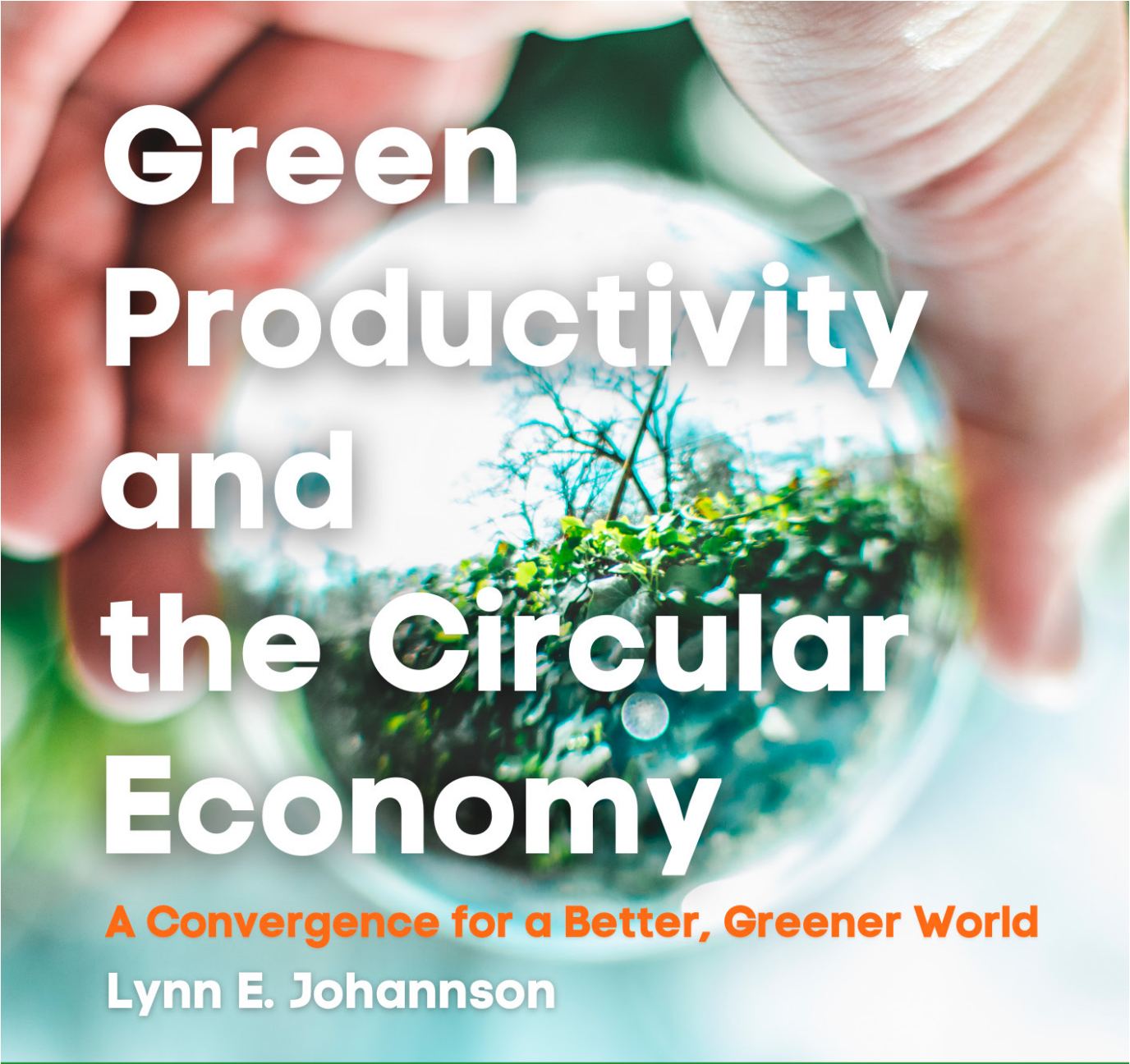

Green Productivity and the Circular Economy

A Convergence for a Better, Greener World

Lynn E. Johannson

Productivity *Insights* Vol. 2-4

Asian Productivity Organization

The Asian Productivity Organization (APO) is an intergovernmental organization that promotes productivity as a key enabler for socioeconomic development and organizational and enterprise growth. It promotes productivity improvement tools, techniques, and methodologies; supports the National Productivity Organizations of its members; conducts research on productivity trends; and disseminates productivity information, analyses, and data. The APO was established in 1961 and comprises 21 members.

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CONTENTS

PREFACE

The P-Insights, short for "Productivity Insights," is an extension of the Productivity Talk (P-Talk) series, which is a flagship program under the APO Secretariat's digital information initiative. Born out of both necessity and creativity under the prolonged COVID-19 pandemic, the interactive, livestreamed P-Talks bring practitioners, experts, policymakers, and ordinary citizens from all walks of life with a passion for productivity to share their experience, views, and practical tips on productivity improvement.

With speakers from every corner of the world, the P-Talks effectively convey productivity information to APO member countries and beyond. However, it was recognized that many of the P-Talk speakers had much more to offer beyond the 60-minute presentations and Q&A sessions that are the hallmarks of the series. To take full advantage of their broad knowledge and expertise, some were invited to elaborate on their P-Talks, resulting in this publication. It is hoped that the P-Insights will give readers a deeper understanding of the practices and applications of productivity as they are evolving during the pandemic and being adapted to meet different needs in the anticipated new normal.

CONVERGENCE: ACHIEVING A BETTER, GREENER WORLD

There is no longer any doubt. We are facing the single largest challenge to the collective creativity and intellectual spirit that humans have ever faced. We have undermined the source of our health and wealth, which is the planet, our only home. We are the cause; we are to blame.

Just as the adversity we face is of our own creation, the future is ours to change if we choose. The clock is ticking. There are actions we can take now to be responsible for a sustainable future. To achieve this, we must tackle the challenge with fierce, unparalleled determination. As C.S. Lewis [1] wrote, "… [h]ardships often prepare ordinary people for extraordinary destiny."

For far too many decades, humans have taken from nature without paying an invoice or addressing the consequences of our inefficiencies. The time for change, to rethink our approach is now, not tomorrow. It requires each of us as citizens, communities, corporations, and countries to learn the rules of Mother Nature, to change our habits, and to take action through collaboration.

We Can Change Our Future and Fulfill This Destiny

While daunting for some, others are recognizing that there is tremendous opportunity if we adopt a systems approach. A convergence (Figure 1) of Green Productivity (GP) and the circular economy (CE) can help ordinary people using their tools and techniques to experience the thrill of outrageous success. This paper explores the following primary concepts that are integral to both GP and the CE. Think of GP and the CE as conjoined twins (Figure 2), linked through various tools and techniques. They are composite concepts, which include:

- Resource efficiency
- Biomimicry

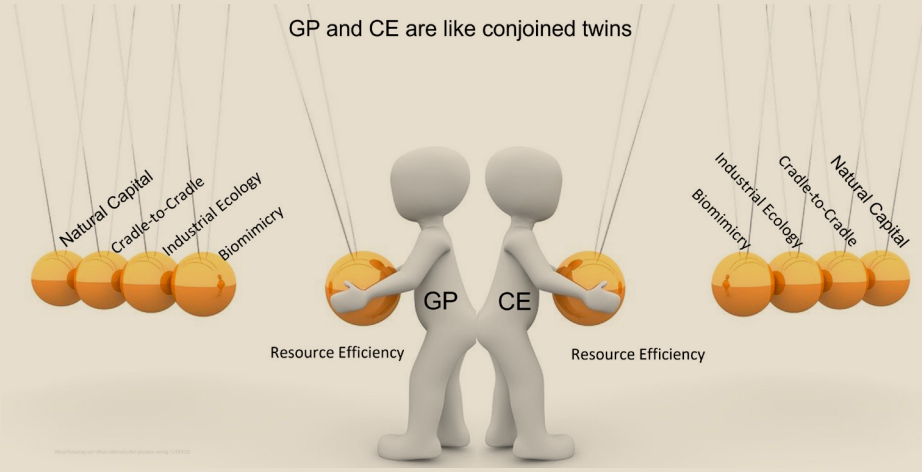
FIGURE 1

CONVERGENCE: GP AND CE

Source: https://pixabay.com/illustrations/buckled-book-book-fantasy-photoshop-2180047/.

FIGURE 2

GP AND THE CE ARE LIKE CONJOINED TWINS



Source: https://pixabay.com/illustrations/bullet-physics-swing-1015302/.

- Industrial ecology
- Cradle-to-cradle
- Natural capital

Most of these tools and techniques have been in existence for decades, and there are more being added as we gain experience in, and an appreciation for, systems. As we evolve our understanding of our relationship with the planet, the source of financial wealth, we are also learning about the unintended consequences of mismanagement, unsubstantiated claims, and false hopes we stake on financial wealth. This is not a situation where one size fits all. Big or small, each of us must learn how these concepts need to be applied to derive the greatest value in our context. We must determine in what order these concepts should be used to improve the greening of our productivity and how this will help achieve prosperity. Applied wisely, we will learn how to collaborate to better manage the stocks and flows [2] that are part of the wealth pyramid, respecting the environment and ensuring a just distribution of wealth.

What Is the Pyramid of Wealth? Why Is It Important?

Quite simply, all wealth comes from nature [3]. Nature is the source of all primary wealth, which is enabled by one supplier, the sun. There are no substitutes. Primary wealth includes the food that the soil nurtures, the water that quenches our thirst, and the air that allows us to breathe. These are some of the living resources that are essential for our survival.

We take from nature and convert these resources into secondary wealth. But this is not wealth creation. Rather this means that we take trees from the forest and make furniture. We take fish from the sea and cook our dinner. We have also taken "dead resources" and burned them. Dead resources refer of course to coal, petroleum, and natural gas. These were formed from the remains of ancient marine organisms, such as plants, algae, and bacteria. Under intense heat and pressure over millions of years, these organic remains transformed into the carbon-rich substances that we discovered could be used to heat our homes, power cars, move mountains with machinery for highways, and become inputs into millions of products. The burning of fossil fuels enabled the

Industrial Revolution, fueling innovations in knowledge, medicine, and even enabling us to leave the planet's atmosphere and reflect upon the wondrous blue planet we call our home.

Yet in just under 150 years, our use of these dead resources has put our lives, and the lives of future generations, at risk. We have grossly misjudged the costs of their use, which is undermining our current and future health and wealth.

The money and currencies used to buy consumer products and services that enable our economies to function and trade with other countries are only a claim on wealth. They represent tertiary wealth. However, we are learning a very difficult lesson now. There was a price to be paid by becoming dependent on dead resources. We are recognizing that we have accumulated a huge ecological debt that neither fiat nor digital currency can repay.

These are also not currencies used by Mother Nature. Energy is the currency of her operations, and those occur though photosynthesis. It is the basis of nature's productivity upon which the whole earth as a system operates. To prevent further debt and to survive, we need to radically change how we manage what we do to align with the business processes and the currency by which Mother Nature operates.

How Do We Change Our Thinking to Align with How the Planet Works?

Gregory Bateson, a respected anthropologist, expressed it in the simplest manner [4]: "The major problems in the world are the result of the difference between how nature works and the way people think." Hence, we need to learn the rules by which the planet operates. These rules are captured in the science of ecology, which is the study of the interrelationships among organisms, and between them and the living and nonliving elements of the environment [5]. These relationships are extremely complex, and we are learning daily that knowledge of them, as well our dependency on their health, is still far from where we need it to be to continue to thrive, and maybe survive, as a species on this planet.

By leveraging GP and the CE, we have an opportunity to implement a systems approach based on practical options. If used universally, we could change our dire, fiery future into an extraordinary destiny. The convergence of GP and the

CE offers power and value to those who are willing to address the hardships today with fierceness for a better, greener tomorrow.

The mindset we need was expressed in the APO's report to the World Summit on Sustainable Development in 2002 [6]: "Productivity is above all a state of mind. It is an attitude that seeks the continuous improvement of what exists. It is a conviction that one can do better today than yesterday, and that tomorrow will be better than today. Furthermore, it requires constant efforts to adapt economic activities to ever-changing conditions and the application of new theories and methods. It is a firm belief in the progress of humanity."

What we need to do now is link this attitude to an understanding of the planetary rules. GP is a simple extension of this mindset, with the goal to do better, not grow bigger, and align with how nature operates. Bigger does not mean more efficient. Becoming better is a growth in quality, not quantity. This is a critical outcome if we are to ensure that we can feed and house the more than 7.9 billion people on this planet. However, we need to keep in mind that it is not just about us.

We need to protect the other species who are essential shareholders of primary wealth. Without them, our secondary and tertiary wealth will fall victim to a domino effect. GP offers practical tools and techniques, methodologies, and systems to reduce these risks, enabling opportunity to redesign for a living, vibrant, green economy. But this will require a fundamental paradigm shift.

Traditional thinking about productivity focused on human or labor productivity, which ignored the real value of materials. Productivity was decoupled from nature. This resulted in a dramatic increase in environmental burden, with the cost of waste in any form being borne by someone other than the producer. As there were short-term benefits enabled by human productivity, society chose to ignore this inefficiency.

We need a rapid adoption of innovation, which GP supports. GP is a proven concept and a positive move toward prosperity. It is the logical connection between the environment (primary wealth), providing methodologies based on the understanding that a healthy environmental system and a robust, competitive economy are mutually dependent. The concepts embodied in GP, like nature, are not static. GP is dynamic and can be adopted by ordinary people who are dedicated to a better, greener world.

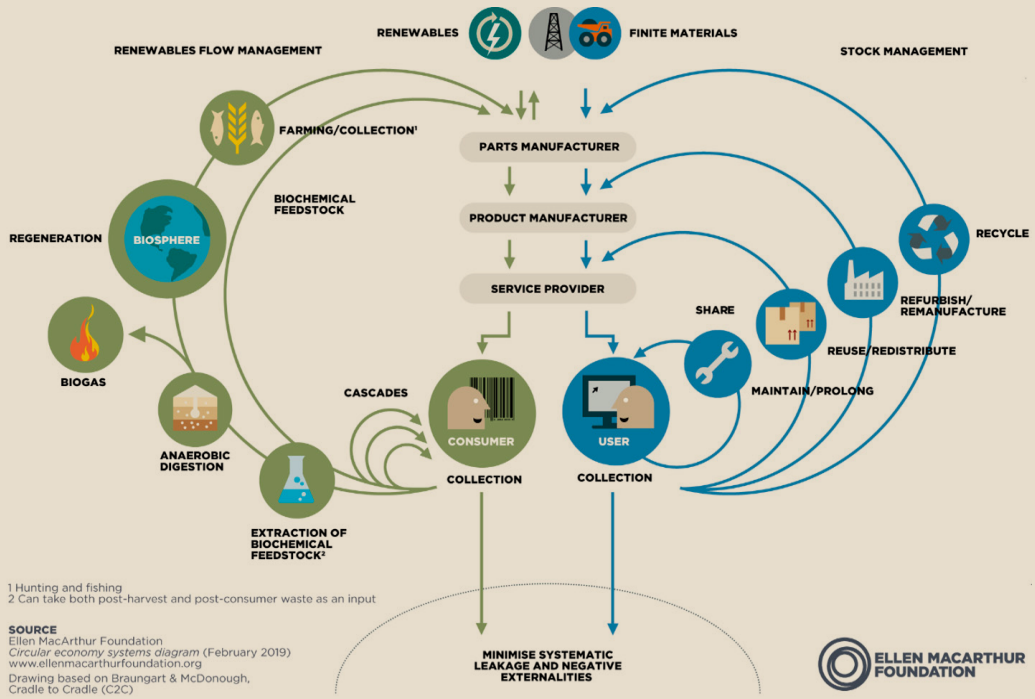
A New Business Model Is Needed

A new business model, based on collaboration and a true ecosystem approach, is replacing one driven by individual entities acting as if they were in isolation. While competition historically resulted in winners and losers, there is a shift to cooperative competition, in which companies work in collaborative ways to eliminate all different forms of waste, not just material waste. This is an opportune moment to leverage the synergy that interdependently supports the CE and the practicality of GP. The new model is a business ecosystem that optimizes the stocks of materials and returns them to the system, which the CE supports (Figure 3).

According to Walter Stahel, who is considered one of the most influential thinkers behind the CE, 2020 (± 6 years) has become a crossover point. Stahel [7] asserted

FIGURE 3

CE SYSTEMS DIAGRAM



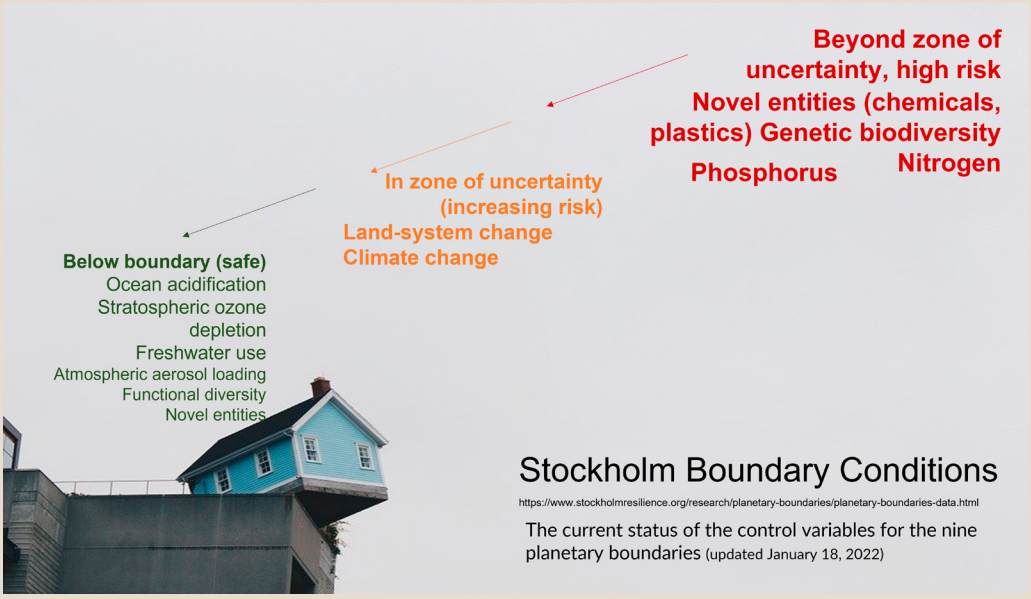
Source: https://ellenmacarthurfoundation.org/circular-economy-diagram.

that we cannot continue to operate at the current level of inefficiency, as human biomass has exceeded what nature can support. Therefore, protecting the biodiversity of the planet is a critical element to be included in our plans and actions to green our productivity. The Stockholm Resilience Centre has conducted some important research that has identified an "environmental ceiling" that consists of nine planetary boundaries (Figure 4). As noted by Stahel, our disregard for the real value of nature has resulted in unacceptable environmental degradation. These are shown by red zones, where humans are at risk now. It is not sufficient to rethink product efficiency, we need to design for system optimization. Stahel also encouraged only paying for system performance. Improvements in greening productivity can result in better system performance.

The CE seeks to rebuild capital, building on natural capital (as primary wealth) (Figure 5) and connecting other forms of capital, be it manufactured capital, human, social (through the lens of secondary wealth), or financial capital (recognized as tertiary wealth).

FIGURE 4

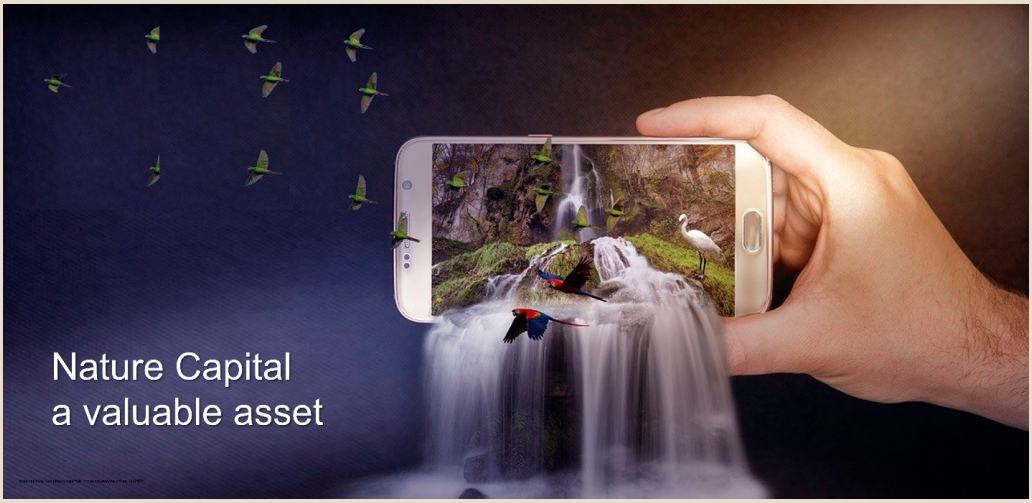
STOCKHOLM BOUNDARY CONDITIONS



Source: https://pixabay.com/photos/living-on-the-edge-home-house-edge-844873.

FIGURE 5

NATURAL CAPITAL: A VALUABLE ASSET



Source: https://pixabay.com/photos/waterfalls-phone-smartphone-nature-2987477/.

Who Is Supporting the Diffusion of the CE?

Dame Ellen MacArthur [8] was the first woman to set a world record for the fastest solo nonstop voyage around the world in 2005. Her experience caused her to take a different look at the resources used globally. Her voyage demanded that she achieve an extremely delicate balance between carrying all her essential resources and optimizing her performance, while surviving despite great odds. Driven by her experience, she established the Ellen MacArthur Foundation to drive adoption of the CE as a better business model. She challenged the business world in Europe to abandon linear thinking, which has been mainstream.

What Is the Problem with Our Current Business Models?

The world is operating as if we are on an endless one-way street. A linear economy is based on a "take, make, and dispose" mentality, which experts in economics and physics have calculated to be extremely inefficient. One of the fatal flaws embedded in current practices in all economies is demonstrated when we take from nature a material or a service; we make something by

heating, beating, or treating it with chemicals; and after a very short life, we throw it away. At least that's the perception, but it is not the reality. There is no place called "away" that takes material, renders it benign, and makes it disappear. Burning it means we are adding to greenhouse gas emissions and letting intrinsic value go up in smoke. Practices that perpetuate this inefficiency cannot be allowed to continue. Nor will they.

In the most recent report from the Intergovernmental Panel on Climate Change (IPCC) [9], we have been issued a dire warning. Change now or face changes that will make life as we know it impossible. Possible climate futures include increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, agricultural and ecological droughts in some regions, and increasingly intense tropical cyclones, as well as reductions in Arctic Sea ice, snow cover, and permafrost. These are but a few of the headlines for policymakers.

What Are the Practical Actions That We Can Take as Ordinary People?

We all must do better. Many people do not realize how inefficient current designs are for products or services. Because we fail to align our designs with nature, experts state that between 94% and 98% of the materials used in manufacturing durable products become waste even before the product is sent to the market. That means that the value we gain is between USD2 and USD6 out of every USD100 expended to make a product or to offer a service. This does not include the cost of the damage to the environment, which other stakeholders must bear. These include our customers, our communities, and our families.

In addition to anecdotal evidence, confirmed statistics calculated by experts reinforce the need for a radical shift in resource efficiency. The CE not only reveals but designs out the negative impacts of economic activity which cause damage to human health and natural systems, increased health and insurance costs, and failing infrastructure. This includes the release of greenhouse gases and hazardous substances; the pollution of air, land, and water; and structural waste such as traffic congestion. Threats to people related to traffic safety have also surged as a sinister segue of the pandemic, one that is not expected to end with the pandemic nor reduce carbon emissions.

What Does the CE Offer That's Better?

The CE is restorative and regenerative by design. It means that economic activity builds and rebuilds overall system health as part of its DNA. It embraces the productivity cycles of the earth's system, upon which life on this planet depends. This is another area where GP aligns with the CE, as GP focuses on improving how we can be more productive from a systems perspective. Experts recognize the need for the economy to work for big and small businesses, for governments and individuals, globally and locally. Our challenge is how and now.

The CE is founded on three action-based principles:

- Design out waste and pollution.
- Keep products and materials in use.
- Regenerate natural systems.

To optimize our adoption of the CE, we need to learn to think differently, to move away from a linear or a 1-2-3 mentality. Systems thinking is a critical skill we need to acquire. Why? We live on a planet that operates as a highly networked, interconnected system of species, from the biggest to the tiniest. The explosion and convergence of computing, communications, and financial technologies have created a world of instantaneous interdependence, which we need to leverage. However, if the world's three biggest employers ceased to exist, humanity would continue. If they failed, global politics and economies would be disrupted, but these companies are expendable and replaceable.

However, if we lost one, two, or three species, the story would change. From a whole-earth perspective, after springtails [10], ants are the second most-pervasive species. Despite being outnumbered by springtails, ants have far greater and more varied powers to influence the environments in which they live. Ants control every millimeter of the Earth's land surface, which is most places, according to experts at the Smithsonian Institute.

Ants are often described as "ecosystem engineers" [11] as they perform many vital ecological services. While individually tiny, there is power in their sheer numbers. Ants are an important part of our natural capital, intricately woven

into value chains and the planetary system. Without them, some experts believe there would be dire outcomes for humans because of the services ants provide which keep our ecosystems healthy.

While so much of the world's attention is focused on the phenomenon of climate change, this is not where we are at the greatest risk, as indicated by the work of Stahel and the Stockholm Resilience Centre and others. We need to radically change our behavior, forging a global consensus on action and not just hope, although inspired by it.

In theory, the UN developed this global consensus, articulated in 17 Sustainable Development Goals (SDGs) (Figure 6), which is a universal call for action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The goals are outlined in 169 targets that are interlinked,

FIGURE 6

THE UN SDGs

Source: https://pixabay.com/photos/lens-ball-glass-ball-equality-7071808.

recognizing the need to balance environmental, social, and economic factors to achieve a sustainable future.

Between the SDGs' social targets and the Stockholm Resilience Centre's planetary boundaries lies an environmentally safe, socially just space for humans to thrive. What do we need to learn? What do we need to do to get on the right pathway? How do we cooperate to enter this safe operating space? Remembering the quote by Gregory Bateson that to learn how natural systems operate is a fundamental first step.

The importance of understanding systems cannot be overstated. As noted systems thinker Russell Ackoff stated [12], "…[a] system is a whole that consists of its parts, each of which can affect its behaviour or its properties. No part of a system or collection of parts of a system has an independent effect on it. The parts are all interconnected. Therefore, a system as a whole cannot be divided into independent parts.… When a system is taken apart, it loses its essential properties. A system is not the sum of the behaviour of its parts, it is the product of [their] interactions. A system of improvement that is directed at improving the parts taken separately means that the performance of the whole will not be improved."

Why Is This Relevant?

The reasoning above means that a linear approach, the "take, make, and dispose" mentality, is counterproductive to doing better. To gain the highest return by greening the productivity of an organization requires us to understand how the "parts" of our organizations interact. Achieving a sustainable future requires that we not only do a better job of working internally, we need to work collaboratively. This needs to occur along supply chains, within communities, across countries, and with global partners. We all need to understand how one organization is interdependent on others and how this can foster the CE, leveraging the tools, techniques, methodologies, management systems, and programs that are inherent to GP.

Two examples can demonstrate the power of systems. If we were to contact every car company in the world and ask each to bring its best part to a factory in Yokohama or Jalan Ipoh, what would happen? Would these make the best car? No. Why? Because none of these car parts were designed to fit together. The car would not run.

Let's think about how systems affect us on a personal basis. Each one of us operates as a biochemical system or a mobile chemical plant. "As our body 'parts' are interdependent, the way your heart affects you depends on what your lungs are doing, and this depends on what your brain is doing. Each of these organs are interconnected. You cannot separate any and survive. The single most important characteristic that you have is life. None of your parts, none of your organs on their own have life, you have life. Very simply, with life, you can write, but your hand cannot write without the rest of you [13]." However, without your hand, you still have life.

With the understanding of the critical nature of systems and systems thinking, let's explore the synergy between GP and the CE. Starting with GP offers some advantages. For one, the concept of productivity is simple. If asked "Do you want to be more productive?" most people would agree. Adding the importance of green is relatively simple; even small business can understand it.

However, the CE takes more explanation. In a report published by the APO in December 2020, it stated that the lack of awareness or knowledge of the CE was the biggest bottleneck. Words matter. So, what do these words (concepts) mean?

Resource Efficiency

Resource efficiency starts with the design of a process to recover materials, for disassembly, for clean material flows, for shared standards, and for remanufacturing. By designing with nature, we can cut energy costs and waste and improve quality. As the APO's original GP starting point was to enhance productivity as a cost reduction strategy, this reinforces its alignment with the CE, which does the same.

Biomimicry

Biomimicry has been described as the art and science of mimicking nature's genius, or the technology of biology per se, to solve human design challenges. Biomimicry enables us to value nature as primary wealth. In the process of applying nature's genius, these living systems serve as "model, mentor, and measure" for us.

There are many examples of biomimicry [14]. The best-known is Velcro, which was inspired by someone noticing how burrs stuck to his dog's fur 63 years ago. The estimated value of biomimetic products by 2025 is USD300 billion and by 2030 USD425 billion.

Industrial Ecology

Industrial ecology is enabled where industries cooperate to reduce their consumption of natural resources and minimize waste and their environmental impacts. The most famous case study, which started in 1961, is the industrial complex that is now called the Kalundborg Symbiosis. Each industry in the complex benefits from the output of one industry as an input to the next, minimizing waste throughout.

In the APO's *Handbook on Green Productivity* [15], it explains the mathematics of this kind of business cooperation in very simple terms. Let's limit the example to three companies. If each of these companies operates in isolation, the maximum benefit is the sum of three distinct operations. Assuming that each operation is worth the same, let's say "9" for the sake of this example, the equation is X +Y + Z = Sum, with the maximum value in this case being 27. However, if these three organizations design their respective business systems to collaborate, as in an ecopark, the equation changes.

By working collaboratively, the business ecosystem changes, and the result is a product, not a sum. Now the math becomes Z*Y*Z = Product. In this case its worth is now 729, not 27, offering greater value and lower risk.

It's also worth noting that waste is not limited to materials. Waste includes:

- Time, such as waiting for a delivery;
- Transportation (which can include shipping something around the world and made worse when there is no dockside space);
- Processing, especially when based on old designs;
- Inventory: too much, too little;

- Motion, which can include the lack of good housekeeping;
- Energy;
- Defects;
- Labor, which can be affected by a lack of training; or
- Poor-quality raw materials.

Inefficiency in any of these elements also means a waste of money and a loss of value.

Being able to explain the value proposition in simple math is important. While any form of waste undermines success, the financial world tends to focus on "materiality." Materiality is a filter for decision-making when it comes to money. But remember, money is only a claim on wealth. To thrive, the business system must address its interdependence with natural and social capital. This disconnection from nature, or the propensity to think in a linear manner, must end now.

Cradle-to-cradle

Cradle-to-cradle is a design philosophy that offers a practical approach to improving quality across many sectors, from urban planning to products and material science. The cradle-to-cradle concept distinguishes between materials from the "green or biological" side and the "blue or technical" side as materials need to be returned to the system at the appropriate place in the system where they belong. Flow is important; mixing flows undermines success.

The design or redesign of products enables the materials to be correctly placed back into the system, either to be returned to the soil as biological nutrients or reutilized as high-quality materials for new products as technical nutrients without contamination.

There is a misconception that some entities have about the CE. It is not just a rebranded look at recycling. Simply trying to recycle a product does not result in real change. Recycling is seen as an incomplete loop in which leakage or

loss is very high, especially for low-value, short-cycle items. Even 90% recycling for a product considered high value like aluminum cans means that losses are quickly compounded if the cycle is a few weeks or months from the foundry to a recycling bin. Time and distance matter. For plastics it is especially challenging as single-service items tend to be littered and are the cause of multiple problems.

Natural Capital

As shown in Figure 5, natural capital can be defined as the world's stocks of natural assets, which include geology, soil, air, water, and all living things. It is from this natural capital that people derive a wide range of services, often called ecosystem services, which make human life possible. But humans do not do a great job of managing natural capital. Humans take from nature as if it is free because they think that there is no immediate invoice to be paid. There is, and we are all paying a high price for our delinquent accounts.

The natural capital concept was an effort to make nature visible to the accounting world and to recognize its importance as an asset. Putting a value on nature was intended to enable economists and the financial world to integrate thinking about its value on the balance sheet. It represents a valiant effort to get the financial world to recognize just how valuable nature is to the global economy and to humanity.

However, some people are challenged by the idea of accounting for the value of nature in this way. Without a robust understanding of all the stakeholders in an ecosystem, the value may be completely misjudged. As ants can be tiny, their net worth may be misjudged, and the wrong decision may result, causing a collapse in a system and the loss of other important species. This may also lead to a domino effect, causing other system failures.

Without a true understanding of nature as natural capital and as the source of all primary wealth, any and therefore all economies may be at risk. If nature as we know it is rendered completely unstable, this will undermine societies and the future of humanity. The financial world needs to understand how expensive, if not impossible, it would be to operate if an ecosystem were irreversibly damaged. There is no Planet B.

So what can we do together to build a better, greener world? How can we optimize what and how we borrow from nature, ensuring that it is returned to the appropriate place in the system? How do we accelerate these changes through collaboration? Many projects start with resource efficiency, which underscores both GP and the CE. Apply one concept, some, or all to gain the greatest value, whether it is for a community, a company, or a country.

As time is critical, what first steps could ordinary people take to overcome hardships in achieving an extraordinary destiny? The following are encouraged:

1. Learn the rules of nature; understand how natural systems operate.

2. Learn the various terms that are used to achieve better environmental management. In 2005, the APO published *Greening on the Go: A Pocket Guide to Green Productivity* [16]. It explains in simple terms over 80 practical tools and techniques.

3. Evolve "Greening on the Go" into an app; expand and update the terms referenced to include the CE.

4. Map what and where your environmental impacts are occurring. *Greening on the Go* refers to a technique called "ecomapping." This is a visual process that enables you to quickly and simply identify where opportunities exist to reduce your environmental impacts and optimize your performance. An ecomap can be drawn in less than 20 minutes, with minimal instruction [17]. Time is the primary cost, so it is a useful tool for small business.

5. Learn more about the synergy between GP and the CE. Decide how the synergy of the concepts can help your community, your company, and your country do better.

6. Determine which SDGs at the target level are most important to your success.

7. Remember that the health and wealth of your community, company, or country start with the protection of its natural capital. Start with the SDG targets that address the environment.

8. Share your ideas with the APO. Let it know what your needs and priorities are.

9. Collaborate with at least seven other stakeholders, including national productivity organizations in the APO membership.

10. Start today. There is no time for inaction or complacency.

REFERENCES AND NOTES

[1] C.S. Lewis (1898–1963) was a respected Irish scholar affiliated with Oxford University and then Cambridge University. He is probably the most well known for his Narnia series that became a children's literature classic.

[2] Stocks represent an accumulation of something (a quantity) in specific locations or conditions; stocks can accumulate or drain over time. Flows refer to the movement of the quantity between stocks within a system. Think of a stock as being a quantity of water in a bathtub. Water flows in and out. If more water enters than leaves, the level in the tub rises. If more water exits the tub, the level lowers.

[3] The concept of the wealth pyramid is attributed to Chris Martenson, author of The Crash Course. Hoboken, New Jersey: John Wiley & Sons; 2011, with modifications by the author.

[4] https://batesoninstitute.org/gregory-bateson/ (accessed 19 August 2021).

[5] Adapted from Allaby M. The Concise Oxford Dictionary of Ecology. Oxford: Oxford University Press; 1994.

[6] From The Concept of Productivity and the Aim of National Productivity Agencies, referenced in Johannson L. Green Productivity: An Approach to Sustainable Development. Presented to the World Summit on Sustainable Development, September 2002. Tokyo: Asian Productivity Organization (accessed 18 October 2021).

[7] Walter Stahel provides a brief explanation of the CE and some examples at https://www.youtube.com/watch?v=2oofLhRGeMs (accessed 15 November 2021).

[8] Ellen Patricia MacArthur was the youngest woman in modern history to be honored with the designation Dame Commander of the British Empire (DBE) for her record-breaking nonstop solo sailing voyage in 2005. https://www.britannica.com/biography/Ellen-MacArthur (accessed 12 September 2021).

[9] IPCC. Climate Change 2021, The Physical Science Basis. Intergovernmental Panel on Climate Change; 2021. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf (accessed 16 August 2021).

[10] Springtails are closely related to insects, but they lack wings and have soft bodies and hidden mouth parts. Most importantly, springtails have been shown to be useful bioindicators of environmental change. https://theconversation.com/hidden-housemates-springtails-are-everywhere-even-in-your-home-60233 (accessed 16 August 2021).

[11] https://www.sciencedaily.com/releases/2011/01/110131133227.htm (accessed 16 August 2021).

[12] To listen to the full explanation, watch If Russ Ackoff had given a Ted Talk, presentation Ackoff R. https://youtu.be/OqEeIG8aPPk (accessed 16 August 2021).

[13] This is a continuation of Ackoff's explanation of interdependency, with minor modification by the author. https://youtu.be/OqEeIG8aPPk (accessed 16 August 2021).

[14] AskNature is "a portal to the wisdom nature holds." https://asknature.org/about/ (accessed 16 August 2021).

[15] Johannson L. Handbook on Green Productivity. Tokyo: Asian Productivity Organization; 2005: pp. 3.15–3.17 (accessed 18 October 2021).

[16] Johannson L. Greening on the Go: A Pocket Guide to Green Productivity. Tokyo: Asian Productivity Organization; 2005 (accessed 18 October 2021).

[17] Ecomapping is also available in an app called EcoMarker, which helps the user map, analyze, visualize, and synthesize better environmental performance.

LIST OF FIGURES