a transdisciplinary approach (Liu et al., 2010; Røpke, 2004).

From this foundation, there are two main topics at the center of ecological economics dominated by prolific research and controversy: the possible alternatives to growth and the application of ecosystem valuation. To begin, economic growth and its possible alternatives represent one of the main controversies within this field. Ecological economists primarily reject GDP as a progress indicator and some of the most renowned actors in this field like Herman Daly actually distinguish "growth" as an increase in the use of materials, from "development", achieving more societally desirable goals by using the same amount of materials (Victor, 2010). While concern for the throughput of energy and materials is foundational to ecological economics, it is not foundational in classical economics, dictating a stark contrast in their basic ideologies. To move past the issues of GDP and incessant growth, there are many alternatives proposed by ecological economists. The most prominent are degrowth—an economic policy that looks to reduce Earth's energy and resource throughput by decoupling it from economic activity (Kallis et al., 2018) — and green growth, a process which states that economic growth may continue as long as there is ecological impact reduction (Victor, 2010). While green growth seems to represent the more viable and less drastic transition, a complete separation of economic growth from material throughput is considered not possible due to the biophysical nature of growth, challenging its ability to reduce environmental impact (Kallis et al., 2018). Yet, degrowth also faces challenges due to the inability of current economic models to complete a transition of this scale and to halt incessant growth as their main objective (Kallis et al., 2018). Therefore, while the wide rejection of GDP by ecological economists is certain, the most desirable alternative path is still uncertain and represents a complicated, daunting and critical task for ecological economists moving forward.

In addition to economic growth, ecosystem valuation represents the other main controversy within ecological economics. Ecosystem valuation hopes to raise the public interest in environmental conservation by reframing the functions of ecosystems into services (Gomez-Baggethun et al., 2010). Because the ecosystems that provide these services aren't given the same market value as more traditional goods and services, the actual advantages they provide

are overlooked, often leading to their destruction or liquidation (Costanza et al., 1997). Ecosystem service valuation (ESV) is a mechanism to associate monetary values with natural services and safeguard their protection against traditional market structures. The first high profile demonstration of this process was offered in 1997 when prominent ecological economists from around the world provided a rough estimate of the world's ecosystem services and natural capital. They calculated an estimated value of 16-54 trillion dollars, with a $33 trillion average per year (Costanza et al., 1997). Moving forward from this popular and contentious report, ESV has been put into practice both globally and locally, with various methodological techniques and applications, including the calculation of the renowned 1989 Exxon Valdez oil spill reparations (Costanza & Wainger, 1991; Liu et al., 2010). While ESV research has developed immensely and is very promising, it faces many obstacles, particularly the issue of "monetary reductionism" which is considered by some as immoral and anthropocentric because it values nature with these economic metrics (Liu et al., 2010). Yet, some proponents argue that although it's complicated, valuation will occur no matter what in every decision about ecosystems, and ESV is at least an explicit way to acknowledge potential value (Costanza et al., 1997). Therefore, ecosystem valuation is an essential concept in the field of ecological economics, restructuring monetary value and its ecological applications. The importance of ecosystem service valuation also stems from its application in Market-Based Instruments (MBIs) but primarily Payment for Ecosystem Services (PES), a contractual relationship in which the beneficiary of a particular ecosystem service offers payment to the service provider to safeguard the continuation of the service benefits.

Since economic growth and ecosystem valuation are key issues in ecological economics currently, they will play an important role in its future as well. A world of this nature focused on equity and sustainability will be incredibly different than that in current governance, and although the current trajectory is causing a plethora of ecological issues, many societies in humanity's past have perished in their inability to escape path dependence (Costanza, 2020). That being said, these clashing dilemmas have guided the main objective behind my senior project: building on the history of ecological economics and its main objectives, what is in store for its future?

Another important aspect to consider is through what medium can I most effectively investigate these questions. The podcast industry has grown exponentially in the last few years,

generating 116 million listeners in the United States in 2021 (Kaufer, 2022). This growth is also happening globally, with 383.7 million listeners in 2021, a 15% increase from 2020 (Götting, 2023). The “audible revolution” or “podcast movement” is completely transforming the ease with which individuals can consume their preferred media (Cundill, 2019; Hammersley, 2004). Using a podcast and its degree of influence among the current population, I hope to use this form of storytelling and style to articulate what is happening in ecological economics not only in its past and at this very moment, but also where it is headed in the future as the planet continues to fall victim to the dangers of the Anthropocene.

It is important to mention that this extensive literature review based on four aspects of ecological economics was used to create the four chapters of the written section of this project. The material for each podcast episode will then be drawn from their corresponding chapter, to communicate what I learned in my writing and reach more listeners with this easily digestible digital format. These two components are not independent of each other, and they will both provide a detailed understanding of ecological economics and its implications.

Chapter 1: History of Ecological Economics

How do new fields of study emerge? For some, they are a path created as a continuation of existing ideas. For others, they are conceptualized as a result of certain social and political characteristics shaping our society. But for ecological economics, its inception has followed a particularly unique trajectory that is a combination of previous intellectual developments, the social and political atmosphere, and a turbulent era of human history.

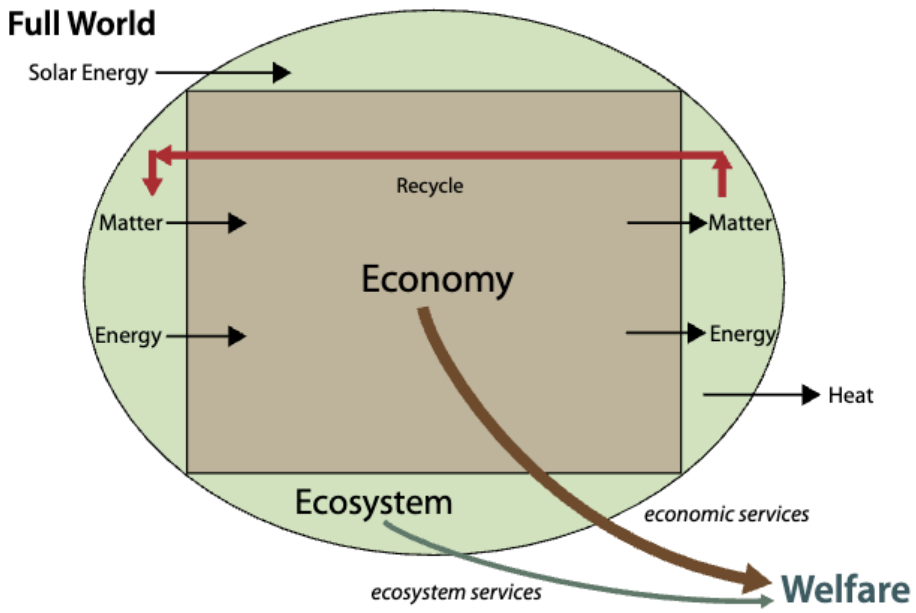
Why is This Field Important?

To begin, what is the main purpose of ecological economics? As demonstrated in Figure 1, the core understanding of ecological economics is the understanding that the human economy is embedded within nature, and does not represent its own entity (Røpke, 2005). While the timeline and trajectory of ecological economics will be discussed in much detail, it's crucial to recognize what many renowned ecological economists have deemed the publication that set the stage for its entire creation: Kenneth Boulding's *The Economics of the Coming Spaceship Earth*. Published in 1966, Boulding expresses the powerful dichotomy between the "cowboy economy", one of openness and unlimited resources, and the "spaceman economy", a representation of the earth as a single spaceship, in which nothing is unlimited, and we must learn to function in a fully cyclical ecological system (Boulding, 1966). Not only do these economies represent Boulding's understanding of both the world economy as it is and his normative approach, they also represent a radically different perception of intensive material consumption, in that it does have negative repercussions on human and environmental welfare, an idea that was essentially the starting point for ecological economics (Costanza, 2020). To this day, understanding that the economy is embedded within nature is not the mainstream understanding, and the current mechanisms of economics are not set up to support the sustainability of a thriving ecological life (Costanza & Wainger, 1991). To demonstrate, one of the most important indicators of economic success, Gross Domestic Product (GDP), essentially ignores nature and its contributions. For example, a forest has a multitude of services and value in its soil, habitat, and water filtration, yet its only price is in the timber it provides. On the other side of the spectrum, in a case of a natural

disaster like an oil spill, there is an improvement seen in the economy and production as measured by the GDP.

Figure 1

The Economy as a Subsphere



Note. The economy represented from the ecological economics perspective, as a subsphere of the world's ecosystem. Daly, H. (2015, June). *Economics for a full world*. Great Transition Initiative. https://greattransition.org/publication/economics-for-a-full-world

The 1989 Exxon Valdez Oil Spill is just one example of an ecological catastrophe providing billions of dollars of economic stimulus that was needed to clean up the mess (Costanza & Wainger, 1991). This is only a glance into the many ecological issues that develop with this mainstream economic viewpoint. It is because of this disconnect between the functions of the economy and the needs of nature that ecological economics has looked to revise the idea that the economy could keep growing boundless without any repercussions. Now that the basics of this field are understood, we turn to the timeline and different characteristics that contributed to its formal conception.

How Did Ecological Economics Emerge?

It's important to understand the social and political context that shaped the creation of this new field. Most prominently, the environmental movement of the 1960s and 1970s. During this time, there was a new conceptualization of pollution, and human-caused environmental damage was beginning to become widespread in public awareness (Røpke, 2004). Also, due to rapidly growing global populations, concern for food and resource security was also growing immensely. Rachel Carson's *Silent Spring*— showing the negative effects of pesticides on bird populations—and Paul and Anne Ehrlich's *Population Bomb*—demonstrating the grave consequences of overpopulation— were among the most renowned publications that instilled this period of environmental awareness. The oil price shock of 1973, an embargo by the oil-producing countries of the Middle East on the United States that quadrupled the global price of oil, provided the perspective that resources and energy are not always at our constant disposal, something uncommon to Americans to that point (Corbett, 2013). Therefore, these events each played their part in reframing the human understanding of their place within the environment and what effect their actions might have on the environment. This awareness generated a proper breeding ground for ecological economics. However, these social conditions were not the sole reasons for the creation of this field. There was an important gestation period in the 1970s and early 1980s, in which many influential actors in the field surfaced, research groups were developed, and there was a reliance on and collaboration with other concepts that sought to reconsider the relationship between the environment and the economy.

In the development of ecological economics, the growth of environmental and resource economics was instrumental. This field is still based in a mainstream economics framework and was primarily concerned with pricing pollution control, policy instruments and valuing the benefits of environmental amenities (Røpke, 2004). So, although environmental economics has similar considerations, its viewpoint is still fundamentally different than ecological economics and lacks crucial considerations, particularly the consideration of externalities. Externalities, such as air & chemical pollution, represent the neglected negative consequences that the economy can have on the environment, and "the message that externalities are pervasive and potentially threatening for the life support of the human economy was nearly invisible in environmental economics at that time" (Røpke, 2004). Therefore, ecological economics saw the

shortcomings of environmental economics and looked to see how it could be improved to better understand the consequences of the economy. However, even more influential, ecological economics developed a lot of its thinking from thermodynamics and entropy. While thermodynamics developed as a field much earlier and focused on equilibria of energy and matter in closed systems, it was further extended to look at biological systems that are closed in terms of matter, but still give and receive energy (Røpke, 2004). Entropy looks at the distribution of energy in the universe and states that it can never decrease, only increase or remain constant in spontaneous processes. The application of this term to biological processes was popularized by Georgescu-Roegen, in his landmark publication *The Entropy Law and the Economic Process* (Røpke, 2004). The universal laws of thermodynamics, combined with the understanding of entropy applied to biological systems, demonstrated that the economy is not beyond and actually based in these biophysical principles. Increased scale and scope of economic activity, as dictated by an open, infinite system striving towards continued economic growth, threatens nature's ability to support human life. Therefore, thermodynamics applied to biological systems contributed to the creation of ecological economics.

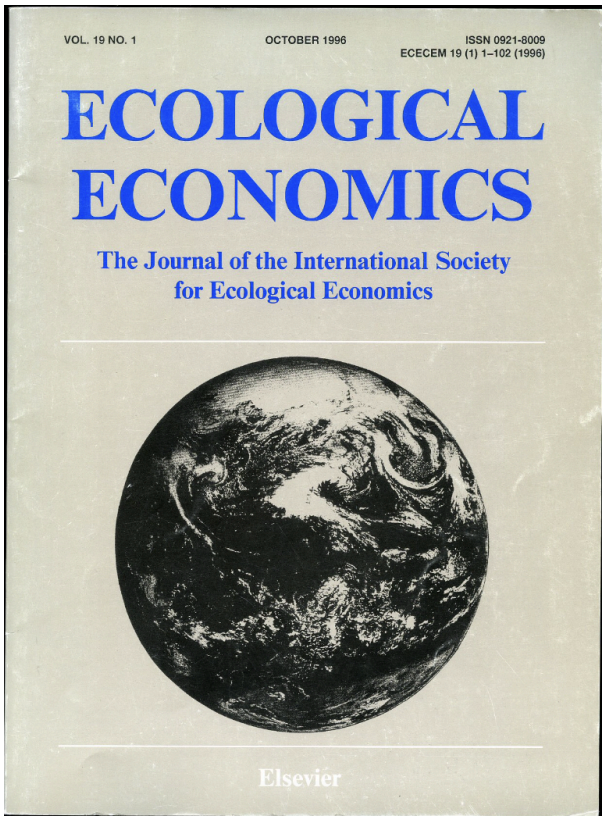
Not only did ecological economists gather influential concepts from other fields, but within this period of gestation in the 1970s-1980s, two incredibly noteworthy publications sought to fully reconsider the composition of the economy, and highlight how it was inherently damaging human well-being. First, *The Limits to Growth* by Donella Meadows and others. Published in 1972, this book imagines a global transition from the growth model, to one of equilibrium. These authors analyzed five factors that determine growth on Earth: population, food production, industrialization, pollution and consumption of nonrenewable natural resources and expressed how they function within the current economic model (Meadows et al., 1972). These researchers discovered that each one is following a trajectory of exponential growth, and proposed alternative models that could achieve an equilibrium state instead. These ideas pushed organizations and individuals to reevaluate the processes and infatuation associated with growth that became so embedded within society. As said in the foreword, "We hope that it will encourage each reader to think through the consequences of continuing to equate growth with progress" (Meadows et al., 1973). Essentially, this book introduced how the growth model could destabilize human life and that changes need to be made immediately.

The second influential publication was by Herman Daly and his *Introduction to Steady-State Economics* in 1977. Named the father of ecological economics, Daly incorporated and built off important concepts from the past—including the work of Rachel Carson, Kenneth Boulding, Donella Meadows and the work of thermodynamics — transforming economics from a physical science to a life science, one that was more related to ecology and biology. Daly tried to connect to environmental economics but saw that his ideas were fundamentally different from that perspective and their understanding of growth and resources. Daly revealed that the human economy had grown to an immense size, due to matter-energy being transformed into high-entropy waste. According to Daly, in a steady-state economy, the growth paradigm is reconsidered, as unlimited growth in a world of finite resources is impossible. Focused on equal wealth and income distribution, the steady state is one of constant stocks of capital and population, with an equal rate of inflow and outflow with throughput (the rate of both inflow and outflow) as low as possible (Daly, 1977). This concept was revolutionary, especially in 1977. It debunked the infinite growth requirements that had become so normalized, demonstrating that continuing these patterns is detrimental to societal well-being. With the introduction of Daly's steady-state, ecological economics was one step closer to its formal creation.

After these two decades of developing interested researchers, gathering contacts and increasing transdisciplinary research, there was then an international push to collaborate on the creation of ecological economics. Throughout the 1980s, there were growing efforts and multiple meetings with very influential actors like Daly and Costanza, hoping to create the first official journal in the field. To increase the success rate of the journal, the International Society for Ecological Economics was created in 1988, with the first journal released soon after in 1989 (Figure 2). There was finally a place for ecological economists to share and collaborate, a huge milestone that had been on the horizon since Boulding's spaceship publication in 1966. Now that the ecological economics society and journal had been established, it's important to look at what objectives were on the horizon for this newly established field, and how they have changed throughout the years.

Figure 2

An Early Edition of Ecological Economics Released by the ISEE



Note. Released in 1996, this is one of the first journals released by the ISEE after its formal creation. *Rare & secondhand books, rare & used textbooks, rare & out of print books, antiquarian books, collectable books*. Rare & Secondhand Books, Rare & Used Textbooks, Rare & Out of Print Books, Antiquarian Books, Collectable Books. (n.d.). https://www.littlestourbooks.com/

Identity and Goals of Ecological Economics

To reiterate once again, the worldview of ecological economics is the embedded economy. Instead of thinking of the economy as a boundless entity that can grow without any repercussions on global ecology, it is only a subsystem of the larger ecosphere, meaning that the composition of the economy can have grave impacts on the natural world if not managed properly. Throughout its formal years of research, some authors believe that the field has three

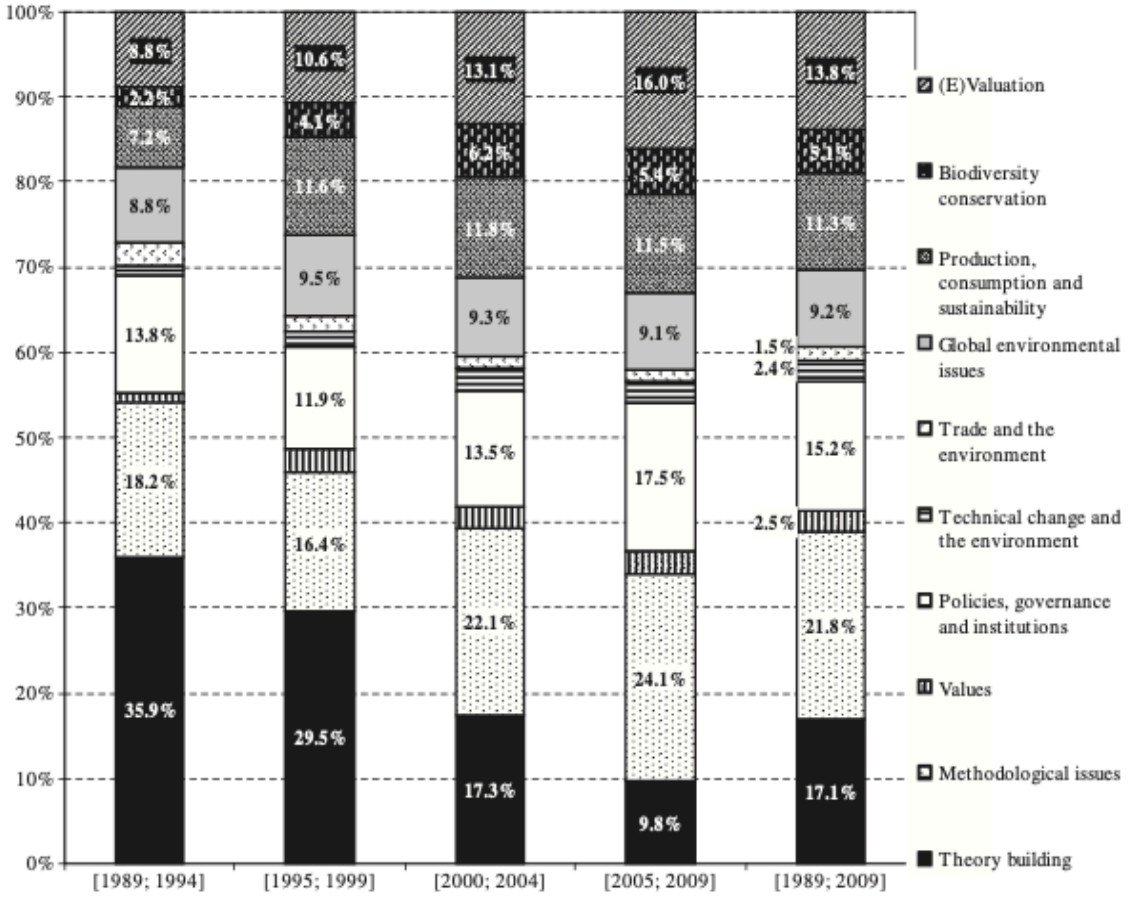
agendas: explicit, implicit and reconstruction. The explicit agenda is akin to the desire to transform towards an embedded economy. Pulling from Meadows' *Limits to Growth* and Daly's *Steady-State Economics*, the explicit agenda is concerned with placing restrictions on the economy, while also thinking about sustainable development (Brown & Timmerman, 2015). It has three main areas of concern: 1) scale, how the economy can be a subset of biogeochemical processes, 2) distribution, how sustainable development can be split within and between generations, and 3) efficient allocation, a goal of classical economics yet adjusted to consider scale and equity as well. These are three conditions that must be met when thinking from an ecological economics perspective. The implicit agenda rejects the neoclassical vision and forces us to understand the world as it currently exists. This viewpoint emphasizes that not only is human ownership of the natural world not viable but that the independence of humanity strictly contradicts the law of the conservation of matter and energy. Essentially, this agenda is a modification of humanity's relationship with the rest of the planet, a relationship that has been severely skewed by the current economic model and growth paradigm. Lastly, the reconstruction agenda articulates how this damaged relationship has severely affected Earth's biophysical nature and life-support systems, and the current path will only get worse. With these agendas in mind, it is clear that ecological economics points out certain shortcomings in humanity and the mainstream economic system. Overall, this represents the identity of ecological economics as a field.

But how exactly are these objectives unfolding in the scientific discourse of the field? In 2011, a group of researchers completed a bibliometric account of the evolution of ecological economics by using all articles published in the journal and classifying them based on the main topic of research. They used ten main topics of research, theory building, methodological issues, values, policies governance & institutions, technical change & the environment, trade & the environment, global environmental issues, production consumption and sustainability, biodiversity conservation and finally, valuation. They found that since the first journal in 1989, there has been a predominance of methodological issues, policies, governance and institutions, and valuation, all gaining more relevance over time (Figure 3). This trend is aligned with the notion that ecological economics is a policy-driven science, and related to its three agendas, looks at the relationship between humans and the environment (Castro e Silva, 2011). This large

collection of topics also demonstrates that ecological economic researchers do not subscribe to a single theory, and are pluralistic in nature.

Figure 3

Topics Represented in Ecological Economics from 1989-2009



Note. A bibliometric analysis of what topics are being represented in the journal *Ecological Economics* since it was first published. Castro e Silva, M., & Teixeira, A. A. C. (2011). A bibliometric account of the evolution of EE in the last two decades: Is ecological economics (becoming) a post-normal science? *Ecological Economics, 70*(5), 849-862. 10.1016/j.ecolecon.2010.11.016

Is This Field at a Crossroads?

Ecological economics is indeed a radical collection of ideas and has seen many ups and downs in its 30 years of existence. Indeed, in recent years, many important actors have noticed that ecological economics has strayed far from its original intent, especially due to tensions with classical economics. Clive Spash expresses that the message of Ecological Economics is twisted and misused, and because economics was never unified as its own discipline, the type of economics followed by this new field was up for debate, leading to an ambiguous development (Spash, 2012). He also mentions that there are three camps of thought: 1) new environmental pragmatists, those concerned with practical consequences and policy initiatives, 2) new resource economists, a creeping of neoclassical economics into the movement and finally, 3) social ecological economists, the only viewpoint that addresses the shortcomings in the existing economic framework. These differing opinions demonstrate that within this field, there are discrepancies over the best approach to the increasingly complex economic and social problems that are so common to our world. He argues that "shallow ecological economics" works within the current economic model without providing strong enough alternatives. "Deep ecological economics" requires an actual confrontation of pre-conceptions in society, while actively attempting to change the public policy that is making these economic transitions impossible. As put by Spash, "Once you learn to sail, shallow waters soon appear more dangerous than the depths of the open sea. Deep waters are also much preferred when riding-out a storm" (Spash, 2012). So, is ecological economics at this crossroads? In this chapter we looked at the societal origins that created this field, the most important publications, the gestation period and intellectual complements, while finally understanding what the field is actually trying to achieve and how it is falling short of those objectives. In the following chapters, we will look at the two main issues that have been of utmost controversy in ecological economics history: economic growth and its alternatives, and ecosystem valuation. Each of these has many conflicting opinions and can't seem to find a widely accepted solution, one of the reasons why this field is considered to be struggling at the moment. As Peter Brown and Peter Timmerman, two renowned ecological economists, share in their description of economic growth: "A specter is haunting the Earth— the living ghost of an economic theory that, no matter how much it is assaulted or how much damage it causes, refuses to die" (Brown & Timmerman, 2015).

Chapter 2: Economic Growth & its Alternatives

If you wanted to find what international statistic is of the highest societal concern, I suggest looking at the GDP reports that are released every economic quarter. This single number dictates the progress of global and domestic economies based on how many goods and services are being produced. Whether this number is going up, down, or staying the same is considered by policymakers and economists as fully consequential and the sole factor dictating societal prosperity and progress. However, should one statistic have that much influence on something as monumental as societal well-being? Returning to the main understanding of ecological economics, it is understood that the economy is embedded within the larger ecological sphere, not the current mainstream idea that the economy can act free from these ecological factors. Therefore, it wouldn't exactly be wise to consider GDP and the constant growth of this GDP to be the indicators of progress, especially when the pursuit of this growth is causing so many problems to the global natural environment. In this chapter, we will discuss why the perception of economic growth has become central to economic and social development, the issues with this growth paradigm, and evaluate three alternative economic models that have been developing among ecological economists.

Introducting the Growth Paradigm

The history of this growth paradigm has roots in economic theories dating back hundreds of years, yet large societal events of the mid-twentieth century solidified its place in economic policy. Countries such as Britain and France which were most developed during the eighteenth and nineteenth centuries, started to separate the economy from other spheres of social life, and it became something autonomous and self-governing, beyond the laws of nature through which it had previously been existing. Its identity once again shifted during the 1930s and 1940s, a turbulent timespan due to the Great Depression and World War 2. While the Great Depression decimated both national and international economics, the war was an opportunity for economic stimulus due to increased needs for production of materials to be shipped overseas. Because of these drastic changes in the strength of the economy, economic growth and adequate ways to measure its success simultaneously became important policy goals. At this time, Gross Domestic Product became a symbol of national strength and sovereignty, linked to combatting economic

shortcomings after the Great Depression, and tracking World War 2 expenditures and societal reconstruction after the war (Kallis, 2018). Relying on GDP as a measure of economic progress has been internalized since then, and any efforts to divert to another method have proved futile. The use of this measure goes hand in hand with the modern need for constant economic growth to maintain societal prosperity, however, many ecological economists have outlined the issues that are associated with economic growth, issues that can be found in economic, social and environmental spheres.

When the post-war prosperity began to fade, questioning the growth paradigm was gaining traction during the environmental movement of the 1960s and 1970s. Publications like Daly's Steady State and Meadows' The Limits to Growth which were influential in the creation of ecological economics were also important in criticizing economic growth. Limits to Growth was especially notorious because it provided a strong mathematical basis on five factors such as population growth, pollution and depletion of natural resources, and concluded that a system based on growth would result in future collapse (Spash, 2021). This was also influential because it demonstrated that there are so many possible interactions between these factors on a global scale, and a single solution would be widely ineffective in solving the core issues. Therefore, this report outlined the basis for why the growth paradigm is dangerous in terms of resource throughput because it doesn't take into account the natural world and ecosystems' ability to properly handle resources without facing degradation.

Disputes Regarding the Growth Paradigm

This disconnect from the biophysical world is also evident from a thermodynamics perspective. Entropy is defined as the qualitative state of energy, and industrialization is built upon exploiting one of Earth's main sources of useful energy: terrestrial stocks of concentrated materials (Spash, 2021). Since the burning of fossil fuels is correlated to this economic growth, then this pollution and the environmental effects are a direct outcome of the growth economy. This pollution can be extended to so many other consequences such as deforestation, ocean acidification, microplastics and so on. The Law of Conservation state that energy and mass can never be created or destroyed. With increased production comes increased waste generation, and overall, economic growth has created these deplorable environmental conditions.

In addition to a negative environmental impact, the structure of the mainstream economy has also geared social behaviour toward perpetuated consumerism, having negative effects on human well-being. This involves "keeping up with the Joneses", a phenomenon in which status and conspicuous consumption are reinforced by corporate advertising and overall lifestyle (Spash, 2021). This is also supported by the fixed obsolescence of products and the understanding that resource extraction is inconsequential. A critique that has been used in economics for many years is the Easterlin paradox, in which it "deconstructs the economic preoccupation with growth in income as a measure of happiness, and its failure to address what really counts in contributing to human well-being" (Spash, 2021). Therefore, from a social perspective in developed countries, economic growth is no longer a contributing factor to well-being, outlining a severe drawback in the growth paradigm as the measure for this growth, GDP, increases.

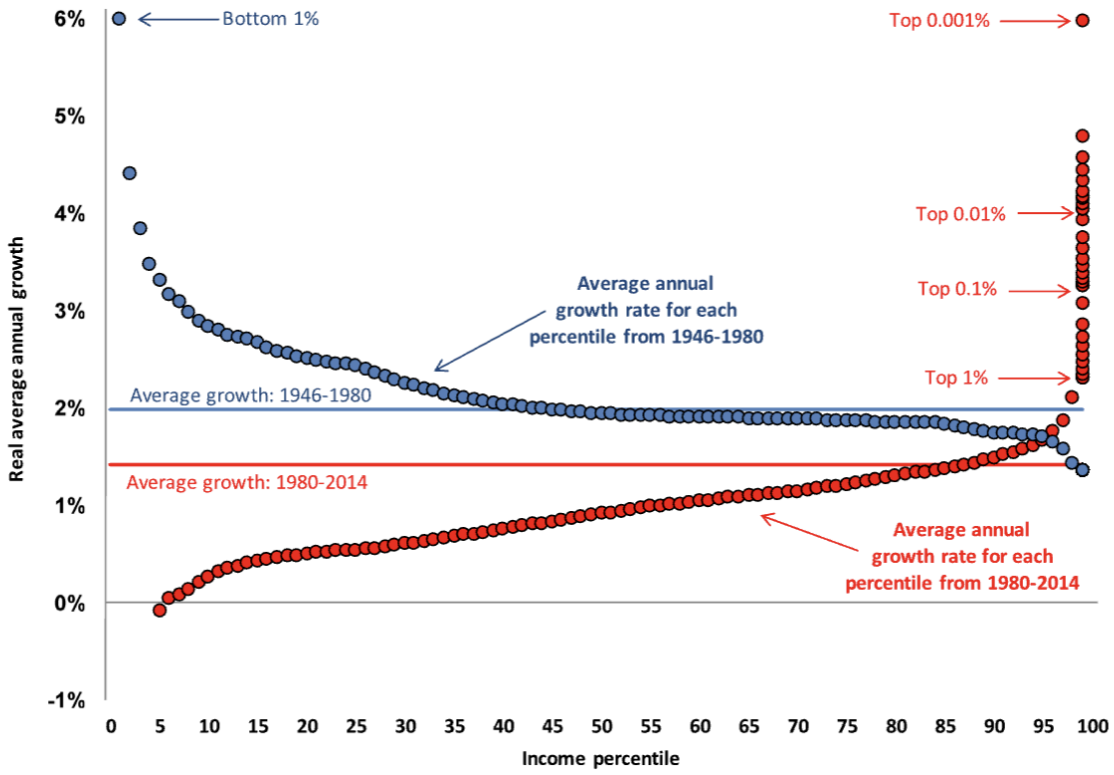
The shortcomings of GDP as a measure of progress are numerous, especially among ecological economists. Examining GDP as a measure, it is solely the value of output that the economy holds, not the value of the economy itself (Victor, 2010). Therefore, while it is being used to measure economic output, it is also being used as a blanket measure for societal progress, something that should be measured more effectively. There are alternative measures that have been proposed, including the Genuine Progress Indicator, which adjusts GDP to be more accurate in its measurement of actual well-being and properly accounts for the negative impact of environmental externalities. However, GDP is still accepted widely in the growth paradigm, exposing yet another issue with this economic system.

The last element of this growth paradigm that warrants discussion is the economic consequences that are affecting the prosperity of society as a whole, primarily the decline in labour productivity and the rising rates of inequality. Recent trends in labour productivity, or the real economic output per unit of labour, are indicative of possible challenges that accompany economic growth. When looking at the United Kingdom's labour productivity growth over the past several decades, it has been decreasing consistently since the 1960s, with important technological inventions such as internet, cellular phones and computers only creating slightly slower rates of decline (Jackson, 2019). What the lowering of labour productivity rates demonstrates to ecological economists is the need for a change in the economic system design, especially given the reality of declining energy resource quality. The peak Energy Return on

Energy Investment (EROEI) in the U.K. corresponded to the peak in labour productivity growth in the 1960s. Therefore, this seems to be a situation where growth in labour productivity is tied to the availability of inexpensive, high-quality fossil fuels. As a result, growth in labour productivity is now declining as the EROEI of fossil fuels is also declining. While there isn't a definite causal link between EROEI and labour productivity, as it takes more and more energy to extract high-quality resources, there will be a need for more growth-based labour rather than less to extract these resources, an inherent controversy within the economic system. In the desire to keep the growth rate ever increasing as labour productivity declined, fiscal and financial policies were put in place to increase demand. Lower-middle class citizens were those who felt the weight of these policies, through rising inequality and instability. Rising inequality is a direct result of the economic system in place. As it began in the 1900s, trickle-down economics is the idea that economic growth was the best way to reduce inequality by letting the rich spend their income on goods and services that would be returned into and uplift the economy (Jackson, 2019). These ideas were successful in growing the spending power in all socioeconomic statuses and keeping average annual growth relatively similar. Fast forward to the last 40 years, this story has changed dramatically, with the richest 0.001% growing their earnings by 5%, and the poorest 5% seeing a drop or stagnation in their incomes during the same period (Figure 4) (Jackson, 2019). Clearly relying on trickle-down economics has created a widening income gap, benefiting the richest and further destroying the poorest. Relying on economic growth has created these problems discussed, such as the disconnect from the biophysical world, environmental degradation, inaccurate measures of progress, and rising inequality. Perhaps one of the alternative approaches in understanding growth proposed by ecological economics are capable of correcting the flaws of the current economic system.

Figure 4

Average Growth by Income Percentile from 1946-2014



Note. A visual demonstration of substantial income growth for the top percentage of wealth, but not for the rest of the population. Jackson, T. (2019). The Post-growth Challenge: Secular Stagnation, Inequality and the Limits to Growth. *Ecological Economics, 156*, 236-246. 10.1016/j.ecolecon.2018.10.010

Economic Growth Alternatives

There are three main alternatives to growth that have gained traction among ecological economists: green growth, degrowth, and the steady-state system.

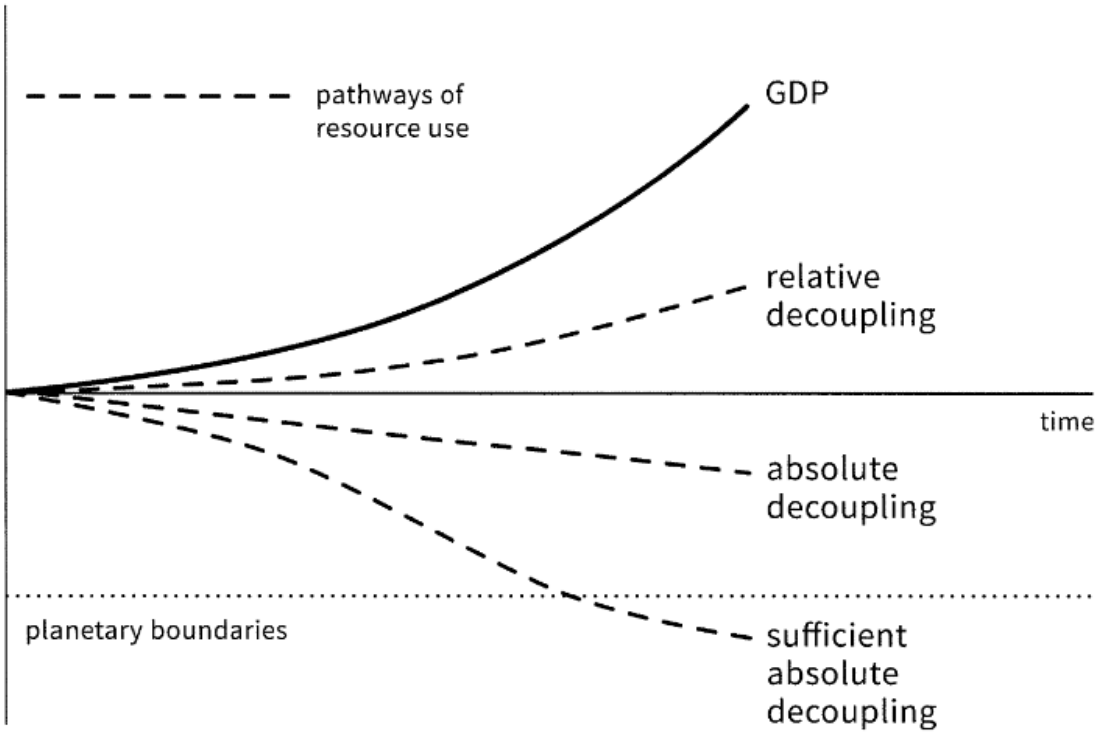
Green Growth

To begin, the only alternative to still support a notion of growth and coincidently also the one with extensive flaws is green growth. Green growth is based on increasing resource efficiency and decoupling the material intensity of production from economic growth. It focuses on the idea that with substitution between natural and manufactured capital, diminishing returns and technological advancements, economic growth can continue without environmental degradation and be decoupled from the resource base (Meran, 2023). This concept was proposed by the World Bank and the Organization for Economic Cooperation and Development (OECD) in the 1980s and represents a mainstream economics approach in which growth can continue indefinitely without the environmental consequences it currently creates. However, the belief that "environmentally compatible growth" could actually exist is dwindling fast among ecological economists for a multitude of reasons. Complete decoupling on both the inputs and outputs of the economy can alternatively be described as a circular economy, in which every input of production and consumption is out into the environment as waste, and then recycled back into the cycle to be used in this process again, fully closing the material circle. However, this process doesn't compute with an ecological economics perspective or that of Boulding's Spaceship Earth, because the interconnectedness of the biosphere also affects the abiotic sphere of the atmosphere and the geological nature of the earth (Meran, 2023). As a subsystem of the environment, the economy cannot act independently of these systems, and the conditions of the biotic and abiotic spheres will in turn affect these material cycles. In ecological economic terms, there are four possible scenarios of decoupling from GDP: 1) relative material decoupling, 2) relative emissions decoupling, 3) absolute material decoupling and 4) absolute emissions decoupling (see Figure 5). Absolute decoupling contrasts with relative decoupling in the strength and rapid rate of either the material intensity of GDP or the emission intensity of GDP. Absolute decoupling has been considered highly unlikely among ecological economists because of the connection between carbon emissions and GDP (Figure 5). The reduction of carbon intensity must happen at an immense rate to still allow for GDP growth. For example, with a 1.5% annual increase in income per capita, carbon intensity must decline 4.4% every year in order to stay within 2 degrees of warming (Kallis, 2018). This would be an incredibly difficult task to achieve among all developed nations striving to reduce their carbon intensity. As a result, renowned

ecological economists such as Tim Jackson have expressed that even with some substitution of cleaner energies for fossil fuels, there exists no climate mitigation scenario in which growth can continue. Several other authors have discussed the same thing, calling green growth the lie of sustainable inclusive growth and a complete oxymoron because historically, greenhouse gas emissions have only fallen due to economic recession (Spash, 2021). Some are so bold to say that "green growth is a Cornucopian pipe-dream that won't save the Earth under any circumstances" (Lawn, 2011). While economic growth without environmental consequences seems desirable from an economic policy standpoint, especially for developed countries, it has not yet been proven as a viable option moving forward. However, there are advocates for the next alternative, degrowth.

Figure 5

Projected Pathways of Different Decoupling Scenarios



Note. This figure demonstrates how each decoupling scenario has a different relationship to both GDP and the biophysical limits of the planet. Raworth, K. (2018). *Doughnut economics*. Random House UK.

Degrowth

The concept of degrowth was gathered as a normative term from Georgescu-Roegen in the 70s-80s. It is defined as the "political and economic reorganization to drastically reduce resource and energy throughput" (Kallis, 2018). This concept details the actual reduction process from a growth economy to a no-growth economy through changes to the economic system as it stands today. First, constant growth isn't a necessity in neoclassical models, and there are zero growth scenarios that are compatible with stability and full employment. In fact, there are many adjustments that can be made in order to reduce growth and simultaneously remain a stable economy. To begin, investments play a role in a degrowth transition. Particularly, the investment in certain sectors like renewable energy, and the disinvestment in others, such as the coal industry, to keep net investments at zero. Also, high levels of employment can be achieved in these economies by reducing working hours, shifting employment towards labour-intensive sectors or redirecting technological advancements to increase the productivity of resources, rather than labour (Kallis, 2018). While no growth systems may not seem compatible with capitalism, Kallis et. al 2018 argue that growth is derived from the qualities of the current capitalist push towards competition, private ownership and cheap energy supply. By limiting competition, pushing for public ownership and diminishing fossil fuel exploitation, growth couldn't flourish under these different conditions. However, the viability of this transition is called into question, due to the current path dependency towards growth, and the strong efforts to avoid transitions that would invoke systemic change to this degree. One method to modernize degrowth theory is to concentrate spending for this social-ecological transition in the central government, as power is currently held in the hands of commercial banks and investment is dominated by large firms (Olk et al., 2023). By focusing on the central bank as they are the sole actors that aren't subject to liquidity constraints, they would be able to adequately support degrowth policies. However, that would be a political choice, not an economic necessity (Olk et al., 2023). While there is a necessity for deeper analysis of transition paths that concern getting away from growth, degrowth has generated significant scholarship in recent years, and the development of its practicality and further modelling of the transition could impact its viability as a post-growth scenario.

Steady-State

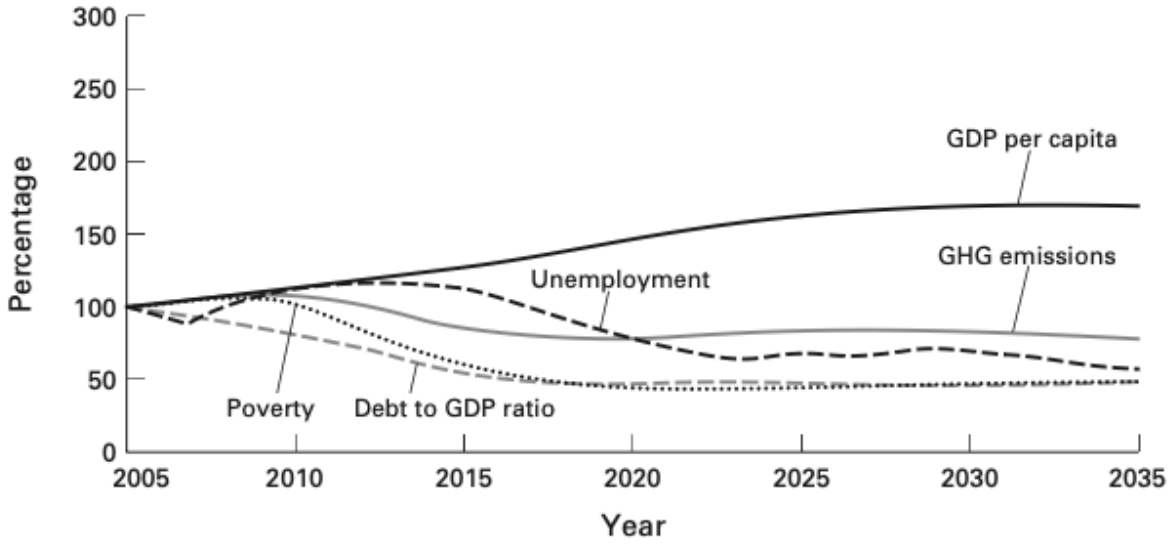
A transition that seems even less viable in the face of capitalism is the steady-state economy, first put forward by Herman Daly in the 1970s. However, the steady-state has extreme promise in its potential to create a no-growth economy with environmental and social stability in mind, even with capitalist ideals at the center. Firstly, the steady-state is defined as a physically non-growing economy where the production of new goods matches the consumption and physical depreciation of existing goods, and the human population is constant (Lawn, 2011). Capitalism is an economic system in which capital is privately owned and sold by individuals or private businesses in markets that are formally established (Lawn, 2011). There is a strong belief that these two ideas cannot function together symbiotically to create a strong society, however, there are some ecological economists that say otherwise. Firstly, the largest concern with steady-state systems is a fear of unemployment increases if real GDP were to stop growing. However, there are two ways to achieve full employment in a steady state, through qualitative improvement, and central governments becoming an employer of last resort. By producing higher quality goods, workers could get higher wages through higher prices and reduced work hours, generating more social welfare as well. The Job Guarantee is a program where the central government would ensure that all unemployed people would acquire employment to provide public goods and services. There are worries that this would increase inflation, however, Lawn argues that the spending on the Job Guarantee could always be adjusted to ensure that this employment would be non-inflationary. All in all, the Job Guarantee and producing high-quality goods are some ways to adjust capitalism to be more in tune with a steady-state economy. Governments can also reduce the capitalist dependency on the market, by intervening and distributing wealth and income to the poor. This would limit the power of markets and the vulnerability of citizens towards its forces because the government could act in favour of reducing potential inequalities (Lawn, 2011). The last element of a steady-state system worth mentioning is the understanding of money as a financial asset. If the real money supply is increasing, then real wealth must also increase to prevent high rates of inflation. To adjust this idea, similar to the degrowth transition mentioned above, Daly suggested moving the control of a state's money supply towards the central government, an extremely large and systemic change to the financial systems in place. All in all, the steady-state is considered by some to be the best and

only way to achieve sustainable development, by ensuring full employment, lowering stress levels and increasing leisure time. It could also represent the strategy through which developed countries shrink their economies from their currently bloated state. Misgivings and fears about anti-growth capitalism systems previously wreaking havoc on society are considered misleading, because "If an economic system is institutionally designed to grow and doesn't what would one expect other than disaster" (Lawn, 2011). Therefore, a steady-state economy represents a promising post-growth transition that could be environmentally, socially and economically more prone toward happiness, success and stability.

An interesting application of the steady-state economy comes from Peter Victor and Tim Jackson, in their chapter of *Ecological Economics for the Anthropocene*. Using the macroeconomic model LowGrow, this software is able to evaluate different pathways that the Canadian economy could take in the coming future, by introducing different measures that could reduce the rate of increase of five different parameters: poverty, Greenhouse Gas emissions, GDP per capita, Debt to GDP ratio and unemployment (Victor & Jackson, 2015). These authors compared a model of complete instability of these factors to one of gradual changes that represented a steady-state model. The results demonstrated in Figure 6 were obtained by simulating a "slower growth in government expenditure, net investment, and in population: a reduced work week; a revenue-neutral carbon tax; and increased government expenditure on antipoverty programs, adult literacy programs, and health care" (Victor & Jackson, 2015). This is a remarkable model, yet is still a preliminary step used to demonstrate the need for more frequent and demonstrative macroeconomic modelling. Some of the conditions included in this particular LowGrow model include Canada's central bank keeping inflation at or below 2% per year, which isn't guaranteed with a fluctuating economy. There is also a concern with whether full employment is possible as economic output stays constant but labour productivity continues to grow. In fact, there is doubt that substantial productivity increases will be possible because certain tasks such as rebuilding wetlands can be labour intensive, but is also necessary to reduce human impact on the environment. All in all, this model is a great example of the steady-state economy, demonstrating the need for targeted macroeconomic policy changes, and how long it will take for these policies to have their desired effect; an immensely challenging model for current economies to achieve.

Figure 6

A Simulated Canadian Steady-State Economy from 2005-2035



Note. A simulation of a steady-state Canadian economy from 2005-2035 using the LowGrow macroeconomic model. Victor, P., & Jackson, T. (2015). Towards an Ecological Macroeconomics . In *Ecological Economics for the Anthropocene: An emerging paradigm,* edited by Peter Brown, and Peter Timmerman, Columbia University Press.

Are These Transitions Possible in the Near Future?

Yet it must not be forgotten that the growth paradigm has been dominating since modern economies developed. A transition to another approach hasn't been widely proposed, as there is yet to be one dominating alternative that could be implemented immediately. Green growth isn't remotely viable, degrowth has some dangers in the speed and overall possibility of absolute decoupling, and the steady-state generates the most skepticism due to the sheer scale of its transition and fears of economic collapse. However, when looking at all these options, I believe that the steady-state is most aligned with actual prosperity, and outlines what practices need to be put in place to reduce environmental degradation and improve social welfare. Yet could a transition like this be genuinely viable in the current political sphere? That has yet to be determined.

Table 1

Differentiating Amongst Economic Models

Assumptions/Features of Each Economy	Green Growth	Degrowth	Steady-State	Business As Usual
GDP Growth Rate	Continually growing	Decreasing	Static, unchanging	Continually growing
Environmental & Resource Impacts	Declining through material & emissions decoupling	Absolute reductions in material throughput	Rate of throughput not exceeding regeneration, rate of waste not exceeding assimilation	Conventional regulation of environmental impact
Investment/ Money	Green energy & clean production methods	Investment in natural capital systems & renewable energy systems	Investment in natural capital systems & renewable energy systems	Markets determine allocation
Employment	Economic growth necessary to maintain employment	Reducing working hours, guaranteed income	Government acts as employer of last resort	Non-interventionist approaches to employment levels

Note. Each alternative growth model evaluated against the Business As Usual scenario based on four different markers of an economy.

Chapter 3: Ecosystem Service Valuation

In 1997, Robert Costanza and other ecological economists worldwide performed a calculation that immensely transformed our conception of nature. To demonstrate *The Value of the World's Ecosystem Services and Natural Capital*, they estimated how much the different biological and ecological processes contributed to human welfare by estimating the dollar value of these systems. They calculated that the entire biosphere was worth 33 trillion dollars annually in 1997 (Costanza et al., 1997). At this time, this was almost double the global GDP. This report opened the door to both opportunity and controversy in valuing ecosystem services within traditional economic bounds, and it has been one of, if not the most contested topics in ecological economics ever since. To further understand ecosystem service valuation (ESV), it is important to look at its history of development, the different types of this valuation, the main issues at stake and the most promising solutions moving forward. As these natural services become more scarce each year, they will be even more important in maintaining ecological balance, and ecosystem valuation is a possible approach to rethink our characterization of the natural world.

Defining Ecosystem Goods and Services

Ecosystem goods and services are essentially the benefits that the human population can derive from a particular ecosystem function. During the 1960s -1970s, ecosystem functions were used to explain how nature served human societies, however, it was mainly a pedagogic understanding that surrounded the largest issues at that time, such as the disappearance of biodiversity and the acknowledgment that it has a direct effect on the ecosystem functions that are critical to human well-being (Gomez-Baggethun et al., 2010). It wasn't until much later, with Costanza's 1997 paper, that further ESV research was inspired as a whole.

Ecosystem services are commonly divided into 4 classes based on their contribution to humans: supporting, regulating, provisioning and cultural (Turner et al., 2010). They can be both direct or indirect, as ecosystem goods represent physical entities such as food, whereas waste assimilation functions are an example of a service that ecosystems can offer (Costanza et al., 1997). One of the most important definitions that returned to distinguish between goods and services comes from Georgescu-Roegen in 1971. Ecosystem goods represent stock-flow resources, which are materially transformed and used in production. Fund-services are a

configuration of interacting stock-flow resources that generate a flux of services over time (Farley et al., 2015). To use this definition in the case of ecosystems, the water, animals, minerals and plants, which represent the stock-flow resources that could be transformed and used in economic production, all interact with one another to create an ecosystem service. Georgescu-Roegen's definition helps to demonstrate the interconnectedness of ecosystems, as the stock-flow resources contribute to the services that are essential to well-being, and any alteration could have profound effects. It is worth differentiating ecosystem services from marketable goods and services because the distinction is vital to the creation of ESV. A key feature of marketable goods and services is the fact that they are rival— when one person's consumption precludes another's consumption of that good or service— and excludable— when the seller and owner of this good or service can exclude those who didn't pay for it (Heal, 2000). Ecosystem services are generally both non-rival and non-excludable. This represents the antithesis of the requirements for a market transaction and sets up an instance of market failure because consumers of these ecosystem goods and services aren't given a mechanism to reveal their preferences or demonstrate an accurate representation of value.

Correcting for market failures and properly valuing ecosystem services is one of the reasons for ESV as a mechanism, and there are many different frameworks of ESV. There are three main valuation methods: revealed-preference approaches, state-preference approaches and cost-based approaches. Revealed preferences entail processes of valuation that are able to clearly demonstrate preferences in the real world. These can be market methods for tradable ecosystem goods, or an individual's travel costs as an indicator of their enjoyment and subsequently the importance of a particular service (Liu et al., 2010). State-preference approaches, the most commonly used method for ESV in practice, involves asking individuals directly their willingness to pay (WTP) for or willingness to accept (WTA) a change in a particular ecological service, meaning what financial costs they would be willing to contribute to maintaining a particular service (Liu et al., 2010). Cost-based approaches represent a value that is calculated based on what the replacement cost would be for a lost good or service, or what costs would be avoided by maintaining these services. All of these methods can be used when valuing different types of services that ecosystems provide. But in addition to these methods, other mechanisms were established to formally integrate ESV into both active markets and the policy arena: Market-Based Instruments (MBIs) and Payment for Ecosystem Services (PES).

Defining MBIs and PES

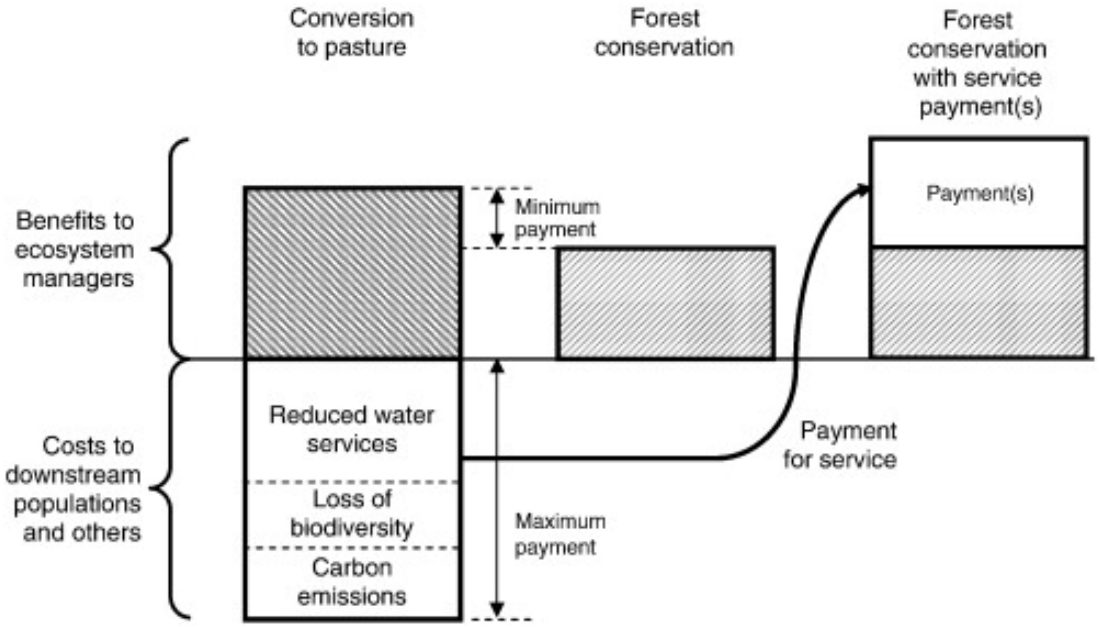
MBIs were initially created for conservation purposes in the 1990s-2000s. MBIs represent the monetary value of ecosystem services in formal markets. Markets are defined as "an actual or nominal place where forces of demand and supply operate and where buyers and sellers interact (directly or through intermediaries) to trade goods, services, contracts or instruments, for money or barter" (Wunder, 2013). Some of the most common examples of MBIs are emission trading of greenhouse gases and carbon markets. Through these markets, companies that are emitting more than their set target can purchase credits from under-emitting companies, thus creating a formal trading mechanism to reduce emissions overall (Gomez-Baggethun et al., 2010). PES has been generally defined as a voluntary and conditional transaction between at least one buyer and one seller of a well-defined service, or a corresponding land-use proxy (Wunder, 2013). Figure 7 is a visual demonstration of how PES systems are created. PES was created as a more direct alternative to Integrated Conservation and Development Projects (ICDP), programs that promised to correct inequality while also preserving biodiversity in protected areas, yet found little success in achieving their many objectives (Muradian, 2013). PES were created following the assumption that market failures were causing this underappreciation of ecosystem services, and creating payments would correct the market mechanism and adequately reveal the value that these services hold (Muradian, 2013).

One successful example of PES in the United States is New York City's Water Supply. New York City gets its pristine freshwater fully filtered by natural processes from the Catskill/Delaware and Croton Watersheds which are upstream from the city. However, the watershed was being depleted and lacked proper conservation, which severely threatened the city's water. So, the New York City Water Authority had a choice to make. They could have either allowed the depletion to continue and spent billions of dollars over the next several years building new filtration infrastructure, yet they decided to invest only a fraction of those funds toward replenishing the watershed's natural filtration system upstream, which has proved to be extremely successful (Hu, 2018). Speaking in PES terms, New York City's population is the beneficiary of the ecosystem service of the watershed's filtration (Figure 8). They created a payment to the service provider— residents and officials who live in and take care of the watershed — to conserve, restore and protect the watershed so they could continue benefiting

from the service indefinitely. This example serves to demonstrate how PES can be created to serve in favour of conserving these ecosystem services.

Figure 7

Payment for Ecosystem Services



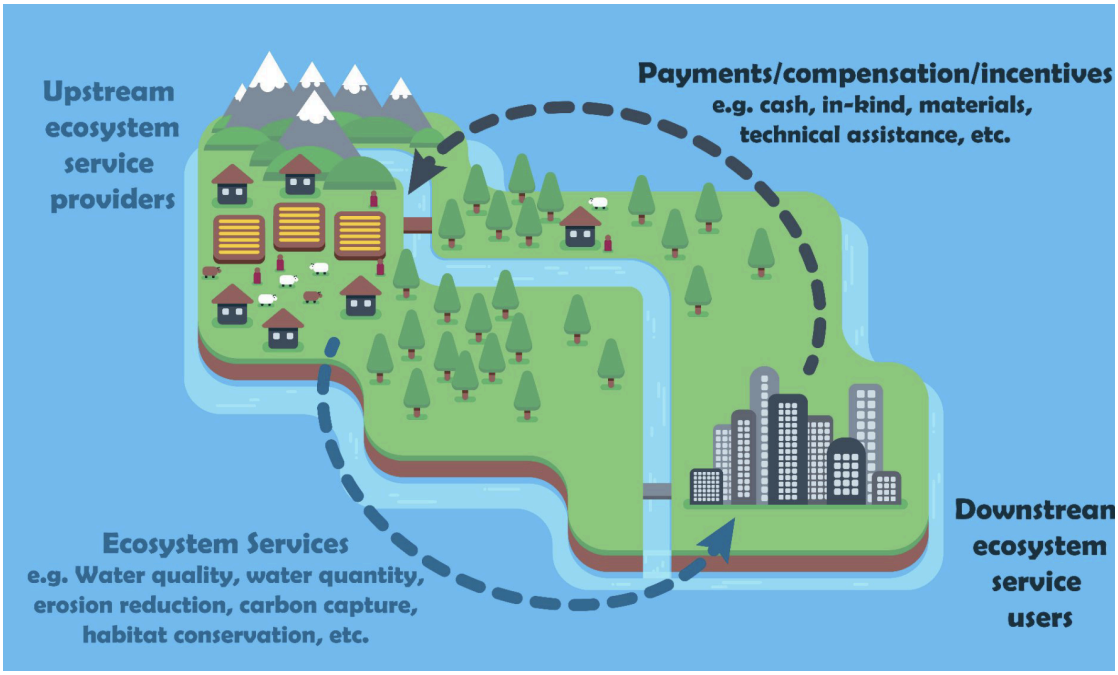
Note. Using forest conservation as the ecosystem service, this figure demonstrates the costs and benefits associated with PES systems. Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics, 65*(4), 663-674. 10.1016/j.ecolecon.2008.03.011

It is worth explaining where ESV fits into the PES structure. It is a common misconception that ecosystem valuation is required before PES systems are put in place because usually prices are negotiated between the buyer and seller of the service, and going through the extensive ESV process isn't always necessary as long as it is established that the service wants to be kept (Wunder, 2013). Therefore, ecosystem valuation is a way to put ecosystem value in terms that will reveal its value in economic terms, and PES is the negotiation to protect a service

between beneficiary and provider. Yet, not all valuation turns into PES, and not all PES have an ecosystem valuation component. The disconnect and multiple conditionalities of these systems, along with the idea that not all PES systems are representative of markets, demonstrates the complicated and widely ambiguous nature of ecosystem valuation, MBIs and PES across the world, and issues with these instruments have generated significant attention in the ecological economics community.

Figure 8

Water Quality PES System



Note. There are several possible ecosystem services provided in one PES system, as well as different types of compensation that could be provided. Payment for ecosystem services. (2024, February 4). In *Wikipedia*. https://en.wikipedia.org/wiki/Payment_for_ecosystem_services

What are the Issues With These Methods?

There are a plethora of shortcomings associated with ecosystem valuation, MBIs and PES, ranging in economic, environmental, behavioural and institutional issues. While these

issues are applied to ESV in general, it will be mentioned when certain issues concern MBIs or PES specifically. First, the economic issues with ecosystem valuation.

Economically-Based Shortcomings

There are many concerns with using monetary valuation as a way to propel conservation. This is framed by many scholars as the "commodification of nature", or assigning an ecological function an exchange value, which then can link providers and users in a market exchange (Gomez-Baggethun et al., 2010). The action of hypothetical discussion of commodification leads to more commodification in real markets, MBIs and monetary exchanges (Neuteleers & Engelen, 2015). This can be problematic because, through this monetary valuation, it imposes a strict relationship between society and nature that is solely based on this exchange and ignores other factors that are at play in ecological systems. Commodification can raise issues of incommensurability as the value in natural systems can cover many other areas beyond its monetary exchange value, and this could lead to improper treatment of an ecosystem service, which will be covered more in-depth later. This commodification can also create a tradeoff in PES projects between project efficiency and equity. Because return on investment is of primary concern to some PES advisors when looking for which land to conserve, striving for efficiency could ignore equity concerns. Targeting specific land could exclude some people already engaging in conservation and could also reinforce existing power structures (Chan et al., 2017). Another point worth reinforcing about market-based instruments is the fact that markets only function for rival and excludable goods and services. Ecosystem services rarely fill those criteria, and it makes cooperation necessary to protect non-excludable services, and price mechanisms highly inefficient for non-rival services (Farley et al., 2015). One final concern for the functionality of PES systems is the trap of compensation logic. Once ecosystem service providers receive compensation for the provisioning of a particular service, they may need continued compensation indefinitely, due to the increased opportunity costs of not converting their service to another use (Muradian et al., 2013). This would undermine the goal of conservation, while also leading to equity issues if there are large disparities in wealth between the recipient of funds and the local beneficiaries.

Environmentally-Based Shortcomings

The environmental impacts of ESV are worth mentioning, particularly concerning the marginality and threshold effects of ecosystem services when they are on the brink of complete destruction. ESV is often needed when the service is almost completely gone, and the more scarce the service, the more an additional unit is valued, because the effects of an ecosystem lacking a service completely are detrimental. Therefore, when the quantity of a service approaches zero because it is being degraded, the demand for that service approaches infinity (Turner et al., 2010). This demand curve makes it difficult to pinpoint when thresholds are actually being crossed, and they are of grave concern because the next unit of a particular good or service could tip the scales of ecological stability (Turner et al., 2010). This is a clear shortcoming of applying economic logic towards an ecological good or service.

Socially-Based Shortcomings

While the economic and environmental implications of ESV, are extensive, the area of most concern to researchers is that of behaviour changes once commodification is introduced. The principal apprehension towards monetary valuation comes from the fact that commodification of nature could lead to a crowding-out of the intrinsic motivations for conservation. Once money is introduced, it can manipulate and preside over the original intent of conservation. While a particular instance of ESV may be successful, this crowding-out may have potentially negative effects on the long-term protection of ecosystem services (Gomez-Baggethun & Muradian, 2015). In terms of issues of behaviour, the largest concern is incommensurability. The incommensurability of values means that the single monetary value of a particular service doesn't fully demonstrate its actual value, because aesthetic, cultural or symbolic values cannot be expressed in the same way (Jax et al., 2012). It has also been shown that the displacement of these altruistic motivations may be difficult to reverse in the future (Chan et al., 2017). Monetary motivations can also be more detrimental to conservation than social incentives because some experiments have confirmed that those receiving social incentives actually put more effort into achieving the goal of the program, than those who are additionally offered monetary compensation (Chan et al., 2017). Behavioural economics has also

evaluated the limitations of ESV because the "rational self-interested individual" that is associated with mainstream economics has been undermined by the fact that preferences originate from within and they can also be easily swayed as people are prone to systematic biases when making economic decisions (Turner et al., 2010). All of these considerations demonstrate how ESV isn't fully compatible with ecosystem services, as there are many values that extend beyond just one price, and conservation efforts are in turn subject to failure.

How Can Institutions Influence ESV Practices?

Institutions also contribute greatly to the failure or success of ESV, which manifests through individual PES projects. PES systems are part of broader structures of power, and there are certain pressure groups such as global conservation efforts and government initiatives that have a large influence on shaping their outcomes according to their agendas (Muradian et al., 2013). Essentially, payment design cannot be depoliticized, and designing payments in a certain way could continue the status quo and marginalization of certain groups (Muradian et al., 2013). This is also of concern when payments are prescribed with a top-down approach by outside agencies because they are often inflexible in their agreement and often resisted by farmers and landowners, as there could be differing understandings of the relationship between people and nature (Chan et al., 2017). Where PES projects are placed is also important, because certain developing countries do not have a payment culture in which service providers are motivated by payments for the service and would be better motivated by socially developed projects (Wunder, 2013). In the same vein, implementing payment and market structures in places where they didn't exist prior, is essentially manufacturing an economically thinking person in different parts of the world, which could severely alter the values of certain communities (Gomez-Baggethun et al., 2010). All in all, there are several concerns with the implementations of ESV, PES and MBIs, proposing a rather bleak outlook on the degree of their success in the future.

While ESV and MBIs are important in the overall sphere of valuing ecosystem services, PES systems specifically have developed significant scholarship and were promised to revolutionize ecosystem service conservation, but have had multiple shortcomings in practice. Yet they are still of great concern for ecological economists, and many look to see what could be changed to ensure they work effectively.

Proposed ESV Solutions

As an alternative to the issue of crowding out, some scholars propose an opportunity to crowd in. Crowding in the intrinsic motivations for conservation can be created by adjusting PES systems to use co-payments. By paying only a proportion of costs and splitting them between both sides of the transaction, it could ensure that ecosystem service providers are participating wholeheartedly in the project if they contribute their own time and resources (Chan et al., 2017). Since landowners already possess a care for the service their land provides, co-payments are less prone to crowding out and also conserve social approvement as conservation is still seen to be morally driven (Chan et al., 2017). This idea is derived from the suggestions of rewarding stewardship rather than particular actions, and distribution of rights and responsibilities inclusively. By rewarding overall stewardship towards conservation, it looks to reward patterns of behaviour that could inspire both short and long-term actions (Chan et al., 2017). This might also allow for more flexibility in how the project is implemented, engaging land owners and their specific knowledge of the area. Increasing the number of stakeholders may be motivating to find adequate solutions more rapidly (Chan et al., 2017). Distributing rights and responsibilities is also crucial, especially when ecosystem service beneficiaries are disempowered or poor. Ecosystem service providers are expected to bear some of the costs of management, which increases stakeholders' investment and assigns responsibility to everyone involved (Chan et al., 2017). These are some ways to distribute investment in the project, which will improve collaboration and overall desire for success.

When thinking about adequate treatment of a particular service, there are many policy tools for ecosystem service provision that have been proposed. Depending on the service provided, 5 types of provisions can be enforced: prescription, penalty, property rights, persuasion and payment. This variety demonstrates that payment shouldn't always be the desired solution. For example, penalties which are usually taxes, are a highly automatic solution and an efficient mechanism to draw out land management that provides ecosystem services (Kemkes et al., 2010). Also, prescriptive policies are costly to implement, but they may be the best solution when there is extensive marginal damage to an ecosystem (Kemkes et al., 2010).

Another important consideration to apply when considering the effectiveness of ecosystem service provision is a monopoly versus a monopsony power. Monopolies represent a

disconnect in power between the beneficiary and the provider of a particular service. Monopolies are undesirable when market payments are involved because they can drive up the asking price if the service provided is scarce or the provider has minimal financial incentive to participate (Kemkes et al., 2010). What is desirable for a market is a monopsony power. A monopsony power is generated through a single beneficiary and single potential buyer. If this exists, the free-rider problem in which people live off the efforts of others can be avoided, and a clearly identified sole beneficiary is able to capture all the benefits that they are paying for (Kemkes et al., 2010). These powers can be created through institutions. For example, in the New York City watershed example, the New York City Water Authority acted as a monopsony on behalf of all New York City citizens (Kemkes et al., 2010). This is an important gauge before setting up a payment or using another policy tool, which could create more effective projects based on the particular service.

A localized ecosystem service is less complicated to evaluate, however many authors discussed how some of the most pressing global ecosystem services should be handled, primarily climate change and the decline in biodiversity. These services aren't limited to any spatial boundaries and their effects are felt globally, so there is a need for a global institution to act on behalf of beneficiaries to reduce the costs of the transaction and the free-riding problem (Kemkes et al., 2010). Both of these challenges carry an enormous amount of uncertainty. Economists have primarily used cost-benefit analyses (CBA) to dictate what is needed in climate change mitigation, while some argue that climate change only has a small impact on human welfare because it only affects agriculture, a small percentage of GDP for developed countries (Farley et al., 2010). However, CBAs are wildly problematic, because of the moral debate of measuring all values monetarily, and they also assume constant economic growth which is a point of contention for environmental degradation as explained in Chapter 2 (Farley et al., 2010). Biodiversity is even more uncertain, as its outcomes will depend on technological and evolutionary change, leading to wildly unreliable opportunity cost calculations (Farley et al., 2010). The current global institutions that provision these two services, the IPCC for Carbon and the Global Environmental Facility (GEF) for biodiversity, both have their collection of shortcomings. The IPCC cannot come to a consensus on their carbon offset policy and has failed to educate politicians on the importance of carbon caps, and the GEF fails to ensure funding beyond a 5-7 year cycle, without guaranteeing the project will succeed (Farley et al., 2010).

However, there are possibilities for new International PES schemes. Farley et al., 2010 propose that projects looking at biodiversity and carbon should complement national projects that provide other services, which requires a fundamental rethinking of property rights. The projects should meet 3 criteria: the marginal payment from each contributor should at least be proportional to the benefits received or the harm done to the service, there should be a feedback loop where revenue that is collected should go back into the service, and transaction costs should be minimized, which is more probable if the project continues off of existing institutions (Farley et al., 2010). Also, global carbon taxes can fund biodiversity, because more resources for PES schemes are available as threats increase (Farley et al., 2010). A $30/ton carbon tax would reduce emissions by 20% and generate 150 billion dollars for the US alone (Farley et al., 2010). Therefore, focusing on carbon and biodiversity should be prioritized, as there is a lack of globalized systems that can tackle these extremely widespread services.

Although using financial methods for ecosystem services has been demonstrated in a primarily negative light, it shouldn't be fully disregarded yet, especially with ecological economists working to improve their conservation outcomes. As an attempt to provide clarity regarding whether monetary valuation should be used for ecosystem services, Kallis et al., 2013 provide 4 criteria that encompass when including money in the ecological conversation is desirable. These criteria include: "Will that improve the environmental conditions at stake? Will it reduce inequalities and redistribute power? Is it likely to suppress other languages of valuations and value-articulating institutions? Will it serve processes of enclosure of the commons?" (Kallis et al., 2013). By looking at how PES schemes and ecosystem valuation are perceived among ecological economics literature, it is evident that these four criteria have not always been followed in the past, and serve as a major opportunity of development for ecological economists of the future.

Chapter 4: Where Do We Go Next?

We have looked at the origins of ecological economics as a field of study and made a deep dive into two issues that are currently of great importance, 1) economic growth & its alternatives and 2) ecosystem valuation and its applications, primarily Payment for Ecosystem Services and Monetary Valuation. Where to go from here? As demonstrated in the breadth of literature that has emerged in ecological economics, it is clear that some visible points of contention have been dominating this field. Many scholars have argued that ecological economics is in grave need of change, and it has moved too far from its original purpose. Since its inception in 1989, there have been growing doubts about the field's ability to tackle problems at the level of complexity needed to solve them.

Ecological Economics and its Origins

It's important to acknowledge the origins of ecological economics and the intentions set forth by two of its original thinkers, Herman Daly and Robert Constanza. Guiding this new field was the fact that traditional models in both ecology and economics weren't equipped to handle global ecological problems. As a new transdisciplinary field, ecological economics set out to go beyond the boundaries of scientific disciplines to provide multiple perspectives, but also develop new tools and models when the issues require them, as economic tools wouldn't capture the ecology side and vice-versa (Costanza et al., 1991). They also wanted to emphasize how ecological economics was different from conventional approaches. This field differs from mainstream economics in frames of time, space and even species. The overarching goal of ecological economics is sustainability for current and future generations and species fairness. As a field, ecological economics has a transdisciplinary, pluralistic and integrative approach that also contains skepticism about technology's ability to remove resource constraints, whereas conventional economics is optimistic about that possibility, even though it could cause irreversible destruction to resource bases and civilization in general (Costanza et al., 1991).

Distinctions Between Ecological Economics and Mainstream Economics

Therefore, there are key distinctions between mainstream and ecological economics, and the latter was created as a way to address the rigidity and ecological damage of economics as it existed. The research agenda put forth in 1991 by Costanza and Daly covered many topics that are still relevant today. These include sustainability, valuation of ecosystem services and natural capital, ecological economic system accounting, modelling at local and global scales, and finally innovative instruments for environmental management. While each one of these areas has an ambitious amount of research questions to answer, one of the most notable revelations is that these questions still have yet to be fully answered for almost 30 years. To name two examples, the valuation of ecosystem services is struggling in its application to real-world situations, and GDP is still used as a widespread measure of progress, even though it doesn't properly acknowledge natural resource depletion and proper ecological economics system accounting. In addition, Costanza et al., 1991 set out a list of policy recommendations for ecological economics. Firstly, sustainability should remain the goal that permeates through every institution. Even larger global institutions like the World Bank, should require that the rate of harvest doesn't exceed the rate of regeneration for renewable resources, and the rate of waste generation can't exceed the assimilative capacity of the environment (Costanza et al., 1991). Other recommendations include maintaining natural capital to assure sustainability, improving our use of policy instruments, linking revenues and uses in economic incentives and improving ecological economic research. One of the most critical recommendations was to develop ecological economics education in a transdisciplinary curriculum that covers both ecological and economic skills. This combination of disciplines would help the International Society for Ecological Economics (ISEE) to allow students to focus on "big picture" questions. Another issue was the lack of awareness of sustainability and environmental degradation by the general public. Institutions would need to be more transparent in their dissemination of information and global institutions such as the World Bank would need to be de-bureaucratized to solve these problems. Costanza et al., (1991) provided a clear demonstration of what was wrong with the mainstream models and what needed to be changed to solve these problems. Fast forward 30 years later, these recommendations and research agendas would prove difficult to fulfill, as the mainstream economic model continues to dominate despite its immense shortcomings.

The influence of neoclassical economics has caused an internal conflict in the field of ecological economics in recent years, so it is worth mentioning why the application of the neoclassical model of economics can be problematic in an ecological economic context. To begin, the creation of this theory demonstrates why mainstream economists still support the economy existing separately from any ecological or biophysical principles. Neoclassical economic theory was derived by substituting economic values into the physical variables of physics at the time, which soon became outdated (Nadeau, 2015). This physical model defined a "closed system" as a system of unchanged internal dynamics in which no outside influence could change its behaviour or properties. Economists translated this understanding to be applied to market systems, in that they are closed and exist separately from the external environment and also that these dynamics govern the decisions made by economic actors and are responsible for sustaining these market systems in states of equilibrium (Nadeau, 2015). Economists claim that if energy is conserved through the First Law of Thermodynamics, utility in economic market equations is also conserved. This explains why neoclassical models so often don't equate to or fully encapsulate what is happening in the real world. It wasn't a demonstration of reality, but rather a way to justify the use of mathematical formalism in market systems. In addition, with the release of behavioural economics as a field, the idea that humans are explicitly rational in their preferences was slowly confronted by the fact that economic decisions are wildly complex and humans can't possibly be entirely rational in these instances (Nadeau, 2015). The behavioural economic model has also pervaded the field of ecological economics as well. Clive Spash divides current ecological economics into 3 camps: 1) new resource economists who still follow mainstream economics, 2) new environmental pragmatists who adopt tools and methods that they consider useful even though there are theoretical concerns and finally 3) social ecological economists, who are seeking a theoretically sound approach that rejects economic concepts and believes that ecological economics has a direct path towards unity (Spash, 2020). These three camps demonstrate the confusion and conflict that is currently felt by ecological economists in their ideology but also demonstrate the influence of mainstream economics, something that has created a range of problems for the validity and success of the field.

Lessons Learned from the First Thirty Years

Delving into this conflict, there are many lessons to be learned from the first thirty years of ecological economics. In 1990, the ISEE was heavily oriented towards North America. Initially, the field has been labeled as a subfield of mainstream neoclassical economics, leading to immense epistemological confusion (Spash, 2020). One example of this confusion would be the use of monetary valuation as a way to measure ecosystem services, and then claiming that anything lying beyond this specific measure has no inherent value. This is problematic due to the difficulty of assigning a strictly monetary value to an ecosystem service whose value can primarily be expressed in other forms. Therefore, this connection between fields created early confusion for ecological economics. Another point of contention is the ISEE journal: *Ecological Economics*. This journal has grown in scale, yet it's debatable whether its quality and progress have also improved. To get both perspectives equally, the journal used to have both an ecologist and an economist during the review process. This has since stopped, and the journal has increasingly attracted and published what would be considered neoclassical economics works. As mainstream economics has generally become more concerned with finding prosperity in growth-oriented markets, there is an increasing encroachment of these elements in *Ecological Economics*, changing the overall perception of the journal. Similar to the journal, the two main textbooks in EE, 1) *Ecological Economics: An Introduction* (Common & Stagl, 2005) and 2) *Ecological Economics: Principles and Applications* (Daly & Farley, 2010), also have close ties to neoclassical economics. These textbooks are extremely ambiguous because although they are written for the field of ecological economics, they could be considered to be within the mainstream economics context (Spash, 2020). If the top ecological economics literature is shared with the world through a neoclassical lens, this could be incredibly detrimental to what ecological economics is trying to accomplish.

The editors of *Ecological Economics* share this sentiment, as they have identified multiple points of tension within the field. First off, the debate on pluralism is extremely contentious. As mentioned previously, the field was introduced as transdisciplinary and pluralist. However, it has led to the journal being unrepresentative of the ecological economics community, because the lack of boundaries allows mainstream articles to dominate. Yet, some ecological economists argue that this pluralism is a necessity because it can open the door to

many other disciplines such as political economy, feminism and constructivism (Lundgren, 2022). Even if ecological economics wanted to expand its reach in certain academic institutions, this formalization either through a PhD-Program or a core curriculum has the potential to threaten the transdisciplinarity. Lundgren (2022) interviewed several members of the *Ecological Economics* editorial board and their responses reflected this fragmentation. Most consider ecological economics to be a field, but some argue against this classification and consider it a community because of its lack of framework. Several also argued that the label of "ecological economics" is damaging in the way it functions: "Concepts and labels are important, and I think what's happening with ecological economics is that people, young researchers, read 'economics' and immediately think of valuation and willingness-to-pay-, all of these applied economics concepts" (Lundgren, 2022). These qualities in addition to the fact that a large majority contrast ecological economics drastically with the reductionist, narrow and static field of conventional economics, demonstrate that there is a mismatch between the field's ambitions and its institutional and intellectual environment (Lundgren, 2022). Røpke (2005) elaborates on how these issues can affect the future of ecological economics: "One risk is that the field becomes uninteresting as a field, if identity is lost by the acceptance of anything as being justified as transdisciplinarity. Another risk is that the field loses its bite and becomes a sub-field of neoclassical environmental and resource economics modelling links between ecosystems and the economy" (Spash, 2020).

Possible Improvements For the Next Thirty Years

We've looked at what's gone wrong with ecological economics, but what can be done to fix it? The first argument is that ecological economics needs to return to its biophysical roots. Biophysical economics (BPE) was developed to investigate nature transformations from an energy flow perspective (Melgar-Melgar & Hall, 2020). BPE shares some roots with ecological economics, including using entropy and thermodynamics to understand natural systems, while also criticizing neoclassical economics for not taking the biophysical embeddedness seriously enough. When Ecological Economics became more concerned with valuation methods and finding more economically driven models for ecosystems, BPE looked to take up its core vision. Research agendas for ecological economics rooted in its biophysical foundation haven't been

discussed frequently, however, there are some interesting ways to get back to that original vision. It is important to acknowledge that not all world-renowned sustainability projects have been evaluated biophysically, specifically the United Nations' Sustainable Development Goals. Only some of these goals do focus on promoting economic growth in developing countries, so it could be more beneficial, and realistic to pursue more socially-oriented goals than it is to attempt to solely increase material wealth in emerging countries as a way to improve overall well-being (Melgar-Melgar & Hall, 2020). Another aspect to consider is the impact of financialization and debt crises. The rapid rate of wealth generation isn't sustainable, and it wouldn't be possible at all if the human population lived off of the interest of the planet's natural capital. National and international debt seems insurmountable as of late, and there will be even less energy available to consume as the world population grows (Melgar-Melgar & Hall, 2020). Understanding that debt needs to be considered from a biophysical perspective could avoid unsustainable natural capital exploitation as well as a potential ecological collapse in the future. Next, models need to be developed to see where waste and other inefficiencies can be reduced or eliminated. Analyzing the consumption of certain prevalent resources, such as phosphorus in agricultural systems or plastic pollution that produce so much waste, could limit the impact of this increased throughput that is felt by Earth's natural systems as its assimilative capacity is overwhelmed (Melgar-Melgar & Hall, 2020). Lastly, the neoclassical economic circular flow model needs to be replaced with a biophysical foundation that permeates all disciplines and levels of education. Educating individuals about their place within the broader world of energy and matter could help ecological economics create a competitive alternative to the classical model, a necessity for the fate of the environment.

To separate from the unflinchingly rigid growth paradigm, Clive Spash suggests two areas in which this can be accomplished. There first needs to be an understanding that markets are only useful for rival and excludable goods, and even if markets were set based on sociological and ecological constraints, it would then alter the purpose and operation of the market altogether (Spash, 2020). So, when considering the application of steady-state systems, for example, they would need to be introduced without adopting market capitalism as well, because the concept of accumulation that is necessary for market systems would not be compatible with a successful steady-state. The next area is green growth and post-growth systems. Some argue that economic growth shouldn't be abandoned entirely, as it alleviates

poverty in developing countries. However, the issue with these green growth and post-growth systems is that they would just contribute to the spreading of capital accumulation to a majority of the world's population, as only a small percentage is currently at the top of the accumulation scale. Therefore, growth cannot be treated as an option to capitalism, when it is inherently present in its operation.

Spash goes on to explain what needs to happen in the next 30 years of ecological economics by suggesting three areas to work towards. There needs to be realism in describing economic and ecological processes, whether it surrounds real institutional arrangement, the role of the economy or consumer psychology, all of these need to be described with transparency to fully understand how they operate and what impacts they have. Second, there needs to be an end to the industrialized economy, and an understanding of power relationships as it relates to production and fossil fuels. Lastly, alternative views need to be acknowledged and encouraged, especially those who feel the need to conserve nature just because it is the right thing to do. Non-monetary life and livelihoods should also be researched because, for example, only paid work is acknowledged in the current economy (Spash, 2020). In general, it is imperative that the economic mainstream is left behind, and the markets and economic growth they create need to be overthrown.

Ecological economics has had a rough lineage thus far, however, there are some ideas as to how to save it and achieve its original intentions. To put it simply, if ecological economists are committed to improving the chances of human survival, they must be prepared to talk openly about the fake beliefs in the current economic reality that are so common (Nadeau, 2015). It would be serving the greatest good for current and future generations to climb this hill, even though it is extremely daunting. Ecological economics was created for a reason, and it needs to rediscover that purpose to tackle the greatest problems that the world will face in the coming century.

Final Reflection

Ecological economics has been experiencing some discrepancies in its objectives as a field. It has strayed far from its original purpose as a field and has been heavily influenced by mainstream and resource economics, as demonstrated by those concepts bleeding into a large selection of the literature published in the ISEE journal. This will be a challenge if ecological economics is to return to its roots and look to solve the global issues that need immediate attention.

Completing a podcast based off of a densely academic subject was challenging, yet fulfilling. As I became comfortable with the material, I thought of ways to incorporate pop culture and other types of media into the episodes, with a big emphasis on using music to reflect the decades represented in each episode. When constructing the scripts, I noticed that it was most difficult to record and convey the most intensely academic subjects within each chapter, leaving some to be leftout of the podcast and only included in the written chapters, for example the section on labour productivity and EROEI. This is interesting because it is usually the most important material to get through, but because of its complexity, lacks the possibility for its proper understanding in media like podcasts, which is how most people in the general public are getting their information. I found myself altering my writing style as I transitioned from written thesis to podcast script, to make sure these concepts could be understood, but also so it didn't seem like a waste of time to listen to a topic I find interesting.

Overall, I have enjoyed this experience not only diving into a field that I find interesting, but also using equipment and software that has become mainstream and could be useful in my further studies. All in all, I hope there are many more ecological economics podcasts in the future.

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