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# Sustainable Capital Budgeting: Assessing Long-Term Effects Beyond Profitability

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## ABSTRACT

**Purpose:** This research seeks to create and implement a multidimensional scoring mechanism for assessing sustainability initiatives across several sectors. The research aims to transcend conventional financial measurements by incorporating economic, environmental, social, and governance (EESG) factors, thereby providing a more comprehensive framework for project evaluation.

**Method:** This study employs a literature-based conceptual framework and a composite indicator methodology to create weighted score matrices for three separate case studies: a carbon retrofit program, a regional water infrastructure enhancement, and a circular packaging business. Each case is assessed using twelve indicators and displayed on radar charts to show performance profiles and strategic trade-offs.

**Findings:** The results indicate that each project excels in different areas, highlighting the need for evaluations to consider the situation. The carbon retrofit argument is strong in terms of the environment and governance, while the water infrastructure project is balanced and has a big social impact. The circular packaging project earns high marks for environmental innovation and community engagement, despite not generating as much revenue. Radar charts are a good way to show these profiles, which helps with clear decision-making and comparing different sectors.

**Novelty/Value:** This study advances theory by transforming EESG dimensions into a versatile, reproducible framework. In practice, it provides individuals involved in sustainability planning, investing, and policymaking with a tool to aid their decision-making. The model can be applied across various industries and locations, making it a versatile tool for open evaluation that focuses on driving positive change in line with global sustainability goals.

**Keywords:** circular economy, composite indicators, ESG, inclusive development, multidimensional assessment, sustainability evaluation.

## INTRODUCTION

The urgent global sustainability challenges – such as climate change, biodiversity decline, social inequality, and resource exhaustion – have called for a reassessment of how organizations allocate capital and review long-term investments. Traditional capital budgeting tools like Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period have historically guided decision-making in both public and private sectors. These methods tend to focus on financial returns and short-term efficiency, often at the expense of broader environmental and social considerations (Brealey et al., 2020; Ruoxin & Yijie, 2022). As the limitations of exclusively profit-driven models become clearer, stakeholders are pushing for more holistic approaches that recognize the complex nature of sustainable development.

The convergence of sustainability and capital budgeting has become a vital area in financial and strategic management studies. Researchers have proposed various frameworks to incorporate environmental, social, and governance (ESG) concerns into investment evaluation, such as the Triple Bottom Line (Elkington, 1997; Crace & Gehman, 2023; Cantele et al., 2024), life-cycle costing (Gluch & Baumann, 2004; Mathath et al., 2024; Ruggeri et al., 2025), and integrated reporting (Eccles & Krzus, 2010; Rendtorff, 2023). These methods show that people are starting to focus on long-term impacts and involve stakeholders. However, its application in capital budgeting remains somewhat unorganized and does not always follow strict guidelines. Many models are either qualitative, applicable only to certain sectors, or fail to provide useful metrics that can be integrated into regular budgeting processes (Gibson & O'Donovan, 2007; Hahn & Figge, 2011; Chouaibi et al., 2022).

Even as academics and stakeholders show increasing interest in sustainable finance, there remains a significant research gap on how to incorporate sustainability into capital planning. The current literature mainly focuses on corporate social responsibility or ESG disclosure, rather than the complexities of investment appraisal itself. Additionally, limited research offers a comprehensive approach that integrates sustainability indicators into the financial analysis of capital budgeting decisions (Bebbington & Unerman, 2018; Geoffrey & James, 2021). This disconnect between sustainability theory and budgeting practice makes it more difficult for businesses to make smart, future-oriented investment choices aligned with global sustainability goals like the UN Sustainable Development Goals (SDGs).

This essay addresses that gap by introducing a new approach to sustainable capital planning that considers long-term impacts beyond simple financial gains. The framework features a composite indicator system that combines economic viability, environmental stewardship, social equality, and governance integrity. The methodology allows decision-makers to assess investment projects not just by their financial return but also by their contributions to sustainable development, translating these aspects into a score matrix. This approach bridges the gap between strategic sustainability goals and practical investment tools, making the evaluation process more integrated and transparent.

The main goal of this project is to develop and test a multidimensional capital budgeting framework that can be applied across various sectors and organizations. The framework aims to evaluate sustainable performance by creating weighted indicators and thematic categories that align well with traditional financial metrics. This approach contributes to the field by offering a reproducible, data-driven method for assessing sustainable investments. The framework is designed to be adaptable, allowing organizations to modify the weighting and criteria to suit their strategic goals and stakeholder requirements.

The paper not only makes a theoretical contribution, but it also provides real-world examples from the fields of infrastructure, education, and renewable energy. These examples illustrate how the suggested framework can be applied in practice. It also shows how to promote communication across departments, helps identify trade-offs, and uncovers hidden risks. The case studies further demonstrate how the framework can support more transparent decision-making and hold individuals accountable for budget allocation. The study highlights the importance and practicality of the model for practitioners seeking to align investment decisions with sustainability goals by grounding it in real-world applications.

Ultimately, this work contributes to the growing body of research that seeks to redefine the concept of value in financial decision-making. By integrating sustainability into capital planning, businesses are encouraged to move away from profit-focused models and adopt a more inclusive, resilient, and future-oriented approach. In doing so, it links financial strategy to broader social and environmental systems that are critical for long-term success (Schaltegger et al., 2012; Alkhodary, 2023). The framework presented here offers a practical way for businesses to implement sustainability in capital allocation, transforming investment from a simple transaction into a strategic tool for systemic change.

The structure of the article is as follows. The next section explores the development of capital budgeting and its convergence with sustainability discourse, emphasizing key theoretical and methodological advancements. This is followed by a detailed description of the proposed framework, including how composite indicators are developed and why thematic categories are used. The subsequent section presents case studies and discusses how the framework can be applied across different types of organizations. The final sections examine the implications of the findings, acknowledge their limitations, and suggest directions for future research, especially in improving the model and broadening its global application.

## LITERATURE REVIEW

Capital budgeting, rooted in financial optimization, has long been essential for making strategic investment decisions. Brealey, Myers, and Allen (2020) state that traditional models like Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period focus on profitability, liquidity, and risk-adjusted returns (Ruoxin & Yijie, 2022). These frameworks come from neoclassical economic theory, emphasizing rational choice, market efficiency, and maximizing shareholder value. However, as global sustainability issues worsened, it became evident that financial criteria alone had limitations. The emergence of environmental economics, stakeholder theory, and integrated reporting frameworks has shifted the focus toward multidimensional evaluation. Elkington (1997) and other scholars introduced the concept of the Triple Bottom Line, considering economic, environmental, and social value (Crace & Gehman, 2023; Cantele et al., 2024). This marked a significant step toward reconceptualizing how companies perform and sparked the convergence of sustainability and capital budgeting.

### Key Theoretical Developments

Several important theoretical advances have transformed capital budgeting from a simple financial task into a multidimensional strategic tool (see Figure 1). One of the earliest and most notable shifts came from Stakeholder Theory, which Freeman (1984) discussed. This theory challenged the idea that shareholders should be the only decision-makers for a company. By redefining investment choices as ways to create value for a wide range of stakeholders – such as employees, communities, regulators, and ecosystems – this concept laid the foundation for more comprehensive and ethically sound budgeting approaches.

Natural Capital Accounting incorporated ecological limits into economic value, emphasizing the significance of ecosystem services and environmental externalities in long-term planning. This was based on a broader perspective. Costanza et al. (1997) argued that traditional financial models often ignore the depletion of natural resources and the decline of ecological systems, leading to unsustainable investment outcomes. Their work helped integrate environmental indicators into capital planning, allowing companies to consider carbon emissions, biodiversity loss, and resource efficiency alongside financial gains.

Sustainable Finance has enhanced capital budgeting by including Environmental, Social, and Governance (ESG) factors in the investment assessment process. This shift aligns with global reporting standards like the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD). These organizations all advocate for transparency, accountability, and long-term value creation (Eccles & Krzus, 2010; Clark,

Feiner, & Viehs, 2015). Incorporating ESG into capital budgeting transforms it into a strategic tool for ensuring that financial success supports the health of people and the planet.

In addition to these frameworks, Systems Thinking and Resilience Theory have been adopted. These theories emphasize the importance of adaptive planning, feedback loops, and the ability to manage shocks and uncertainty. They recognize that investment decisions are part of complex, ever-changing systems that evolve over time. Walker et al. (2004) state that resilience-oriented budgeting helps organizations plan for future issues such as climate change, political instability, or technological shifts. It also assists in planning capital projects that are robust, adaptable, and less likely to become obsolete.

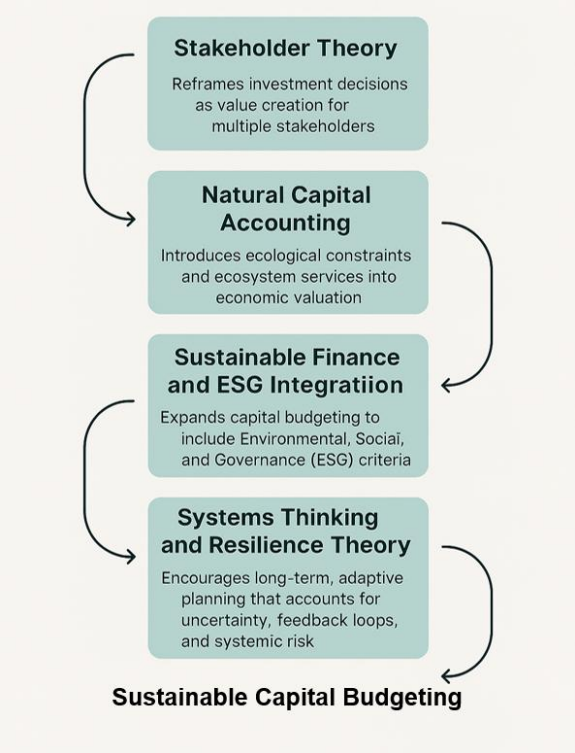



**Figure 1**. Important Theoretical Advances in Sustainable Capital Budgeting

All of these theoretical advances point to a significant change in how capital budgeting functions. Investment appraisal is no longer limited to short-term profits; it now also considers ethical, ecological, and systemic factors. This reflects a growing consensus that creating long-term value requires methods that incorporate all of these elements.

**Methodological Shifts**

The way capital budgeting is conducted has evolved significantly, shifting from a narrow financial focus to a broader, sustainability-driven approach. One of the key new concepts is the use of Multi-Criteria Decision Analysis (MCDA), which combines both qualitative and quantitative indicators across various areas such as social equality, environmental impact, and economic viability. MCDA provides a structured framework for balancing trade-offs and incorporating stakeholder preferences, making it especially useful in complex decision-making situations (Cinelli et al., 2014; Mardani et al., 2015; Abdullah et al., 2021).

Composite Scoring Matrices, which enable the assessment of sustainability factors alongside typical financial indicators, are a valuable addition to MCDA. These matrices activate multidimensional criteria by assigning each indicator a relative level of importance, making judgments clear and repeatable. Schaltegger & Burritt (2010) highlight that these tools are very helpful for making

investment decisions that align with long-term sustainability goals, especially when there are conflicting priorities in ESG areas.

Scenario Planning and Sensitivity Analysis have become essential parts of capital budgeting to address uncertainty and long-term impacts, especially in industries vulnerable to climate change. Scenario planning enables businesses to consider different potential futures and evaluate how their investment plans perform in various situations (Amer, Daim, & Jetter, 2013). Sensitivity analysis, in contrast, assesses how fluctuations in key assumptions influence financial and sustainability outcomes. This helps people become more aware of risks and adapt more effectively (Saltelli et al., 2008).

At the same time, the rise of Bibliometric Analysis and Systematic Literature Reviews (SLR) has improved the rigor of methods in sustainability-focused investment research. These approaches clarify topic groups, citation networks, and new trends, offering high-level insights on how sustainability is understood and applied in capital budgeting discussions (Tranfield, Denyer, & Smart, 2003; Donthu et al., 2021). Mapping intellectual paths helps scholars identify gaps, unify frameworks, and develop more complete evaluation tools.

All these changes in methods indicate a larger shift in how we view knowledge. Capital budgeting is no longer just a technical task focused on short-term profits; it now involves making strategic, ethical, and environmental decisions. This shift demonstrates that more people are recognizing that creating long-term value requires tools that benefit not only business but also people and the planet.

## RESEARCH METHOD

This study uses a literature-based conceptual framework, focusing on the case of sustainable capital budgeting and its evaluation beyond mere profitability or financial metrics. This research employs Multi-Criteria Decision Analysis (MCDA) as the main framework due to its ability to combine qualitative and quantitative indicators from different aspects of sustainability. MCDA supports decision-making by weighing trade-offs among indicators and promotes stakeholder participation in setting weights and priorities (Cinelli et al., 2014; Mardani et al., 2015; Abdullah et al., 2021). When it comes to capital budgeting, MCDA is an effective way to evaluate projects that account for more than just financial returns. It also considers the social and environmental impacts of the project in the long term.

This article expands on MCDA to develop a Composite Scoring Matrix composed of ESG and economic indicators, each assigned a weight based on its significance to the strategy. For each indicator, every project receives a score from 1 to 5, and these scores are then summed to produce a weighted total. This matrix offers a systematic and repeatable method for evaluation, supporting a more transparent decision-making process (Schaltegger & Burritt, 2010). The technique advances through five consecutive stages:

1. Indicator Identification and Categorization
   Drawing from a systematic literature review and global sustainability frameworks (e.g., GRI, SASB, SDGs), relevant indicators are selected and grouped into four thematic dimensions:
   - Economic Viability (e.g., ROI, NPV, payback period)
   - Environmental Stewardship (e.g., carbon intensity, resource efficiency)
   - Social Inclusion (e.g., equity, employment, stakeholder engagement)
   - Governance Integrity (e.g., transparency, compliance, risk management)

   Each indicator is chosen based on its strategic relevance, measurability, and alignment with long-term sustainability goals.

2. Normalization of Indicator Values
   To ensure comparability across diverse metrics, raw indicator values are normalized to a common scale. This study uses a 1–5 Likert scale, where:
   - 1 = minimal alignment with sustainability criteria
   - 5 = exemplary performance or alignment

Normalization may be based on benchmarks, expert judgment, or qualitative assessment, depending on data availability and indicator type.

3. Weight Assignment
   Each indicator is assigned a weight reflecting its relative importance within its thematic category. Weighting can be:
   - Equal (for simplicity and transparency)
   - Stakeholder-derived (via Delphi method or AHP)
   - Strategic (based on policy priorities or organizational goals)

   This step ensures that the scoring matrix reflects context-specific values and decision-making logic.

4. Composite Score Calculation
   Using the MCDA framework, a Composite Scoring Matrix is constructed. For each project, the score for each indicator is multiplied by its assigned weight, and the results are aggregated to produce:
   - Thematic scores (per dimension)
   - Total composite score (overall sustainability performance)

5. Visualization and Interpretation
   Radar charts and heatmaps are used to show results in a way that helps people make decisions and communicate effectively. These tools show performance profiles, point out strengths and weaknesses, and make it easier to compare projects. The visual outputs also make things clearer and encourage conversation amongst people from different departments.

This process transforms MCDA from a theoretical framework into a practical evaluation tool that allows firms to assess capital projects not only based on their profitability but also on their long-term environmental benefits. It helps individuals make informed decisions grounded in facts, applicable across various fields and locations.

## RESULTS AND DISCUSSION

### Composite Scoring Matrix for Sustainable Capital Budgeting

Using a process that combines developing a conceptual framework, selecting indicators, assigning weights, and establishing scoring logic, the scoring system was developed for four areas of sustainability: economic, environmental, social, and governance (EESG). The composite matrix is designed to help firms incorporate sustainability concepts when making capital budgeting decisions. This enables them to consider the long-term impacts of their choices, beyond just profitability or financial metrics.

The methodology begins by identifying the key assessment categories for each dimension. This approach is grounded in research on sustainable finance, ESG integration, and strategic investment appraisal (Bebbington & Unerman, 2018; Hahn & Figge, 2011; Schaltegger et al., 2012). For the economic component, metrics such as Net Present Value (NPV), Internal Rate of Return (IRR), and Return on Investment (ROI) are maintained to ensure that financial viability remains a core standard (Brealey, Myers, & Allen, 2020). Cost efficiency and financial resilience are also included to highlight the importance of adapting and effectively managing capital.

Environmental indicators include carbon emissions, resource efficiency, and ecological impact, aligning with global climate goals and life-cycle assessment principles (Gluch & Baumann, 2004). Social indicators focus on inclusivity, social value creation, and risk mitigation, emphasizing equity and community engagement (Elkington, 1997; United Nations, 2015). Governance indicators evaluate transparency, compliance, and strategic risk management, ensuring ethical and resilient project oversight (Eccles & Krzus, 2010).

Each indicator is assigned a weight based on its significance to the strategy. The economic and environmental dimensions carry larger total weights because they are crucial for both financial and ecological sustainability. A score from 1 to 5 is assigned, where 1 indicates little alignment and 5 indicates excellent performance. To calculate a weighted score, you multiply the raw score by its weight. This results in a composite value that reflects how sustainable the project is overall. The composite scoring matrix in Table 1 is displayed as a decision dashboard to promote transparent, data-driven investment assessment and encourage cross-functional dialogue among stakeholders.

**Table 1**. Composite Scoring Matrix for Sustainable Capital Budgeting – Proposed

| Dimension | Evaluation Category | Indicator | Weight (%) | Score (1–5) | Weighted Score |
|---|---|---|---|---|---|
| **Economic** | Profitability | NPV, IRR, ROI | 10% | | |
| | Cost Efficiency | Payback Period, Cost-Benefit Ratio | 10% | | |
| | Financial Resilience | Sensitivity to market risks and inflation | 10% | | |
| **Environmental** | Emissions and Carbon Footprint | Estimated $CO_2e$, use of renewable energy | 10% | | |
| | Resource Efficiency | Water, material, and waste management | 10% | | |
| | Ecological Impact | Risk to biodiversity and local ecosystems | 5% | | |
| **Social** | Inclusivity and Equity | Impact on vulnerable groups, accessibility | 10% | | |
| | Social Value Creation | Job creation, training, and community engagement | 10% | | |
| | Social Risk | Potential for conflict, displacement, and local resistance | 5% | | |
| **Governance** | Transparency and Accountability | Reporting mechanisms, stakeholder involvement | 5% | | |
| | Compliance and Ethics | Regulatory compliance, ethical business practices | 5% | | |
| | Strategic Risk Management | Identification and mitigation of long-term risks | 5% | | |
| **TOTAL** | | | **100%** | | |

*Note: How to use the composite scoring matrix in Table 1:*

- *Score (1–5): Assigned based on qualitative and quantitative evaluation of each indicator.*
- *Weighted Score: Calculated by multiplying the score by its respective weight.*
- *Interpretation: The total weighted score helps compare projects, identify trade-offs, and support sustainability-aligned investment decisions.*

The recommended composite scoring matrix in Table 1 is flexible and can be adjusted as needed. The weights can be modified to align with the company's priorities. For instance, the energy sector might assign more importance to environmental indicators. Sub-metrics or specific metrics can be added to the indicators, such as tons of $CO_2e$, the number of local jobs, or the social risk index. You can set thresholds to categorize projects into one of three groups: "Sustainable," "Moderately Sustainable," or "Unsustainable."

## Justification for the Composite Scoring Matrix

This study introduces a multidimensional framework for sustainable capital budgeting that extends beyond traditional financial evaluation by incorporating environmental, social, and governance (ESG) factors into a unified scoring system. The framework aims to assist decision-makers in evaluating the

long-term value and systemic effects of investment projects, especially where profitability alone does not fully reflect strategic importance or societal benefits.

The main idea of the framework is to create composite indicators, which are measures that combine multiple aspects of performance into a single score. These indicators are developed through a step-by-step process that involves selecting indicators, normalizing them, assigning weights, and integrating them. The selection process begins with a thorough review of existing literature (Tranfield et al., 2003; Donthu et al., 2021), complemented by benchmarking against international sustainability standards, including the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB). Indicators are chosen based on their relevance to long-term impacts, their measurability, and their alignment with strategic sustainability goals, such as the United Nations Sustainable Development Goals (SDGs).

After selection, the indicators are scaled similarly to allow comparison across different measures. This may involve normalizing from minimum to maximum, adjusting percentiles, or using Likert-style assessments to provide qualitative scores. Each indicator is then assigned a weight, either equally for simplicity or through stakeholder participation methods like the Delphi technique or Analytic Hierarchy Process (AHP) (Saaty, 1980; Okoli & Pawlowski, 2004). Using a weighted sum approach, a final composite score is calculated for each thematic dimension. This facilitates easy comparison of projects and their outcomes.

The framework is divided into four main areas: Economic Viability, Environmental Stewardship, Social Inclusion, and Governance Integrity. These categories illustrate how sustainable development and capital investments are connected, providing a comprehensive view of how to evaluate capital investments. Return on investment (ROI), net present value (NPV), and payback period are all common financial measures that fall under the category of economic viability. These metrics ensure that projects remain financially sound. Environmental stewardship measures how well an organization performs in terms of the environment, including carbon intensity, energy efficiency, and resource circularity. It emphasizes resilience and climate alignment (Schaltegger & Burritt, 2010). Social Inclusion focuses on fairness, community involvement, and building human capital. It also recognizes the importance of inclusive growth and stakeholder input (Raworth, 2017). Governance Integrity evaluates transparency, ethical behavior, and regulatory compliance, highlighting the importance of institutional trust and accountability in sustainable finance (Eccles et al., 2014).

The proposed composite score matrix combines four main areas – economic, environmental, social, and governance (EESG) – to help individuals evaluate investment projects from a sustainability perspective. Each dimension includes specific evaluation categories and indicators, which are weighted to reflect their strategic importance. This multidimensional approach recognizes the growing consensus that capital budgeting should go beyond solely financial metrics to incorporate long-term systemic effects (Bebbington & Unerman, 2018; Schaltegger, Lüdeke-Freund, & Hansen, 2012).

The economic dimension includes traditional metrics like Net Present Value (NPV), Internal Rate of Return (IRR), and Return on Investment (ROI), which remain important for assessing if a business is financially healthy. These indicators set a standard for profitability and are widely used in investment analysis (Brealey, Myers, & Allen, 2020). However, economic evaluation now also considers cost efficiency, measured by the Payback Period and Cost-Benefit Ratio, to demonstrate how quickly and fairly profits are realized. Additionally, financial resilience is viewed as a key indicator of a project's sensitivity to economic changes, inflation, and stock market shifts. This highlights the need for flexible investment strategies in uncertain situations (Gibson & O'Donovan, 2007).

The environmental dimension examines how investment projects impact the environment. Estimated $CO_2e$ and the use of renewable energy sources are employed to measure emissions and the carbon footprint. This aligns with global climate goals and ESG reporting standards (Gluch & Baumann, 2004). Resource efficiency evaluates how effectively we use water, resources, and waste management systems in an environmentally friendly way. It also recognizes that resource scarcity and circular economy concepts are becoming increasingly important in planning for infrastructure and industry (Hahn & Figge, 2011). The ecological impact considers how a project might affect biodiversity and local ecosystems, especially in rural or vulnerable areas. This indicator encourages proactive environmental risk assessment and development of mitigation strategies (Schaltegger et al., 2013).

The social dimension emphasizes the importance of ensuring that everyone is treated fairly, included, and benefits the community. To evaluate how inclusive and fair a project is, consider how it impacts vulnerable groups and whether it makes access easier – whether physically, financially, or informationally. This aligns with the SDGs' focus on "leaving no one behind" (United Nations, 2015). The project's potential to create jobs, provide training, and engage the community are all examples of social value creation, which indicate long-term societal benefits (Elkington, 1997). Social risk assesses the likelihood of conflict, displacement, or local resistance, which can hinder initiatives and erode trust. Including this signal promotes proactive communication with stakeholders and ethical planning (Eccles & Krzus, 2010).

The governance aspect involves ensuring that initiatives are conducted in a manner that is open, accountable, and forward-looking. The presence of reporting mechanisms and stakeholder involvement are two ways to measure transparency and accountability. These are important for legitimacy and confidence (Bebbington & Unerman, 2018). Compliance and ethics assess conformity to legal regulations and ethical corporate practices, emphasizing the importance of integrity in capital distribution. Strategic risk management focuses on identifying and addressing long-term risks such as changes in regulations, threats to reputation, and technological obsolescence. This indicator encourages businesses to incorporate resilience into their approach to investments (Schaltegger et al., 2012).

Each indicator receives a score from 1 to 5, with 1 indicating the least alignment with sustainability criteria and 5 representing the best. To calculate a weighted score, the scores are multiplied by their respective weights. This allows for a more detailed comparison of projects. The overall composite score provides a complete view of a project's sustainability profile, helping decision-makers assess trade-offs, prioritize actions, and ensure investments align with strategic sustainability goals. The weighting system is designed to be flexible, allowing businesses to adjust focus based on stakeholder values or sector priorities.

This scoring matrix not only integrates sustainability into capital planning but also promotes a culture of holistic thinking, where financial, environmental, social, and governance factors are considered together. By including these indicators in investment assessments, businesses can move beyond simple transactions and adopt a more transformative, forward-looking approach to capital allocation. These theme areas work collaboratively to create a balanced evaluation framework that enables organizations to select projects based on more than just financial returns. They can also assess how projects will contribute to the organization's long-term sustainability and system change. Using composite indicators clarifies the trade-offs, and grouping information by themes helps align strategy with both internal values and external demands.

## Strategic Advantage of EESG over ESG

The shift from ESG to EESG represents a significant conceptual and practical change in sustainability assessment. ESG is now a widespread standard for evaluating non-financial performance, but it often treats economic viability as a separate or implicit factor. This is usually assessed through traditional financial metrics like ROI or NPV. Conversely, the EESG framework adds Economic Viability as a fourth pillar, illustrating that long-term sustainability cannot be separated from fiscal resilience and strategic capital allocation (Schaltegger & Burritt, 2010). Table 2 shows a detailed comparison between EESG (Economic, Environmental, Social, and Governance) and the conventional ESG (Environmental, Social, and Governance) framework.

Table 2 shows that this integration offers several benefits. First, it enables decision-making that considers all factors of a situation, such as profitability, environmental impact, social equality, and governance integrity. EESG supports multi-criteria decision analysis (MCDA) by combining economic data into a single evaluation framework, thus capturing real-world complexity (Cinelli et al., 2014; Mardani et al., 2015).

Second, EESG helps businesses work together more effectively to achieve global sustainability goals. When EESG evaluates a project, it doesn't just look at whether it follows rules or risks reputation. It also considers how it can promote systemic change, such as climate adaptation, inclusive growth, and institutional resilience. This aligns with frameworks like the UN SDGs, which emphasize cooperation across sectors and making an impact on multiple levels (UNDP, 2020).

**Table 2**. Comparative Table: EESG vs ESG

| Aspect | ESG Framework | EESG Framework |
|---|---|---|
| Economic Dimension | Implicit or external to ESG; often assessed separately via financial metrics | Explicitly integrated as a core dimension alongside sustainability indicators |
| Decision-Making Scope | Focused on non-financial risks and ethical performance | Balances financial viability with sustainability and governance |
| Strategic Alignment | Often reactive to regulatory or reputational pressures | Proactive alignment with long-term value creation and SDG targets |
| Stakeholder Engagement | Emphasizes social and governance transparency | Expands to include economic equity and fiscal accountability |
| Evaluation Tools | ESG ratings, disclosure checklists, qualitative assessments | Composite scoring matrix, radar charts, heatmaps, and MCDA-based analysis |
| Policy Relevance | Supports ESG compliance and reporting | Enables integrated policy design across fiscal, social, and environmental domains |
| Resilience Modelling | Limited integration of systemic risk and adaptive capacity | Incorporates systems thinking and resilience theory explicitly |

Third, EESG enhances policy effectiveness. The framework promotes integrated policy design that connects environmental regulation, social welfare, and public finance by incorporating economic metrics such as local economic impact, innovation investment, and fiscal transparency. This is particularly beneficial in developing countries and the public sector, where resource distribution needs to be fair, efficient, and sustainable (Costanza et al., 1997; Raworth, 2017).

Finally, EESG specifically integrates systems thinking and resilience theory, allowing evaluators to model interdependencies, feedback loops, and system adaptability. This is a major flaw in many ESG models because they often depend on static indicators and miss changing risk environments (Walker & Salt, 2006). EESG helps stakeholders visualize performance through radar charts and heatmaps, assisting them in identifying weaknesses and creating stronger solutions.

## Three Case Studies: Implementing the Scoring Matrix

Case studies from the infrastructure, education, and renewable energy sectors are used to test the framework. These examples demonstrate the matrix's applicability in various situations, enabling people to identify trade-offs, hidden hazards, and strategic opportunities.

### *Case Study 1: Multinational Manufacturing Firm – Retrofitting for Carbon Reduction*

A global manufacturing company needed to decide how to update its factories to reduce carbon emissions. In the past, capital budgeting in these situations often focused on financial metrics like net present value (NPV) and internal rate of return (IRR). However, by applying the recommended composite framework, the company expanded its evaluation to include environmental indicators such as lowering carbon intensity, increasing energy efficiency, and complying with climate disclosure rules. This shift highlights that more people recognize that strong sustainability performance can make a business more competitive in the long term and help build trust with stakeholders (Eccles et al., 2014; Schaltegger & Burritt, 2010).

According to Table 3, the project performed adequately in terms of economic viability but excelled in environmental stewardship and governance integrity. Scenario planning indicated that the conversion would save significant money and enhance the company's reputation under future carbon pricing systems. This aligns with Raworth's (2017) claim that ecological limits should be considered when making economic decisions to reduce systemic risk. The radar chart illustration helped company members understand how the investment had value in many different ways. This facilitated agreement across departments and strengthened the company's plan to reduce carbon emissions.

This decision aligns with Stakeholder Theory, which states that businesses must consider the needs of all stakeholders, not just shareholders, to remain legitimate and succeed in the long term (Freeman, 1984). The company responded to growing pressure from regulators, investors, and civil

society by prioritizing carbon reduction. This strengthened its social license to operate. Natural Capital Accounting made the environmental benefits of the retrofit clearer by quantifying saved emissions and resource efficiency as tangible value streams (UNEP, 2018).

**Table 3**. Case Study 1: Multinational Manufacturing Firm – Carbon Retrofit

| Dimension | Indicator | Score (1–5) | Weight (%) | Weighted Score |
|---|---|---|---|---|
| Economic | ROI | 3 | 10 | 0.30 |
| | Payback Period | 2 | 10 | 0.20 |
| | Financial Resilience | 3 | 10 | 0.30 |
| Environmental | Carbon Intensity Reduction | 5 | 10 | 0.50 |
| | Energy Efficiency | 4 | 10 | 0.40 |
| | Resource Circularity | 3 | 5 | 0.15 |
| Social | Workforce Upskilling | 3 | 10 | 0.30 |
| | Community Impact | 2 | 10 | 0.20 |
| | Social Risk Mitigation | 3 | 5 | 0.15 |
| Governance | ESG Disclosure Quality | 5 | 5 | 0.25 |
| | Compliance and Ethics | 4 | 5 | 0.20 |
| | Strategic Risk Management | 4 | 5 | 0.20 |
| **Total Composite Score** | | | **100%** | **3.15 / 5.00** |

From a Sustainable Finance perspective, the project enabled the company to secure green financing instruments and improve its ESG ratings, which are increasingly linked to capital market performance (Friede, Busch, & Bassen, 2015). Using Systems Thinking, the company was able to simulate how environmental performance, regulatory risk, and brand equity are interconnected. Scenario modelling indicated that the retrofit would save significant money and make the company more resilient under future carbon pricing regimes. This would support the company's long-term strategic position.

### *Case Study 2: Regional Public Utility – Water Infrastructure Upgrade*

In Southeast Asia, a public utility used the framework to decide whether or not to invest in updating its old water distribution system. The utility added indicators for reducing water loss, improving public health, and complying with regulations, along with financial measures. The emphasis on social inclusion and governance integrity was especially important because the utility had a public mandate and served marginalized populations (see Table 4).

Table 4 shows strong performance in the social and governance areas, and that the system is quite resilient to future climate scenarios. The financial gains are modest but reasonable from a business perspective. Stakeholder-derived weights guided the decision-making process, prioritizing equity and resilience over short-term profit. This approach aligns with concepts of participatory evaluation and inclusive governance (Okoli & Pawlowski, 2004; Mardani et al., 2015). Scenario planning simulated future climate stressors, such as prolonged droughts, and demonstrated the project's robustness under challenging conditions. The utility ultimately approved the investment because it aligned with SDG 6 (Clean Water and Sanitation) and could enhance social license and institutional credibility.

This case demonstrates Stakeholder Theory in the public sector, where the utility's responsibility includes citizens, regulators, and environmental systems. By assigning weights to stakeholders, the utility ensured that community needs and fairness remained central to decision-making (Donaldson & Preston, 1995). Using Natural Capital Accounting helped the utility assess the value of ecosystem services, such as improved watershed health and reduced contamination risks (Costanza et al., 1997).

**Table 4.** Case Study 2: Regional Public Utility – Water Infrastructure Upgrade

| Dimension | Indicator | Score (1–5) | Weight (%) | Weighted Score |
|---|---|---|---|---|
| Economic | Cost-Benefit Ratio | 3 | 10 | 0.30 |
| | Payback Period | 2 | 10 | 0.20 |
| | Financial Resilience | 3 | 10 | 0.30 |
| Environmental | Water Loss Reduction | 4 | 10 | 0.40 |
| | Ecosystem Health | 4 | 10 | 0.40 |
| | Climate Adaptation Potential | 5 | 5 | 0.25 |
| Social | Equity in Access | 5 | 10 | 0.50 |
| | Public Health Outcomes | 4 | 10 | 0.40 |
| | Stakeholder Engagement | 5 | 5 | 0.25 |
| Governance | Regulatory Compliance | 5 | 5 | 0.25 |
| | Transparency | 4 | 5 | 0.20 |
| | Institutional Resilience | 4 | 5 | 0.20 |
| **Total Composite Score** | | | **100%** | **3.85 / 5.00** |

From the perspective of Sustainable Finance and ESG Integration, the project aligned with SDG 6 (Clean Water and Sanitation) and increased the likelihood of securing climate adaptation funds. Governance measures, such as compliance and transparency, enhanced the credibility of institutions, which is vital for public trust and long-term financing. The utility employed Resilience Theory to forecast how effectively the system might withstand shocks like droughts or infrastructure failures. They found that the updated network significantly improved the system's adaptability (Walker & Salt, 2006). This systems-based approach made the investment worthwhile, even though the financial returns were only modest.

### *Case Study 3: Social Enterprise – Circular Packaging Initiative*

A social enterprise that focuses on eco-friendly packaging used the framework to explore a financial investment in new biodegradable materials. Table 5 shows that the project's financial returns were uncertain because of high R&D expenses, but it performed well in terms of environmental stewardship and social inclusiveness. The review emphasized factors like the ability to divert waste, create local jobs, and educate consumers.

**Table 5**. Case Study 3: Social Enterprise – Circular Packaging Initiative

| Dimension | Indicator | Score (1–5) | Weight (%) | Weighted Score |
|---|---|---|---|---|
| Economic | ROI | 2 | 10 | 0.20 |
| | Market Potential | 3 | 10 | 0.30 |
| | Financial Resilience | 2 | 10 | 0.20 |
| Environmental | Waste Diversion | 5 | 10 | 0.50 |
| | Material Innovation | 4 | 10 | 0.40 |
| | Lifecycle Impact | 5 | 5 | 0.25 |
| Social | Local Employment | 5 | 10 | 0.50 |
| | Consumer Education | 4 | 10 | 0.40 |
| | Inclusion and Equity | 4 | 5 | 0.20 |
| Governance | Mission Alignment | 5 | 5 | 0.25 |
| | Impact Reporting | 4 | 5 | 0.20 |
| | Strategic Risk Management | 3 | 5 | 0.15 |
| **Total Composite Score** | | | **100%** | **3.85 / 5.00** |

Table 5 shows that the initiative performs very well in social and environmental areas, even though its financial performance is lacking. This makes it highly attractive to impact investors and aligns with the principles of a circular economy. Sensitivity analysis indicated that the company's decision to move forward was a prudent one because it revealed significant potential upside if policies and market trends shift favorably. This supports the claim made by Donthu et al. (2021) that strategic foresight and bibliometric mapping can help identify new opportunities in sustainability-focused innovation. The radar chart was very useful in demonstrating to impact investors how the project will influence many different areas. They appreciated that it aligns with SDG 12 (Responsible Consumption and Production) and has the potential to drive systemic change. The case illustrates how mission-driven companies can use composite evaluation to balance short-term financial needs with long-term societal benefits.

The business's approach exemplifies Stakeholder Theory by involving communities, employees, and customers in co-creating value. Natural Capital Accounting, which recognizes the inherent worth of ecosystems and the economic benefits of reducing waste and pollution, aligns with the project's focus on circularity and ecological regeneration (TEEB, 2010). The business demonstrated that environmental benefits can be converted into financial gains and reinvested by measuring the costs of avoiding landfills and extending the lifespan of materials.

From a Sustainable Finance perspective, the project enhanced the company's ESG profile, attracting impact investors who prioritize long-term social value over short-term profits (Gibson, Krueger, & Schmidt, 2020). The radar chart visualization effectively conveyed this multidimensional impact by connecting technical details with a compelling narrative. Using Systems Thinking, the business created a map of feedback loops involving customer behavior, legislative incentives, and supply chain innovation. Sensitivity analysis indicated that the project could expand rapidly in environments where regulatory conditions were favorable, increasing its resilience and ability to drive change.

### *Cross-Case Reflections*

These case studies demonstrate that the proposed framework can be applied across various types of organizations and industries. By integrating composite indicators and thematic aspects, each company was able to uncover hidden value, anticipate future scenarios, and make capital decisions aligned with their overall sustainability objectives. The framework facilitates a shift from short-term financial focus to long-term systemic thinking, as advocated by authors like Raworth (2017) and Schaltegger & Burritt (2010). It also promotes open, participatory decision-making that adheres to modern ESG standards. Figure 2 presents the radar charts for the three case studies.

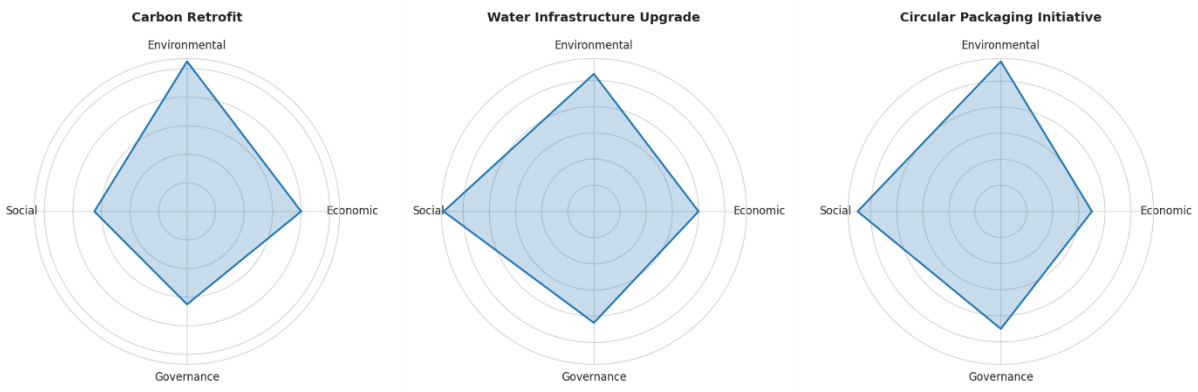



**Figure 2**. Radar Charts for Three Cases

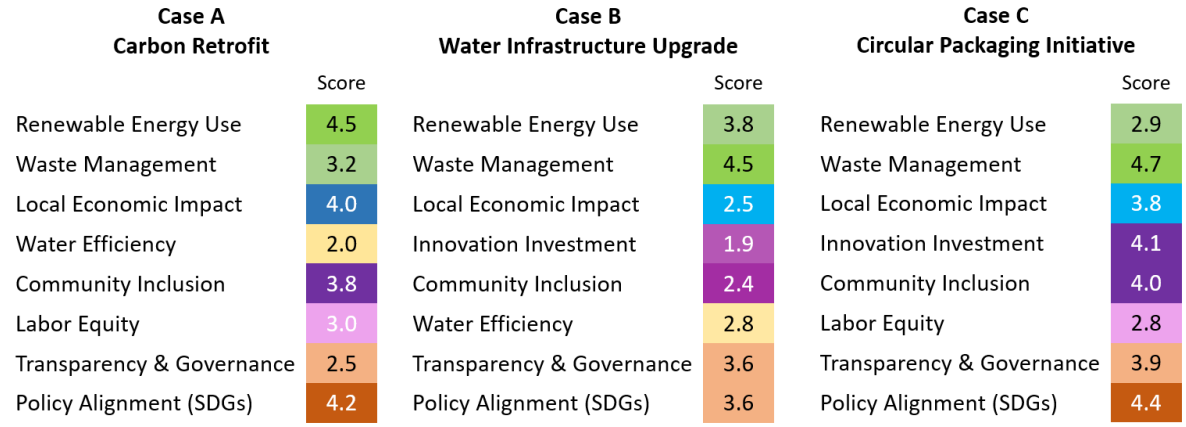
Figure 2 shows the varying strengths and weaknesses of sustainability-focused projects across the three case studies. Each effort, while unique in its scope and setting, demonstrates how multidimensional evaluation can offer valuable strategic insights beyond traditional financial measures. The grading

matrices provide a clear and transparent way to assess economic viability, environmental impact, social equity, and governance quality.

For example, the Carbon Retrofit project performs well in terms of environmental and economic features, demonstrating that it aligns with decarbonization goals and adheres to regulations. However, its scores on governance and social dimensions are relatively low, indicating that the initiative may require more stakeholder engagement or financial incentives to have a greater impact. The radar chart clearly illustrates this profile, with the environmental and economic aspects standing out while the others remain low.

The Water Infrastructure Upgrade, on the other hand, is a strong social and environmental project. Its high scores in equity of access, public health outcomes, and climate adaptation potential demonstrate its importance to public sector goals and long-term resilience. Although the project's economic returns are only average, its overall score provides a compelling argument for strategic investment, especially in areas that are likely to face water shortages or infrastructure issues. The radar chart above illustrates that the footprint is well-balanced, with social and environmental components forming a broad, open arc.

The Circular Packaging Initiative, run by a social enterprise, demonstrates a new kind of strength. Although its economic metrics aren't strong (which is common for new or mission-driven businesses), it excels in environmental friendliness and community involvement. It receives high marks for waste diversion, material innovation, and local job creation, indicating that it aligns with the principles of the circular economy and has a positive community impact. The radar graphic illustrates this well. The environmental and social aspects form the main shape, while the economic and governance dimensions are less prominent.




*Notes: The heatmaps' layout spots strengths, gaps, and thematic patterns across cases. Green zones highlight top performers (e.g., Renewable Energy in Case A, Waste Management in Case C). Yellow and orange zones signal areas for improvement or moderate performance. Purple and blue add dimension for social and economic indicators.*

**Figure 3**. Heatmaps for Three Case Studies

Figure 3 presents a comparative heat map analysis of Case Studies A, B, and C, revealing that each entity approaches sustainability differently across environment, economy, society, and governance (EESG). The visual framework allows for quick comparisons by transforming radar chart data into a color-coded matrix. It also highlights areas of both convergence and divergence in performance.

There are many variations in environmental indicators. Case Study A demonstrates a strong commitment to using renewable energy (score: 4.5), while Case Study C highlights a high level of waste management (score: 4.7). This indicates that environmental strategies should be tailored to each area's needs. Although Case Study B is consistent, it shows that most environmental measures are only moderately effective, presenting opportunities for strategic improvement.

Case Study A has the highest local economic effect score (4.0) in the Economic Dimension. This shows it is well-integrated into the community and makes a significant financial contribution. Case

Study C indicates promising investment in innovation (score: 4.1), suggesting that capital is being allocated with an eye toward the future. Case Study B, on the other hand, receives lower ratings on economic indicators. This could be because it is still in the early stages of development or because it lacks the resources to advance.

The main difference lies in the social indicators. The fact that Case Study C received a high score (4.0) for community inclusion demonstrates the importance of participatory frameworks and fairness. In contrast, Case Study B, which scored lower (2.4) in the same area, indicates potential gaps in stakeholder involvement and how policies are designed to be fair. Meanwhile, Case Study A maintains a consistent level of performance, suggesting a more integrated social strategy.

The Governance Dimension indicates that all three examples scored around 3.5, demonstrating their strong focus on aligning policies with the SDGs. Case Study A has the lowest score (2.5), which could suggest that the organization is either unclear or fragmented. In contrast, Case Study C has the highest score (3.9), showing that its governance processes are more developed.

The heat map comparison shows that while each example has strengths in some areas, none of them performs well across all EESG parameters. This underscores the importance of using multidimensional evaluation frameworks that consider the nuances and priorities specific to each setting. The heat map's clear visuals also help stakeholders communicate more effectively, enabling policymakers, researchers, and practitioners to identify gaps that need action and replicate successful techniques from the past.

These visual and quantitative tools demonstrate the importance of evaluating things in context. No single initiative excels in all areas, but each has its own value depending on strategic goals such as climate change, public health, or inclusive innovation. The scoring matrix and radar chart not only simplify decision-making but also encourage thinking at the portfolio level, where the strengths of different initiatives can be combined to achieve larger sustainability objectives.

These case studies demonstrate how the proposed framework assists businesses in applying sustainability ideas across various settings and sizes. Each company was able to uncover hidden value, anticipate future risks, and make capital decisions aligned with broader social and environmental goals by combining Stakeholder Theory, Natural Capital Accounting, Sustainable Finance, and Systems Thinking. The framework supports transitioning from a linear, profit-focused approach to a circular, resilient, and inclusive investment strategy—one that captures the complexity and interconnectedness of modern challenges.

Future research could explore long-term changes in these variables, assess the impacts of policy measures, or expand the framework to include additional factors like cultural resilience or digital inclusion. This approach fosters transparency, comparability, and strategic foresight by grounding sustainability assessment in both data and design.

## CONCLUSION

The multimodal scoring methodology and radar map representations provide a solid basis for assessing sustainability projects across various fields. The model goes beyond traditional cost-benefit analysis by including economic, environmental, social, and governance factors. This enables it to illustrate the complex trade-offs involved in decision-making in the real world. The three case studies demonstrate that different projects can succeed in areas such as reducing carbon emissions, improving public health, or promoting circular innovation, while still contributing significantly to broader sustainability goals.

These results highlight the importance of having a clear, adaptable evaluation method that can assist with strategy planning, stakeholder engagement, and policy alignment. The radar charts, in particular, are simple visual tools that help both technical and non-technical audiences understand a project's strengths and weaknesses. This approach provides journal editors, grant reviewers, and institutional decision-makers with a way to measure impact, prioritize spending, and promote collaboration across sectors.

The composite matrix provides a systematic and insightful framework; however, it is important to acknowledge its limitations. First, the scoring process relies on subjective judgments and expert guesses, which can vary between evaluators or cultures. Second, although the weighting of dimensions

is based on strategic reasoning, it may not accurately reflect the priorities of all stakeholders or regional policy frameworks. Third, the case studies are limited in number and scope; they do not cover all types of sustainability challenges faced worldwide. Additionally, while the radar chart and heatmap visualizations are useful for comparison, they might oversimplify complex interdependencies among dimensions. For instance, improved socioeconomic justice may enhance governance resilience, a nuance that static scores may not fully capture.

This study significantly advances the ongoing discussion on sustainability assessment by offering a multidimensional framework that combines theoretical rigor with practical usefulness. It simplifies the use of composite indicators in sustainability evaluations by converting abstract elements like economic, environmental, social, and governance factors into measurable, weighted components. This approach builds on and enhances existing models such as the Triple Bottom Line and ESG frameworks. It provides a more detailed and adaptable structure that can accommodate different project types and stakeholder priorities. Additionally, radar chart visualizations expand the analytical toolkit by enabling comparisons of profiles and revealing patterns across cases.

The grading matrix, along with the visualization, offers a consistent and transparent way to evaluate real-world projects from a practical perspective. Its modular design allows people in academia, business, or civil society to tailor the framework to their needs across different settings, fields, or regions. The case studies demonstrate that it can be applied in many different ways, as it can compare projects with various goals and constraints. Additionally, the visual outputs help stakeholders communicate, plan strategically, and make investment decisions. This makes the application especially valuable for teams from diverse fields and cross-sector collaborations.

The framework offers a decision-support tool aligned with global sustainability aims, such as the UN Sustainable Development Goals (SDGs), climate adaptation strategies, and policies for inclusive growth. It assists policymakers in selecting optimal interventions by illustrating the trade-offs and synergies across various aspects. The model's transparency and adaptability also promote participatory governance by allowing stakeholders to set weights, indicators, and thresholds. This creates opportunities for more democratic and context-sensitive policy development, especially where sustainability issues intersect with fairness, resilience, and institutional capacity.

## Directions for Future Research

Future research should focus on improving the scoring methodology by using participatory approaches, which include stakeholder feedback to adjust indicators and weights in a more comprehensive way. Incorporating dynamic feedback loops, scenario simulations, or time-based performance tracking into the model could enhance its ability to predict and adapt. There is significant potential to integrate the framework into digital platforms or dashboards, enabling real-time evaluation and cross-project benchmarking. Additionally, applying the model in different parts of the world – especially in the Global South, Indigenous communities, or regions emerging from conflict – would demonstrate its flexibility and applicability across diverse cultures. Comparative studies across various regions could help us understand how local values, government systems, and resource limitations influence project outcomes. Such insights would support the development of more consistent international policies. This paradigm paves the way for a more comprehensive, equitable, and practical approach to evaluating sustainability. It merges academic rigor with real-world relevance and promotes continuous improvement.

## Authors' Contribution

Each author equally contributes to the research and writing the Article. The first author conceived the idea for this research.

## Conflict of Interest

The authors declare no competing interests.

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