Unveiling Sustainability's Shadows Through PESTEL Analysis

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ABSTRACT

This study employs the PESTEL framework to critically examine the dark side of sustainability, focusing on systemic paradoxes and negative externalities in sustainability initiatives. Using a qualitative approach, it synthesizes secondary data from case studies and literature reviews in technology, construction, and agriculture to assess sustainability complexities. The analysis reveals that political incoherence, economic disparities, social resistance, rapid technological shifts, environmental trade-offs, and fragmented legal frameworks create unintended consequences, limiting the effectiveness of sustainability efforts. By offering the first comprehensive PESTEL-based analysis of sustainability paradoxes, this research underscores the necessity of structured risk identification to enhance decision-making and refine sustainable development strategies. It emphasizes the social implications for corporations, policymakers, and academia, advocating for community-driven initiatives, adaptive legal frameworks, and international collaboration to address inequities, particularly between developed and developing nations, in transitioning to low-carbon economies.

Keywords: Sustainability, Dark side, PESTEL framework, Negative outcomes, Impacts and evaluation, Implications, Conceptual framework

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INTRODUCTION

Addressing global issues such as climate change and resource depletion relies heavily on sustainability (Ahlström & Monciardini, 2021), which influences policy development across various sectors to promote long-term resilience. Although sustainability contributes to improved financial performance and enhances brand image, it can also lead to unintended negative effects, often referred to as its "dark side" (Geissdoerfer, 2017). These adverse impacts include economic instability, social disparities, and harm to the environment (Schaltegger, 2016). Additionally, political tensions emerge due to conflicting interests among governments, businesses, and NGOs, resulting in ineffective regulations (Singh, 2025). Furthermore, the transition to environmentally friendly economic models may disproportionately affect vulnerable populations (Agarwal & Boechat, 2024).

Efforts to achieve sustainability can inadvertently marginalize vulnerable groups, thereby widening social inequalities (Sukhdev & Feger, 2012). Technological innovations that support sustainable development may also bring challenges such as concerns over data privacy and the displacement of jobs (Brynjolfsson & McAfee, 2014). Although legal frameworks aim to regulate sustainability practices, they can sometimes impede innovation or struggle to keep pace with rapid changes (Ekins, 2012). Moreover, environmental initiatives may cause unintended effects like excessive resource extraction or the transfer of environmental impacts to other regions (Barbier, 2016). This study employs a PESTEL analysis to explore these complexities, demonstrating how sustainability initiatives can occasionally intensify the very problems they intend to address. By examining political disputes, economic disparities, social exclusion, technological risks, legal obstacles, and environmental damages, this research underscores the need for a more inclusive and balanced approach to sustainability (Clegg & Burnes, 2023).

1.1 *Sustainability*

Sustainability refers to the capacity to fulfill current needs without jeopardizing the ability of future generations to satisfy theirs, integrating environmental, social, and economic aspects—commonly known as the "triple bottom line." This framework, introduced by John Elkington in 1994, highlights the importance of balancing economic success, environmental stewardship, and social responsibility. Elkington argues that businesses should prioritize profit, people, and the planet to generate enduring value and safeguard resources for the future (Elkington & Rowlands, 1999).

TABLE 1: DEFINITIONS OF SUSTAINABILITY FROM DIFFERENT AUTHORS

Definitions	References
"Sustainability is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs."	(Hong, 2022)
"Sustainability involves the triple bottom line, balancing economic, social, and environmental responsibilities for long-term success".	(Khan, 2024)
"Sustainability requires operating within the limits of ecological systems to avoid their collapse over time."	(Folke2006)
"Sustainability focuses on creating strategies that are both ecologically and economically viable in the long term'.	(Wheeler, 2013)
"Sustainability is simultaneously fostering human and ecological well-being through integrated approaches."	(Robinson, 2011)
"Sustainability is about harmonizing the environment, economy, and equity to create a balanced, viable future."	(Adams,2019)
"Sustainability ensures that resource use does not exceed the Earth's regenerative capacity".	(Du Plessis, 2012)
"Sustainability is maintaining the ecological base while meeting human needs, ensuring fairness between generations."	(Okereke, 2006)

"Sustainability science aims to understand the interactions between natural and social systems to promote sustainability."	(Kates, Clark, Corell, Hall, Jaeger, Lowe, & Svedin ,2001)
"Sustainability integrates environmental preservation with economic profitability and social equity for enduring solutions."	(Shrivastava & Kennelly, 2013)

Source: Author's own

Sustainability involves fulfilling current needs without compromising the ability of future generations to meet theirs, by balancing economic development, environmental protection, and social well-being. According to Nekrasov and Melnyk (2017) research works, they conclude as it encompasses responsible management of resources, reducing environmental harm, and promoting long-term resilience within ecosystems and communities. Amid increasing concerns over climate change, resource scarcity, and social inequality, sustainability has become a key priority for governments, businesses, and individuals worldwide. Raworth, (2012) highlights that various industries—including energy, agriculture, construction, and manufacturing—are adopting sustainable practices to foster a healthier environment and a fairer society, while aligning with technological progress and regulatory requirements. The PESTEL framework, which considers Political, Economic, Social, Technological, Environmental, and Legal factors, is instrumental in shaping sustainability strategies by influencing policies, innovations, and consumer behavior that advance long-term sustainability objectives(Kates, 2008).

1.2 *PESTEL Framework*

The PESTEL framework is a strategic analysis tool used to evaluate the external macro-environmental factors that impact an organization. Issa & Issa (2014) examined 6 key dimensions: Political, Economic, Social, Technological, Environmental, and Legal factors.

1. **Political** – Government policies, regulations, trade restrictions, and political stability.
2. **Economic** – Inflation, exchange rates, economic growth, interest rates, and employment levels.
3. **Social** – Demographic trends, cultural attitudes, consumer behaviours, and lifestyle changes.
4. Technological – Innovations, research & development, automation, and technological advancements.
5. **Environmental** – Climate change, sustainability, carbon footprint, and environmental regulations.
6. **Legal** – Laws, regulations, consumer protection, labor laws, and industry-specific legal requirements.

The PESTEL framework is essential in evaluating how external factors affect sustainable development strategies. Governments worldwide are enacting policies to encourage environmental protection, green technologies, and ethical business conduct. Economic elements, including investments in renewable energy, growing social awareness of sustainability, and technological progress in green innovation, further accelerate the shift toward sustainable business models. Moreover, environmental and legal regulations compel organizations to implement eco-friendly practices and adhere to international sustainability standards. Based on Iacovidou, Busch, Hahladakis, Baxter, Ng, and Herbert (2017) research works, they explain by incorporating the PESTEL framework into sustainability strategies enables businesses to anticipate changes, reduce environmental risks, and align with global sustainability initiatives such as the United Nations Sustainable Development Goals (SDGs). This proactive approach fosters long-term resilience, enhances competitiveness, and promotes positive societal and environmental outcomes.

1.2.1 Negative Outcomes of Sustainability Initiatives in the PESTEL Framework

The PESTEL framework is a widely recognized strategic tool used to analyze the external macro-environmental factors affecting businesses and industries. Matović (2020) highlights that although sustainability initiatives are crucial for fostering long-term environmental and social well-being, they may also produce unintended negative effects across the Political, Economic, Social, Technological, Environmental, and Legal dimensions. Issues such as regulatory uncertainty, high costs of implementation, workforce displacement, technological inefficiencies, and unforeseen environmental consequences can emerge as organizations shift toward sustainable practices (Alghamedy, 2024). By examining these challenges through the PESTEL framework, businesses and policymakers can create more balanced and effective sustainability strategies that promote long-term resilience and regulatory compliance.

TABLE 2: NEGATIVE OUTCOMES OF SUSTAINABILITY INITIATIVES IN THE PESTEL FRAMEWORK

PESTEL Factors	Issues	Negative Outcome	Example & Source
Political	Regulatory Burden	Increased bureaucracy slows business operations.	Sudden coal bans in India caused job losses (Lahiri-Dutt, 2016)
	Policy Uncertainty	Frequent policy changes create investment hesitancy.	
	Government Overreach	Excessive intervention restricts business freedom.	
Economic	High Costs	Green investments burden businesses.	SMEs struggle with strict sustainability regulations (Durrani , 2024)
	Job Losses	Transition to renewables causes unemployment.	
	Market Disruptions	Bans on plastics/diesel increase costs.	
Social	Resistance to Change	Employees/consumers oppose sustainable shifts.	U.S. coal miners lose jobs (Carley ,2018)
	Social Inequality	Green products exclude low-income groups.	
	Cultural Conflicts	Sustainability policies clash with traditions.	
Technological	High R&D Costs	Small businesses struggle with green tech.	Traditional automakers lag in EV production (Wells & Nieuwenhuis, 2012)
	Technology Dependence	Over-reliance on renewables causes risks.	
	E-waste Issues	Digital transformation increases e-waste.	
Environmental	Resource Scarcity	Lithium mining damages ecosystems.	Hydroelectric dams displace communities in Brazil (Graeff, 2011)
	Unintended Ecological Effects	Renewable projects disrupt wildlife.	
	Greenwashing	False sustainability claims mislead consumers.	
Legal	Compliance Burden	Heavy fines increase operational risks.	EU carbon rules raise manufacturing costs (Verde, 2020)
	Legal Conflicts	Laws clash with business contracts.	
	IP Restrictions	Patents limit access to green tech.	

Source: Authors' own

1.3 Dark Side of Sustainability

As a multidimensional concept, sustainability integrates environmental responsibility, social equity, and economic viability. Coined by John Elkington in 1994, the "triple bottom line" framework underscores the need for businesses and societies to balance profit, people, and the planet to ensure long-term value creation and resource preservation. While sustainability is often praised for its potential to address global challenges, emerging research exposes its "darkside"—unintended consequences that can undermine its objectives. Despite its widespread adoption, sustainability efforts can sometimes have paradoxical or counterproductive outcomes (Elkington, & Rowlands, 1999). Four significant concerns are greenwashing, rebound effect, Environmental Justice Issues and economic disruption which challenge the authenticity and effectiveness of sustainability initiatives.

a) Greenwashing: The Illusion of Sustainability

Greenwashing refers to deceptive marketing or corporate practices where companies misrepresent their environmental efforts to attract consumers, investors, or regulatory approvals. Delmas and Burbano (2011) argue that greenwashing erodes consumer trust and dilutes the impact of genuine sustainability initiatives. Companies may:

- Overstate environmental benefits (e.g., claiming carbon neutrality without verifiable offsets) (Paradoulakis, 2024).
- Use misleading labels (e.g., "eco-friendly" without clear criteria).
- Engage in selective disclosure (highlighting positive sustainability aspects while ignoring negative impacts. (Poschen, 2017).

Greenwashing can result in regulatory skepticism and consumer disillusionment, reducing the overall credibility of sustainability efforts. It also fosters market inefficiencies, where truly sustainable businesses struggle to differentiate themselves from those engaging in superficial branding tactics.

b) The Rebound Effect: Efficiency Leading to Increased Consumption

The rebound effect describes a phenomenon were improvements in energy efficiency led to higher overall consumption, partially or fully offsetting the expected environmental benefits. Sorrell (2007) highlights how efficiency gains often reduce costs, making products and services more accessible and encouraging greater use. Examples include:

- Fuel-efficient vehicles lowering fuel costs, leading to more frequent travel.
- Energy-efficient appliances reduce electricity bills, prompting increased usage.
- LED lighting being left on longer than traditional bulbs due to lower energy consumption.

This paradox underscores the complexity of sustainability policies. While technological advancements improve efficiency, they do not necessarily guarantee absolute reductions in resource use, as behavioural and economic factors influence consumption patternsa (Gössling, 2017).

c) Environmental Justice Issues: The Unequal Burden of Sustainability Initiatives

Environmental justice refers to the fair distribution of environmental benefits and burdens across all communities, regardless of race, class, or geography. Bullard (2000) however contradicts by emphasising on sustainability initiatives sometimes exacerbate inequalities, disproportionately affecting marginalized and low-income populations

TABLE 3: ENVIRONMENTAL JUSTICE IN SUSTAINABILITY

How Sustainability Can Perpetuate Environmental Inequities	**References**	**Addressing Environmental Justice Issues**	**References**
Pollution Burdens: Carbon offsets push pollution into poorer areas; renewable projects displace communities.	Behles (2013)	*Community Involvement:* Engage affected communities in decisions; enforce anti-racism regulations.	Bullard (1990)
Gentrification & Green Spaces: Sustainability projects raise property values, displacing low-income residents.	Rigolon & Németh (2018)	*Equitable Green Access*: Implement rent controls and affordable housing policies.	Anguelovski (2016)
Limited Green Tech Access: High costs exclude lower-income households from solar, EVs, and efficiency upgrades.	Vaishnav (2023)	*Targeted Subsidies:* Provide financial aid for marginalized groups to access green tech.	Sovacool & Dworkin (2015)
Policy Exclusion: Marginalized voices are often overlooked in sustainability efforts.	Ahmad & Islam (2024)	*Fair Policy Design:* Require social impact assessments and equitable representation.	Schlosberg (2007)

Source: Author's own

d) Economic Disruption: The Job Market Consequences of Sustainability Transitions

Transitioning to sustainable practices often leads to economic shifts, particularly in industries heavily reliant on fossil fuels and traditional manufacturing. Blyth, Gross, Speirs, Sorrell, Nicholls, Dorgan, & Hughes, (2014) say while sustainability creates new economic opportunities, it can also cause job losses and widen economic inequalities if not managed carefully.

TABLE 4: ECONOMIC DISRUPTIONS OF SUSTAINABILITY & MITIGATION STRATEGIES

Key Economic Disruptions of Sustainability Initiatives	**References**	**Strategies to Mitigate Economic Disruptions**	**References**
Job Losses: Workers in coal, oil, and gas face unemployment.	(Gambhir, 2018)	*Just Transition:* Reskilling programs, wage support, job placement.	Bowen & Fankhauser, 2011)
Skill Gaps: Many workers lack training for sustainability jobs.	(Anzelini, 2022)	*Industry-Education Links:* Align curricula with green job needs.	Pollin & Callaci, 2018)
Regional Imbalances: Resource-dependent areas decline economically.	(Gao, 2024)	*Diversification:* Invest in tourism, the digital economy, and alternative industries.	Evans & Phelan, 2016)

Source: Author's own

Sustainability is vital for balancing economic, environmental, and social priorities, but it also has unintended consequences like greenwashing, the rebound effect, social inequalities, and economic disruptions. Ensuring true sustainability requires transparency, innovation, and regulatory oversight. Inclusive policies, strategic workforce planning, and equitable green investments are essential for a just transition, ensuring no community or workforce is left behind (Venkatachalam, 2018). By analyzing these elements, businesses and policymakers can better understand risks, opportunities, and trends shaping their operational landscape. PESTEL analysis is a strategic framework used to analyze external factors that affect an organization, industry, or market.

1.4. Research Gap and Conceptual Framework

1.4.1 Identifying existing research gaps in studying the negative effects of sustainability using PESTEL analysis

Sustainability is crucial for securing the future; however, its unintended consequences—such as environmental degradation, social inequalities, economic displacement, and greenwashing—must be carefully addressed to achieve a balanced and effective approach. The PESTEL framework provides valuable insights into these complexities, yet significant research gaps remain. Politically, issues like policy inconsistencies and regulatory comparisons are insufficiently explored. Economic research often overlooks the long-term financial viability of sustainability initiatives. Social dimensions such as consumer resistance and workforce displacement caused by green technologies require deeper investigation. Technological challenges include barriers to adoption and failures of sustainability-driven innovations, while environmental studies frequently neglect unintended ecological impacts. Legally, global compliance issues and disputes related to greenwashing demand further scrutiny.

Why this study is needed?

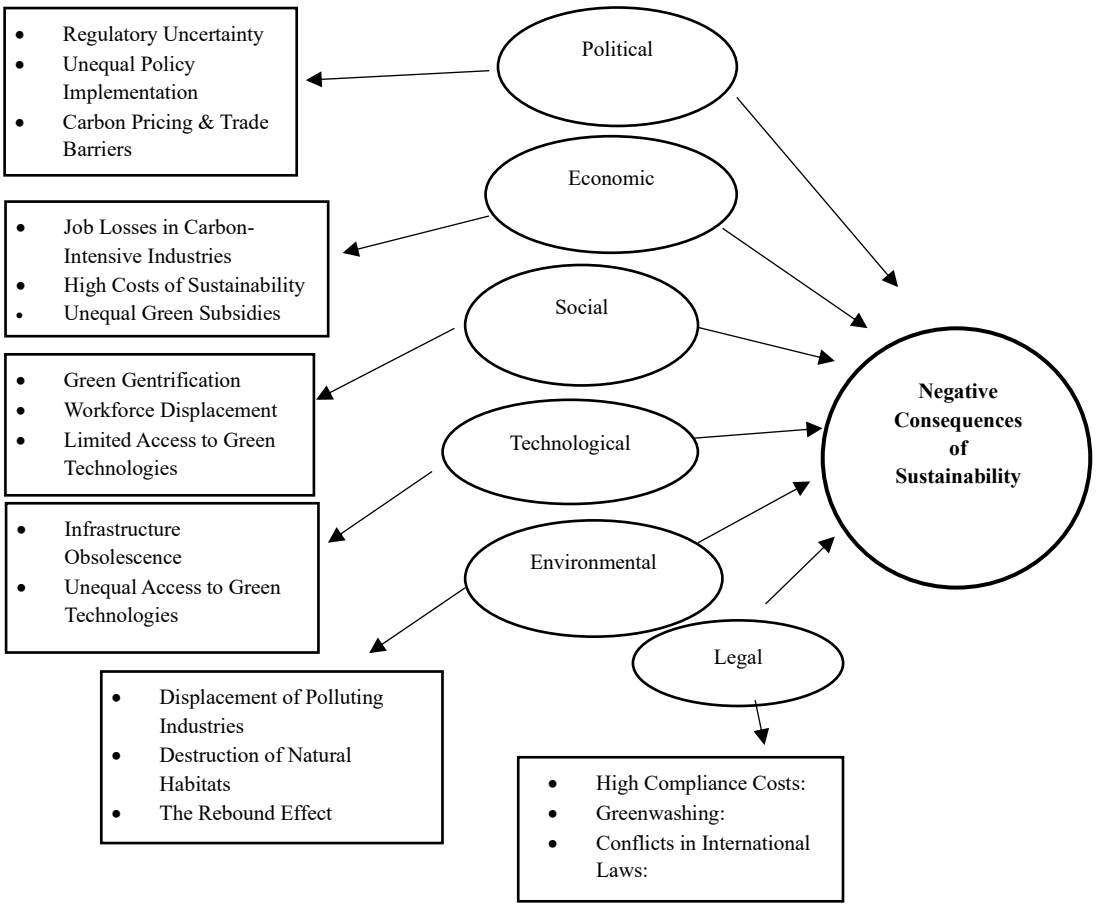
Sustainability initiatives are rapidly transforming industries, but their unintended negative effects are still under examined. Although the PESTEL framework helps assess external influences, limited research has focused on how sustainability challenges reshape these dimensions. Problems such as inconsistent policies, high implementation costs, technological inefficiencies, workforce disruptions, and legal complexities need urgent attention. This study aims to bridge these gaps by providing empirical evidence that will assist businesses and policymakers in developing adaptive strategies. Such strategies will balance sustainability goals with economic feasibility, ultimately enhancing long-term resilience and fostering a sustainable global economy (Yusop, 2018).

1.4.2 Establishing a conceptual framework for understanding these impacts

For businesses aiming to balance economic growth with environmental and social responsibilities, sustainability is vital. The PESTEL framework—which analyzes Political, Economic, Social, Technological, Environmental, and Legal factors—offers a structured method to navigate regulatory demands, shifting consumer preferences,

and technological changes. While sustainability promotes innovation and competitive advantage, challenges such as inconsistent regulations, financial burdens, and workforce disruptions remain. Utilizing the PESTEL framework enables organizations to anticipate and manage these risks, align sustainability efforts with their strategic goals, and enhance long-term resilience. The conceptual model shown in Fig no-1, created by the author, depicts how interactions among PESTEL factors can produce unintended negative effects on sustainability. This model integrates the contradictory challenges discussed in the literature (Mallik arvind, 2025) and supports academia, industry, and policymakers in developing data-driven strategies that foster economic sustainability alongside environmental and social well-being.

FIGURE 1: CONCEPTUAL FRAMEWORK FOR DARK SIDE NEGATIVE CONSEQUENCES OF SUSTAINABILITY PRACTICES ON PESTEL FRAMEWORK



Source: Author's own

PESTEL FRAMEWORK

PESTEL analysis, introduced by Aguilar in 1967 as "ETPS," examines macro-environmental factors—Political, Economic, Social, Technological, Environmental, and Legal—impacting business strategy (Dalirazar & Sabzi, 2023). It aids in aligning operations with market dynamics and sustainability goals (Kremer & Symmons, 2015). While variations like PEST and STEEPLE exist, PESTEL remains comprehensive for sustainability without requiring additional ecological factors (Torres Arriaga, 2019) and therefore, PESTEL was decided to cover essential factors related to sustainability without the need to include an ecological dimension) Torres Arriaga, (2019) defines sustainability has emerged as a cornerstone of modern business practices, yet its implementation often reveals complexities and challenges that are not immediately apparent. Janet, T. O. U. A. T. I. (2013) and the PESTEL framework—Political, Economic, Social, Technological, Environmental, and Legal—offers a robust approach to analyzing factors influencing sustainability.

Political elements, such as government policies, regulatory frameworks, and international agreements, significantly impact sustainability initiatives (Iacovidou,2017). Key considerations include potential government changes, new initiatives, and environmental regulations, which can impose costs but also encourage greener practices (Cadle, 2014). Political stability fosters sustainable investments, creating an environment for long-term growth (Dhlamini, 2024).

Theobald, E. (2019) say governments worldwide are introducing regulations to promote sustainability, such as carbon taxes, emissions caps, and incentives for green energy. However, these political interventions may have unintended side effects:

- **Regulatory Uncertainty**: Frequent policy changes can make long-term investments risky for businesses(Kansongue , 2023)
- For example, inconsistent renewable energy policies in the U.S. have created uncertainty for investors in wind and solar energy projects (Elliott, 2013)
- **Unequal Policy Implementation**: Developing countries may struggle to meet global sustainability regulations, leading to economic disadvantages in international trade. (Juntarbutra, 2020).
- **Carbon Pricing & Trade Barriers**: Countries that impose carbon pricing policies on industries increase operational costs, which can be passed down to consumers or lead to industries relocating to countries with weaker regulations (Pan, 2019).

Economic factors play a critical role in sustainability. While transitioning to sustainable practices often requires significant investment, impacting short-term profitability (Song, 2017), economic downturns can shift focus away from sustainability to financial survival (Zalengera , 2023). However, rising consumer demand for sustainable products offers growth opportunities. These factors, including macroeconomic conditions, economic cycles, and currency fluctuations, affect market dynamics (Ho, 2014). Laws and regulations are sometimes included in the political dimension for broader analysis (Ha & Coghill, 2008).While sustainability initiatives create new industries; they can also disrupt existing economies:

- **Job Losses in Carbon-Intensive Industries**: The transition to renewable energy leads to job losses in coal, oil, and gas industries.
- For example, Germany's coal phase-out resulted in regional unemployment and economic decline in former mining towns (Bowen & Fankhauser, 2017).
- **High Costs of Sustainability**: Green technologies (solar panels, electric vehicles) often require high upfront investments. Lower-income households struggle to adopt them due to financial constraints (Delmas & Burbano, 2011).
- **Unequal Green Subsidies**: Government incentives for sustainability often benefit wealthier individuals who can afford electric cars and energy-efficient homes. In contrast, lower-income communities face energy poverty, as rising electricity costs make sustainable energy less affordable (Kates, 2008)

Social factors reflect evolving consumer attitudes and societal expectations around sustainability. Increasing environmental awareness drives support for brands committed to sustainable practices, but businesses must ensure genuine claims to avoid consumer backlash (Iacovidou , 2017). These factors also include demographics, wealth distribution, cultural shifts, and market geography, influencing strategic decisions (Ha & Coghill, 2008). Additionally, organizational networks play a key role, in impacting innovation, power dynamics, and overall effectiveness (Venkatachalam, 2018).

Sustainability efforts can inadvertently reinforce social inequalities, affecting marginalized communities the most:

- **Green Gentrification**: Urban sustainability projects (such as eco-friendly buildings and green spaces) can lead to rising property values, pushing out low-income residents. Studies on New York City and Los Angeles show that green renewal projects contributed to higher rent and living costs, displacing long-term residents (Gould & Lewis, 2016).
- **Workforce Displacement**: Many workers in traditional industries (such as fossil fuels) may not have the skills required for green jobs. This results in economic disparity between urban areas (which benefit from the green economy) and rural areas (which suffer from job losses (Venkatachalam, 2018)

- **Limited Access to Green Technologies**: Sustainable products, such as electric vehicles and energy-efficient appliances, remain unaffordable for many low-income families due to high costs and lack of government subsidies.(Kansongue , 2023)

Technological advancements drive sustainability through innovations in renewable energy, waste management, and resource efficiency, reducing environmental impacts (Dhlamini, 2024). However, rapid technological change poses risks, requiring organizations to stay competitive by tracking trends (Buye, 2021). Technological factors influence products, processes, and distribution (Theobald, 2019). Proactive strategies, such as analyzing R&D budgets, product launches, and media coverage, can identify potential innovation areas (Iacovidou, 2017).Technological advancements are essential for sustainability, but they also create new challenges:

- **Infrastructure Obsolescence**: The push for sustainability makes traditional energy infrastructure (such as coal plants) obsolete, leading to stranded assets and financial losses (Alanzi,2018).
- **Unequal Access to Green Technologies**: Many developing countries lacks the financial and technological resources to implement advanced sustainability initiatives, creating a global green divide(Kralj, 2009)
- **Dependence on Rare Earth Materials**: Green technologies (such as batteries for electric vehicles) require rare earth elements like lithium and cobalt. Mining these materials has significant environmental and human rights concerns, particularly in countries like Congo, where child labor and ecosystem destruction are prevalent (Sovacool, 2019).

Environmental factors directly influence the feasibility and effectiveness of sustainability initiatives. Climate change poses significant risks to business operations and supply chains, necessitating proactive strategies to mitigate these impacts (Song, 2017). Organizations must not only comply with existing environmental regulations but also anticipate future challenges related to resource scarcity and ecological degradation

Ironically, some sustainability efforts harm the environment instead of protecting it:

- **Displacement of Polluting Industries**: Carbon offset programs allow polluting companies to continue emissions by investing in environmental projects elsewhere, often pushing pollution into poorer regions (Bullard, 1990).
- **Destruction of Natural Habitats**: Large-scale renewable projects, such as hydroelectric dams and wind farms, can disrupt local ecosystems and displace indigenous communities(Rastogi & Trivedi, 2016)
- **The Rebound Effect**: Energy-efficient technologies may increase overall consumption instead of reducing it. For example, energy-efficient lighting reduces electricity bills, encouraging higher usage, which negates sustainability gains (Sorrell, 2007).

Legal factors cannot be overlooked in the sustainability discourse. Compliance with environmental laws and regulations is critical for avoiding penalties and maintaining operational licenses (Kansongue, Njuguna, & Vertigans, 2023) Furthermore, legal frameworks can incentivize sustainable practices through mechanisms such as tax breaks or subsidies for green technologies (Iacovidou , 2017). Sustainability regulations are necessary for accountability, but they can also create legal and ethical challenges:

- **High Compliance Costs**: Stricter sustainability laws can burden small businesses, making it harder for them to compete with larger corporations that can afford compliance measures(Gaspar, 2018)
- **Greenwashing**: Many companies falsely market their products as sustainable to attract environmentally conscious consumers, misleading the public (Delmas & Burbano, 2011).
- **Conflicts in International Laws**: Countries have different environmental laws, making it difficult to enforce global sustainability standards. For instance, developing nations may resist sustainability regulations that could slow their economic growth. (Sdg, 2019)

While sustainability is often framed as a positive endeavour aimed at protecting the planet for future generations, it is imperative to recognize the darker complexities that accompany this transition. By employing a PESTLE analysis, orga nizations can gain a nuanced understanding of the external factors that influence their sustainability effort (Torres Arriaga, , 2019). This comprehensive approach enables businesses to identify potential pitfalls and

develop strategies that not only promote sustainability but also ensure long-term viability in an ever-evolving landscape.

1.4.2.1 Industries and Sectors Most Affected: The Dark Side of Sustainability

PESTEL analysis can sometimes impede sustainability efforts when factors like weak environmental laws, excessive resource use, insufficient social responsibility, outdated technologies, political instability, and economic pressures prioritize short-term benefits over long-term objectives (Sigcha, 2020). Given the significant impact of the macro-environment on businesses, it is crucial to address these challenges proactively (Cadle, 2014). Although sustainability aligns with global environmental priorities, it also presents risks across political, economic, social, technological, environmental, and legal areas (de Sousa & Castañeda-Ayarza, 2022). These risks may hinder effective implementation through policy changes, economic downturns, technological failures, and regulatory challenges (Folke, 2006). Major risks, such as disruptions to operations and damage to reputation, carry significant strategic consequences, while smaller risks contribute to incremental costs (Lim, 2020). The PESTEL framework enables organizations to recognize these vulnerabilities and take proactive steps to strengthen the resilience and success of their sustainability initiatives.

TABLE 5: LIST OF INDUSTRIES WHICH HAS BEEN IMPACTED BY THE DARK SIDE OF SUSTAINABILITY AND ITS IMPACT ON THE PESTEL FRAMEWORK

Industry	Short Case Study	Challenges & Negative Impacts	PESTEL Factors Affected	References
Energy Sector	Solar Energy (China, India, USA)	- Mining for rare earth metals causes environmental degradation.	*Political:* Trade policies on rare earth metals.	(Shuai, Zhao, Wang & Cheng, 2022)
		- Exploitation of labor in developing countries.	Economic: High dependency on imported materials.	
		- Economic volatility due to fluctuating material costs.	*Environmental:* Mining-related ecological damage.	
Automotive Industry	Electric Vehicles (Tesla, Toyota, Volkswagen)	- High battery production costs.	*Economic:* Expensive production process.	(Jetin,2023)
		- Resource scarcity of lithium, cobalt, and nickel.	*Technological:* Battery recycling challenges.	
		- Geopolitical tensions over supply chain dependencies.	Legal: Stricter regulations on mining and emissions.	
Fashion Industry	H&M Conscious Collection, Adidas Sustainability Initiatives	- Greenwashing misleads consumers.	*Social:* Misleading marketing impacts consumer trust.	(Rosenstein, 2021)
		- Sustainable products remain expensive and inaccessible.	*Environmental:* Textile waste and pollution.	
		- Continued reliance on fast fashion production models.	Legal: Lack of strict greenwashing regulations.	
Agriculture Sector	Sri Lanka's Organic Farming Ban (2021)	- Drastic drop in crop yields, leading to food shortages.	*Political:* Poor policy planning.	(Kataria, Manur, & Pradhan, 2022)
		- Increased food prices, affecting low-income populations.	Economic: Food supply chain disruption.	

		- Economic instability, forcing policy reversal.	*Social:* Farmers' financial losses and protests.	
Technology Sector	E-Waste Crisis (Apple, Samsung, Planned Obsolescence)	- Frequent hardware updates create excessive e-waste.	*Technological:* Energy-intensive production.	(Zhang, 2020)
		- Sustainable tech requires high energy consumption.	*Environmental:* Growing e-waste pollution.	
		- Unethical mining of rare metals for devices.	Legal: Weak regulations on planned obsolescence.	
Construction Industry	LEED-Certified Buildings (UAE, USA, India)	- High construction costs make green buildings inaccessible.	*Economic:* Expensive sustainable materials.	(Al Qubaisi, 2015)
		- Limited focus on total lifecycle sustainability.	*Environmental:* Limited real impact despite certifications.	
		- Some certifications do not ensure long-term environmental benefits.	Legal: Varying green building regulations.	

Source: Author's own

Table No-5 provides a structured overview of how different industries face unintended sustainability challenges, analyzed through the PESTEL framework. Understanding these issues helps businesses, policymakers, and researchers develop balanced strategies that maximize sustainability benefits while minimizing risks.

1.4 Comprehensive PESTEL Impact on the Dark Side of Sustainability:

Businesses must integrate sustainability into their strategies amid increasing environmental and socio-economic challenges (Sebbag, 2024). The PESTEL framework—Political, Economic, Social, Technological, Environmental, and Legal—helps assess sustainability risks at both macro and micro levels (Thakur, 2021). While sustainability aims to promote long-term well-being, it can also lead to unintended consequences such as economic burdens, social displacement, ethical concerns, environmental damage, and regulatory loopholes (Bebronne,2024). The PESTEL framework analyzes Political, Economic, Social, Technological, Environmental, and Legal factors shaping policies and businesses (Vidgren, 2022). Understanding "*How*" issues arise, "*Why*" they occur, and "*What*" their consequences are helps assess sustainability challenges effectively, ensuring informed decision-making. This systematic analysis ensures informed decision-making, helping stakeholders develop effective, balanced sustainability strategies mentioned in below Table no-6.

TABLE 6: PESTEL FACTORS INFLUENCING SUSTAINABLE DEVELOPMENT

PESTEL Factors	How	Why	What	Which Situation	Evaluation
Political	Forceful policies cause unintended issues.	Lack of stakeholder consultation.	Food price hikes, deforestation, unrest.	When sustainability goals ignore economic/social impacts.	Negative effects can outweigh the benefits.
Economic	Increases costs for businesses/consumers.	High investments in green tech.	Higher costs for energy, products, and infrastructure.	When costs are passed to consumers or businesses relocate.	Leads to inequality, job losses, and resistance.

Social	Causes displacement and inequality.	Green gentrification, job losses.	Low-income communities and workers suffer.	When policies ignore social justice.	Increases disparities distrust, and resistance.
Technological	Raises ethical/environmental concerns.	Rare materials, high energy use.	Lithium mining leads to water depletion, labor issues.	When green tech lacks sustainability assessment.	Creates new crises, and resource depletion.
Environmental	Sustainability efforts can harm ecosystems.	Poorly planned renewable projects.	Deforestation, biodiversity loss.	When ecological assessments are ignored.	Can cause irreversible damage.
Legal	Weak regulations enable greenwashing.	Loopholes, poor enforcement.	Misleading eco-labels, compliance burdens.	When laws are weak or exploited.	Reduces trust, and allows harmful practices.

Source: Author's own

Table No-6 assesses sustainability risks through political, economic, social, technological, environmental, and legal factors at both macro and micro levels. It evaluates their impact, likelihood, and time horizon, helping identify key challenges and mitigation strategies. Also, this table effectively summarizes the PESTEL factors, their impacts, and the situations in which they occur, providing a comprehensive overview of the challenges associated with sustainability efforts.)

1.6. Challenges and Criticism of the Dark Side of Sustainability across PESTEL Factors

Sustainability is widely promoted for its environmental, economic, and social benefits, yet it also has a "dark side" with unintended negative consequences. While aimed at long-term gains, sustainability initiatives can contribute to economic instability, social inequality, regulatory burdens, and technological dependencies (He, 2022). For instance, the transition to renewable energy requires extensive extraction of rare minerals, and certain sustainable projects may displace marginalized communities (Tura, 2019). Additionally, if not carefully managed, sustainability-driven economic growth can exacerbate inequality rather than reduce it (Cooke, 2024). Understanding these challenges through the PESTEL framework—examining political, economic, social, technological, environmental, and legal factors—helps stakeholders develop more balanced and effective strategies.

TABLE 7: SUSTAINABILITY THROUGH THE PESTEL LENS: CHALLENGES, CRITICISMS, AND POTENTIAL SOLUTIONS

PESTEL Factors	Challenges	Criticism	Potential Solutions	Long-Term Implications
Political	Complex regulations, policy inconsistency, government overreach.	Increases costs, and limits business growth.	Stable policies and public-private partnerships.	Uncertainty may deter investment and innovation.
Economic	High costs, job losses, and market disruptions.	Green inflation favours big businesses.	Financial incentives, gradual transitions.	Short-term strain, long-term resilience.
Social	Resistance to change, inequality, cultural conflicts.	Seen as elitist, lack of awareness.	Community engagement, affordable solutions.	Risk of polarization, unequal sustainability access.

Technological	High R&D costs, tech dependence, e-waste.	Not all businesses can afford green tech.	R&D funding, e-waste recycling.	Widening tech gap, resource depletion.
Environmental	Resource depletion, ecological damage, greenwashing.	Some green solutions create new problems.	Strict impact assessments, and accountability.	Biodiversity loss, declining public trust.
Legal	Strict compliance, legal conflicts, IP restrictions.	Increases business risks, and limits access.	Open-source innovations, global legal standards.	Legal uncertainty discourages investment.
Ethical	Greenwashing, labor exploitation, consumer manipulation.	Reduces trust, and profit-driven motives.	Transparent reporting, stronger audits.	Public distrust, and sustainability as a gimmick.

Source: Author's own 1.6.1 Addressing the Challenges of Sustainability

Sustainability is essential for long-term global well-being, but its implementation must be managed carefully to avoid unintended consequences. While sustainability initiatives promote environmental and economic stability, they can also lead to social and economic disparities if not planned inclusively. Bocken(2014) emphasis to ensure a just and effective green transition, key measures includes:

- **Balanced Policies**: Sustainability regulations must consider economic and social impacts.
- **Equitable Access**: Targeted financial support can help low-income communities adopt green technologies.
- **Transparency & Accountability**: Stricter regulations should prevent greenwashing and unethical practices.
- **Global Cooperation**: Policies must be inclusive, addressing the needs of both developed and developing nations.
- **Consumer Awareness**: Educating consumers on genuine sustainability efforts empowers responsible choices.
- **Holistic Policy Design**: Sustainability initiatives should anticipate behavioral impacts to maximize real benefits.

By applying the PESTEL framework, policymakers, businesses, and communities can work together to create sustainability strategies that are fair, transparent, and impactful. Collaboration among governments, industries, and individuals is crucial to ensuring that sustainability remains inclusive, effective, and truly beneficial for all (Dyllick & Muff, 2016)

1. 7. Impacts and Evaluation - How PESTEL Factors Influence the Dark Side of Sustainability

The PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) framework provides a structured approach to understanding how sustainability efforts, despite their good intentions, can lead to unintended negative consequences. Bell,& Rochford (2016) says each factor plays a role in shaping policies, market dynamics, social structures, and environmental impacts, which, if not carefully managed, can contribute to the "dark side of sustainability."

TABLE 8: PESTEL CONSEQUENCES AND ITS IMPACT ON STAKEHOLDERS

PESTEL Factors	Reasons	Unintended Consequences	Impact on Stakeholders	Evaluation & Solutions
Political	Biofuel Mandates	Increases food prices (Cernea, 2004)	Food insecurity for low-income groups.	Balance food security & biofuel production.
	Industry Relocation	Polluting industries shift to developing nations (Acuña, 2015)	Environmental damage in host nations.	Global environmental regulations.

	Green Displacement	Renewable projects displace communities (Bonds & Downey, 2012)	Indigenous land loss.	Community-inclusive decision-making.
Economic	Job Losses	Carbon taxes affect fossil-fuel industries (Bowen & Fankhauser, 2011)	Unemployment in traditional energy sectors.	Reskilling programs.
	High Green Tech Costs	EVs, solar panels remain expensive (Milani, 2000)	Excludes lower-income groups.	Subsidies & affordable financing.
	Green Gentrification	Eco-projects raise housing costs (Gould & Lewis, 2016)	Low-income displacement.	Affordable housing policies.
Social	Energy Poverty	High costs of renewable energy (Cha, 2017)	Excludes marginalized communities.	Targeted energy subsidies.
	Greenwashing	Misleading eco-claims (Milani, 2000)	Consumer distrust.	Stricter regulations.
Technological	Rare Earth Mining	Lithium & cobalt extraction damages ecosystems (Singh & Singh, 2017)	Resource depletion & labor exploitation.	Responsible sourcing policies.
	Digital Divide	Smart city initiatives exclude low-income groups (Gould & Lewis, 2016)	Widened inequality.	Inclusive tech policies.
Environmental	Biofuel Deforestation	Palm oil demand drives deforestation (Griggs, 2017)	Biodiversity loss.	Sustainable land-use policies.
	E-Waste	Solar panels & EV batteries create waste (Krafft & Saito, 2015)	Toxic disposal issues.	Circular economy & recycling.
Legal	Carbon Offsets	Loopholes allow emissions without real reductions (Lohmann, 2009)	Industries avoid sustainability efforts.	Stronger regulatory enforcement.
	Weak Labor Laws	Sustainable supply chains exploit workers (Paradoulakis, 2024)	Poor labor conditions.	Fair trade & ethical sourcing.

Source: Author's own

1.8. Implications

1. 8.1 Theoretical Implication: Broadening Sustainability Theories: Traditional sustainability frameworks, such as the Triple Bottom Line (Elkington, 1994) and the United Nations Sustainable Development Goals (UN, 2015), generally emphasize positive environmental and social impacts but often fail to address unintended negative consequences. Roy, Tscharke, Waisman, Abdul Halim, Antwi-Agyei, Dasgupta, and Suarez Rodriguez (2018) concludes that the advance sustainability theory by integrating PESTEL-related risks, drawing attention to important trade-offs like economic displacement, resource overuse, and reliance on technology. Recognizing these complexities, their research advocates for a more sophisticated approach to sustainability that challenges the assumption that all green initiatives produce solely positive outcomes. According to Polat, Güngör, Haldenbilen, and Ceylan (2024), future studies should enhance sustainability models by balancing both benefits and risks, aiming to develop strategies that reduce negative externalities while maximizing long-term environmental, social, and economic benefits.

1. 8.2 Managerial Implication: Avoiding Greenwashing and Enhancing Transparency: Sustainability has become a vital aspect of corporate branding and consumer relations. However, false or exaggerated claims about sustainability, often called "greenwashing," can lead to loss of consumer confidence and damage to a company's reputation. Many firms promote environmentally friendly initiatives without fully committing to transparency or ethical supply chain practices. Canga, (2024) says to prevent this; managers must ensure that sustainability claims are supported by credible evidence, such as third-party audits, transparent lifecycle analyses, and responsible sourcing of materials. Managing supply chains ethically, especially in industries dependent on key resources like

lithium, cobalt, and palm oil, is critical to maintaining corporate trustworthiness. Businesses that genuinely implement measurable sustainability practices can build stronger consumer loyalty and reduce risks related to regulatory oversight and changing consumer expectations.

1. 8.3 Policy Implication: Ensuring Inclusive Sustainability Policies: Sustainability policies should be crafted to promote both economic and social equity while advancing greener solutions. Pinto (2018) highlights that although policies encouraging renewable energy use, carbon taxes, and sustainable urban development are vital, they can also lead to unintended socio-economic issues, such as job losses in traditional sectors and higher living costs for low-income groups. To address these challenges, governments need to implement support measures like financial aid for communities impacted by the energy transition, retraining programs for workers in carbon-heavy industries, and policies ensuring affordable access to sustainable resources. By preventing these policies from disproportionately affecting vulnerable populations, governments can enable a fair and balanced transition that aligns environmental objectives with economic stability and social welfare (Partanen, 2014)

CONCLUSION & FUTURE SCOPE

This study emphasizes the complexity of sustainability initiatives, particularly the unintended negative effects that can arise from poorly managed transitions. By applying the PESTEL framework, it highlights the importance of balancing environmental objectives with economic stability, social fairness, and technological practicality. The research advances sustainability theory by uncovering hidden risks and regulatory shortcomings, while offering guidance to managers on maintaining ethical supply chains and fostering responsible innovation. Policymakers are urged to design sustainability policies carefully to avoid causing inadvertent harm. A cautious, well-informed, and collaborative approach involving multiple stakeholders is crucial to prevent inequalities, exploitation, and environmental degradation, ensuring that sustainability efforts drive positive change without unintended consequences.

Scope for future

Future research should aim to enhance sustainability policies by achieving a balance between economic stability, social justice, and environmental protection while reducing unintended negative effects. Important focus areas include evaluating the impacts of policies, creating ethical business practices, utilizing technologies like AI and blockchain to improve transparency, and ensuring that transitions are inclusive of marginalized groups. Effective sustainability also requires collaboration across sectors, understanding consumer behavior, conducting life cycle assessments, and establishing robust legal frameworks to minimize risks. By tackling these issues, future studies can support the development of more effective, responsible, and equitable sustainability initiatives.

REFERENCES

Acuña, R. M. (2015). The politics of extractive governance: Indigenous peoples and socio-environmental conflicts. *The Extractive Industries and Society, 2(1),* 85–92. doi:10.1016/j.exis.2014.11.007

Adams, W. M. (2019). *Sustainability and degrowth. In Green development* (pp. 156–175). London, England: Routledge.

Agarwal, B. (n.d.). *Governance: Issues and challenges. In Additional readings* (p. 361). [Publisher not specified].

Ahlström, H., & Monciardini, D. (2021). The regulatory dynamics of sustainable finance: Paradoxical success and limitations of EU reforms. *Journal of Business Ethics.* Advance online publication. doi:10.1007/s10551-021-04763-x

Ahmad, I., & Islam, M. R. (2024). Empowerment and participation: Key strategies for inclusive development. In Building strong communities: *Ethical approaches to inclusive development* (pp. 47–68). Bingley, England: Emerald Publishing.

Alanzi, S. (2018). *PESTEL analysis. In Project management* (Vol. 1). [Publisher not specified].

Alghamedy, F. H., El-Haggar, N., Alsumayt, A., Alfawaer, Z., Alshammari, M., Amouri, L. & Albassam, S. (2024). Unlocking a promising future: Integrating blockchain technology and FL-IoT in the journey to 6G. IEEE Access. Advance online publication. doi:10.1109/ACCESS.2024.XXXXXXX

AlQubaisi, A. M. (2015). *Toward efficient residential buildings in the UAE* (Unpublished master's thesis). The Petroleum Institute, United Arab Emirates.

Anguelovski, I. (2016). *Green gentrification: Urban sustainability and the struggle for environmental justice*. London, England: Routledge.

Anzelini, S. (2022). *The role of skills in the green transition and the implications on labour markets* (Doctoral dissertation). Politecnico di Torino, Turin, Italy.

Barbier, E. B. (2016). Sustainability and development. *Annual Review of Resource Economics, 8(1),* 261–280. doi:10.1146/annurev-resource-100815-095227

Bebronne, E., Heng, S., & Limbourg, S. (2024). Towards sustainable nocturnal environment management: A social-ecological-technical system analysis in Wallonia (Belgium). *Discover Environment, 2(1),* 98. doi:10.1007/s44189-024-00098-2

Behles, D. (2013). From dirty to green: Increasing energy efficiency and renewable energy in environmental justice communities. *Villanova Law Review, 58(1),* 25–54.

Bell, S., & Rochford, K. (2016). PESTEL analysis: A strategic tool for business. [Publisher not specified].

Blyth, W., Gross, R., Speirs, J., Sorrell, S., Nicholls, J., Dorgan, A., & Hughes, N. (2014). *Low carbon jobs: The evidence for net job creation from policy support for energy efficiency and renewable energy*. London, England: UK Energy Research Centre.

Bocken, N. M., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production, 65*, 42–56. doi:10.1016/j.jclepro.2013.11.039

Boechat, A. C., Baptista, N., & dos Reis Torgal, M. (2024). *When sustainability goes wrong: A critical perspective about consumer behaviour, greenwashing, and its impact on sustainability.* In Effective digital marketing for improving society behavior toward DEI and SDGs (pp. 242–262). Hershey, PA: IGI Global.

Bonds, E., & Downey, L. (2012). Green? Technology and ecologically unequal exchange: The environmental and social consequences of ecological modernization in the world-system. *Journal of World-Systems Research, 18(2),* 167–186.

Bowen, A., & Fankhauser, S. (2011). T*he green growth narrative: Paradigm shift or just spin? Global Environmental Change*, 21(4), 1157–1159. doi:10.1016/j.gloenvcha.2011.07.007

Bowen, A., & Fankhauser, S. (2017). *Good practice in low-carbon policy. In Trends in climate change legislation* (pp. 123–140). Cheltenham, England: Edward Elgar Publishing.

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York, NY: W. W. Norton & Company.

Bullard, R. D. (2018). *Dumping in Dixie: Race, class, and environmental quality* (3rd ed.). New York, NY: Routledge.

Buye, R. (2021). Critical examination of the PESTEL analysis model. Project: Action Research for Development. [Publisher not specified].

Cadle, J., Paul, D., & Yeates, D. (Eds.). (2014*). Business analysis*. Swindon, England: BCS, The Chartered Institute for IT.

Canga, M. (2024). *Towards a sustainable future: Exploring diverse environmental perspectives* (Master's thesis). Hamad Bin Khalifa University, Qatar.

Carley, S., Evans, T. P., & Konisky, D. M. (2018). Adaptation, culture, and the energy transition in American coal country. *Energy Research & Social Science, 37*, 133–139. doi:10.1016/j.erss.2017.10.007

Cernea, M. (2004, October*). Impoverishment risks, risk management, and reconstruction: A model of population displacement and resettlement*. Paper presented at the UN Symposium on Hydropower and Sustainable Development, Beijing, China.

Cha, J. M. (2017). A just transition: Why transitioning workers into a new clean energy economy should be at the center of climate change policies. *Fordham Environmental Law Review, 29(2),* 196–220.

Clegg, S., & Burnes, B. (2023). *Taking the lead on leadership: Reimagining the responsible business school of the future. In Practicing responsibility in business schools* (pp. 56–77). Cheltenham, England: Edward Elgar Publishing.

Cooke, P. (2024). The dark side of KIBS agency, the creative economy, and regional sustainability. *Journal of Open Innovation: Technology, Market, and Complexity, 10(1),* 100177. doi:10.1016/j.joitmc.2023.100177

Dalirazar, S., & Sabzi, Z. (2023). Strategic analysis of barriers and solutions to development of sustainable buildings using PESTLE technique. *International Journal of Construction Management, 23(1),* 167–181. doi:10.1080/15623599.2020.1854933

de Sousa, G. C., & Castañeda-Ayarza, J. A. (2022). PESTEL analysis and the macro-environmental factors that influence the development of the electric and hybrid vehicles industry in Brazil. *Case Studies on Transport Policy, 10(1),* 686–699. doi:10.1016/j.cstp.2022.01.030

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California Management Review, 54(1),* 64–87. doi:10.1525/cmr.2011.54.1.64

Dhlamini, J. (2024). Financing the growth of small to medium enterprises in emerging markets: The role of private capital. *Journal of Contemporary Management, 20(si1),* 22–48.

Dibattista, I., Camara, A. R., Molderez, I., Benassai, E. M., & Palozza, F. (2023). Socio-environmental impact of mining activities in Guinea: The case of bauxite extraction in the region of Boké. *Journal of Cleaner Production, 387*, 135720. doi:10.1016/j.jclepro.2022.135720

Du Plessis, C. (2012). Towards a regenerative paradigm for the built environment. *Building Research & Information, 40(1),* 7–22. doi:10.1080/09613218.2012.628548

Durrani, N., Raziq, A., Mahmood, T., & Khan, M. R. (2024). Barriers to adaptation of environmental sustainability in SMEs: A qualitative study. *PLoS ONE, 19(5),* e0298580. doi:10.1371/journal.pone.0298580

Dyllick, T., & Muff, K. (2016). Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability. *Organization & Environment, 29(2),* 156–174. doi:10.1177/1086026615575176

Ekins, P. (2012). Sustainable growth revisited: Technology, economics and policy: A contribution to the special section of mineral economics. *Mineral Economics, 24(2–3),* 59–77. doi:10.1007/s13563-011-0013-5

Elkington, J., & Rowlands, I. H. (1999). Cannibals with forks: The triple bottom line of 21st century business. *Alternatives Journal, 25(4),* 42.

Elliott, E. D. (2013). Why the United States does not have a renewable energy policy. *Environmental Law Reporter News & Analysis, 43(2),* 10095–10101.

Evans, G., & Phelan, L. (2016). Transition to a post-carbon society: Linking environmental justice and just transition discourses. Energy Policy. [Volume and issue not specified], [Pages not specified]. doi:10.1016/j.enpol.2016.XX.XXX

Folke, C. (200 a perspective for social–ecological systems analyses. *Global Environmental Change, 16(3),* 253–267. doi:10.1016/j.gloenvcha.2006.04.002

Gambhir, A., Green, F., & Pearson, P. J. (2018). *Towards a just and equitable low-carbon energy transition* (Grantham Institute Briefing Paper No. 26). London, England: Grantham Institute.

Gao, Z., Zhao, Y., Li, L., & Hao, Y. (2024). Echoes of dependency: The impact of resource reliance on green industry transformation in China. *Resources Policy, 96*, 105219. doi:10.1016/j.resourpol.2024.105219

Gaspar, A. F. M. (2018). *Decision support methodology when entering new markets for a semi-finished bronze products foundry* (Unpublished doctoral dissertation). [Institution not specified].

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The circular economy—A new sustainability paradigm? *Journal of Cleaner Production, 143,* 757–768. doi:10.1016/j.jclepro.2016.12.048

Gössling, S. (2017). Tourism, information technologies and sustainability: An exploratory review. *Journal of Sustainable Tourism, 25(7),* 1024–1041. doi:10.1080/09669582.2015.1122017

Gould, K. A., & Lewis, T. L. (2016). *Green gentrification: Urban sustainability and the struggle for environmental justice.* London, England: Routledge.

Graeff, B. (2011). Should we adopt a specific regulation to protect people that are displaced by hydroelectric projects: Reflections based on Brazilian law and the Belo Monte case. *Florida A & M University Law Review, 7(1),* 261–286.

Griggs, D. J., Nilsson, M., Stevance, A., & McCollum, D. (2017). *A guide to SDG interactions: From science to implementation*. Paris, France: International Council for Science.

Ha, H., & Coghill, K. (2008). Online shoppers in Australia: Dealing with problems. *International Journal of Consumer Studies, 32(1),* 5–17. doi:10.1111/j.1470-6431.2007.00645.x

He, Q., Wang, Z., Wang, G., Xie, J., & Chen, Z. (2022). The dark side of environmental sustainability in projects: Unraveling greenwashing behaviours. *Project Management Journal, 53(4),* 349–366. doi:10.1177/87569728221101276

Ho, J. K. K. (2014). Formulation of a systemic PEST analysis for strategic analysis. *European Academic Research, 2(5),* 6478–6492.

Hong, H. S. (2022). A study on the sustainability of social cooperatives. *The Journal of the Convergence on Culture Technology, 8(1)*, 93–104. doi:10.17703/JCCT.2022.8.1.93

Iacovidou, E., Busch, J., Hahladakis, J. N., Baxter, H., Ng, K. S., & Herbert, B. M. (2017). A parameter selection framework for sustainability assessment. *Sustainability, 9(9),* 1497. doi:10.3390/su9091497

Iacovidou, E., Millward-Hopkins, J., Busch, J., Purnell, P., Velis, C. A., Hahladakis, J. N., ... & Brown, A. (2017). A pathway to circular economy: Developing a conceptual framework for complex value assessment of resources recovered from waste. *Journal of Cleaner Production, 168*, 1279–1288. doi:10.1016/j.jclepro.2017.09.002

Issa, T., & Issa, T. (2014). Sustainable business strategies and PESTEL framework. *GSTF Journal on Computing, 1(1),* [Pages not specified]. doi:10.5176/2251-3043_1.1.7

Janet, T. O. U. A. T. I. (2013). The PESTEL environment and its impact on the value created. *International Journal of Management & Information Technology, 6(2),* 805–816.

Jenkins, J. D. (2014). Political economy constraints on carbon pricing policies: What are the implications for economic efficiency, environmental efficacy, and climate policy design? *Energy Policy, 69*, 467–477. doi:10.1016/j.enpol.2014.02.003

Jetin, B. (2023). Electric batteries and critical materials dependency: A geopolitical analysis of the USA and the European Union. *International Journal of Automotive Technology and Management, 23(4),* 383–407. doi:10.1504/IJATM.2023.100000

Juntarbutra, S. (2020). *A development of strategic management model of small and medium enterprises in the automotive parts industry in Thailand* (Doctoral dissertation). Rajamangala University of Technology Thanyaburi, Thailand.

Kansongue, N., Njuguna, J., & Vertigans, S. (2023). A PESTEL and SWOT impact analysis on renewable energy development in Togo. *Frontiers in Sustainability, 3,* 990173. doi:10.3389/frsus.2022.990173

Kataria, A., Manur, A., & Pradhan, S. (2022). Sri Lanka's economic crisis. *Journal of Takshashila Case Study, 1(02)*, [Pages not specified].

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., ... & Svedin, U. (2001). *Sustainability science. Science, 292(5517),* 641–642. doi:10.1126/science.1059386

Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2008). *What is sustainable development? Goals, indicators, values, and practice.* In The development economics reader (pp. 367–382). [Publisher not specified].

Khan, F. A. (2024). Sustainable business management: Balancing profit and purpose. *Journal of Management Science Research Review, 2(1),* 24–32.

Krafft, J., & Saito, R. (2015). *Greenwashing: An experimental study about the effects of misleading and deceptive environmental claims in advertising*. [Publisher not specified].

Kralj, D. (2009, April). *Sustainable green business. In Advances in marketing, management and finances: Proceedings of the 3rd International Conference on Management, Marketing and Finances* (pp. 30–35). Houston, TX: [Publisher not specified].

Kremer, P. D., & Symmons, M. A. (2015). Mass timber construction as an alternative to concrete and steel in the Australia building industry: A PESTEL evaluation of the potential. *International Wood Products Journal, 6(3),* 138–147. doi:10.1179/2042645315Y.0000000006

Lahiri-Dutt, K. (2016). *Introduction to coal in India: Energising the nation*. In The coal nation (pp. 1–35). London, England: Routledge.

Lim, Y. J. (2020). The PESTEL model application to Ok Boomer and TikTok from a public relations perspective. *Journal of Media Research—Revista de Studii Media, 13(37),* 94–110. doi:10.24193/jmr.37.6

Matović, I. M. (2020, September). *PESTEL analysis of external environment as a success factor of startup business.* In ConScienS conference proceedings (pp. 96–102). Scientia Moralitas Research Institute.

Milani, B. (2000). *Designing the green economy: The postindustrial alternative to corporate globalization*. Lanham, MD: Rowman & Littlefield.

Nekrasov, V., & Melnyk, V. (2017). *Application of SWOT and PESTEL analysis in combating economic crimes and when identifying threats to economic security of the state*. Problems of Legality, 136, 193–[Page end not specified].

Okereke, C. (2006). Global environmental sustainability: Intragenerational equity and conceptions of justice in multilateral environmental regimes. *Geoforum, 37(5),* 725–738. doi:10.1016/j.geoforum.2005.10.005

Pan, W., Chen, L., & Zhan, W. (2019). PESTEL analysis of construction productivity enhancement strategies: A case study of three economies. *Journal of Management in Engineering, 35(1),* 05018013. doi:10.1061/(ASCE)ME.1943-5479.0000662

Paradoulakis, A. (2024). *Sustainable mobility, climate change and geopolitics*. [Publisher not specified].

Partanen, R., Paloheimo, H., & Waris, H. (2014). *The world after cheap oil. London*, England: Routledge.

Pinto, J. V. (2018). *The sustainability of managing the environmental process of agglomerating smelter* by-products (Doctoral dissertation). North-West University, South Africa.

Polat, O., Güngör, A., Haldenbilen, S., & Ceylan, H. (2024). *From analysis to action with PESTEL insights into Izmir's sustainable urban logistics plan. In Theories and practices for sustainable urban logistics* (pp. 108–127). Hershey, PA: IGI Global.

Pollin, R., & Callaci, B. (2018). *A just transition for U.S. fossil fuel industry workers*. [Publisher not specified].

Poschen, P. (2017). *Decent work, green jobs and the sustainable economy: Solutions for climate change and sustainable developmen*t. London, England: Routledge.

Rastogi, N., & Trivedi, M. K. (2016). PESTLE technique—A tool to identify external risks in construction projects. *International Research Journal of Engineering and Technology, 3(1),* 384–388.

Raworth, K. (2012). *A safe and just space for humanity: Can we live within the doughnut?* Oxford, England: Oxfam.

Rigolon, A., & Németh, J. (2018). *"We're not in the business of housing": Environmental gentrification and the nonprofitization of green infrastructure projects*. Cities, 81, 71–80. doi:10.1016/j.cities.2018.03.016

Rosenstein, C. E. (2021). *Breaking news: Sustainable fashion is in and fast fashion is out; Constructions of sustainable consumption in fast fashion advertising*. [Publisher not specified].

Roy, J., Tscharket, P., Waisman, H., Abdul Halim, S., Antwi-Agyei, P., Dasgupta, P., ... & Suarez Rodriguez, A. G. (2018). *Sustainable development, poverty eradication and reducing inequalities. In Global warming of 1.5°C* (pp. 445–538). Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. G. (2016). Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation. *Organization & Environment, 29(3),* 264–289. doi:10.1177/1086026616633272

Schlosberg, D. (2007). *Defining environmental justice: Theories, movements, and nature*. Oxford, England: Oxford University Press.

Sdg, U. (2019). *Sustainable development goals. In The energy progress report: Tracking SDG 7* (pp. 805–814). [Publisher not specified].

Sebbag, T. S. (2024). *Sustainability strengths, weaknesses, opportunities, and threats and PESTEL analysis for special district revenue generation* (Doctoral dissertation). Walden University, Minneapolis, MN.

Shrivastava, P., & Kennelly, J. J. (2013). Sustainability and place-based enterprise. *Organization & Environment, 26(1),* 83–101. doi:10.1177/1086026612475068

Shuai, J., Zhao, Y., Wang, Y., & Cheng, J. (2022). *Renewable energy product competitiveness: Evidence from the United States, China and India. Energy*, 249, 123614. doi:10.1016/j.energy.2022.123614

Sigcha, E., Martinez-Moscoso, A., Siguenza-Guzman, L., & Jadan, D. (2020, July). *PESTEL analysis as a baseline to support decision-making in the local textile industry. In International Conference on Systems and Information Sciences* (pp. 144–156). Cham, Switzerland: Springer International Publishing.

Singh, B., Lal, S., Arora, M. K., & Kaunert, C. (2025). *Mounting legal-driven solutions for plastic pollution focusing on environment and coastal management: Eradicating marine pollution in alignment with SDG 14* (Life Below Water). In Societal and environmental ramifications of plastic pollution (pp. 223–252). Hershey, PA: IGI Global.

Singh, R. L., & Singh, P. K. (2017). *Global environmental problems. In Principles and applications of environmental biotechnology for a sustainable future* (pp. 13–41). Singapore: Springer.

Song, J., Sun, Y., & Jin, L. (2017). PESTEL analysis of the development of the waste-to-energy incineration industry in China. *Renewable and Sustainable Energy Reviews, 80*, 276–289. doi:10.1016/j.rser.2017.05.033

Sorrell, S. (2007). *The rebound effect: An assessment of the evidence for economy-wide energy savings from improved energy efficiency.* London, England: UK Energy Research Centre.

Sovacool, B. K. (2019). The precarious political economy of cobalt: Balancing prosperity, poverty, and brutality in artisanal and industrial mining in the Democratic Republic of the Congo. *The Extractive Industries and Society, 6(3),* 915–939. doi:10.1016/j.exis.2019.05.018

Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy, 142*, 435–444. doi:10.1016/j.apenergy.2015.01.002

Sukhdev, P., & Feger, C. (2012). *The economics of nature. In Business Standard India 2012* (p. 16). [Publisher not specified].

Thakur, V. (2021). Framework for PESTEL dimensions of sustainable healthcare waste management: Learnings from COVID-19 outbreak. *Journal of Cleaner Production, 287*, 125562. doi:10.1016/j.jclepro.2020.125562

Theobald, E. (2019). *PESTEL-Analyse. Die wichtigsten Einflussfaktoren der Makroumwelt. Pforzheim, Germany: Management Monitor.*

Torres Arriaga, M. G. (2019). *Análisis PESTEL*. [Publisher not specified].

Tura, N., Keränen, J., & Patala, S. (2019). The darker side of sustainability: Tensions from sustainable business practices in business networks. *Industrial Marketing Management, 77*, 221–231. doi:10.1016/j.indmarman.2018.09.002

Vaishnav, P. (2023). Implications of green technologies for environmental justice. *Annual Review of Environment and Resources, 48(1)*, 505–530. doi:10.1146/annurev-environ-112420-021057

Venkatachalam, A. M. (2018). *Identifying dynamics of growth in a competitive and transitioning lighting industry using PESTLE and SWOT analysis* (Doctoral dissertation). Delft University of Technology, Delft, Netherlands.

Verde, S. F. (2020). The impact of the EU emissions trading system on competitiveness and carbon leakage: The econometric evidence. *Journal of Economic Surveys, 34(2),* 320–343. doi:10.1111/joes.12356

Vidgren, R. (2022). *Sustainability assessments for novel materials in development*. [Publisher not specified].

Wells, P., & Nieuwenhuis, P. (2012). Transition failure: Understanding continuity in the automotive industry. *Technological Forecasting and Social Change, 79(9),* 1681–1692. doi:10.1016/j.techfore.2012.06.010

Wheeler, S. (2013). *Planning for sustainability: Creating livable, equitable and ecological communities*. London, England: Routledge.

Yusop, Z. (2018). *PESTEL analysis. In COMRAP* (pp. 34–39). [Publisher not specified].

Zalengera, C., Munro, P. G., Samarakoon, S., Hansen, U. E., Kearnes, M., Bruce, A., & Cross, J. (2023). *Towards a repair research agenda for off-grid solar e-waste in the Global South. Nature Energy, 8(2),* 123–128. doi:10.1038/s41560-022-01178-6

Zhang, K. S. (2020). *Turning trash into treasure: A comparative study of e-waste recycling in China and the US through systems thinking* (Doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA. Retrieved from https://karenszhang.com/wp-content/uploads/2020/11/Turning-Trash-Into-Treasure.pdf