Post-COP28: Climate Change and Productivity Opportunities for Businesses

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Vol. 5–3

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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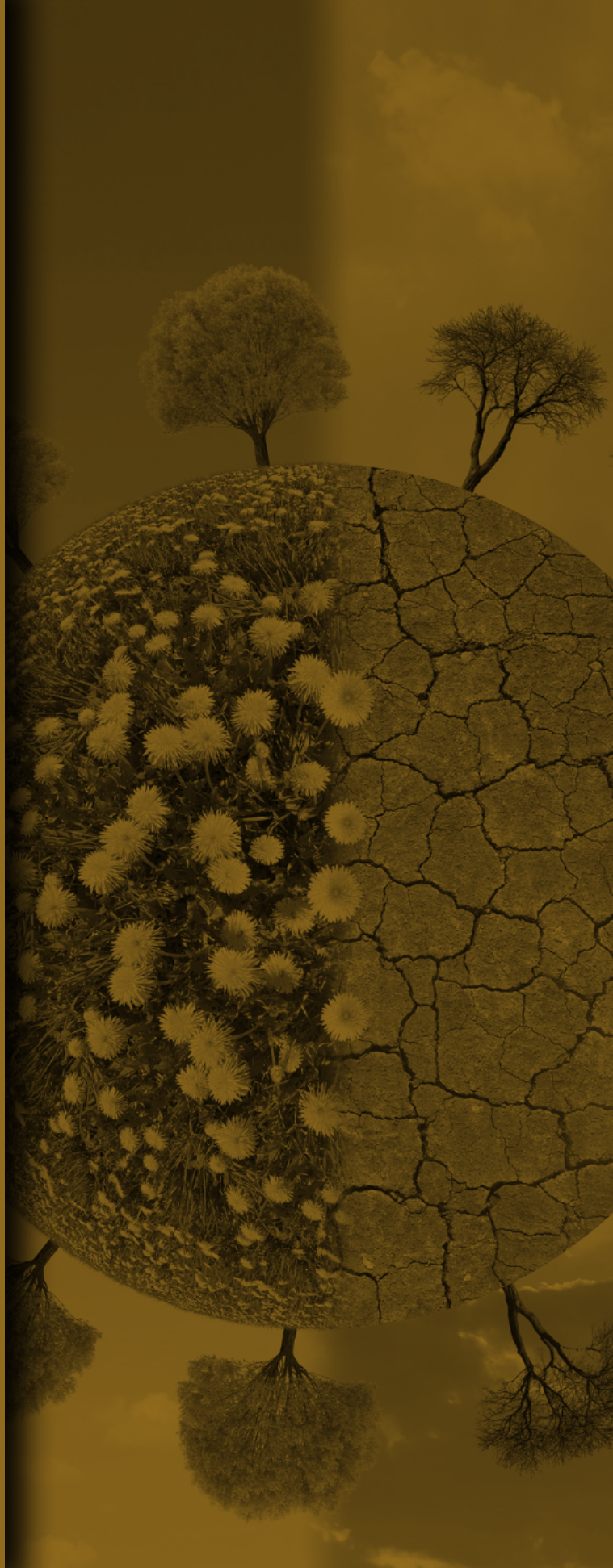

Post-COP28: Climate Change and Productivity Opportunities for Businesses

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Post-COP28: Climate Change and Productivity Opportunities for Businesses

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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.

INTRODUCTION

Climate Change as a Global Pressing Challenge

Climate change is one of the most pressing challenges of our time, posing significant risks to the environment, economies, and societies globally. The Intergovernmental Panel on Climate Change (IPCC) has warned that without urgent action to reduce greenhouse gas (GHG) emissions, the world could face catastrophic consequences, including extreme weather events, rising sea levels, and biodiversity loss (Forbes Middle East, 2023).

Businesses play a crucial role in both contributing to and mitigating climate change. According to the World Resources Institute, businesses are responsible for approximately 70% of global GHG emissions (GHGSat, 2023). This reality presents a dual challenge: companies must adapt to the impacts of climate change while also taking proactive steps to reduce their emissions.

Trends and Commitments at COP28

Especially after attending the COP28 in Dubai, during which I spoke at the two different panels on Carbon Credits as a Financial Instruments and ESG and Implications on SMEs, I witnessed the following trends and commitments:

i. Most countries and international citizens wanted a strong statement on reducing fossil fuel use.

ii. Establishing "loss and damage" funds for developing countries suffering from climate change disasters was supported.

iii. A pledge had been signed by 118 countries to triple the renewable energy capacity and double the global rate of efficiency by 2030 (Forbes Middle East, 2023).

iv. Over 50 national and international oil companies representing 40% of global production had signed a decarbonization charter (GHGSat, 2023).

Notably, Singapore, a member of the Asian Productivity Organization (APO), managed to "substantively conclude" separate negotiations with Bhutan and Paraguay, which will pave the way for carbon credit trading aligned with Article 6 of the Paris Agreement. Article 6 aims to prevent double counting, so that both sellers and buyers cannot claim reductions or removals on the same amount of credits. With agreements also concluded with Ghana and Vietnam, Singapore has now wrapped up negotiations on Article 6 implementation agreements with four countries. Singapore negotiators also used their time in Dubai to lock in memoranda of understanding (MOU) for collaboration on carbon credits with 13 countries, including Rwanda, Fiji, Cambodia, Chile, Colombia, the Dominican Republic, Indonesia, Kenya, Mongolia, Morocco, Papua New Guinea, Peru, and Sri Lanka.

Carbon Credits as Vital Mechanisms for Sustainable, Productive Opportunities

With this as a backdrop, carbon credits have emerged as a vital mechanism for enabling businesses to offset their carbon footprints. In the face of climate change, carbon credits present a dual opportunity for businesses: they provide a pathway to meet environmental regulations while opening new avenues for productivity and growth. Companies that invest in sustainability and carbon reduction are not only enhancing their environmental performance but also unlocking financial benefits and operational efficiencies. As climate change continues to shape the global economy, businesses that adapt and innovate will find themselves at the forefront of both environmental stewardship and competitive advantage.

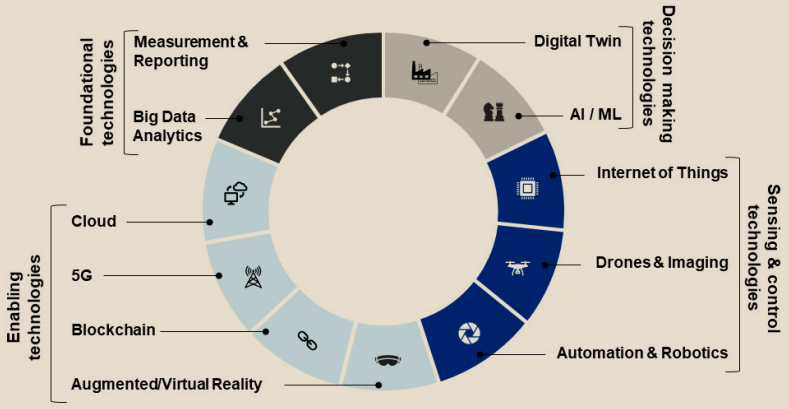
By participating in carbon markets, companies can invest in sustainable practices that not only benefit the environment but also enhance their productivity and competitiveness. In achieving better transparency and productivity, the WEF reported that productive digital solutions can reduce global emissions by 20% (WEF, 2022). This includes four clusters of high-impact digital technologies (Figure 1):

- decision-making technologies that augment human intelligence;
- sensing and controlling technologies that collect data and change physical processes to be more sustainable;

- enabling technologies that are core for any digital business; and
- foundational technologies that assist current operations.

FIGURE 1

DIGITAL TECHNOLOGIES THAT CAN DRIVE DECARBONIZATION.



Source: Reproduced with permission from WEF (2022).

This report explores the intricate relationships among climate change, carbon credits, and business productivity, highlighting the opportunities and challenges that arise from this intersection.

UNDERSTANDING CARBON CREDITS

Definition and Mechanism

Carbon credits represent a market-based approach to controlling pollution by providing economic incentives for reducing emissions. One carbon credit permits the emission of one metric ton of carbon dioxide or an equivalent amount of other GHGs. The system operates under the principle of "cap-and-trade," where a regulatory body sets a limit on total emissions and allows companies to buy and sell allowances as needed. The cap-and-trade system encourages companies to reduce emissions by allowing them to trade excess allowances with others needing them. This flexibility creates a financial incentive for companies to invest in cleaner technologies and practices.

Carbon credits and markets unlock the much-needed capital for climate change to achieve Paris Agreement goals, although carbon credit issuance will need to increase 40-fold by 2035 (McKinsey & Company, 2021). The mature carbon ecosystem is comprised of various players across private developers, project advisers, validation bodies, independent standards, trading exchanges, standard developers, and market and reference data providers (Figure 2).

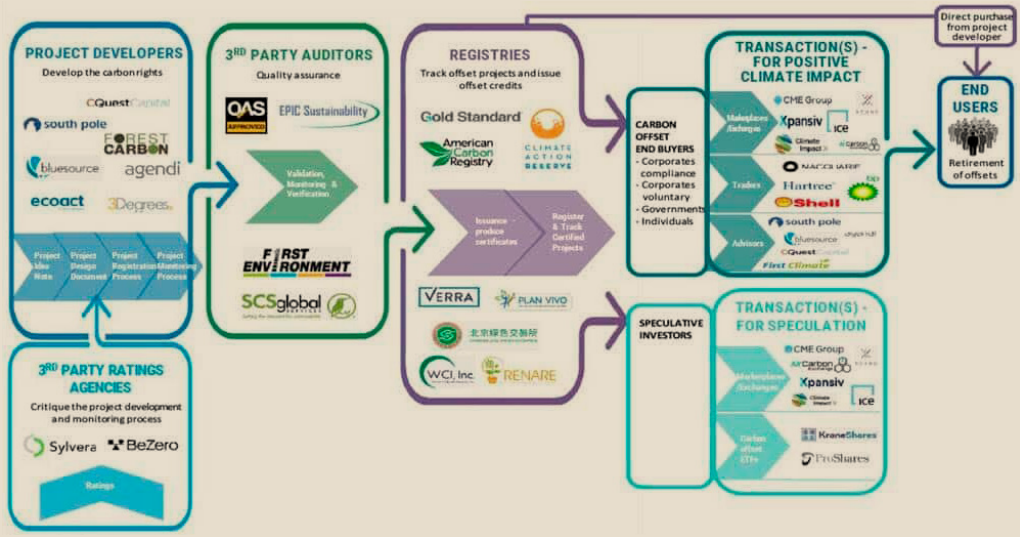
Types of Carbon Credits

i. **Compliance Credits:** These are issued in regulated markets where companies must adhere to legally binding emission reduction targets. Compliance credits are often used in systems like the EU Emissions Trading System (EU ETS), which mandates emission reductions for specific sectors.

ii. **Voluntary Credits:** These credits are purchased by organizations looking to offset their emissions voluntarily, often as part of corporate social responsibility (CSR) initiatives. The voluntary carbon market has grown significantly, with an estimated value of USD320 million in 2020 (Ecosystem Marketplace, 2021).

FIGURE 2

CARBON ECOSYSTEM VALUE CHAIN.



Source: Reproduced with permission from CarbonCredits.com (2023).

Role of Carbon Markets

Carbon markets facilitate the trading of carbon credits, creating a financial incentive for companies to reduce emissions. According to the World Bank, the global carbon market was valued at approximately USD272 billion in 2020, reflecting a growing recognition of the importance of carbon pricing (World Bank, 2021). The market dynamics are influenced by various factors, including regulatory changes, technological advances, and public awareness of climate issues.

Key Functions of Carbon Markets

- **Liquidity:** Carbon markets provide liquidity, allowing companies to buy and sell credits based on their needs.
- **Price Discovery:** These markets help establish a price for carbon, reflecting the cost of emissions and incentivizing reductions.
- **Innovation:** By placing a price on carbon, markets encourage investment in cleaner technologies and practices.

Statistics and Trends

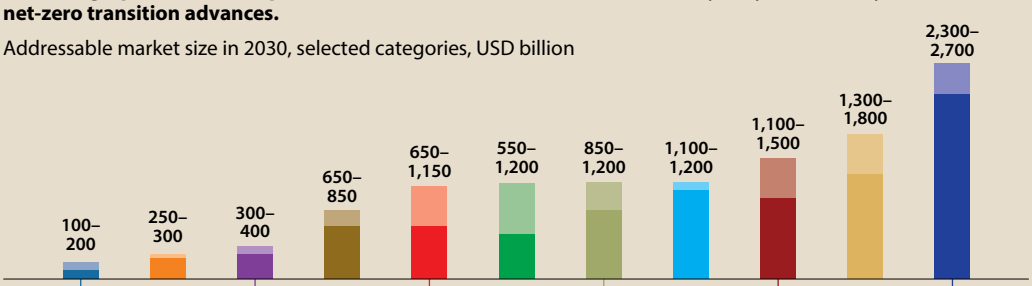
The global potential value pool can be worth USD12 trillion of yearly revenues as of 2030 as the net-zero transition advances (McKinsey & Company, 2022). Figure 3 rates the top industries as transport, buildings, power, water, and

FIGURE 3

GLOBAL POTENTIAL REVENUES OF INDUSTRIES.

Eleven high-potential value pools could be worth more than $12 trillion of yearly revenues by 2030 as the net-zero transition advances.

Addressable market size in 2030, selected categories, USD billion



Industrials
- Steel
- Aluminum
- Cement
- Mining
- Chemicals

Hydrogen
- Production
- Transmission
- End use

Agriculture and land use
- Land and forest management
- Agricultural production
- Alternative proteins
- Food waste reduction
- Sustainable agricultural inputs
- Sustainable agricultural equipment

Water
- Municipal water supply
- Industrial water supply

Buildings
- Sustainable design, engineering. and construction advisory
- Green building materials
- High-efficiency equipment
- Green building tech/operations

Waste
- Enablers of materials reuse
- Industrial- and mature-materials processing
- Materials-processing innovation

Carbon management
- Carbon capture, utilization, and storage
- Carbon-offset markets
- Carbon tracking and measurement

Oil, gas, and fuels
- Electrification of upstream and downstream
- Efficiency improvements
- Direct emissions elimination
- Sustainable fuels

Consumer
- Consumer electronics
- Sustainable packaging
- Sustainable fashion

Transport
- Electrification
- Micromobility
- Infrastructure for electric vehicles
- Sustainable aviation

Power
- Renewable-power generation
- Grid modernization and resiliency
- Flexibility and energy storage
- Power system tech and analytics
- Decommissioning and thermal conversion

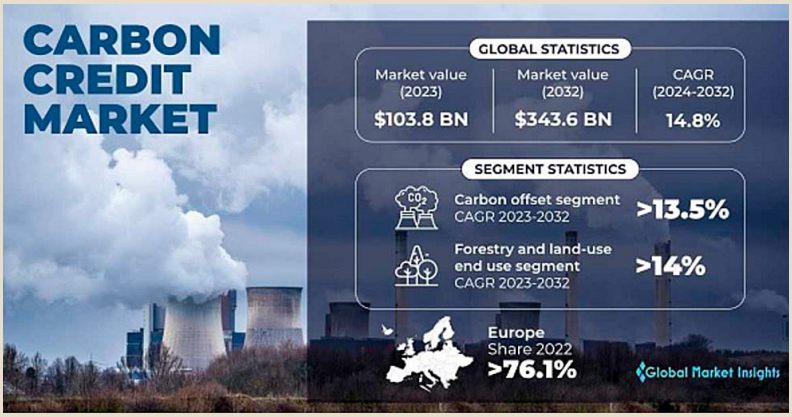
Note: Preliminary, not exhaustive
Source: Reproduced with permission from McKinsey & Company (2022).

consumers; agriculture and land use; oil, gas, and fuels; hydrogen; waste; industry; and carbon management in descending order. Notably, the carbon management sector, which comprises carbon capture, utilization and storage, tracing, and measurement as well as carbon offset markets was aggregated at a forecast of USD100–200 billion.

The global carbon credit market was valued at USD103 billion in 2023 and projected to reach USD343.6 billion by 2032, with an average CAGR growth of 14.8% (Figure 4) (Global Market Insights, 2023).

FIGURE 4

CARBON CREDIT MARKET 2023–32.



Source: Reproduced with permission from Global Market Insights (2023).

The global carbon market has witnessed a significant increase in trading volumes, with a 20% rise in 2020 compared with the previous year (World Bank, 2021). The price of carbon credits in the EU ETS reached an all-time high of €60 per ton in 2021, driven by tightening regulations and increased demand (European Commission, 2022). The voluntary carbon market is projected to grow significantly, with estimates suggesting it could reach USD50 billion by 2030 (Ecosystem Marketplace, 2021).

IMPACT OF CLIMATE CHANGE ON BUSINESS PRODUCTIVITY

Debunking the Linkage of Carbon Consumption and National Productivity

The usual concept of productivity is defined as the ratio of the outputs produced to the inputs consumed. Outputs are mainly economic results, such as services, goods, and added value, while input resources usually consist of labor and capital. Productivity is an important indicator of how the inputs are effectively transformed into outputs, and thus becomes a hot topic in academia (Tangen, 2005).

Furthermore, with the increasing emphasis on sustainable development, more attention has been paid to evaluating productivity in conjunction with carbon emissions. Beijing, the capital of PR China, has suffered from serious pollution in the process of development. Like most capitals in the world, Beijing was also confronted with huge energy consumption and carbon emissions during rapid urbanization and industrialization (Li, et al., 2022; Zhou, et al., 2020).

Research results in Beijing show that GDP did not decrease with reduced energy consumption, which could be a valuable reference for other countries (National Bureau of Statistics, 2017). Reduced carbon emissions without sacrificing growth and productivity improvement related to carbon emissions could offer examples for other cities to emulate.

Global Economic and Productivity Implications for Industry Sectors

The global economic cost of climate change is projected to reach USD23 trillion by 2050 if no action is taken (Swiss Re Institute, 2021). A study by the Global Commission on the Economy and Climate estimated that climate action could deliver USD26 trillion in economic benefits by 2030 through the creation of jobs and increased productivity (World Resources Institute, 2018). According

to a report by the National Bureau of Economic Research, climate change could reduce US GDP by up to 10% by 2100 if current trends continue (National Bureau of Economic Research, 2021).

Climate change poses significant economic risks, including increased operational costs, supply chain disruptions, and loss of productivity. A report by the National Oceanic and Atmospheric Administration (NOAA) found that extreme weather events caused over USD95 billion in damages in the USA in 2020 alone (National Oceanic and Atmospheric Administration). These costs can severely impact businesses, particularly in sectors like agriculture, insurance, and manufacturing. The key economic impacts are:

1) Operational costs: Increased energy costs due to extreme weather can drive up operational expenses for businesses.

2) Supply chain disruptions: Natural disasters can disrupt supply chains, leading to delays and increased costs.

3) Productivity losses: Extreme weather events can hinder worker productivity, particularly in outdoor or unprotected environments.

Global Adoption and Voluntary Reporting Frameworks

GHG Protocol

The GHG Protocol is not tied to any single country's legislation. It is a globally accepted framework used by companies voluntarily to measure and report their GHG emissions. Many multinational corporations, particularly those in sectors with high environmental impacts, adopt the GHG Protocol to meet investor expectations, engage in sustainability initiatives, and report to voluntary platforms, including the following.

Carbon Disclosure Project (CDP): The CDP is a global disclosure system used by companies to report their environmental impacts, which strongly encourages the use of the GHG Protocol for GHG emission reporting.

Sustainability reporting frameworks: Many sustainability reporting standards, such as the Global Reporting Initiative (GRI) and Sustainability Accounting Standards Board (SASB), also align with the GHG Protocol guidelines.

Country-specific Regulations

In some countries, governments have started implementing mandatory GHG emission reporting requirements for companies, which may require or encourage adherence to the GHG Protocol for standardization and consistency. The specific timelines for compliance can vary by country.

Under the EU Emissions Trading System (ETS), large industrial facilities must monitor and report their GHG emissions. Additionally, the Corporate Sustainability Reporting Directive (CSRD) will require companies to disclose their emission data, and many will use the GHG Protocol to comply.

The US Securities and Exchange Commission (SEC) is considering regulations that would mandate public companies to report climate-related risks and emissions, likely requiring adherence to GHG accounting standards such as the GHG Protocol.

Large businesses in the UK are required to report their emissions under Streamlined Energy and Carbon Reporting (SECR) rules. The GHG Protocol serves as a commonly used framework to comply with this requirement.

The Japanese Act on Promotion of Global Warming Countermeasures requires certain companies to report GHG emissions, with the GHG Protocol often used as a guideline.

Corporate Platforms and Timelines

Science-based Target Initiative (SBTi): Many companies set emission reduction targets based on the SBTi, which uses the GHG Protocol as the accounting standard. Companies setting these targets typically adopt the GHG Protocol's standard immediately to ensure compliance and alignment with global climate goals.

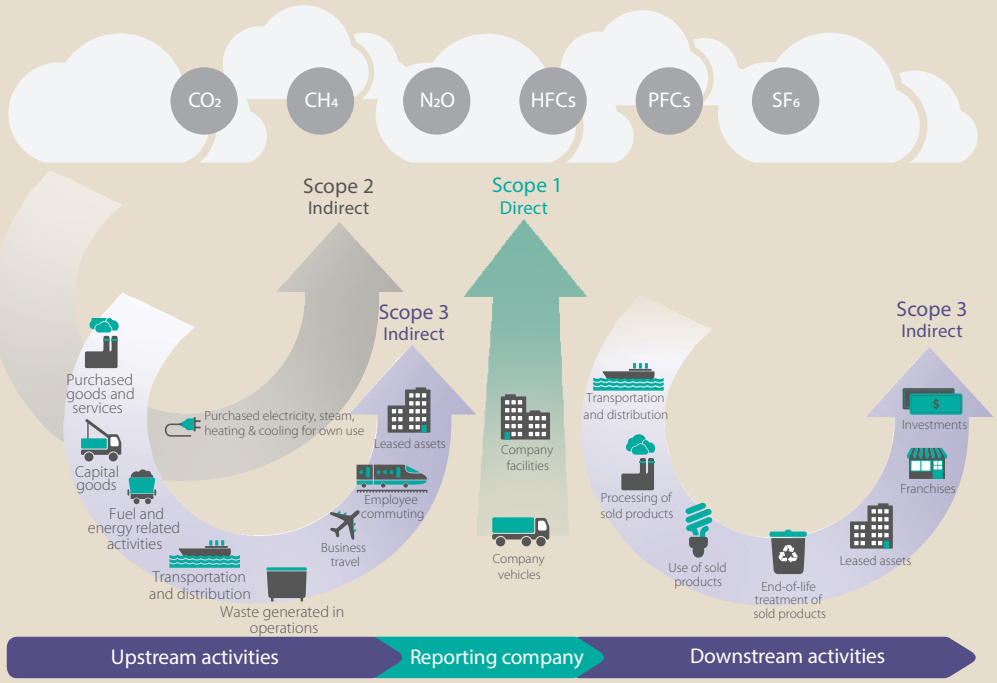
Net-zero Targets: Companies committing to net-zero emissions by a specific date (e.g., 2030 or 2050) often adopt the GHG Protocol early in their journey to measure and manage their emissions more rigorously. For voluntary initiatives like the CDP or SBTi, companies typically set their own timelines based on internal goals or industry-specific pressures. National regulatory frameworks, such as the CSRD in the EU or potential future rules from the SEC in the USA, have specified timelines, with many expected to require disclosures as early as 2024 or 2025.

Main Scope of Carbon Emissions

The Greenhouse Gas (GHG) Protocol Corporate Value Chain Accounting and Reporting Standard provides a comprehensive framework for companies to measure and report their GHG emissions. Understanding the different scopes is crucial for businesses aiming to manage and reduce their carbon footprints. The three main scopes cover various sources of emissions, and companies should be attentive to them in the ways shown in Figure 5.

FIGURE 5

GREENHOUSE GAS PROTOCOL SCOPES 1, 2, AND 3.



According to Greenhous Gas Protocol Corporate Value Chain Accounting and Reporting Standard:

- Scope 1 emissions are the direct emissions from sources that are owned or controlled by the company (including emissions from fleet)
- Scope 2 emissions are the indirect emissions of a company from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the company
- Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions

Source: Reproduced with permission from Greenhouse Gas Protocol (2011).

Scope 1 covers direct GHG emissions that occur from sources owned or controlled by a company. These emissions are typically the result of activities such as fuel combustion in company-owned facilities and vehicles. Common examples include emissions from onsite manufacturing processes; company-owned or -controlled vehicles, e.g., delivery trucks; or fuel combustion for heating or power generation on company premises

Scope 2 involves indirect emissions from purchased energy, such as electricity, steam, heat, or cooling. Although these emissions occur at the energy provider's facilities, they are a result of the company's energy use. Companies should focus on tracking and reducing electricity consumption; transitioning to renewable energy sources, such as wind or solar power; and improving energy efficiency in buildings and operations.

Scope 3 covers all other indirect emissions that occur throughout a company's value chain. These emissions can be extensive and often constitute the largest portion of a company's carbon footprint. Scope 3 includes: upstream activities, such as emissions from suppliers, transportation, and business travel; and downstream activities, such as emissions from product use, disposal, and transportation.

Importance of Comprehensive Reporting

Accurately accounting for scope 1, 2, and 3 emissions enables companies to identify the most significant sources of emissions within their operations and value chains. These data help businesses to develop targeted emission reduction strategies, improve sustainability performance, and meet regulatory requirements or stakeholder expectations. By addressing all three scopes, companies can enhance transparency, reduce climate-related risks, and position themselves as leaders in the transition to a low-carbon economy.

CARBON CREDITS AS STRATEGIC FINANCIAL INCENTIVES

Monetizing Carbon Credits

While many have attempted to comply with regulatory reporting, other forward-looking companies strategize with the monetization of carbon credits. Carbon credits are typically purchased by companies, governments, and other entities aiming to offset their carbon emissions or comply with regulatory frameworks. Different parties that purchase carbon credits are listed below.

Corporations

Many large companies, especially those in carbon-intensive industries like energy, manufacturing, aviation, and shipping, purchase carbon credits for the following reasons.

In regions with cap-and-trade systems, like the EU's Emissions Trading System, companies are legally required to limit their carbon emissions. If they exceed their caps, they must buy carbon credits to offset the excess emissions.

Companies often buy carbon credits to voluntarily offset their emissions as part of their corporate social responsibility (CSR) strategies or to meet sustainability goals. This helps improve their public image and meet investor and consumer expectations of environmental responsibility.

National and regional governments purchase carbon credits owing to international agreements as well as to finance sustainable development. Governments that are part of global climate agreements, like the Paris Agreement, may buy carbon credits to meet their emission reduction targets if they are unable to reduce emissions domestically. Some governments buy credits from projects in developing countries, which help fund renewable energy, reforestation, or other carbon-reducing projects in those regions.

Financial Institutions and Investors

Hedge funds, banks, and other investors attempt to use carbon credits as a form of financial instruments. Carbon credits can be bought and sold on carbon

markets, and some investors purchase them as financial instruments, speculating that their value will increase over time due to tighter emission regulations or higher demand.

Carbon credits are seen as a way to diversify an investment portfolio with assets linked to environmental and sustainability goals. Among individual investors, 2024 witnessed the highest temperature across global cities for the last half-century. Unusual heatwaves, strong typhoons, and unprecedented flooding motivated many global citizens wishing to offset their personal carbon footprints. There is an increasing trend for individuals to purchase and invest in carbon credits to offset their travel emissions, energy use, or lifestyle impacts to help contribute to fighting climate change on a personal level.

Carbon Credits as Strategic Tools

While some governments have imposed carbon taxes to curb emissions, capital markets now see carbon credits as strategic financial instruments. Businesses have moved toward the following strategic objectives:

1) In regulated carbon markets, entities need to meet emission caps. Buying carbon credits helps them offset the carbon taxes and comply if they cannot reduce their emissions through internal measures.

2) For both businesses and governments, purchasing carbon credits is a way to meet emission reduction goals when internal efforts (like energy efficiency or switching to renewable energy) are insufficient or too costly.

3) Companies buy carbon credits to demonstrate their commitment to sustainability, which can enhance their reputation among consumers and investors.

4) Carbon credit purchases help fund environmental projects, such as reforestation or renewable energy initiatives, which contribute to global efforts to reduce emissions.

By buying carbon credits, companies and governments can balance their emissions by financing projects that reduce or capture carbon elsewhere, making it a practical solution for those unable to fully decarbonize their operations.

BUSINESS AND PRODUCTIVITY OPPORTUNITIES IN A CHANGING CLIMATE

Transiting to Sustainable, Productive Practices

Businesses that embrace sustainable practices can not only mitigate risks but also capitalize on new market opportunities. For example, companies that invest in energy-efficient technologies can reduce operational costs significantly. A study by McKinsey found that energy efficiency measures could save businesses up to USD1 trillion globally by 2030 (McKinsey & Company, 2022). Examples of sustainable practices include the following:

- **Energy efficiency:** Implementing energy-efficient lighting and HVAC systems can reduce energy consumption and costs.
- **Waste reduction:** Companies can adopt circular economy practices to minimize waste and improve resource efficiency.
- **Sustainable sourcing:** Sourcing materials from sustainable suppliers can enhance brand reputation and reduce environmental impact.

Leveraging Innovation and Technology

The transition to a low-carbon economy is driving innovation across various sectors. For instance, the renewable energy sector has seen exponential growth, with global investment in renewable energy reaching USD300 billion in 2020 (International Renewable Energy Agency, 2023). Companies that innovate with clean technologies are well positioned to capture market share in this burgeoning industry. Key areas of innovation are:

- **Renewable energy:** Investment in solar, wind, and other renewable sources is essential for reducing carbon footprints.

- **Electric vehicles:** The shift to electric vehicles presents significant opportunities for automakers and related industries.

- **Smart technologies:** Smart grids and energy management systems can enhance energy efficiency and reduce costs.

Utilizing Government Incentives

Governments worldwide are implementing incentives to encourage businesses to adopt sustainable practices. For instance, the US government offers tax credits for renewable energy investments, which can significantly enhance a company's return on investment. According to the Solar Energy Industries Association, the solar industry in the USA grew by 167% between 2010 and 2020, largely due to supportive policies (Solar Edition, 2020). Examples of government incentives include:

- **Tax credits:** Financial incentives for businesses that invest in renewable energy or energy-efficient technologies.

- **Grants and subsidies:** Funding opportunities for companies adopting sustainable practices or developing green technologies.

- **Regulatory support:** Policies that promote sustainability and reduce barriers to entry for green businesses.

Business Opportunities and Productivity Examples

Carbon credits are a market-based mechanism designed to incentivize companies and individuals to reduce their carbon emissions by investing in projects that remove or reduce GHGs from the atmosphere by monetizing carbon credits to improve revenue flow and financial value added, which directly increase business productivity. Below are some examples of how carbon credits can be secured through various sustainable practices, focusing on regenerative fertilizers, ecosystem preservation, renewable energy, and innovative technologies:

Regenerative Fertilizers

Regenerative fertilizers, often derived from organic matter and designed to enhance soil health, can contribute to carbon sequestration by improving the

soil's ability to capture and store carbon. Examples of how carbon credits can be secured through regenerative fertilizers include:

Increased soil carbon storage: Using fertilizers that enhance soil organic matter and microbial activity increases the amount of carbon stored in the soil.

Reduction in nitrous oxide emissions: Fertilizers that reduce the need for synthetic nitrogen fertilizers lower nitrous oxide emissions, a potent GHG. Companies engaged in regenerative farming can earn carbon credits for enhancing soil carbon levels or reducing emissions related to fertilizer use.

Sustainable Forest Management

Sustainable forest management involves practices to ensure that forests continue to grow and absorb carbon dioxide while supporting biodiversity. Carbon credits can be secured through several methods.

Afforestation and reforestation: Planting new forests (afforestation) or restoring degraded forests (reforestation) enhances the carbon absorption capacity of the land, resulting in carbon credits.

Selective logging: Sustainable logging practices that reduce forest degradation while maintaining the carbon sink capacity allow forest managers to generate carbon credits.

Forest conservation: Preventing deforestation through conservation programs locks carbon in trees, with carbon credits awarded for protecting forest areas.

Preservation of Ecosystems

Preserving critical ecosystems, such as wetlands, peatlands, and grasslands, helps store significant amounts of carbon. Projects focused on ecosystem preservation generate carbon credits by:

Preventing ecosystem degradation: Protecting ecosystems from degradation and ensuring that they continue to function as carbon sinks secures carbon credits.

Ecosystem restoration: Restoring degraded ecosystems, such as rewetting peatlands or restoring coastal habitats, improves their carbon sequestration potential.

Generation of Biofuels and Biowaste Conversion

The production of biofuels and the conversion of organic waste into energy or other usable products help reduce carbon emissions by replacing fossil fuels and reducing methane emissions. Carbon credits can be earned through several methods, including:

Biofuel production: Generating biofuels from sustainable sources, such as agricultural waste or algae, reduces dependence on fossil fuels and earns carbon credits by lowering emissions.

Converting waste into biogas: Converting organic waste, e.g., food waste, animal manure, into biogas for energy production prevents methane emissions and generates carbon credits.

Waste Management

Effective waste management practices can significantly reduce GHG emissions by diverting waste from landfills and reducing methane emissions. Examples of how carbon credits can be secured include:

Landfill gas capture: Capturing methane from landfills and using it for energy production can earn carbon credits for reducing potent methane emissions.

Recycling and composting: Programs that promote recycling or composting divert waste from landfills, reducing emissions and securing carbon credits for lower methane and carbon emissions.

Solar Panel Adoption

The adoption of solar panels directly replaces the need for fossil fuel-based electricity generation, reducing carbon emissions and generating carbon credits. Specific examples include:

Residential and commercial solar installations: Solar installations on homes, businesses, and large-scale solar farms reduce grid-based emissions, generating carbon credits for renewable energy production.

Community solar projects: Community solar projects that generate renewable energy for multiple users can secure carbon credits by reducing regional emissions.

Adoption of Drones

Drones are increasingly used in agriculture and forestry to monitor land use and improve carbon sequestration efforts. Carbon credits can be secured through:

Precision agriculture: Drones enable precision agriculture techniques that optimize the use of water and fertilizers, reducing emissions and improving soil carbon sequestration.

Forest monitoring: Drones can monitor forest growth and health, ensuring that forests remain effective carbon sinks and securing credits for sustained or increased sequestration.

Web3 Technologies

Web3 technologies, which include decentralized platforms, blockchains, and smart contracts, offer secure, transparent, tamper-proof systems for tracking and trading carbon credits. Companies can explore leveraging Web3 to help secure carbon credits through several methods, including:

Blockchains for carbon credit transparency: Blockchain technology can be used to create a transparent, verifiable system for tracking carbon credits from their generation to retirement. Every step, from emission reduction projects to the purchase and use of carbon credits, can be recorded on a blockchain, ensuring credibility and preventing fraud. This transparency boosts investor confidence and enhances confidence in carbon credits in the market.

Tokenized carbon credits: Companies can create tokenized carbon credits on blockchain platforms, allowing these credits to be traded easily, with real-time tracking of ownership. These tokens can be purchased or sold on decentralized platforms, creating a more liquid, accessible carbon market. Projects that successfully remove or reduce carbon emissions can mint tokens representing their carbon credits, ensuring accurate issuance and compliance with verification standards.

Smart contracts for automatic credit issuance: Smart contracts can automatically issue or retire carbon credits based on predefined conditions being met. For example, if an IoT device measures a verified reduction in emissions from a renewable energy project, the smart contract can instantly issue carbon credits to the project owners, streamlining the process and reducing administrative costs.

Decentralized carbon markets: Web3 enables the creation of decentralized carbon markets where individuals, companies, and projects can directly buy and sell carbon credits without intermediaries. By using decentralized exchanges and protocols, carbon markets become more accessible, reducing the barriers to entry for smaller carbon-reducing projects and enabling a wider range of participants to secure credits.

IoT Technologies

The IoT involves interconnected devices and sensors that collect real-time data on various processes, including emissions and energy use. These data can be used to verify carbon reductions more accurately and efficiently, thereby securing carbon credits for a range of activities. Here are some examples of how the IoT can help to optimize costs to generate carbon credits:

Smart meters and energy efficiency monitoring: IoT-based smart meters installed in homes, businesses, or factories can monitor real-time energy consumption. When energy efficiency measures, such as the adoption of renewable energy or efficiency upgrades, result in reduced emissions, the data can be fed directly into carbon accounting systems to secure carbon credits. Accurate measurement of reduced energy use ensures that credits are issued based on verifiable data.

Agriculture and precision farming: IoT sensors in agriculture can monitor soil health, water use, and crop growth to optimize inputs like fertilizers and irrigation. By reducing water and fertilizer use, farmers can reduce nitrous oxide emissions and enhance soil carbon sequestration. These emission reductions can be measured in real time through IoT devices, enabling the generation of carbon credits for more sustainable agricultural practices.

Smart waste management systems: IoT-enabled waste management systems can track waste collection, recycling rates, and methane emissions from landfills. By optimizing collection routes or increasing recycling rates, waste management companies can reduce their carbon footprints. IoT sensors that monitor methane emissions from landfills can verify reductions, allowing the issuance of carbon credits for these initiatives.

Monitoring renewable energy projects: IoT sensors can be used to track the performance of renewable energy projects such as solar panels, wind farms, or

bioenergy plants. These sensors provide real-time data on energy generation and GHG emissions avoided. The data can then be fed into carbon-crediting systems to accurately determine how many credits are earned for each megawatt of renewable energy produced.

Forestry and ecosystem monitoring: IoT sensors, along with drones, can monitor the health and growth of forests, seagrass meadows, and other ecosystems that act as carbon sinks. Real-time data from these devices can be used to verify carbon sequestration rates, ensuring that the correct number of carbon credits is issued based on actual performance. This method improves the accuracy and trustworthiness of ecosystem-based carbon credit projects.

Through sustainable practices like regenerative agriculture, forest management, waste management, and renewable energy adoption, companies can secure carbon credits by reducing emissions or enhancing carbon sequestration. These examples demonstrate how businesses can contribute to a low-carbon economy while benefiting from the carbon credit market.

CASE STUDIES OF INTERNATIONAL BUSINESS STRATEGIES

Netflix (Sustainable Content Production)

Netflix has made significant strides in integrating sustainability into its business model. The company committed to achieving net-zero GHG emissions by 2022 and has invested in renewable energy projects, including wind and solar. According to the company's sustainability report, Netflix has reduced its emissions by 50% since 2019 (Netflix, n.d.). This commitment not only enhances its brand image but also leads to long-term cost savings.

Netflix has adopted sustainable practices in its film and television production processes. The company has implemented guidelines for reducing waste and energy consumption on set, contributing to its overall emission reduction goals.

IKEA (Circular Economy and Resource Efficiency)

The circular economy focuses on minimizing waste and making the most of resources, and it aligns well with carbon reduction efforts. Businesses can improve productivity by adopting circular practices, like recycling materials, which reduce the need for raw material extraction and energy-intensive manufacturing processes.

IKEA announced in its IKEA Sustainability Report 2023 that it aims to become fully circular by 2030 (IKEA, 2024), when all products will be designed with reusability, renewability, and recyclability in mind. By improving resource efficiency and reducing waste, IKEA not only cuts carbon emissions but also boosts productivity by streamlining its supply chains and reducing material costs.

BP (Carbon Offsetting as a Revenue Stream)

Businesses that invest in green technologies or sustainable practices often generate excess carbon credits, which they can sell in carbon markets, creating

a new revenue stream. BP rebranded itself as "Beyond Petroleum" to become significant player in the carbon credit market, investing in carbon offset projects like reforestation and renewable energy. In its Sustainability Report 2023, BP showcased its internal carbon pricing mechanism launch, pushing for productivity improvements across its operations (BP, n.d.). Participation in carbon-offset projects also opens new business lines, like carbon-neutral fuel offerings. For companies in industries that are hard to decarbonize (like manufacturing or mining), purchasing carbon credits can offset emissions while improving their overall carbon footprints.

Apple (Access to Green Financing)

Companies committed to reducing emissions through carbon credits and sustainable practices can broaden their access to an enlarged pool of green financing. Green bonds, loans, and other financial products are often tied to carbon reduction goals, incentivizing businesses to enhance productivity through more sustainable operations.

The Apple Green Bond Impact Report 2022 announced its issuance of USD4.7 billion in green bonds to finance clean energy and environmental projects (Apple, 2023). The company's commitment to carbon neutrality by 2030 has led to the development of more energy-efficient products and a reimagining of its supply chain, leading to operational efficiencies and reduced costs.

ReSeed (Community Building)

ReSeed's business model focuses on empowering smallholder farmers to engage in carbon markets by leveraging their sustainable agricultural practices. Through blockchain technology, ReSeed tracks and verifies carbon credits generated by farmers, enabling them to receive compensation for their climate-positive actions. This model helps small farmers access global markets and incentivizes carbon sequestration at a grassroots level.

Earthshot Labs (Ecological Restoration and Nature-based Solutions)

Earthshot Labs leverages technology to support ecological restoration on a planetary scale. Its core platform, LandOS, provides landowners with satellites

and IoT and data insights on ecological interventions and access to carbon markets. By combining ecological science with financial incentives, Earthshot aims to restore ecosystems and make nature-based carbon solutions more accessible and scalable.

Green Trade (Low-carbon International Trade)

The Green Trade Initiative, supported by the WEF, focuses on driving sustainability in international trade by encouraging low-carbon supply chains and supporting the circular economy. Green Trade works with both private and public entities to analyze and implement trade practices that align with climate goals. It aims to establish frameworks where international trade supports environmental sustainability, reducing carbon emissions through green innovation.

BYD (Vertical Integration and Consumer Incentivization)

BYD, a Chinese electric vehicle manufacturer, has positioned itself as a leader in the green technology sector. The company's focus on electric vehicles and renewable energy solutions has allowed it to capture a significant market share. In 2020, BYD sold over 400,000 electric vehicles, making it one of the largest EV manufacturers globally (CGTN, 2021). By prioritizing sustainability, BYD has differentiated itself from traditional automakers and seen substantial growth.

BYD's strategy includes vertical integration in its supply chain, allowing it to control production processes and reduce costs. This approach has enabled the company to offer competitive pricing while maintaining high-quality standards. BYD gains carbon credits in the preemption of fossil fuels and shares the incentives with car owners via a point system for their exchange of BYD products and services. This creates a mutual win–win situation while creating car owner loyalty.

CONCLUSION

The intersection of climate change, carbon credits, and business productivity presents both challenges and opportunities. As businesses navigate this complex landscape, those that proactively embrace sustainability and leverage carbon credits will likely emerge as leaders in their industries. The future of business will increasingly depend on the ability to adapt to climate realities while driving innovation and productivity. The analyses presented above show the following main findings.

1) BYD's example has shown that economic growth need not be sacrificed with carbon reduction. It was able to reduce carbon emissions while continuing to grow its GDP output and productivity.

2) Enterprise productivity can be increased by leveraging technologies like drones, Web3, IOT technologies, and blockchains for traceability and high quality, which generate high-quality carbon credits.

3) Adopting ESG reporting does not equate with decarbonization. ESG compliance does not necessarily reduce carbon emissions. Nature-based, e.g., afforestation, regenerative fertilizer, or science-based, e.g., solar panel and hydrogen energy, solutions are necessary for decarbonization.

4) Financial injections in sustainability projects can be made by leveraging blended financing for capital investment, government grants, and carbon credits. Good-quality carbon-credit projects can bring in additional revenue flows with good returns on investment. This improves the adoption of technologies for productivity improvement.

5) Businesses have adopted and demonstrated numerous productivity improvements through the adoption of innovations and technologies including regenerative fertilizers and sustainable forest management to rejuvenate land usage. Cheaper alternative energy usage through biowaste, biofuel conversion, and solar panels is helpful. Optimizing

waste management, while improving resource productivity through the adoption of drones, robotics, and Web3 technologies, is also helpful.

6) Carbon credits are a new form of financial revenue. A new business model can be generated with new productivity opportunities, as shown by the examples of community building (Earthshot Labs), branding (Netflix), circular economy (IKEA), strategic partnership (Greentrade), access to green funds (Apple), community building (ReSeed), and vertical integration and consumer incentivization (BYD).

In summary, businesses must recognize that climate change is not just an environmental issue but a significant economic and social challenge. By integrating sustainability into their core strategies, companies can not only mitigate risks but also unlock new opportunities for growth and innovation.

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LIST OF FIGURES

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