Vilnius University Press

Content lists are available at VilniusUniversity Press

Transformations In Business & Economics
2026, Vol. 25 No 2 (68), pp.261-303.

ISSN 1648–4460 | eISSN 2538-872X
https://doi.org/10.15388/Tibe.2026.25.2.4

Measuring the economic impact of environmental sustainability practices: a systematic literature review

Rimantė Balsiūnaitė
E-mail: rimante.balsiunaite@lei.lt
ORCID: https://orcid.org/0009-0001-5279-5373
Affiliation: Lithuanian Energy Institute, Lithuania
ROR: https://ror.org/0350e0c50

Vidas Lekavičius
E-mail: vidas.lekavicius@lei.lt
ORCID: https://orcid.org/0000-0002-8193-3114
Affiliation: Lithuanian Energy Institute, Lithuania
ROR: https://ror.org/0350e0c50

Irma Petrusevičienė
E-mail: irma.petruseviciene@lei.lt
ORCID: https://orcid.org/0009-0001-5892-4148
Affiliation: Lithuanian Energy Institute, Lithuania
ROR: https://ror.org/0350e0c50

Annotation. This study examines methodological approaches used to evaluate the economic impacts of environmental sustainability practices. The research is based on a systematic literature review conducted using the SALSA framework and the PRISMA statement to ensure transparency and reproducibility. After implementing the PRISMA statement for the articles found, 62 articles were identified. In addition, the snowball method was employed, and 13 more articles were discovered. The analysis shows that the most frequently discussed practices in the reviewed literature relate to renewable energy consumption (50 percent of studies analyzed), waste management (6.6 percent), environmental taxation (6.6 percent), and the circular economy (6.6 percent). However, some practices emphasized in the global sustainability agenda, such as energy efficiency and green finance, receive comparatively limited attention in the literature. In addition, there is a noticeable lack of studies comparing these practices. The most applied methods include econometric analyses (64.6 percent of studies analyzed), which typically examine relationships among variables; economy-wide assessments such as computable general equilibrium (CGE) models (9.8 percent); and product-specific evaluations, including life cycle costing (LCC) (8.5 percent), and life cycle assessment (LCA) (8.5 percent). Econometric methods are particularly valued for their ability to establish statistical relationships and test causality, while LCC and LCA provide comprehensive insights into environmental and economic performance across the life cycle of a product or process. CGE models, in turn, offer an economy-wide perspective by capturing intersectoral linkages and feedback effects. This article also discusses the definition of environmental sustainability practices and identifies several methodological gaps, including the limited use of holistic econometric assessments, the need for integrated methodological approaches that combine multiple methods, and the insufficient evaluation and comparison of sustainability practices addressing global environmental challenges.

Keywords: economic impact, environmental practices, effects, sustainability, methods.

JEL classification: A10.

Submitted on March 2026. Accepted on April 2026.

Introduction

As the global community intensifies efforts to address environmental challenges, the use of environmental sustainability practices is growing in popularity. The intersection between sustainability practices and economic performance has emerged as a critical area of research and policy interest. Governments, industries, and international organizations are increasingly seeking to implement environmental measures – ranging from the adoption of renewable energy and improvements in resource efficiency to waste reduction and circular economy strategies – that are not only ecologically sound but also economically advantageous. However, evaluating the economic implications of these diverse sustainability practices remains complex.

In the literature, environmental sustainability practices are often defined as practices that help to solve environmental challenges. However, environmental challenges are understood differently in various countries with different political and cultural backgrounds (Tennakoon *et al*., 2024). Moreover, understanding of environmental sustainability practices is challenging due to the nature of sustainability itself, which includes the aspects of environmental, economic, and social dimensions. However, the popularity of these practices, and the definition, became more obvious when countries and worldwide organizations decided to pay more attention to solving global environmental challenges. This is how the base of environmental sustainability practices was set. While the concept of sustainability began to take shape in the 1970s and 1980s, it was formally articulated through the 27 principles of the Rio Declaration on Environment and Development in 1992 (Cowan *et al*., 2010). This milestone is widely recognized as a foundational moment in formalizing global frameworks for environmental sustainability and was a starting point of the international environmental sustainability agenda. Subsequently, environmental sustainability became increasingly embedded within the business domain and was referred to as “the business issue of the 21st century” (McEwen, 2013). Between 2010 and 2023, coordinated global action – driven by governments, organizations, and informed by research-based evidence – led to broader adoption of sustainability practices across multiple sectors. Key outcomes include the expansion of renewable energy, strengthened policy frameworks, increased public awareness and advocacy, corporate sustainability initiatives, technological innovation, advancement of circular economy models, enhanced natural resource conservation, and improved climate resilience. These developments reflect widespread engagement across governments, industries, and communities.

Furthermore, in this study, environmental sustainability practices are considered as those that respond to the United Nations Sustainable Development Goals 7, 11, 12, 13, 14, and 15, and their indicators (United Nations, 2025). The Global indicator framework for Sustainable Development Goals is used further as a selection criteria for the environmental practices observed in the literature, as they also include the improvement status in 2025 which shows the pressing areas of sustainability that need to be addressed and solved by adapting environmental sustainability practices. The most pressing areas include energy efficiency, sustainable use of natural resources, food waste and losses, managing chemicals and waste, reducing waste in generation, and fossil fuel subsidies (United Nations, 2025).

Addressing these areas is important not only from an environmental perspective but also from an economic standpoint. In addition to the environmental benefits of environmental sustainability practices, it is also known that sustainable environmental practices could have significant economic impacts across various sectors. Studies show that adopting these practices in industries like manufacturing, agriculture, and transportation can lead to cost savings, increased efficiency, and new market opportunities (Kunal *et al*., 2025; Ukpoju *et al*., 2024). For instance, implementing sustainable supply chain practices can result in substantial waste reduction and cost savings (Liu *et al*., 2024). Similarly, studies in India and Ecuador demonstrate long-term economic advantages of sustainable practices, including job creation and enhanced productivity (Kunal *et al*., 2025). However, the scope of the economic impact of these practices depends to a large extent on how the economic impact was measured.

The economic impact is often defined as a quantitative measurement of events that change variables of the economy from the previous state. In this study, the economic impact is measured in gross domestic product, socioeconomic changes, and other neoclassical economic variables that are measured with econometric methods. However, it is important to mention that the economic impact can be measured using other econometric methods included but not limited to cost-benefit analysis, economic surplus approach, and LCA (Ardito *et al*., 2024; Bantilan *et al*., 2005). The gap observed in the literature is related to the choice of methods to evaluate the economic impact of sustainability practices which are often limited to the current knowledge of researchers. Although significant progress has been made in developing these methods, there is a lack of research on understanding what kinds of methods could be used to assess the economic impact of environmental sustainability practices specifically, and how they can be improved, as the accurate economic evaluation of environmental impacts is crucial for designing effective public policies and guiding environmental regulation (Barbosa *et al*., 2024; Cropper, 2000).

In addition, this review highlights a few more research gaps. First, existing studies exhibit a strong thematic imbalance, with a predominant focus on renewable energy consumption, while other critical sustainability practices, such as energy efficiency, waste reduction, and ecosystem-related interventions, remain comparatively underexplored, despite their limited or negative progress under key SDG indicators. This suggests that current research priorities are not fully aligned with the most pressing environmental challenges. Second, the methodological landscape is highly fragmented and largely dominated by econometric approaches, which although valuable for causal inference, often fail to capture indirect, economy-wide, and long-term structural effects of sustainability practices. Finally, literature lacks robust frameworks for systematically comparing different environmental sustainability practices, which is essential for policy prioritization under resource constraints. Taken together, these gaps indicate the need for more integrated, comparative, and multi-dimensional methodological approaches that better reflect the complexity of evaluating the economic impacts of environmental sustainability practices and supporting more effective evidence-based policymaking.

Moreover, this study contributes to the field of environmental sustainability and economic impact assessment in several important ways. From a theoretical perspective, it advances the conceptual understanding of environmental sustainability practices by linking them directly to the United Nations Sustainable Development Goals (SDGs 7, 11, 12, 13, 14, and 15) and by emphasizing the multidimensional relationship between environmental sustainability and economic performance. Moreover, the study makes a methodological contribution by systematically identifying, comparing, and synthesizing the methods used to evaluate the economic impacts of environmental sustainability practices. Through the application of the SALSA framework and PRISMA guidelines, the research provides a transparent and replicable review structure while critically evaluating the strengths and limitations of existing economic impact assesment approaches. Finally, the study contributes to practice and policy by offering evidence-based insights that can support policymakers, researchers, and practitioners in selecting more appropriate methods for evaluating the economic impact of sustainability interventions and prioritizing environmental practices under resource constraints.

The research questions asked in this study are: (1) What are the most common methods to assess the economic impact of environmental sustainability practices?; (2) What environmental sustainability practices are analyzed?; and (3) How can the strengths and limitations of existing evaluation methods be addressed to improve the assessment of the economic impacts of environmental sustainability practices?

By employing the SALSA (Search, Appraisal, Synthesis, and Analysis) framework alongside PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, the review ensures methodological transparency and replicability. Drawing from 75 peer-reviewed sources, we identify and categorize the methods used to evaluate economic outcomes and sustainability practices examined across different contexts.

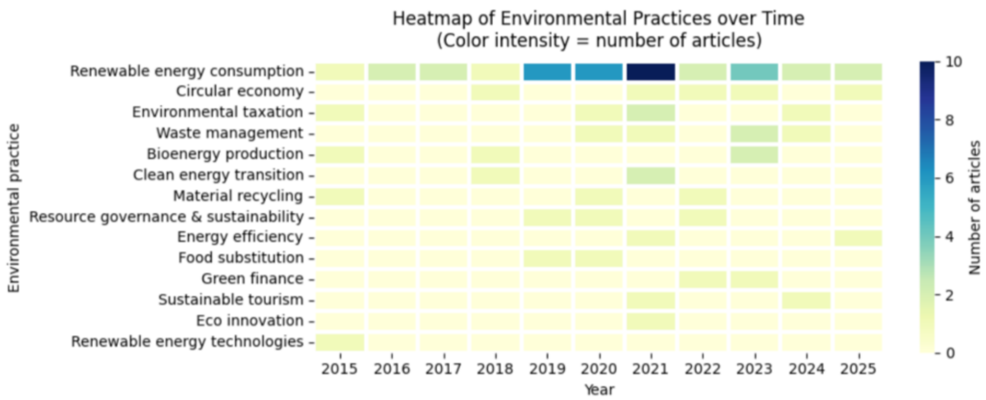
The goal of this review is to provide a structured synthesis of existing research to better understand which methods are most used, what types of environmental practices are evaluated, and how the economic impact evaluation could be improved. In doing so, it contributes to the ongoing discourse on how to best design, implement, and evaluate sustainability strategies that align environmental sustainability goals with economic development. This article is divided into five main sections. The following sections present the systematic literature review, methods, discussion on results and future research opportunities, and conclusions.

1. Systematic Literature Review

This study reviews research that examines the economic impacts of environmental sustainability practices, encompassing a different analytical approach that differs in scope, methodological complexity, and research objectives.

1.1 Geographical and Thematic Focus of Reviewed Studies

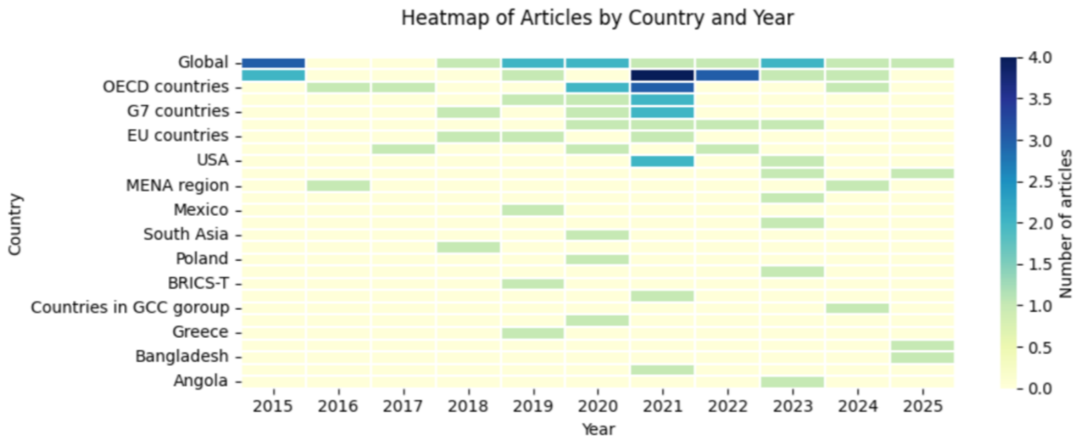
One of the most important topics of this research is the choice of environmental sustainability practices. *Figure 1* illustrates that renewable energy consumption is the most extensively examined theme in the reviewed studies. This might be related to the increasing popularity of environmental sustainability policies, such as mentioned in the European Green Deal. Based on *Figure 1*, the popularity of renewable energy consumption research increased notably after 2019, reached a peak in 2021, and subsequently declined after 2023. The heatmap below shows that the most popular environmental practice was Renewable energy consumption, and it was discussed in 2021 the most.



Source: created by the authors.

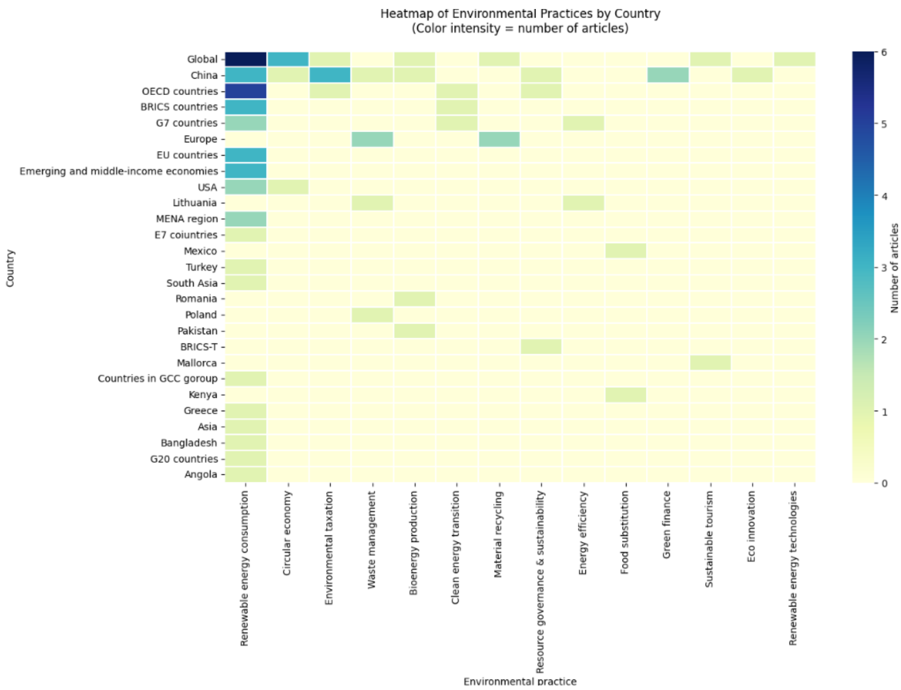
Figure 1. **Heatmap of the Popularity of Environmental Sustainability Practices over the Years**

In addition to the prevalence of thematic topics, it is also important to consider the countries and regions examined in the reviewed literature. From 2015 onward, a substantial share of studies focused on the economic impacts of environmental sustainability practices at the global level and within China (*Figure 2*). These geographical foci remained prominent globally and across OECD countries during the period 2019–2020. The year 2021 marked a peak in scholarly attention, with China, the OECD, the G7 countries, BRICS economies, and the United States emerging as the most frequently analyzed contexts. Although interest in China persisted through 2022, a gradual decline is observed from 2024 onward, while analyses addressing the global economic impacts of sustainability practices continued to attract significant attention.



Source: created by the authors.

Figure 2. **Heatmap of Research articles by Country and Year**



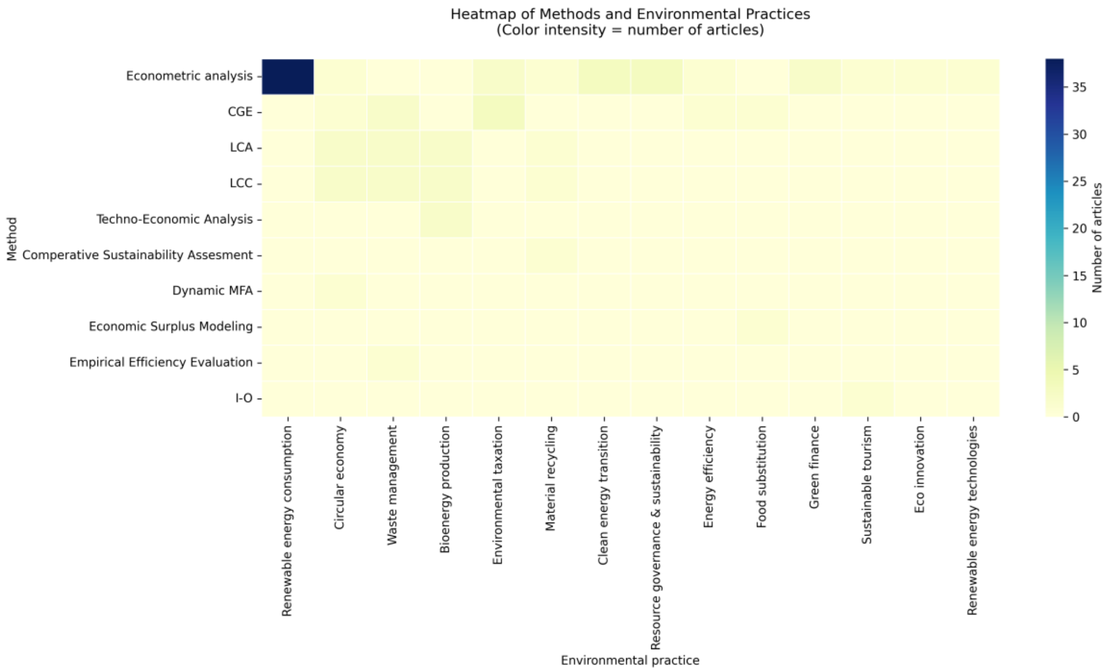
Source: created by the authors.

Figure 3. **Heatmap of Environmental Sustainability Practices by Country**

Moreover *Figure 3* illustrates that the most frequently examined environmental practice – renewable energy consumption – has predominantly been analyzed at the global level and within OECD countries, followed by China, BRICS economies, the European Union, and emerging middle-income countries. Studies addressing this practice also extend to the United States and the Middle East and North Africa (MENA) region.

Other prominent environmental practices, including the circular economy and environmental taxation, are primarily investigated in global contexts and within China.

Moreover, *Figure 4* shows that the most popular environmental sustainability practice – renewable energy consumption – is analyzed using econometric methods.



Source: created by the authors.

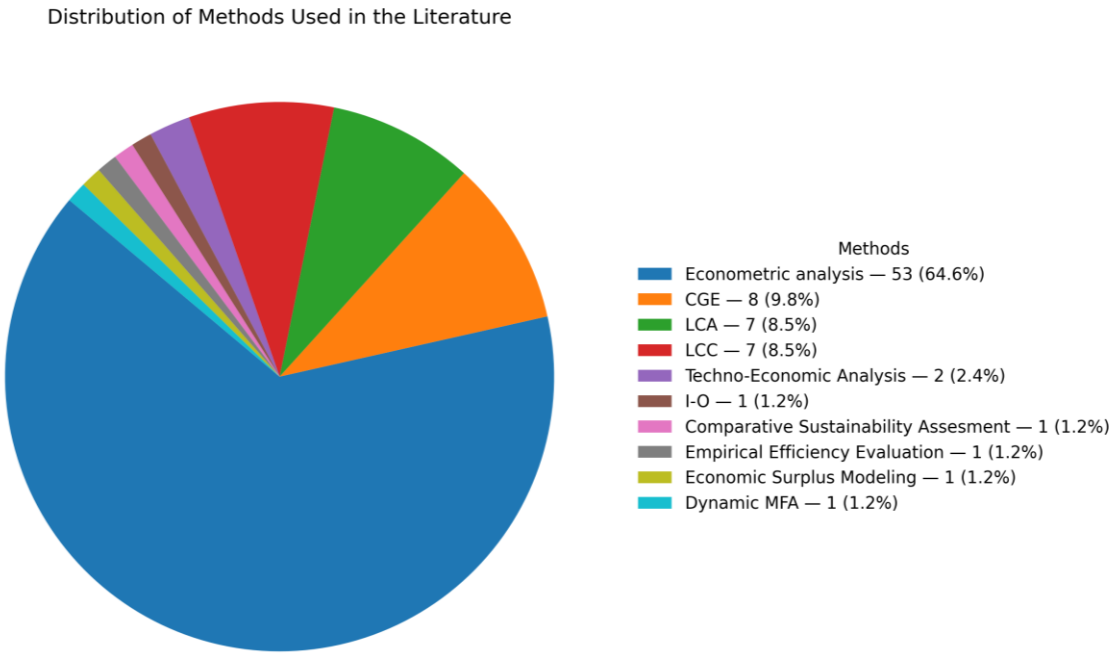
Figure 4. **The Heatmap of Methods and Environmental Practices**

This pattern suggests that the evaluation of renewable energy consumption impact on the economy relies heavily on quantitative techniques, which enable the examination of long-term economic relationships and policy effects but limit research in evaluating feedback effects and wider economic impact.

1.2 Methodological Patterns in Assessing the Economic Impact

The following section provides a detailed overview of the analytical methods employed and the studies in which they are applied. The methodological distribution indicates that each analytical approach is selected to address specific research objectives related to evaluating the economic impacts of environmental sustainability practices. The subsequent sections examine the research directions explored in the literature and discuss the rationale underlying the selection of methodological approaches to address these questions.

The economic effects' evaluation methods used in the literature analyzed include, but are not limited to: advanced econometric techniques (such as autoregressive distributed lag (ARDL) modeling, frequency domain causality (FDC) analysis, panel data regressions, and input–output modeling), economy-product simulations (using life-cycle assessment (LCA)), techno-economic analysis (TEA), and Computable General Equilibrium (CGE) modeling. Based on *Figure 5*, the most used method for evaluating the economic impact of environmental practices is econometric analysis (64.6% of studies analyzed), followed by Computable General Equilibrium Modelling (9.8%) and LCA/LCC (8.5%). The least frequently applied methods include Comparative Sustainability Assessment, Empirical Efficiency Evaluation, Economic Surplus Modelling, and Dynamic Material Flow Analysis, each representing 1.2% of the reviewed studies.



Source: created by the authors.

Figure 5. **Methods Used in the Literature to Assess the Impact of Environmental Practices on the Economy**

A wide range of econometric techniques – such as ARDL models, cointegration tests, quantile regression, method of moments quantile regression (MMQR), and difference-in-differences (DID) – are employed to capture short- and long-term dynamics, causal relationships, and heterogeneity across countries and regions. Econometric analysis is a category that defines methods that use statistics to quantify the economic relationship. These methods are particularly effective in identifying how variables like renewable energy use, green finance, R&D expenditures, and socio-economic factors influence environmental and economic indicators. However, while econometric approaches provide detailed insights into variable interactions and causal mechanisms, they are generally limited in assessing the broader, system-wide economic impacts, which often require more comprehensive modeling frameworks.

Econometric analysis is often used to determine a specific impact on the economy. For example, Abbasi *et al*. (2022) evaluate the impact of economic and technological factors on environmental outcomes in Pakistan, using Autoregressive Distributed Lag simulations and FDC analysis. The ARDL approach captures both short- and long-run relationships between variables such as economic globalization, financial development, energy use, economic development, technological innovation, and consumption- and territory-based emissions, accommodating variables with different levels of stationarity. Complementing this, authors of research implement FDC analysis that identifies the direction and strength of causal relationships across different time horizons, revealing how these factors influence emissions over short, medium, and long-term cycles. In addition, econometric analysis helps to determine the relationship between specific variables. For example, Ahmad *et al*. (2021) analyze the economic impact of energy-industry investments in China using dynamic panel data modeling across 27 provinces and municipalities from 1997 to 2017. In this study, the economic performance model was developed, treating energy-industry investment as a production input alongside variables such as human capital, physical capital, inflation, trade, and foreign direct investment. The analysis employed the Dumitrescu-Hurlin panel causality test to assess bilateral causality between energy-industry investment and economic performance, confirming a mutual influence that varies by regional development level.

A similar analysis was carried out by Dasanayaka *et al*. (2021). This study analyses the economic impact of renewable energy consumption using path analysis, a statistical technique that models direct and indirect relationships between multiple variables. At the beginning, the conceptual model was developed to examine how renewable energy establishments influence key economic indicators such as household consumption, government spending, capital formation, trade balance, and energy imports, ultimately affecting GDP. The analysis was conducted using SPSS Amos software, which specializes in structural equation modeling. To evaluate the model's validity and fit, the researchers applied the Chi-square (χ^2) test and maximum likelihood estimation. A similar approach is used by other authors who focus on analyzing the relationship among variables (Razzaq *et al*., 2021; Mahmood Ahmad *et al*., 2021; Yin and Xu, 2022). In all these studies, econometric analyses helped to understand the relationship between variables, however, the wider impact on the economy was not directly analyzed.

Similar relationships were explored by Wei *et al*. (2022). Their study investigated the relationship between green finance, foreign direct investment (FDI), renewable energy consumption, and economic growth across 30 Chinese provinces from 2000 to 2019 using a range of panel data econometric methods. To determine the stationarity properties of the data, both first-generation and second-generation unit root tests were applied. Gao *et al*. (2024) analyzed the drivers of domestic material consumption and material footprint in 129 countries from 1995 to 2019 using several advanced econometric techniques to assess the environmental impact of tourism, globalization, economic growth, ICT, renewable energy, and forest area. These techniques included the Driscoll–Kraay regression, which provides robust standard errors in the presence of cross-sectional dependence, heteroskedasticity, and autocorrelation in panel data. Additionally, this research included external hypotheses to understand the wider impact on the economy. The Environmental Kuznets Curve hypothesis was tested to explore the non-linear relationship between tourism and material consumption across income groups, identifying turning points for high, upper-middle-, and lower-middle-income countries.

To explore the relationship between determinants, Elsherif (2024) investigated the impact of blue economic activities, renewable energy consumption, and other socio-economic factors on the ecological footprint in the MENA region from 2000 to 2022, also using a range of econometric analyses. Grounded in the STIRPAT (Stochastic Impacts by Regression on Population, Affluence, and Technology) model, the methodology they used includes cointegration tests to examine long-run equilibrium relationships, quantile regression via method of moments to capture heterogeneous effects across the distribution of the ecological footprint, threshold regression to identify non-linearities, and the panel

Granger causality test to determine the direction of causality between variables. Furthermore, Hazmi *et al*. (2024) examined the relationship between clean energy, environmental pollution, and economic growth in the Gulf Cooperation Council (GCC) countries from 1980 to 2019 using the ARDL model, which allows for the analysis of both short- and long-term dynamics among variables. The ARDL approach is particularly useful for handling variables with mixed orders of integration. The study also employed causality tests – likely Granger-type – to explore the direction of influence among energy consumption, energy production, urbanization, economic growth, and environmental pollution. Aydin (2019) examined the relationship between economic growth and biomass energy consumption in BRICS countries (Brazil, Russia, India, China, and South Africa) from 1992 to 2013 using the Cross-sectionally Augmented Im, Pesaran, and Shin (CIPS) panel unit root test to assess the stationarity of the data, the Westerlund and Edgerton bootstrap LM panel cointegration test to determine the existence of long-run relationships, and a bootstrap panel causality test to identify the direction of causality between biomass energy use and economic growth.

Alongside the direct relationships between determinants, econometric analyses can also be used for assessing the data heterogeneity and long-run relationships. For example, Ameer *et al*. (2024) analyze the economic impact of renewable energy consumption in the emerging seven economies from 1990 to 2020. To account for long-run relationships and data heterogeneity, the researchers first confirmed the presence of long-run co-integration, slope heterogeneity, and cross-sectional dependency. Given the non-normal distribution of the data, the study applied the method of moments quantile regression (MMQR), which allows for capturing heterogeneous effects across different points of the conditional distribution of renewable energy consumption. Bootstrap quantile regression was used to validate the robustness of the results. Additionally, the panel Granger causality test was employed to explore the directional relationships between renewable energy consumption and its determinants – renewable electricity output, environmental taxes, economic growth, carbon emissions, and environmental innovation – revealing significant bidirectional causality among these variables. Moreover, Wang *et al*. (2024) evaluated the economic impact of China's coal resource tax reform using the difference-in-differences (DID) model, a quasi-experimental econometric technique that estimates causal effects by comparing changes over time between treated and untreated regions. Panel data from 30 Chinese provinces between 2006 and 2021 are used to assess how the reform influenced regional real GDP and resource tax revenue. The DID approach isolates the effect of the tax reform by controlling for time-invariant regional characteristics and common shocks. Additionally, robust tests were conducted to validate the reliability of the results. Other authors analyze the financial development of environmental practices and policy effects related to the implementation of those practices (L. Yang *et al*., 2024; Peçe *et al*., 2023).

In addition, econometric methods might be a helpful tool to assess the socioeconomic effects of environmental practices. Kostakis and Tsagarakis (2022) analyzed the impact of socioeconomic factors on recycling and circularity within the European Union using fixed-effects and instrumental variable fixed-effects panel regression models. These econometric methods account for unobserved heterogeneity across countries and help address potential endogeneity issues between explanatory variables, such as economic wealth, fertility rate, environmental taxes, R&D expenditures, urbanization, recycling and circularity rates. The use of these techniques strengthens the causal interpretation of the results by isolating exogenous variation in the independent variables. Similar objectives in analyzing the socio-economic effects are included by other authors (Hieu and Mai, 2023; Pegkas, 2020; Rahman and Velayutham, 2020; Yao *et al*., 2019).

Moreover, econometric analysis can also be used to compare the adaptation of environmental practice to 'business as usual'. Liu and Yuan (2023) analyzed the impact of economic growth, nonrenewable energy use, and renewable energy consumption on carbon emissions in the U.S. from 1985 to 2020 using panel data analysis. After conducting preliminary diagnostic tests confirming stationarity and long-run cointegration among the variables, the researchers employed the quantile regression approach to capture the varying effects of these factors across different levels of carbon emissions. In addition, Majeed *et al*. (2021) investigated the effects of renewable and non-renewable energy consumption on economic growth using global panel data from 174 economies over the period 1980–2019, including separate analyses for developed and developing countries. To estimate the relationship, the researchers applied fixed effects, random effects, and the two-step system generalized method of moments estimation techniques. A similar approach is used by other researchers who employ econometric methods for economic impact evaluation (Ivanovski *et al*., 2021; Asiedu *et al*., 2021; Telly and Liu, 2023; Mohamed *et al*., 2023). This technique finds parameter values that make the model's theoretical moment conditions match the empirical moments in the data as closely as possible. In addition, other authors use econometric methods to develop the development indices (Ye *et al*., 2023).

The literature demonstrates a clear predominance of econometric methods in assessing the economic impacts of environmental sustainability practices, reflecting their flexibility and robustness in analyzing causal relationships, heterogeneity, and temporal dynamics across different contexts. Techniques such as ARDL, cointegration tests, quantile regression, and difference-in-differences models enable researchers to capture complex interactions between economic, environmental, and socio-economic variables, providing valuable insights into specific mechanisms and policy effects. Based on the literature reviewed, the econometric methods commonly rely on panel data analysis, regression-based estimations, causality testing, cointegration analysis, and time-series techniques to examine relationships between environmental sustainability practices and economic indicators. Frequently used approaches include ARDL, quantile regression, MMQR, DID, Granger causality tests, and fixed/random effects models. These methods are primarily applied to evaluate short- and long-term dynamics, heterogeneity across countries or regions, and causal relationships between sustainability variables and economic outcomes. The main strength of econometric methods lies in their flexibility and statistical robustness in identifying causal relationships and variable interactions. They are particularly effective for analyzing policy effects, temporal dynamics, and heterogeneous impacts across different economic contexts. However, their main limitation is the inability to capture broader economy-wide feedback effects, indirect impacts, and structural interdependencies between sectors.

Contradictory findings frequently emerge due to differences in methodological assumptions, regional contexts, time periods, and selected indicators. While many studies identify positive economic effects of renewable energy and environmental practices, others reveal asymmetric or weak relationships depending on financial development, institutional quality, or policy implementation. Recent studies increasingly incorporate non-linear models, heterogeneity-sensitive approaches, dynamic panel techniques, and mixed-method econometric frameworks. There is also growing interest in integrating econometric analysis with environmental hypotheses such as the Environmental Kuznets Curve and with broader sustainability indicators. Future research could focus on integrating econometric approaches with economy-wide models such as CGE and I-O frameworks to better capture systemic impacts. Additional opportunities include applying machine learning methods, expanding analysis toward underexplored sustainability practices, and improving the assessment of long-term structural transformations associated with environmental policies.

1.3 Economy-Wide and Product-System Approaches to Economic Impact Assessment

Other methods that include the economy-wide evaluation are CGE and I-O models. In this study, the economy-wide evaluation approaches refer to methods that assess the impact of a policy, technology, or environmental practice on the entire economy, rather than just on a few variables or a single sector. Economy-wide evaluation approaches provide a more comprehensive understanding of the economic impacts of environmental practices by capturing intersectoral linkages, feedback mechanisms, and indirect effects across the entire economy. While CGE models offer more realistic and flexible representations of economic systems compared to the more restrictive I-O models, both approaches are valuable for assessing direct, indirect, and induced impacts. Moreover, the literature highlights that no single method is sufficient on its own, and combining multiple analytical approaches can enhance the robustness and depth of economic impact assessments, supporting more informed and holistic policy decision-making.

For example, Lekavčius *et al*. (2023b) evaluate the economic impact of shifting away from plastic carrier bags using the CleanProdLT CGE model, which incorporates a Social Accounting Matrix (SAM) for Lithuania based on 2020 data. The study provides estimates of changes in GDP, employment, and greenhouse gas (GHG) emissions, accounting for direct, indirect, and induced impacts. Lekavičius *et al*. (2023a) also analyzed the economic effects of reducing food waste using the SAMmodEU model – an economy-wide framework based on a Social Accounting Matrix (SAM). In addition, Balsiūnaitė *et al*. (2025) evaluated the economic impact of building energy renovation policies also using the CleanProdLT computable general equilibrium (CGE) model. This economy-wide model integrates both I-O quantity and price components and simulates general equilibrium outcomes – including GDP, total and youth employment, and GHG emissions – by endogenizing consumption and market feedback across all sectors, showing that CGE models can assist in understanding wider effects on the economy and help in providing recommendations for policy makers.

I-O models are unpopular in the literature researched but used for the economy-wide evaluations. These models show changes in final demand in one sector and how the other sectors are affected by the economy. For example, Sard and Valle (2024) assessed the economic impact of restricting tourist arrivals in the Balearic Islands using the I-O methodology. By simulating various scenarios of reduced tourist arrivals, the model estimates the resulting changes in production and value added, considering direct, indirect, and induced effects. The study also includes simulations of increased average tourist spending to evaluate how higher per-visitor expenditures could offset the decline in GDP caused by fewer arrivals. The difference between CGE and I-O models lies in complexity. CGE is often more sophisticated and complex than I-O models. The scientific studies show critical distinctions, including that IO models have restrictive assumptions like fixed production coefficients and no capacity constraints, while CGE models can mimic real-world economic conditions more accurately (Holland and Razack, 2006).

Studies show that the CGE modelling approach is often used to determine the feedback loop effects. For example, Kumar and Stauvermann (2024) employed a static oligopolistic general equilibrium model to analyze how environmental taxation affects the economic distribution among different groups – such as labor, capital owners, and firms – and ultimately influences income inequality. The model captures market power in imperfect (oligopolistic) markets and explicitly models interactions across sectors to assess tax incidence. Guo *et al*. (2022) evaluated the economic and environmental impacts of increased electric vehicle (EV) adoption in China using a dynamic CGE model. Xu *et al*. (2015) analyzed the global economic impacts of renewable energy and energy efficiency investments, also using a dynamic CGE model. This economy-wide modeling helped researchers understand the multi-region and multi-sector interdependencies over time, allowing the study to simulate how changes in energy policy and investment affect macroeconomic outcomes such as GDP, productivity, and international spillovers across nations. By integrating dynamic adjustment processes, the model provides a rich view of both short- and long-term economic responses to renewable energy deployment.

CGE models commonly rely on Social Accounting Matrices (SAMs) and integrate feedback relationships, market equilibrium conditions, sectoral interactions, and behavioral responses within an economy-wide framewor Studies using CGE and I-O models frequently simulate policy scenarios, environmental interventions, and consumption changes to estimate impacts on GDP, employment, emissions, and other macroeconomic indicators. These models are often calibrated using national economic data and are designed to capture direct, indirect, and induced effects across sectors. The main strength of CGE models is their ability to represent economy-wide dynamics, intersectoral feedback mechanisms, and market adjustments simultaneously. Compared to simpler models, CGE frameworks provide more realistic representations of economic systems by allowing endogenous price and consumption responses. However, these models are highly complex, data-intensive, and dependent on assumptions regarding elasticities, consumer behavior, and market structure. Their construction and calibration also require substantial expertise and computational resources. Contradictory findings in CGE-based studies often arise from differences in model structure, sectoral aggregation, assumptions about labor and capital mobility, and policy implementation scenarios. Variations in national contexts and baseline economic conditions may also produce differing estimates of employment, GDP, or environmental outcomes. Emerging trends include the development of hybrid CGE frameworks integrating environmental indicators, input–output components, and dynamic adjustment mechanisms. Researchers increasingly apply CGE models to evaluate circular economy transitions, energy renovation policies, food waste reduction, and climate mitigation pathways. Future research could focus on integrating social and behavioral dimensions into CGE frameworks, improving regional and sectoral disaggregation, and incorporating uncertainty analysis and technological innovation dynamics. Additional opportunities exist for combining CGE models with product-level sustainability methods such as LCA or MFA to create more multidimensional sustainability assessments.

Several researchers evaluate the economic impact of environmental practices using multiple analyzing methods. This is usually done for the purpose of triangulation, to employ multi-dimensional sustainability assessments, or simply for collecting different types of evidence. Yazdizadeh *et al*. (2010) importantly highlight that there is “no unique methodological approach” for economic evaluation, underscoring the value of methodological flexibility and combination. The strength of this approach lies in leveraging the comparative advantages of different analytical techniques to generate more comprehensive economic impact assessments. For example, Navarrete-Molina *et al*. (2019) employed an innovative combination of methods to examine the evolving relationship between steel flows/stocks and economic development. The researchers use dynamic material flow analysis (MFA) to reconstruct long-term trends in steel production and usage across six life cycle stages – ranging from iron ore to fabricated steel and in-use stocks. They then applied both quadratic and asymptotic regression functions to model the relationship between per capita steel indicators and per capita GDP, conducting a decoupling analysis to identify how the material intensity of steel evolves with economic growth. This sequential meaning – where steel flows grow more slowly than GDP – reveals a phased decoupling along the steel cycle. By integrating historical MFA data with non-linear econometric modeling, the study provides deep insights into industrialization patterns and implications for sustainable material policy and dematerialization strategies.

The other reviewed literature consistently examines the relationship between renewable and non-renewable energy consumption and economic growth using a wide range of econometric approaches across different geographical contexts. Most studies find evidence of a positive relationship between renewable energy consumption and economic growth, although the strength and direction of causality vary across regions and development levels. Research focusing on oil-exporting and developing economies suggests that renewable energy contributes to long-term economic growth while reducing dependence on fossil fuels (Kahia *et al*., 2016; Syzdykova *et al*., 2021). Similarly, studies covering developed economies, including G7 and EU countries, highlight the importance of clean energy transition, technological innovation, and environmental policies in promoting sustainable growth (Cai *et al*., 2018; Ntanos *et al*., 2018; Sahlian *et al*., 2021). Evidence from country-specific and regional analyses, such as those conducted for the United States, China, Turkey, and emerging economies, further confirms that renewable energy consumption supports economic performance, although the effects may differ depending on financial development, capital formation, and environmental regulations (Salari *et al*., 2021; Wang *et al*., 2021 ; Fotourehchi, 2017). Several studies also emphasize the complex and sometimes asymmetric relationship between renewable and non-renewable energy consumption and economic growth, indicating that transitions toward clean energy systems can generate both economic opportunities and structural adjustment challenges (Abbasi *et al*., 2020; Ivanovski *et al*., 2021). Additionally, broader analyses incorporating green innovation, hydrogen energy development, and trade integration suggest that renewable energy expansion contributes not only to economic growth but also to emissions reduction and environmental sustainability (Xiang *et al*., 2021; Chien *et al*., 2021). Overall, the literature demonstrates a growing consensus that renewable energy plays a crucial role in fostering sustainable economic development, although regional heterogeneity, methodological differences, and varying policy contexts continue to influence empirical findings (Long *et al*., 2015; Omri *et al*., 2015; Destek and Aslan, 2017; Tuna and Tuna, 2019; Inglesi-Lotz, 2016; Zeraibi *et al*., 2021).

Product system evaluations are usually evaluations where one product or service is evaluated. The methods used in product system evaluations often include LCA, LCC, social life cycle assessment or TEA.

The LCA method is often used to account for the environmental implications of raw materials extraction throughout the process of use to the end of product life. LCA is a relative tool designed to help decision-makers compare environmental impacts between alternative options, not to provide absolute evaluations. Despite the fact that LCA is not used to evaluate economic implications directly, it is often used together with life cycle costing analysis (LCC) and social life cycle analysis (S-LCA). LCC, on the other hand, is a similar method dedicated to understanding the costs of a product throughout its life cycle. It calculates the total cost of ownership for a product or system across its entire life cycle, from design and production to operation, maintenance, and disposal. It is often more related to economic impact as it directly influences markets through development, production, and disposal costs. S-LCA is another product system evaluation analysis related to LCA. This life cycle evaluation is an emerging sustainability evaluation that focuses on social impacts of product development. S-LCA assesses the social wellbeing of products or services.

Throughout the literature it was recognized that LCA and LCC are more commonly used when analysis needs to answer questions related to certain products, service or processes. It was observed that LCA and LCC are commonly used together as LCA provides more information on environmental burdens and LCC shows the economic implications. For example, Li *et al*. (2024) assessed the environmental and economic performance of various straw utilization pathways in China – including straw-to-biochar, ethanol, biogas, board, and paper – also using an LCA and LCC approach. Additionally, sensitivity analysis was used to determine how different product outcomes influence both environmental and economic results. In a study by Albizzati *et al*. (2021), both LCA and LCC were employed to evaluate the environmental and economic impacts of waste management systems. The environmental assessment followed ISO standards for LCA (ISO 2006a, 2006b) and applied a bottom-up consequential approach using marginal market datasets. The geographical scope was Europe, covering the period 2015–2030 with current technology efficiencies, and impact assessment was carried out using the ILCD midpoint indicators, considering a 100-year time horizon for emissions.

Furthermore, Musharavati *et al*. (2023) evaluated the environmental and economic performance of biodiesel production from mixed vegetable oil waste in Pakistan using Attributional Life Cycle Assessment with the ReCiPe (H) method to quantify environmental impacts across multiple categories, such as global warming potential, human toxicity, and eutrophication. A scenario analysis was also conducted to assess the environmental benefits of using photovoltaic solar energy instead of grid electricity, revealing significant reductions in particulate matter emissions. Hotspot analysis was performed to identify the most impactful stages in the production process. In addition, Yang *et al*. (2024) assessed the environmental and economic impacts of incorporating recycled materials – specifically reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) – into asphalt concrete (AC) pavement using a life cycle approach. The analysis includes LCA following ISO 14044:2006 guidelines to evaluate energy use, global warming potential, and emissions, alongside an itemized cost analysis to assess economic implications. Eleven AC mix designs with varying asphalt binder replacement (ABR) rates from Illinois were analyzed. Moreover, Dai *et al*. (2015) evaluated the sustainability of a household biogas-linked agro-ecosystem in rural China using a life cycle-based accounting model that integrates economic, ecological, and social metrics. In addition, the analysis combined economic I-O evaluation to quantify energy and resource flows with assessments of conversion efficiency and human influence throughout the biogas production cycle. This multi-objective approach enabled a comprehensive understanding of both the economic benefits and environmental gains associated with biogas systems.

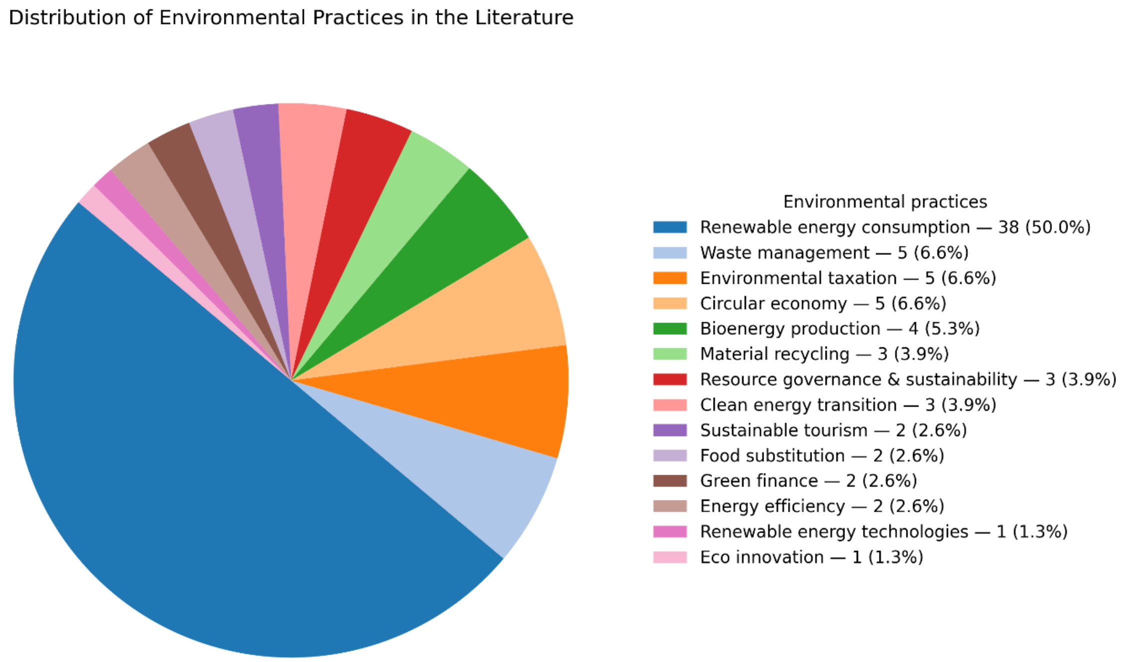
TEA is also used to evaluate the economic impact of environmentally-friendly practices that are more product-specific. This analysis is often used to understand the technological feasibility of certain products or services, and to analyze economic feasibility. For example, Shakelly *et al*. (2024) evaluated the economic impact of producing bio-based jet fuel through a techno-economic assessment of an alcohol-to-jet biorefinery. This method estimated key financial performance metrics – such as capital and operating costs, profitability, and return on investment – under industrial-scale operating conditions. To address uncertainty in the conversion process, the study incorporates a stochastic analysis using Monte Carlo simulation as well modeling variability in conversion efficiency. Additionally, a sensitivity analysis based on a design of experiments approach is used to examine how variations in ethanol price, jet fuel price, and conversion rate affect economic outcomes. Yong *et al*. (2020) evaluated the economic impact of anaerobic digestion (AD) of municipal solid waste using a techno-economic assessment embedded within a sustainability framework. The authors integrate economic I-O evaluation with environmental assessment to quantify the economic performance and viability of biogas systems. This approach assesses resource and energy flows alongside economic values, facilitating a comprehensive view of how converting organic waste into biogas can deliver both environmental benefits and economic returns.

The least used product-system evaluation methods include comparative sustainability assessment, case study analysis, economic surplus modeling, and material flow analysis. Comparative sustainability assessment, which is a comparison between two or more alternatives, evaluates economic, social, and environmental performance. Economic surplus analysis analyses the benefit of the product or service received by consumers or producers. However, material flow analysis provides information on the material flows in a specific period. As an example, Miśkiewicz (2020) evaluated the economic impact of implementing an eco-innovation technology for electricity production from post-process gas heat in Polish industrial companies using a case-based empirical analysis. The methodology involves two main stages: first, a bibliometric analysis to establish the scientific context and relevance of economic evaluations in industrial energy innovation; second, an economic and ecological efficiency assessment of the implemented technology. Case-based empirical analysis is commonly used to analyze the real-world situation. In addition, Martínez-Lage *et al*. (2020) assessed the economic impact of using recycled aggregates in concrete production through a comparative cost analysis across different mixture designs and replacement rates of natural aggregates. The study evaluates economic viability by identifying the additional costs or savings incurred when substituting natural coarse aggregates with recycled concrete or mixed recycled aggregates under various economic and transport scenarios. This economic evaluation is integrated with technical testing (for mechanical properties) and environmental impact assessment (including global warming potential, energy use, and waste generation), allowing a comprehensive view of the trade-offs. Furthermore, Ye and Ching (2022) employed a case-based empirical analysis to explore how big data technology influences sustainable production and consumption within live-streaming e-commerce platforms. The authors focus on consumer behavior metrics – such as purchasing patterns and engagement data – captured through big data analytics to evaluate its economic impact, which likely includes improvements in sales efficiency, consumer targeting, and operational performance. Li *et al*. (2024) evaluated the relationship between material use and economic growth using a combination of dynamic material flow analysis and decoupling analysis. They apply quadratic and asymptotic regression functions to model how various per capita steel flow and stock indicators (across six life cycle stages) relate to per capita GDP across 23 industrialized countries from 1860 to 2018. This methodological approach enables the identification of sequential decoupling patterns, where material use grows at a slower rate than economic output. By integrating long-term historical data with non-linear econometric modeling, the study captures the evolving relationship between steel use and economic development, offering insights into industrialization patterns and informing strategies for dematerialization and resource efficiency. Another method used to analyze the impact on the economy is implementing analysis using the computable general equilibrium model (CGE). With the help of CGE, researchers can see interactions among markets and products; it allows researchers to analyze economy-wide effects and assess the effects of policies.

The reviewed studies reveal several common methodological patterns in assessing the economic and environmental impacts of sustainable production and consumption systems. Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) are the most frequently applied methods, often used together to provide complementary environmental and economic perspectives on products, services, and processes. Many studies also integrate sensitivity analysis, scenario analysis, hotspot analysis, or stochastic modeling to address uncertainty and improve robustness of results. Techno-economic assessment (TEA) is commonly applied to evaluate technological and financial feasibility, particularly for bioenergy and waste management systems, while broader system-oriented approaches such as material flow analysis and computable general equilibrium (CGE) models are used less frequently but provide economy-wide insights. Across the literature, methodological strengths include the ability of integrated approaches to capture environmental, economic, and sometimes social dimensions simultaneously, offering comprehensive sustainability evaluations. However, weaknesses remain, including strong dependence on assumptions, data intensity, limited geographical transferability, and difficulties in capturing long-term systemic effects. Contradictions emerge regarding the economic viability of sustainable alternatives, as some studies identify cost savings and efficiency gains, while others report higher implementation costs depending on technology, scale, and regional conditions. Emerging trends include increasing integration of multi-method approaches, the use of uncertainty and sensitivity analyses, and growing attention to circular economy strategies and recycled materials. Despite these advances, important research opportunities remain, particularly the need for more dynamic and economy-wide assessments, stronger integration of social dimensions, longitudinal analyses, and the broader application of CGE and material flow models to better understand systemic transitions toward sustainable production and consumption.

1.4 Thematic Evolution of Environmental Sustainability Practices

This chapter discusses the environmental sustainability practices discussed in the literature. *Figure 6* presents practices discussed in the literature reviewed.



Source: created by the authors.

Figure 6. **Environmental Practices Analyzed in Researched Articles**

Figure 6 shows that the most common environmental practice is renewable energy consumption (38 articles). Waste management, environmental taxation and circular economy is in second place (5 articles each). The least analyzed environmental practices included such categories as renewable energy technologies and eco innovation, accounting for only one article each. *Table 1* presents the environmental practices and their organization into groups.

Table 1. Environmental practices mentioned in the literature

Groups of environmental practices	Environmental practices mentioned in each group
Renewable energy consumption	Renewable energy use, clean energy consumption, relation between renewable energy consumption and economic growth
Waste management	Solid waste management and economic growth, food-waste recycling, food waste reduction
Environmental taxation	Effects of the environmental taxes on income distribution, carbon taxes
Circular economy	Circular economy approaches to construction and demolition, reduction of plastic bags, waste recycling
Bioenergy production	Effects of biogas installation
Material recycling	Concrete with mixed recycled aggregates, recycled asphalt, materials recycling
Resource government and sustainability	Policy development
Clean energy transition	Upgrading the electricity grid
Sustainable tourism	Tourism degrowth
Food substitution	Replacing poultry with insects, reducing beef consumption
Green finance	Development of green finance and economic growth
Energy efficiency	Efficiency of electricity production, energy improvements of multi-apartment buildings
Renewable energy technologies	Solar thermal systems
Eco innovation	Relationship between eco-innovation and economic growth

Source: created by the authors.

It is important to mention that many environmental practices, such as usage of public transport, were not analyzed at all. Renewable energy consumption was the most widely discussed environmental practice. Researchers addressed various kinds of issues, including investments in renewables, economic viability of renewable energy products, environmental hazards, and impact on GHG, in addition to economic impacts. For example, Ahmad *et al*. (2021) addressed that gap by developing an economic performance model that incorporates energy-industry investment into the aggregate production function and testing it across Chinese regions. The results show a positive and statistically significant bidirectional relationship between energy-industry investment and aggregate production growth, confirming the feedback hypothesis. Notably, the direct influence of investment on performance (0.049) is smaller than the feedback effect of performance on investment (1.069). The study of Dasanayaka *et al*. (2021) analyzes environmental practices related to renewable energy use, reduction of CO_2 emissions, improvements in energy efficiency, and the transition toward sustainable energy systems. Wei *et al*. (2022) analyzed the sustainability practices renewable energy consumption (REC), green finance (GF), and FDI, with GDP growth and CO_2 emissions considered as contextual factors for understanding their role in promoting sustainable development.

The article by Elsherif (2024) analyzed renewable production and consumption, taking into account the blue economy. Sustainability indicators such as renewable energy use, blue economy activities, CO_2 emissions, population density, fiscal capacity, human development, and institutional quality as determinants influencing environmental outcomes were analyzed in the study. Liu *et al*. (2023) analyze environmental practices related to carbon emissions reduction, focusing on the role of energy consumption patterns, renewable energy use, and efficiency improvements as strategies to support sustainable economic growth while lowering environmental impact. Aydin (2019) analyses environmental practices centered on the use of biomass energy as a renewable alternative to fossil fuels in BRICS countries. The study explores how shifting energy consumption toward biomass contributes to reducing carbon emissions, enhancing energy diversification, and supporting sustainable economic development, while also highlighting the role of renewable energy adoption as a key environmental strategy for mitigating climate change.

In addition, Musharavati *et al*. (2023) analyze several environmental sustainability practices, including the integration of circular economy principles by converting mixed vegetable oil waste into biodiesel instead of landfilling, thereby reducing waste and enhancing resource efficiency. Using an attributional life cycle assessment with the ReCiPe (H) method, the study evaluates multiple impact categories – such as global warming potential, human toxicity, ozone depletion, eutrophication, acidification, and photochemical ozone formation – and shows that biodiesel production has significantly lower environmental impacts than conventional disposal. It further examines alternative energy scenarios, particularly the use of photovoltaic-generated electricity, which substantially decreases fine particulate matter formation during the process. The study of Cucui *et al*. (2018) also analyzed the biogas impact for renewables. Considering the anaerobic digestion of food waste as a sustainable waste management strategy, the utilization of biogas for renewable electricity production, and the substitution of synthetic mineral fertilizers with digestate as a nutrient-rich biofertilizer were analyzed, thereby reducing dependence on fossil-based energy and chemical fertilizers while mitigating GHG emissions. Dai *et al*. (2015) analyze environmental practices related to biogas production from livestock manure management, including the substitution of fossil fuels with renewable biogas, reduction of GHG emissions, nutrient recycling through digestate application to land, and overall resource efficiency improvements within agricultural energy systems. Shakelly *et al*. (2024) analyze sustainability practices through a techno-economic analysis (TEA) of the alcohol-to-jet (ATJ) process, evaluating the economic viability of producing sustainable aviation fuel from ethanol; the study incorporates stochastic simulation using Monte Carlo methods to capture uncertainties in conversion efficiency, feedstock price, and jet fuel selling price, and applies factorial design–based sensitivity analysis to assess both individual and interactive effects of these uncertainties on plant profitability, thereby highlighting how economic resilience and financial sustainability of bio jet production can be achieved under real-world variability.

Martínez-Lage *et al*. (2020) analyze environmentally-friendly practices such as recycling construction and demolition waste (C&DW) into recycled aggregates, using these recycled aggregates in concrete production to reduce natural resource extraction (e.g., gravel and sand), and applying an LCA to evaluate reductions in energy use, GHG emissions, and overall environmental impacts compared to conventional concrete production. Moreover, Kostakis *et al*. (2022) analyzed materials recycling and circularity of material use (circular material use rate, CMU), with an additional focus on trade in recyclable raw materials (TRRM) as an indicator of how recycling and circular flows contribute to environmental sustainability. Guo *et al*. (2022) analyze environmental practices related to circular economy strategies for electric vehicle batteries, specifically reuse, remanufacturing, and recycling, as ways to reduce waste, extend battery life, recover valuable materials, and lower environmental impacts across the battery life cycle. In addition, Yang *et al*. (2015) study emphasizes the use of recycled aggregates from construction and demolition waste in concrete, a practice that supports circular economy principles by reducing dependence on virgin raw materials and diverting waste from landfills.

Environmental taxation was another practice analyzed in scientific literature. Based on the article by Kumar and Stauvermann (2024), the environmental practices analyzed in this research center on the role of environmental taxation as a policy tool to reduce GHG emissions, with a focus on how such taxes interact with income distribution and market concentration. Specifically, the study examines how environmental taxes affect workers, capital owners, and firm owners within an oligopolistic general equilibrium model, revealing that the burden of these taxes falls disproportionately on poorer groups while leaving firm owners' real incomes unaffected. The research also highlights the political and social implications of environmental tax policies, considering antitrust measures, wealth and corporate taxation, and improved firm-level GHG disclosure as complementary practices to ensure both environmental effectiveness and social fairness. Ameer *et al*. (2024) analyze three main environmental practices in the E7 economies: environmental taxes, measured as the share of total taxes aimed at discouraging environmentally harmful activities; eco-innovation, captured through research and development (R&D) expenditure as a percentage of GDP, reflecting investment in sustainable technologies; and renewable energy electricity, defined as the share of total electricity generation derived from renewable sources. To provide context, the study also includes carbon emissions as an indicator of environmental pressure and GDP growth as a measure of economic dynamics, ensuring that the relationships between environmental practices and renewable energy consumption are assessed within both ecological and economic frameworks. Wang *et al*. (2024) show that tax reform raises coal costs, which encourages a shift in the energy structure away from coal and towards cleaner alternatives, stimulates firms to adopt energy-efficient technologies and invest in green innovation, and drives industrial restructuring by reducing excessive concentration in coal-dependent sectors. At the same time, by boosting public revenues and redistributing resources, the policy supports improvements in social consumption patterns, indirectly promoting more sustainable lifestyles. Together, these practices link environmental protection with economic development, showing that resource taxation can simultaneously enhance sustainability and regional growth. In addition, the article by Xu *et al*. (2015) analyzes environmental practices related to coal resource tax reform, specifically how shifting from a quantity-based to a price-based resource tax can promote energy conservation, reduce coal over-exploitation, improve resource efficiency, and mitigate environmental degradation at both regional and national levels.

In addition, analyzing sustainable food management practices, authors analyzed various food waste management pathways, certain products for food substitution, and food reduction impacts on the economy and environment. For example, Albizzati *et al*. (2021) highlight the performance of different food waste management pathways in terms of global warming potential (GWP) and life cycle costing. In the article by Abro *et al*. (2020), insect farming as a sustainable food production strategy to reduce food scarcity is analyzed. By promoting insects as an alternative protein source, the research highlights their significantly lower environmental footprint compared to conventional livestock, particularly in terms of GHG emissions, land use, and water consumption. Insect farming also supports circular economy principles, since insects can be reared on organic waste streams. In addition, Lekavičius *et al*. (2023) analyze food waste reduction across the supply chain, including primary production, food processing, retail, food services, and households, as strategies to cut resource use, lower GHG emissions, and support sustainability goals.

Plastic reduction, waste treatment, reduced beef consumption, circular economy, energy efficiency, sustainable tourism, and sustainable consumption were the least popular practices analyzed in the scientific literature. The article by Sard and Valle (2024) analyzes environmental practices related to tourism degrowth, specifically measures to limit tourist arrivals and reduce tourism intensity in the Balearic Islands as a way to lower environmental pressures such as resource consumption, waste generation, and emissions. Ye and Ching (2022) analyze the environmental practice of applying big data technology to sustainable production and consumption, focusing on how data-driven tools can optimize resource use, reduce waste, improve supply chain efficiency, and ultimately lower the environmental footprint of industries while supporting greener economic growth. Yang *et al*. (2024) analyze environmental sustainability practices related to the efficient use of steel across its life cycle, including material flow management, recycling and reuse of steel, reduction of in-use stock growth, and decoupling material consumption from economic growth – all aimed at supporting more resource-efficient and sustainable industrial development. Abbasi *et al*. (2022) offer a fresh perspective by analyzing the relationship between economic globalization, financial development, energy use, economic growth, and technological innovation with both consumption- and territory-based emissions in Pakistan over the period 1990Q1–2019Q4. The empirical findings indicate that financial and economic development increases both types of emissions in the short and long run, while energy use drives emissions only in the long run. In contrast, economic globalization reduces both emissions in the short run but, over time, contributes to higher consumption-based emissions. Technological innovation, however, significantly lowers both forms of emissions in the long term. The Frequency Domain Causality (FDC) results further support these conclusions. Based on these findings, the study recommends that policymakers restrict the use of non-renewable energy sources and promote renewable energy adoption to mitigate both consumption- and territory-based emissions. Moreover, Li *et al*. (2024) analyze environmental sustainability practices related to straw management, specifically comparing straw-to-ethanol production and straw-to-board production. These practices are assessed in terms of their ability to reduce GHG emissions, lower environmental burdens, and enhance resource efficiency within a life cycle framework. In the article by Navarete-Molina (2019), the environmental sustainability practices analyzed are those linked to China's transition toward greener development under different policy scenarios. Ghisellini *et al*. (2018) analyze environmental sustainability practices in the C&D sector mainly through the circular economy's 3R principles – Reduce, Reuse, and Recycle – including waste minimization by design, selective demolition/deconstruction, reuse of salvaged materials, recycling of construction and demolition waste into aggregates and new products, building refurbishment/renovation, substitution of virgin materials with secondary/recycled ones, cleaner production strategies, and cradle-to-cradle life cycle approaches. The article by Lekavičius *et al*. (2023) analyzes environmental practices related to reducing the use of single-use plastic bags and promoting alternatives in order to assess their socioeconomic and environmental impacts. Balsiūnaitė (2025) analyze environmental practices related to energy efficiency improvements in multi-apartment buildings, specifically through renovation measures that reduce energy consumption, lower heating demand, and cut GHG emissions, while also supporting broader sustainability goals.

The reviewed literature reveals several important emerging trends in sustainability research topics. First, there is a growing integration of circular economy principles into environmental practices, particularly through recycling, reuse, remanufacturing, and waste-to-resource strategies. Studies increasingly focus on converting waste streams into valuable products, such as biodiesel from vegetable oil waste, biogas from food and livestock waste, and recycled construction materials. Second, renewable energy remains the dominant research theme, with increasing attention given not only to renewable energy consumption itself, but also to its interaction with green finance, technological innovation, energy efficiency, and economic growth. Another emerging trend is the growing consideration of policy-driven sustainability measures, particularly environmental taxation, eco-innovation, and green industrial restructuring, which connect environmental goals with broader socioeconomic outcomes. In addition, sustainability research is gradually expanding toward behavioral and consumption-related dimensions, including sustainable food systems, tourism degrowth, plastic reduction, and data-driven sustainable consumption practices.

Despite the expansion of sustainability research, several important opportunities remain underexplored. One major gap is the limited attention given to sustainable transportation practices, particularly public transport use, despite its importance for reducing emissions and improving urban sustainability. Similarly, practices related to dietary change, sustainable consumer behavior, and investment flows receive comparatively little attention in the literature. Future research could also further investigate the socioeconomic implications of environmental policies, especially the distributional effects of environmental taxation and the balance between environmental effectiveness and social equity. Another opportunity lies in expanding research on eco-innovation and renewable energy technologies, which are mentioned less frequently despite their growing importance for sustainability transitions. Moreover, there is a need for more interdisciplinary and long-term studies that integrate environmental, economic, and social dimensions simultaneously, while also incorporating behavioral aspects and regional differences.

1.5 Improving the Evaluation of the Economic Impact of Environmental Sustainability Practices

To show the purpose of each method, level of analysis, strengths, limitation and suitable application, *Table 2* was developed. In this table the comparison of methods are shown including strewnghts and limitations defined and compared based on the studies analysed.

Table 2. Comparison of Methods Used for Evaluating the Economic Impact of Environmental Practices

Method	Purpose of Method	Level of Analysis	Strengths	Limitations	Suitable Applications
Econometric methods	Examine long- and short-run relationships between variables with different integration orders, detect causal relationships across short-, medium-, and long-term frequencies, analyzes heterogeneity and distributional effects across quantiles, simultaneously evaluates multiple direct and indirect relationships	Sector / economy-wide	Flexible for mixed integration orders, suitable for small samples, allows dynamic analysis and visualization, identifies time-varying causality and permanent causal relationships, models measurement error, links micro and macro perspectives, captures complex relationships	Requires careful model specification to avoid misinterpretation, sensitive to selected frequency ranges and methodological complexity, relies heavily on assumptions and balanced treatment-control groups,	Energy-growth nexus, emissions-economic growth relationships, sustainability policy evaluation, long-term sustainability and macroeconomic interaction analysis, consumer behavior, sustainability adoption, tourism and environmental perception studies, income-emissions inequality, heterogeneous sustainability impacts, environmental taxation, renewable energy policies, regional sustainability programs
Life Cycle Assessment (LCA)	Evaluates environmental impacts throughout a product's life cycle	Product / sector	Holistic environmental evaluation, evidence-based support for decision-making	Data-intensive, uncertainty in scope and system boundaries, limited comparability	Waste management, renewable energy products, circular economy, construction materials

Table 2 (*continuation*). Comparison of Methods Used for Evaluating the Economic Impact of Environmental Practices

Method	Purpose of Method	Level of Analysis	Strengths	Limitations	Suitable Applications
Life Cycle Costing (LCC)	Assesses total costs across the product life cycle	Product / sector	Comprehensive economic evaluation alongside environmental analysis	Requires detailed and reliable cost data	Product sustainability assessments, industrial systems, waste management
Social Life Cycle Assessment (S-LCA)	Evaluates social impacts throughout product life cycles	Product / sector	Integrates social dimension into sustainability assessment	Lack of methodological harmonization and comparable indicators	Social sustainability, labor and community impact analysis
Input–Output (I-O) Analysis	Measures intersectoral economic relationships and policy effects	Economy-wide	Captures direct and indirect effects across sectors, flexible with aggregate data	Assumes fixed coefficients and no behavioral responses, high data requirements	Sectoral policy analysis, environmental-economic linkages, resource flows
Techno-Economic Analysis (TEA)	Evaluates technical and economic feasibility of technologies and industrial processes	Product / sector	Identifies cost bottlenecks, supports decision-making, estimates capital and operating costs	Potential bias, uncertainty in representing emerging technologies	Biofuels, renewable energy systems, industrial innovation, waste valorization
Computable General Equilibrium (CGE) Models	Simulate economy-wide impacts of policies and sustainability transitions	Economy-wide	Holistic policy analysis, captures interactions between households, firms, and governments	Strong theoretical assumptions, difficulty modeling adjustment processes, detailed SAM data required	Climate policy, taxation, circular economy, sustainable development scenarios
Empirical Efficiency Evaluation (SFA / DEA)	Measures production or operational efficiency	Sector / firm-level	SFA distinguishes inefficiency from noise; DEA requires fewer assumptions	SFA depends on strict specifications; DEA cannot separate noise from inefficiency	Energy efficiency, industrial productivity, environmental performance
Economic Surplus Modelling	Evaluates changes in economic welfare by measuring gains or losses for producers and consumers resulting from policy, market, or technological changes	Sector/ Economy wide	Captures distribution of benefits between consumers and producers; useful for evaluating market and welfare impacts	Relies on strong market assumptions, may overlook environmental and social externalities, sensitive to elasticity estimates	Agricultural policy analysis, environmental regulation assessment, trade policy evaluation, technological innovation impacts
Empirical Efficiency Analysis	Examines real-world implementation and contextual impacts	Project / sector	Provides detailed contextual insights	Results may lack generalizability	Sustainable tourism, eco-innovation, renewable energy case studies

Source: created by the authors.

Table 3. Advantages and limitations of methods used to evaluate the economic impact of environmental sustainability practices

Methods used	Advantages	Limitations
Econometric analysis	Econometric methods address "selection problems" to disentangle real policy effects from personal characteristics (Hujer *et al.*, 2004) Econometric methods have the potential to provide evidence on the causal effects of policy interventions (Rovithis, 2013) Can "construct a comparison group using non-experimental data" when experimental data is unavailable (Cobb-Clark and Crossley, 2003)	Relies on generally untestable (Hujer *et al.*, 2004) Lack credible assessment of key assumptions and scarce evidence regarding the relative performance of different assessment methods (Rovithis, 2013). For example, in regression analysis, the use of multinomial choice models can act as an alternative to pairwise comparisons of interventions (Rovithis, 2013) Heterogeneity in evaluation analysis and data requirements presents practical challenges to reliable impact assessment (Iacono and Levinson, 2008). For example, the contribution of much of the recent research into the relationships between transportation infrastructure provision and economic performance has been to refine methods of analysis (Iacono and Levinson, 2008).
Life Cycle Assessment, Life Cycle Costing	Can express "impacts in homogenous units" and include "social and environmental impacts that would not normally be addressed," producing concrete net benefits (Craighill and Powell, 1996) Provides the ability for analysis with various terminologies and application modes used to concentrate multiple values of different criteria into a single factor (França *et al.*, 2021)	Singular focus on costs is ineffective in representing the multiple facets of economic sustainability (Neugebauer, Forin and Finkbeiner, 2016) Usually ignores the possibility of current or future uncertainty (Moins *et al.*, 2020) Resources such as economic investment and human knowledge are needed to carry out the analyses of both tools. For an LCA study, for instance, if time is of the essence, then greater investments are necessary to speed up the analysis, and more people need to be involved, with knowledge of both the tool and the system under study (França *et al.*, 2021)
General Equilibrium Model	Account for substitution mechanisms in production and consumption as well as market clearing conditions, providing insights often neglected when more partial methods are used (Bergman, 1995) Enables analysis of structural price and quantity changes (Conrad and Henseler-Unger, 1986)	Rely on tight general equilibrium and neoclassical micro-economic theoretical assumptions (Scrieciu, 2007) Limited due to data availability and simplification of assumptions (Bolarinwa, 2024)
Techno-economic analysis (TEA)	Provides a rigorous basis for evaluating science, engineering and technology-oriented projects (Kobos *et al.*, 2020)	Cannot provide understanding of feedback effects such as policy, resource availability and possible scale-up issues (Kobos *et al.*, 2020) TEA can be too narrow in scope. While conventional techno-economic analysis (TEA) evaluates financial feasibility, it may exclude life cycle-based costs and environmental burdens (Kwon *et al.*, 2025)
I-O	Ability to reflect the structure of regional economy in great detail (Okuyama, 2004) Advantages in reflecting industrial interdependencies in an economy (Yu, 2018) Can provide valuable information on growth and investment priorities, sectoral interrelationships, and policy impacts (Mattas *et al.*, 2009)	Fails to capture dynamic impact paths over space and time (Okuyama, 2004) Traditional I-O models cannot analyze subsidy changes and struggle with large demand shifts (Klijs *et al.*, 2015) Inoperability I-O models overestimate impacts they can quantify while neglecting positive indirect effects (Oosterhaven, 2017)
Comparative sustainability assessment	Enables holistic economic evaluation Offers "long-term benefits, better governance, improved decision-making processes (Kumar *et al.*, 2020)	Comparability is fragile (functional unit, boundaries, and multi-functionality). Many comparative results hinge on how you define the function and system boundaries, and on how you treat multi-functional processes (allocation vs system expansion). Pelletier *et al.* (2015) argue that practitioners split into "mutually exclusive schools of thought" and even question whether ISO's preferred solutions are always feasible in practice

Table 3 (*continuation*). Advantages and limitations of methods used to evaluate the economic impact of environmental sustainability practices

Methods used	Advantages	Limitations
Empirical efficiency evaluation	Ability to capture real-world operations (Bosch *et al.*, 1987)	Ondrich and Ruggiero note it is “well recognized that measured efficiency is sensitive to outliers,” and argue it may be impossible to separate “outliers ... due to statistical noise” from genuinely efficient frontier points in typical applications (Ondrich and Ruggiero, 2002).
Dynamic MFA	Provide compact sustainable development indicators for comparison (Barkhausen *et al.*, 2023)	Insufficient for comprehensive economic evaluation

Source: created by the authors.

Moving forward, to better understand the difference between limitations of each method, this chapter also presents the view of other researchers. *Table 3* shows each method used in different studies and presents summarized advantages and limitations.

The econometric analysis methods most used are often described as methods that evaluate the economic impact indirectly. They are more likely statistical methods that provide insights into the relationship among variables, and their heterogeneity. For example, Autoregressive Distributed Lag (ARDL) simulations offer powerful econometric calculations that are flexible for variables integrated in different orders, robust in small sample size, and allows visualization (Sarkodie and Owusu, 2020). However, it also requires model specification to avoid interpretation (Nkoro and Uko, 1995). Another econometric technique frequency domain causality (FDC) analysis detects causal connections between series at different frequencies and exploration of permanent causality across short, medium, and long-term relationships but it depends on specific frequency ranges (Mata *et al*., 2021), (Udeagha and Ngepah, 2021; Wei *et al*., 2021). In addition, structural equation modeling offers significant advantages over traditional regression analysis, in that it is able to model measurement errors and unexplained variances, simultaneously test multiple relationships, and link micro and macro perspectives (Nunkoo and Ramkissoon, 2012). In the meantime, it is described as a methodologically complex method that lacks exploratory research utility (Nunkoo and Ramkissoon, 2012). It is also noted that researchers must be cautious about misinterpreting results by inappropriately inferring causality (Tomarken and Waller, 2005).

The econometric method moments quantile regression (MMQR) is an advantageous method in analyzing heterogeneity and endogeneity across different quantiles, which allows us to explore distributional effects beyond traditional mean estimators. However, the limitations include application complexity (Van, 2021). Difference-in-difference models (DID) can estimate treatment effects in quasi-experimental settings. This compares the change in outcomes over time between targeted groups that are affected by a policy change and a control group. The advantages of this model include its effectiveness for analyzing policy interventions across multiple time periods and demonstrating utility in economic contexts like special economic zones (Callaway and Sant’Anna, 2019; Sheng and Yu, 2024). However, it relies on assumptions and demonstrates the risk of bias if policy effect characteristics are unbalanced between affected and control groups (Abadie, 2005; Griffin *et al*., 2021).

Moving forward toward other evaluation methods, LCA and LCC provide holistic sustainability evaluations and evidence-based policy support, but suffer from uncertainties in design, data, and scope. I-O analysis offers a comprehensive view of intersectoral linkages yet assumes fixed coefficients and linear relations without price or behavioral responses. The static oligopolistic general equilibrium model integrates oligopoly, general equilibrium, and environmental externalities, but is static. LCA of biodiesel captures environmental impacts comprehensively but is limited by data quality and modeling simplifications while experimental mechanical testing combined with economic and LCA analysis gives a rounded view of recycled concrete performance, though scope and data assumptions limit generalizability. Techno-economic analysis of biogas installations provides robust evaluation supported by field data, but could be case-specific. Structural equation modeling captures direct and indirect relationships simultaneously but relies on secondary data, whereas bibliometric analysis, efficiency evaluation, and social impact assessment provide a holistic, multidisciplinary perspective but may overlook non-indexed studies, rely on assumptions, and lack causality. Based on other researchers, LCA, LCC, and social life cycle assessment present advantages in making holistic assessments across the environmental, economic, and social dimensions (Ciroth *et al.*, 2011). These methods also support decision-making in various sectors, such as design and industrial dimensions (Jørgensen, 2013). However, they also lack methodological harmonization, present difficulties in defining coherent system boundaries, require robust databases, and are limited in comparable impact assessment (Costa *et al.*, 2019). What is more, these assessments require further research and case studies to improve methodology and understand interactions between environmental, economic, and social aspects (Costa *et al.*, 2019).

Furthermore, techno-economic analysis (TEA) is an important methodology to evaluate the economic performance of industrial processes by simulating technical and economic factors. TEA estimates capital and operating costs, conducts mass and energy balance assessments, provides information on research priorities, and informs stakeholders about technological feasibility. The evidence from multiple studies is robust and multifaceted. For example, Corinne D. *et al.* (Scown *et al.*, 2021) highlight TEA's utility in process design, cost estimation, and research priority screening. S. Y. W. Chai *et al.* (Chai *et al.*, 2022) note its exponential growth due to increasing business competition, with emerging trends toward integrating advanced technologies. The main advantages discussed in the scientific literature are its ability to identify cost bottlenecks in early research stages and supporting decision making in technology development (Scown *et al.*, 2021). However, the limitations of TEA include potential bias in economic evaluations and challenges in accurately representing the developing technologies (Chai *et al.*, 2022; Barahmand and Eikeland, 2022).

Survey-based methods capture consumer perceptions but are prone to bias, but on the other hand, they provide critical data on consumers' economic activities and assist in including direct data and granular economic information (Delpy and Li, 1998). However, the effectiveness of surveys depends on the form of the survey. For example, online surveys are cost effective but are questioned regarding data validity, potential sampling biases, difficulty capturing wider economic impacts, or challenges in data verification (Delpy and Li, 1998; Wyk *et al.*, 2015; Devkota *et al.*, 2007).

In addition, dynamic CGE captures long-term sectoral interactions but depends on data and assumptions. CGE models allow economy-wide analysis of sustainability practices and policy impacts but require detailed SAM data. Finally, SAM-based multiplier models comprehensively capture direct, indirect, and induced effects of changes, but cannot account for behavioral responses or substitution. CGE represents the behavior of households, governments, and producers and analyzes how policies, economic shocks, or other changes affect the whole economy. These models have several advantages, including but not limited to offering the holistic view on economic changes and providing detailed policy impact assessment (Bolarinwa, 2024). In the meantime, they rely on theoretical assumptions that can be made. However, the models have substantial limitations. They rely on tight theoretical assumptions that can make sustainability and environmental assessments problematic (Scrieciu, 2007). They often focus on equilibrium outcomes while struggling to model actual economic adjustment processes (Scrieciu, 2007).

Static oligopolistic general equilibrium models offer the ability to understand market interactions, complex economic aspects of globalization that are lacking in perfect competition models (Neary, 2002). However, there is a risk of artificially boosted rationalization gains due to unrealistic treatment of fixed costs; there is limited empirical research, with most work remaining theoretical. For the I-O analysis, the main advantages highlighted by other researchers include the ability to capture the direct and indirect effects of policies across sectors of the economy, flexibility for incorporating aggregate data, and the ability to analyze various economic domains (Uku and Shehu, 2024; Sahani *et al.*, 2023). However, it also presents limitations in sophisticated adaptation and substantial data requirements (Uku and Shehu, 2024). In addition, disaggregation might cause the misinterpretation of data (Bunsen and Finkbeiner, 2023).

Another method – empirical efficiency evaluation – offers insightful but highly context-dependent research results. This method can be broadly categorized into parametric and nonparametric techniques. The research reveals that efficiency evaluation methods can be broadly categorized into parametric and nonparametric techniques. Parametric methods, like the Stochastic Frontier Approach (SFA), have significant advantages in distinguishing random noise from true inefficiency (Asmare and Begashaw, 2018). However, they require strict model specifications and can be restrictive. Nonparametric methods, like Data Envelopment Analysis (DEA), offer more flexibility, gaining popularity due to fewer restrictive assumptions. Yet, they struggle to differentiate between true inefficiency and statistical noise (Asmare and Begashaw, 2018).

In addition, cost-benefit analysis is a valuable tool for evaluating policy and investment decisions. It evaluates the monetary costs and benefits and compares them. This analysis is often used to describe if project/service/policy measure is a worthwhile investment. It shows an advantage in providing monetary information, however, it lacks the ability to quantify human elements (Linton, 2024). There are also limitations in providing future costs and benefits, and it creates space for manipulation and subjective judgements (Morosan-Danila and Grigoras-Ichim, 2020). Finally, it is limited in capturing non-market goods and long-term environmental impacts (Hansjürgens, 2004).

2. Methodology and Analysis

The literature review analysis was conducted based on the SALSA (Search, Appraisal, Synthesis and Analysis) framework. The SALSA framework is a valuable tool for conducting literature reviews in various fields (Grant and Booth, 2009). It provides a structured approach to analyzing different review types and their methodologies (Samnani *et al.*, 2017). The accuracy was also ensured by using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. The PRISMA statement, originally published in 2009, is a widely adopted guideline for reporting systematic reviews and meta-analyses (Liberati *et al.*, 2009; Pierson, 2009). The PRISMA statement aims to improve transparency and replicability of systematic reviews (Page and Moher, 2017). The framework for this literature search and review is provided in *Table 4*.

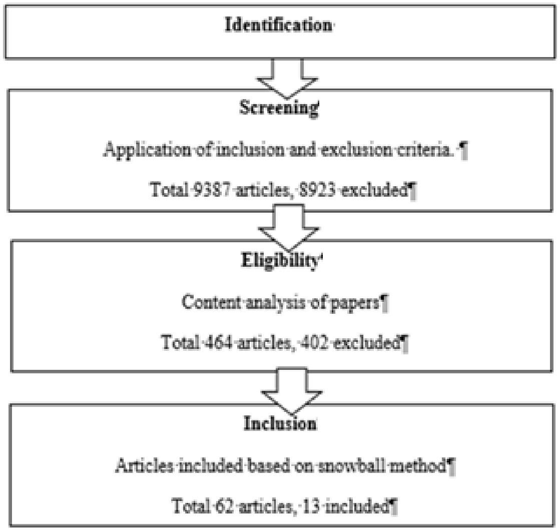
Table 4. Framework for systematic literature search and review

STAGE	DESCRIPTION
SEARCH	Key actions: keyword identification, search database. Research scope: methods for analyzing the impact on economy of environmental sustainability practices.
APPRAISAL	Key actions: papers selection through PRISMA statement.
SYNTHESIS	Key actions: data extraction and categorization.
ANALYSIS	Key actions: analysis of the data, result comparison and conclusions.

Source: created by the authors.

Before initiating the database search, it was essential to define the research scope and identify suitable keywords to guide the process. The literature search was conducted using the Scopus and SpringerLink databases, employing the keyword combination: “economic” + “effects” + “environmental practices.” Articles, research articles, and review articles written in English were included. To ensure a comprehensive review and capture as many relevant studies as possible, the search included all categories within databases. Articles published within the last 10 years were chosen. 9387 articles were found just by employing the keywords in the database. However, the number decreased in further analysis.

The retrieved articles were evaluated according to the PRISMA statement guidelines. Inclusion criteria required that the keywords appear in the title, abstract, or keyword section of the paper and that the paper be published in a peer-reviewed scientific journal. The exclusion criteria were review articles, conference proceedings, editorial letters, non-English publications, papers that did not present original research, and research articles that did not include content of the evaluation of economic impact of environmental sustainability practices.



Source: created by the authors.

Figure 7. **Flow of Information (according to PRISMA)**

A content analysis was carried out on the 62 articles identified through this process. Additionally, the snowballing method was applied, allowing the inclusion and analysis of relevant articles cited within the initially selected studies but not captured in the original search. After implementing the snowball method, 13 additional articles were found. A flow of information is provided in *Figure 7*.

To be included in the review, studies had to be written in English, published within the last ten years, appear in peer-reviewed scientific journals, and contain the selected keywords in the title, abstract, or keyword section. In addition, only studies presenting original research related to the evaluation of the economic impact of environmental sustainability practices were considered eligible. Exclusion criteria eliminated review articles, conference proceedings, editorial letters, non-English publications, and studies lacking original empirical research or direct relevance to the economic assessment of environmental sustainability practices. Following the screening and appraisal stages, 62 articles met the inclusion criteria and were selected for content analysis. Furthermore, the snowballing method was applied to identify additional relevant studies that were not captured during the initial database search. The snowballing approach involves examining the reference lists and citations of the selected articles in order to locate other relevant publications connected to the research topic. Durring this process, 13 additional articles were identified and included in the analysis. The application of both PRISMA screening and the snowballing method strengthened the comprehensiveness and reliability of the final dataset of studies used in the review.

The data from the selected articles were extracted and organized based on predefined categories. Articles discussed present studies that analyze economic impact using various methods. Since environmental practices were analyzed, the variables of the environmental impact were also left out as they might have a direct or indirect impact on the economy.

Several limitations of this literature review should be acknowledged. First, the keyword search strategy was relatively narrow, relying on the combination “economic” + “effects” + “environmental practices.” As a result, some potentially important studies may not have been identified during the search process. On the other hand, durring the selection process, many articles were deducted from selection meaning that these keywords helped to find high number of articles. Second, the literature search was limited to only two databases, Scopus and SpringerLink. While both databases are highly recognized and contain a large volume of peer-reviewed scientific literature, restricting the search to these sources may introduce selection bias and limit the comprehensiveness of the review. In addition, the review only included English-language publications published within the last ten years, which may have excluded valuable earlier studies and research published in other languages. Finally, despite the use of the PRISMA framework to improve transparency and consistency, the selection and categorization of studies may still involve a degree of subjective interpretation during the screening and analysis stages.

The following section offers a detailed overview of the analyzed articles including the methods that were used to analyze the economic impact, environmentally-friendly practices used, and their limitations, together with possible improvements.

3. Discussion

To the best of our knowledge, this research constitutes the first systematic literature review explicitly examining the methodological approaches used to evaluate the economic impacts of environmental sustainability practices. By synthesizing information from more than 70 peer-reviewed studies, this review filled the gap of systemizing the scientific articles evaluating methods used for evaluating the economic impact of environmental sustainability practices, and their methodological advantages and limitations. In this section, we provide discussion based on the results related to the research questions.

3.1 Thematic Evolution of Environmental Sustainability Practices

The findings of the reviewed articles indicate that renewable energy consumption represents the most frequently examined environmental sustainability practice within the existing literature regarding the evaluation of the economic impact. The study further highlights that assessments of environmental sustainability practices should extend beyond purely economic outcomes and incorporate broader social and environmental dimensions. Nevertheless, when discussing these findings, it is important to revisit a fundamental starting point – namely, the selection of environmental practices themselves. The choice of practices under investigation plays a critical role in shaping both the scope of the analysis and the relevance of the resulting policy implications.

The choice of environmental sustainability practices highly depends on differences in cultures (Andersson *et al*., 2022). However, global priorities of the thematic choices of sustainability practices could be selected by the state of Sustainable Development Goal (SDG) indicators and their progress. The most popular practice of renewable energy consumption is reflected in SDG 7, specifically indicator 7.2, which measures the share of renewable energy in total energy consumption. As of 2025, the status of this indicator is classified as moderate progress, but acceleration is needed (United Nations, 2025). This assessment suggests that continued research on renewable energy consumption remains relevant. However, other indicators demonstrate even more limited progress. For example, indicator 7.3, which focuses on energy efficiency, is currently evaluated as showing marginal progress, with significant acceleration required. This highlights the importance of directing research efforts toward environmental challenges that may be less frequently examined, particularly those that do not always generate direct or immediate economic returns.

In addition to energy-related practices, the literature shows that waste management is a popular topic but much less popular than renewable energy consumption. According to SDG 12, some of the most pressing environmental and societal challenges are associated with indicator 12.3, which addresses food waste and losses, and indicator 12.5, which focuses on reducing overall waste generation (United Nations, 2025). Both indicators are currently classified as experiencing regression, indicating a deterioration rather than an improvement in performance. Furthermore, several environmental sustainability practices related to natural ecosystems, particularly those encompassed within SDGs 13, 14, and 15, are also categorized as experiencing regression or stagnation. These observations underline the need for broader and more diversified research efforts that address complex environmental challenges extending beyond traditionally prioritized areas such as renewable energy consumption. Moreover, it also shows that there is some kind of overlap between the environmental challenges needing analysis and the choice of research fields.

It is also important to recognize that countries often face resource constraints that limit their capacity to implement all environmentally sustainable practices necessary to address environmental challenges comprehensively (Bell and Russell, 2003). As a result, it becomes essential to evaluate and compare different environmental practices to identify those that generate the most beneficial outcomes for both economic performance and environmental sustainability. However, comparing environmental practices presents significant methodological challenges due to their heterogeneous characteristics, sector-specific impacts, and varying temporal and spatial effects. Consequently, there is a growing need for research that develops and applies robust comparative frameworks to assess the relative effectiveness of different environmental practices.

The imbalance presented in studies analyzed highlights a significant research opportunity that would allow researchers to analyze a full spectrum of environmental sustainability practices outlined by a policy framework, such as the European Green Deal. In addition, it would allow cross-practice comparison, which is essential for overall policy making. This finding is supported by Bauer (2003), who claims that comparison could provide insights from earlier policy implementations in other jurisdictions, enable more accurate assessment of policy effects, and separate policy impacts from external developments. Extending the analysis to remaining practices would contribute to more comprehensive understanding of how the environmental sustainability practices can affect our economy, social welfare, and provide more information on possible long-term development.

3.2 Methodological Patterns in Assessing the Economic Impact

Our analysis encompassed 10 distinct methods that have been employed, either directly or indirectly, to assess the economic implications of sustainability-related interventions. The review demonstrates that methodological choices are largely shaped by the specific research objectives and the nature of the economic impacts under investigation. Each method appears to be adopted in response to a particular analytical need or conceptual gap, resulting in a diverse yet fragmented methodological landscape. Notwithstanding the value of method-specific applications, the findings suggest that greater methodological integration could substantially enhance the robustness and comprehensiveness of economic impact evaluations. This finding is supported by Barnow *et al.*, who found that mixed methods are currently rare but can significantly improve evaluations by triangulating findings and uncovering program impact mechanisms (Barnow *et al.*, 2024). Moreover, Jiménez *et al.* demonstrated that successful mixed-method evaluations improve study design by collecting more nuanced data and contextualizing quantitative findings (Jimenez *et al.*, 2018). The limited use of mixed-method or hybrid approaches represents a missed opportunity, as combining complementary methods would allow researchers to mitigate the limitations inherent in any single approach and to generate more nuanced insights.

In addition, a further gap identified in the reviewed literature concerns the lack of multi-scalar perspectives. This founding is supported by Saltelli *et al.*, who argue that current economic evaluations rely excessively on standard neoclassical economic tools, which prematurely narrow policy options (Saltelli *et al.*, 2022). The neoclassical economic impact evaluations tools see the economy as a subject that moves towards equilibrium; for example, complexity economics, which is seen as a more complex and dynamic framework which is constantly evolving based on imperfect information. Most of the economic impact methods evaluated are not intrinsically neoclassical, however, they can be embedded in neoclassical theoretical assumptions as was seen in the literature analyzed. For example, the article by Ahmad *et al.* (2021) investigates the causal relationship between investment in the energy industry and economic performance – this focus on investment, output, and performance is consistent with neoclassical concerns about capital accumulation, productivity, and growth. Dasanayaka *et al.* (2021) use the conceptual framework that posits that renewable energy establishments affect capital formation, trade balance, imports, and thereby GDP, which is the neoclassical logic of investment. Kostakis and Tsagarakis (2022) assume that economic determinants affect measurable outcomes via causal relationships, which could also be found in neoclassical theories. Evaluating the sustainability practices in the context of more liquid adaptation might bring us closer to real-time evaluation. Furthermore, it should be noted that disregarding neoclassical approaches altogether may compromise the accuracy and reliability of the results.

In addition, Glen Weisobrod *et al*. (2011) specifically point out the need to better distinguish local, regional, and national perspectives in economic impact assessments. Many articles analyzed in this study focused exclusively on either microeconomic impact – such as firm-level performance, cost dynamics, or behavioral responses – or macroeconomic outcomes, including structural change, aggregate welfare effects, and employment dynamics. Only a small number of studies attempted to link micro- and macro-level effects, thereby constraining the understanding of how local or firm-level sustainability measures translate into broader economic patterns, and vice versa. This shows that looking into broader economic implications of environmental sustainability practices might help us to understand how changes at the micro level affect the macro economy and vice versa.

3.3 Improving the Evaluation of the Economic Impact of Environmental Sustainability Practices

The literature analyzed shows that econometric methods dominate research on the economic impact of environmental practices, reflecting a more statistical direction of economic impact research. Econometric methods provide valuable insights into relationships between variables, helping to understand causal links, heterogeneity, and short and long-term dynamics (Athey and Imbens, 2017). However, these methods most likely cover only a small part of the economy rather than the whole system. These findings suggest that while econometric methods are effective for identifying specific mechanisms of economic impact, they are less suited for assessing economy-wide or feedback effects. They are useful for examining relationships between selected variables and understanding how those relationships change over time or across different contexts, but they do not fully capture how different sectors of the economy interact with each other.

Overall, the literature demonstrates that no single methodological approach is sufficient to fully capture the economic impacts of environmental sustainability practices. Each method offers distinct advantages but also faces inherent limitations (Tennakoon and Janadari, 2022). This underscores the importance of methodological complementarity, where combining different approaches can provide a more comprehensive and robust analysis. Future research should focus on integrating micro-level, product-based, and macroeconomic models, improving data quality and availability, and developing hybrid frameworks that better capture both causal relationships and system-wide dynamics. Such advancements would enhance the ability of researchers and policymakers to design effective sustainability strategies and evaluate their economic implications more accurately.

Econometric approaches are particularly strong in identifying causal relationships, estimating short- and long-term effects, and capturing heterogeneity across observations. However, they present an issue of focusing on partial equilibrium settings and therefore providing only a fragmented view of the economy, often overlooking feedback effects across sectors. In contrast, macroeconomic methods, such as CGE or I-O models, are better suited for capturing economy-wide interactions, structural changes, and policy spillovers, yet they frequently rely on simplifying theoretical assumptions about equilibrium and behavior, which may limit their ability to reflect real-world complexity and dynamic adaptation. Meanwhile, mixed-method approaches offer contextual depth and help uncover underlying mechanisms and institutional factors, but they are less commonly applied and may lack generalizability. The review also shows that many methods can be implicitly embedded in neoclassical frameworks, emphasizing efficiency, investment, and growth, whereas alternative perspectives, such as complexity economics, remain underutilized.

Conclusions

This systematic review has explored the diverse methods used to evaluate the economic impacts of environmental sustainability practices. This study highlights both methodological trends and thematic patterns in recent academic literature. The findings reveal that econometric analysis is the most frequently employed approach, valued for its ability to analyze large datasets across time and space. These methods are particularly effective in assessing causality and heterogeneity. The findings reveal that econometric approaches – such as Autoregressive Distributed Lag (ARDL), Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), Canonical Cointegration Regression (CCR), and Frequency Domain Causality (FDC) analyses – are among the most frequently applied techniques. These models are particularly valued for their flexibility, ability to handle short- and long-run dynamics, and capacity to explore causality and heterogeneity. However, they often require large datasets and robust cointegration testing. Similarly, quantile regressions and difference-in-differences (DID) approaches enhance causal inference and address heterogeneity and endogeneity but depend heavily on strong instruments and are limited in capturing indirect or time-varying effects.

Life Cycle Assessment (LCA), often combined with Life Cycle Costing (LCC), is another widely applied method, especially in studies involving waste valorization, renewable energy systems, and resource efficiency improvements. These approaches provide a comprehensive view of environmental and economic trade-offs throughout the product or system lifecycle while Computable General Equilibrium (CGE) models also feature prominently, offering a holistic understanding of macroeconomic effects and sectoral shifts resulting from environmental policies. These models offer several advantages, such as a comprehensive view of the economy, analysis of policy interactions, and incorporation of behavioral responses (Bolarinwa, 2024).

The reviewed studies span a broad geographical and sectoral spectrum, covering national-level analyses in countries such as China, Pakistan, and the United States, regional assessments within the European Union, and global multi-country comparisons. The most frequently analyzed environmental practices include renewable energy consumption, waste management, environmental taxation, and adaptation of circular economy, reflecting a strong research emphasis on energy. In contrast, practices such as plastic reduction, energy efficiency, sustainable consumption, and tourism appear moderately represented. This imbalance suggests that although one of the main pillars (energy) of sustainability is well established in literature, other practices with potentially significant socio-economic and environmental implications receive comparatively limited attention. This is particularly important considering the global sustainability agenda, such as SDGs and their progress. Based on environmental practices analyzed in the literature and global sustainability challenges, we see that there is a need to focus more widely than on renewable-energy-related practices.

Taken together, the findings underscore that methodological choice should be guided by the scale, scope, and policy context of the sustainability practice under examination. Studies focused on national energy transitions or fiscal reforms benefit from CGE or econometric frameworks, while product-level innovation and circular economy applications are better served by LCA, LCC, or TEA approaches. Based on the findings of this study, three recommendations are drawn:

- Future research should place greater emphasis on addressing the most pressing environmental challenges identified in the Sustainable Development Goal (SDG) indicators, with particular attention to environmental practices that contribute directly to their achievement.

- There is a need to integrate and combine different economic impact evaluation methods to obtain more comprehensive and robust results, allowing for a broader assessment of the economic benefits associated with environmental sustainability practices.

- Further research should aim to develop methodological approaches for systematically comparing environmental practices. Such approaches would enable countries to prioritize the implementation of environmental measures based on their relative environmental effectiveness, economic outcomes, and the specific environmental challenges they face.

Literature

Abadie, A. (2005), "Semiparametric Difference-in-Differences Estimators", *The Review of Economic Studies*, Vol. 72, No 1, pp.1-19.

Abbasi, K., Jiao, Z., Khan, Shahbaz, M., A. (2020), "Asymmetric impact of renewable and non-renewable energy on economic growth in Pakistan: New evidence from a nonlinear analysis, *Energy Exploration & Exploitation*, Vol. 38, No 5, pp.1946-1967, https://doi.org/10.1177/0144598720946496 .

Abbasi, K. R., Hussain, K., Haddad, A. M. Salman, A., Ozturk, I. (2022), "The role of Financial Development and Technological Innovation towards Sustainable Development in Pakistan: Fresh insights from consumption and territory-based emissions", *Technological Forecasting and Social Change*, Vol. 176, 121444, https://doi.org/10.1016/j.techfore.2021.121444.

Abro, Z., Kassie, M., Tanga, C., Bessigamukama, D., Gracious, D. (2020), "Socio-economic and environmental implications of replacing conventional poultry feed with insect-based feed in Kenya", *Journal of Cleaner Production*, 265, 121871, https://doi.org/10.1016/j.jclepro.2020.121871.

Ahmad, M., Inayatullah, J., Jabeen, G., Alvarado, R. (2021), "Does energy-industry investment drive economic performance in regional China: Implications for sustainable development", *Sustainable Production and Consumption*, 27, pp.176-192, https://doi.org/10.1016/j.spc.2020.10.033.

Ahmad, M., Jiang, P., Murshed, M., Shehzad, K., Akram, R., Cui, L., Khan, Z. (2021), "Modelling the dynamic linkages between eco-innovation, urbanization, economic growth and ecological footprints for G7 countries: Does financial globalization matter?", *Sustainable Cities and Society*, 70, 102881, https://doi.org/10.1016/j.scs.2021.102881.

Albizzati, P.F., Tonini, D., Astrup, T.F. (2021), "High-value products from food waste: An environmental and socio-economic assessment", *Science of The Total Environment*, 755, 142466, https://doi.org/10.1016/j.scitotenv.2020.142466.

Ameer, W. Ali, M. S., Farooq, F. Ayub, B., Waqas, M. (2024), "Renewable energy electricity, environmental taxes, and sustainable development: empirical evidence from E7 economies", *Environmental Science and Pollution Research*, Vol. 31, No 34, pp.46178-46193, https://doi.org/10.1007/s11356-023-26930-5.

Andersson, S., Svensson, G., Molina-Castillo, F. J., Otero-Neira, C., Lindgren, J., Karlsson, N. P. E.., Laurell, H. (2022), "Sustainable development—Direct and indirect effects between economic, social, and environmental dimensions in business practices", *Corporate Social Responsibility and Environmental Management*, Vol. 29, No 5, pp.1158-1172, https://doi.org/10.1002/csr.2261.

Ardito, V., Banks, H., Cusumano, N., Tarricone, R. (2024), "OP17 Methods To Measure The Environmental Impacts Of Health Technologies And Include Them In Economic Evaluations: A Scoping Review", *International Journal of Technology Assessment in Health Care*, Vol. 40, No S1, pp.S8-S8, https://doi.org/10.1017/S0266462324000801.

Asiedu, B.A., Hassan, A.A., Bein, M.A. (2021), "Renewable energy, non-renewable energy, and economic growth: evidence from 26 European countries", *Environmental Science and Pollution Research*, Vol. 28, No 9, pp.11119–11128, https://doi.org/10.1007/s11356-020-11186-0.

Asmare, E., Begashaw, A. (2018), "Review on Parametric and Nonparametric Methods of Efficiency Analysis", *Open Access Biostatistics & Bioinformatics*, Vol. 2, No 2, pp.1-7.

Athey, S., Imbens, G.W. (2017), "The State of Applied Econometrics: Causality and Policy Evaluation", *Journal of Economic Perspectives*, Vol. 31, No 2, pp.3-32, https://doi.org/10.1257/jep.31.2.3.

Aydin, M. (2019), "The effect of biomass energy consumption on economic growth in BRICS countries: A country-specific panel data analysis", *Renewable Energy*, 138, pp.620-627, https://doi.org/10.1016/j.renene.2019.02.001.

Balsiūnaitė, R., Bobinaitė, V., Konstantinavičiūtė, I., Lekavičius, V. (2025), "Assessment of Socio-Economic and Environmental Impacts of Energy Efficiency Improvements in Multi-Apartment Buildings: Case Study of Lithuania", *Sustainability*, Vol. 17, No 3, 957, https://doi.org/10.3390/su17030957.

Bantilan, M.C.S., Anupama, K.V., Joshi, P.K. (2005), "Assessing economic and environmental impacts of NRM technologies: an empirical application using the economic surplus approach", in: *Natural resource management in agriculture: methods for assessing economic and environmental impacts*, CABI Books, pp.245-268, https://doi.org/10.1079/9780851998282.0245.

Barahmand, Z., Eikeland, M.S. (2022), "Techno-Economic and Life Cycle Cost Analysis through the Lens of Uncertainty: A Scoping Review", *Sustainability*, Vol. 14, No 19, 12191, https://doi.org/10.3390/su141912191.

Barbosa, A., Orujova, L., Feldens, T., Martins, F., Pinheiro, V., Freitas, A., Santos, J. V. (2024), "Measuring the economic impact of environmental stressors on health*", European Journal of Public Health*, Vol. 34, No Supplement_3, ckae144.487, https://doi.org/10.1093/eurpub/ckae144.487.

Barkhausen, R., Rostek, L., Miao, Z. Ch., Zeller, V. (2023), "Combinations of material flow analysis and life cycle assessment and their applicability to assess circular economy requirements in EU product regulations. A systematic literature review", *Journal of Cleaner Production*, Vol. 407, 137017, https://doi.org/10.1016/j.jclepro.2023.137017.

Barnow, B.S., Sanjay K., Pandey, Qian "Eric" Luo, (2024), "How Mixed-Methods Research Can Improve the Policy Relevance of Impact Evaluations", available at, https://journals.sagepub.com/doi/10.1177/0193841X241227480, referred 19/11/2025.

Bauer, J.M. (2003), "Prospects and Limits of Comparative Research in Communications Policy-Making", *31st Annual Communication, Information and Internet Policy Conference*, available at, https://www.researchgate.net/profile/Johannes-Bauer/publication/228537343_Prospects_and_limits_of_comparative_research_in_communications_policy-making/links/09e4150fee263172b5000000/Prospects-and-limits-of-comparative-research-in-communications-policy-making.pdf, referred 09/12/2025.

Bell, R.G., Russell, C. (2003), "Environmental Policy for Developing Countries", in: *The Theory and Practice of Command and Control in Environmental Policy*, Routledge.

Bergman, L. (1995), "General Equilibrium Costs and Benefits of Environmental Policies", in: G. Boero, A. Silberston (eds.), *Environmental Economics: Proceedings of a conference held by the Confederation of European Economic Associations at Oxford*, London: Palgrave Macmillan UK, pp.3-20, https://doi.org/10.1007/978-1-349-23989-4_1.

Bolarinwa, T. (2024), "Computable General Equilibrium (CGE) Models: A Comprehensive Review and Future Directions", *Management And Economics Review*, Vol. 9, No 1, pp.158-167, https://doi.org/10.24818/mer/2024.01-10.

Bosch, D.J., Eidman, V.R., Oosthuizen, L.K. (1987), "A review of methods for evaluating the economic efficiency of irrigation", *Agricultural Water Management*, Vol. 12, No 3, pp.231-245, https://doi.org/10.3390/su15010046.

Bunsen, J., Finkbeiner, M. (2023), "An Introductory Review of Input-Output Analysis in Sustainability Sciences Including Potential Implications of Aggregation", *Sustainability*, Vol. 15, No 1, 46, https://doi.org/10.1016/j.jclepro.2018.02.035.

Cai, Y., Sam, C.Y., Chang, T. (2018), "Nexus between clean energy consumption, economic growth and CO2 emissions", *Journal of Cleaner Production*, Vol. 182, pp.1001-1011, https://doi.org/10.1016/0378-3774(87)90015-1 doi.

Callaway, B., Sant'Anna, P.H.C. (2019), *Difference-in-Differences with Multiple Time Periods*, Rochester, NY: Social Science Research Network, https://doi.org/10.2139/ssrn.3148250.

Chai, S.Y.W., Phang, F.J.F., Yeo., L.S., Ngu, L.H., How, B.Sh. (2022), "Future era of techno-economic analysis: Insights from review", *Frontiers in Sustainability*, Vol. 3, https://doi.org/10.3389/frsus.2022.924047.

Chien, F., Sadiq, M., Nawaz, M.A., Hussain, M.S., Tran, T.D., Thanh, T.L. (2021), "A step toward reducing air pollution in top Asian economies: The role of green energy, eco-innovation, and environmental taxes", *Journal of Environmental Management*, Vol. 297, 113420, https://doi.org/10.1016/j.jenvman.2021.113420.

Ciroth, A., Finkbeiner, M., Traveso, M., Hildenbrand, J., Kloepffer, W., Mazijn, B., Prakash, S., Sonnemann, G., Valdivia, S., Ugaya, C. M. L., Vickery-Niederman, G. (2011), *Towards a life cycle sustainability assessment: making informed choices on products*, available at, https://www.osti.gov/etdeweb/biblio/21539143, referred 13/11/2025.

Cobb-Clark, D.A., Crossley, T. (2003), *Econometrics for Evaluations: An Introduction to Recent Developments*, available at, https://onlinelibrary.wiley.com/doi/10.1111/j.1475-4932.2003.00148.x, referred 17/04/2026.

Conrad, K., Henseler-Unger, I. (1986), "The Economic Impact of Coal-Fired Versus Nuclear Power Plants: An Application of a General Equilibrium Model", *The Energy Journal*, Vol. 7, No 4, pp.51-63, https://onlinelibrary.wiley.com/doi/10.5547/ISSN0195-6574-EJ-Vol7-No4-3.

Costa, D., Quinteiro, P., Dias, A.C. (2019), "A systematic review of life cycle sustainability assessment: Current state, methodological challenges, and implementation issues", *Science of The Total Environment*, 686, pp.774-787, https://doi.org/10.1016/j.scitotenv.2019.05.435.

Cowan, D.M., Dopart, P., Ferracini, T., Sahmel, J., Merryman, K., Gaffney, Sh., Paustenbach, D. J. (2010), "A cross-sectional analysis of reported corporate environmental sustainability practices", *Regulatory Toxicology and Pharmacology*, Vol. 58, No 3, pp.524-538, https://doi.org/10.1016/j.yrtph.2010.09.004.

Craighill, A.L., Powell, J.C. (1996), "Lifecycle assessment and economic evaluation of recycling: A case study", *Resources, Conservation and Recycling*, Vol. 17, No 2, pp.75-96, https://doi.org/10.1016/0921-3449(96)01105-6.

Cropper, M.L. (2000), "Has Economic Research Answered the Needs of Environmental Policy*?", Journal of Environmental Economics and Management*, Vol. 39, No 3, pp.328-350, https://doi.org/10.1006/jeem.2000.1128.

Cucui, G., Ionescu, C.A., Goldbach, I.R., Coman, M.D., Marin, E.L.M. (2018), "Quantifying the Economic Effects of Biogas Installations for Organic Waste from Agro-Industrial Sector", *Sustainability*, Vol. 10, No 7, 2582, https://doi.org/10.3390/su10072582, referred 10/07/2025.

Dai, J., Chen, B., Hayat, T. Alsaedi, A. Ahmad, B. (2015), "Sustainability-based economic and ecological evaluation of a rural biogas-linked agro-ecosystem", *Renewable and Sustainable Energy Reviews*, 41, pp.347-355, https://doi.org/10.1016/j.rser.2014.08.043.

Dasanayaka, C.H., Abeykoon, C., Nagirikandalage, P. (2021), "Modelling of the Effects of Renewable Energy Establishments towardsthe Economic Growth of a Nation", in: *8th International Conference on Fluid Flow, Heat and Mass Transfer (FFHMT'21)*, https://doi.org/10.11159/ffhmt21.128.

Delpy, L., Li, M. (1998), "The art and science of conducting economic impact studies", available at, https://journals.sagepub.com/doi/10.1177/135676679800400303, referred on 17/11/2025.

Destek, M.A., Aslan, A. (2017), "Renewable and non-renewable energy consumption and economic growth in emerging economies: Evidence from bootstrap panel causality", *Renewable Energy*, Vol. 111, pp.757-763, https://doi.org/10.22004/ag.econ.34997.

Devkota, N., Aslan, A. (2007), Calibrating Online Survey Sample for Economic Impact Analysis, https://doi.org/10.1016/j.renene.2017.05.008.

Elsherif, M. (2024), "Nexus between Blue Economy, Renewable Energy and Environmental Sustainability in the MENA Region: Evidence from Panel Threshold Regression", *International Journal of Energy Economics and Policy*, Vo. 14, No 4, pp.169-185, https://doi.org/10.32479/ijeep1.1625.

Fotourehchi, Z. (2017), "Clean Energy Consumption and Economic Growth: A Case Study for Developing Countries", *International Journal of Energy Economics and Policy*, Vol. 7, No 2, pp.61-64.

França, W.T., Barros, M.V., Salvador, R., Francisco, A.C., Moreira, M.T., Piekarski, C.M. (2021), "Integrating life cycle assessment and life cycle cost: a review of environmental-economic studies", *The International Journal of Life Cycle Assessment*, Vol. 26, No 2, pp.244-274, https://doi.org/10.1007/s11367-020-01857-y.

Gao, L., Ali, Q., Yaseen, M. R., Makhdum, M. S. A., Sarkodie, S. A., Nisa, M., Khan, M. T. I. (2024), "Global nexus between tourism and sustainable futures: the role of economic growth, globalization and renewables", *Environment, Development and Sustainability*, https://doi.org/10.1007/s10668-024-05124-0.

Ghisellini, P., Ripa, M., Ulgiati, S. (2018), "Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review", *Journal of Cleaner Production*, Vol. 178, pp.618-643, https://doi.org/10.1016/j.jclepro.2017.11.207.

Grant, M.J., Booth, A. (2009), "A typology of reviews: an analysis of 14 review types and associated methodologies", *Health Information & Libraries Journal*, Vol. 26, No 2, pp.91-108, https://doi.org/10.1111/j.1471-1842.2009.00848.x.

Griffin, B.A., Schuler, M.S., Stuart, E.A.., Patrick, S., McNeer, E., Smart, R., Powell, D., Stein, B. D., Schell, T.L., Pacula, R.L. (2021), "Moving beyond the classic difference-in-differences model: a simulation study comparing statistical methods for estimating effectiveness of state-level policies", *BMC Medical Research Methodology*, Vol. 21, No 1, 279, https://doi.org/10.1186/s12874-021-01471-y.

Guo, Z., Li, T., Shi, B., Zhang, H. (2022), "Economic impacts and carbon emissions of electric vehicles roll-out towards 2025 goal of China: An integrated input-output and computable general equilibrium study", *Sustainable Production and Consumption*, Vol. 31, pp.165-174, https://doi.org/10.1016/j.spc.2022.02.009.

Hansjürgens, B. (2004), "Economic valuation through cost-benefit analysis – possibilities and limitations", *Toxicology*, Vol. 205, No 3, pp.241-252, https://doi.org/10.1016/j.tox.2004.06.054.

Hazmi, A., Kort, H. M., Khallouli, W. Raissi, N. (2024), "A Dynamic Interrelationships among Clean Energy, Environmental Pollution, and Economic Growth in GCC Economies: A Panel ARDL Approach", *International Journal of Energy Research*, Vol. 2024, No 1, 5571175, https://doi.org/10.1155/2024/5571175.

Hieu, V.M., Mai, N.H. (2023), "Impact of renewable energy on economic growth? Novel evidence from developing countries through MMQR estimations", *Environmental Science and Pollution Research International*, Vol. 30, No 1, pp.578-593, https://doi.org/10.1007/s11356-022-21956-7.

Holland, D., Razack, A. (2006), "Assessing the Economic Impact of an Agricultural Export Shock on the Washington Economy: A Tale of Two Models", *Working Papers*, available at, https://ideas.repec.org//p/wsu/wpaper/holland-4.html, referred on 10/11/2025.

Hujer, R., Caliendo, M., Radic, D. (2004), *Methods and limitations of evaluation and impact research*, available at, https://www.cedefop.europa.eu/files/BgR1_Hujer.pdf, referred on 19/02/2026.

Iacono, M., Levinson, D.M. (2008), *Review of Methods for Estimating the Economic Impact of Transportation Improvements*, Rochester, NY: Social Science Research Network, https://doi.org/10.2139/ssrn.1736116.

Inglesi-Lotz, R. (2016), "The impact of renewable energy consumption to economic growth: A panel data application", *Energy Economics*, Vol. 53, pp.58-63, https://doi.org/10.1016/j.eneco.2015.01.003.

Ivanovski, K., Hailemariam, A., Smyth, R. (2021), "The effect of renewable and non-renewable energy consumption on economic growth: Non-parametric evidence", *Journal of Cleaner Production*, Vol. 286, 124956, https://doi.org/10.1016/j.jclepro.2020.124956.

Jimenez, E., Waddington, H., Goel, N., Prost, A., Pullin, A., White, H., Lahiri, Sh., Narain, A. (2018), "Mixing and matching: using qualitative methods to improve quantitative impact evaluations (IEs) and systematic reviews (SRs) of development outcomes", *Journal of Development Effectiveness*, Vol. 10, No 4, pp.400-421, https://doi.org/10.1080/19439342.2018.1534875.

Jørgensen, A. (2013), "Developing the Social Life Cycle Assessment", available at, https://doi.org/10.1007/s11367-012-0517-5, referred on 12/02/2026.

Kahia, M., Ben Aïssa, M.S., Charfeddine, L. (2016), "Impact of renewable and non-renewable energy consumption on economic growth: New evidence from the MENA Net Oil Exporting Countries (NOECs)", *Energy*, Vol. 116, pp.102-115, https://doi.org/10.1016/j.energy.2016.07.126.

Klijs, J., Peerlings, J., Heijman, W. (2015), "Usefulness of Non-Linear Input—Output Models for Economic Impact Analyses in Tourism and Recreation", *Tourism Economics*, Vol. 21, No 5, pp.931-956, https://doi.org/10.5367/te.2014.0398.

Kobos, P., Drennen, Th.E., Outkin, A.V., Webb, E.K., Paap, S.M., Wiryadinata, S. (2020), *Techno-Economic Analysis: Best Practices and Assessment Tools*, No SAND--2020-13473, 1738878, 692989, https://doi.org/10.2172/1738878.

Kostakis, I., Tsagarakis, K.P. (2022), "Social and economic determinants of materials recycling and circularity in Europe: an empirical investigation", *The Annals of Regional Science*, Vol. 68, No 2, pp.263-281, https://doi.org/10.1007/s00168-021-01074-x.

Kumar, L.R., Talan, A., Tyagi, R.D. (2020), "Sustainable Impact Assessment", in: R. Surampalli, T. Zhang, M.K. Goyal, S. Brar, R. Tyagi (eds.), *Sustainability*, John Wiley & Sons, Ltd, pp.83-110, https://doi.org/10.1002/9781119434016.ch5.

Kumar, R.R., Stauvermann, P.J. (2024), "Environmental Injustice: The Effects of Environmental Taxes on Income Distribution in an Oligopolistic General Equilibrium Model", *Sustainability*, Vol. 16, No 10, 4142, https://doi.org/10.3390/su16104142.

Kunal, P.K., Ramprakash, D.K.R., Prasad, A.R. (2025), "Assessments of Environmental Sustainability and Its Financial Impact on Indian Economy", *International Journal of Environmental Sciences*, Vol. 11, No 1, pp.165-174, https://doi.org/10.64252/jjfbtz07.

Kwon, Y., Jang, Y. and An, J. (2025), "From short-term profitability to long-term sustainability: exploring life cycle cost in chemical processes", *Cleaner Environmental Systems*, Vol. 19, 100358, https://doi.org/10.1016/j.cesys.2025.100358.

Lekavičius, V., Bobinaitė, V., Kliaugaitė, D., Rimkūnaitė, K. (2023a), "Socioeconomic Impacts of Food Waste Reduction in the European Union", *Sustainability*, Vol. 15, No 13, 10151, https://doi.org/10.3390/su151310151.

Lekavičius, V., Bobinaitė, V., Balsiūnaitė, R., Rimkūnaitė, K., Vasauskaitė, J. (2023b), "Socioeconomic impacts of sustainability practices in the production and use of carrier bags", *Sustainability*, Vol. 15, No 15), 12060, https://doi.org/10.3390/su151512060.

Li, T., Liu, H., Zhu, Y., Wei, G. (2024), 'Comparative Assessment of the Environmental and Economic Performance of Two Straw Utilization Pathways in China', *BioEnergy Research*, Vol. 17, No 4, pp.2164-2176, https://doi.org/10.1007/s12155-024-10784-x.

Liberati, A. Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., Clarke, M., Devereaux, P.J., Kleijnen, J., Moher, D. (2009), "The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration", *PLOS Medicine*, Vol. 6, No 7, e1000100, https://doi.org/10.1371/journal.pmed.1000100.

Linton, D. (2024) 'The Uncertainty Problem in Cost-Benefit Analysis Expanded: A Current Review', *Journal of Economic Impact*, Vol. 6, No 1, pp.21-26, https://doi.org/10.52223/econimpact.2024.6103.

Liu, X., Yuan, X. (2023), "Novel research methods for energy use, carbon emissions, and economic growth: evidence from the USA", *Economic Research-Ekonomska Istraživanja*, Vol. 36, No 1, pp.1735-1750, https://doi.org/10.1080/1331677X.2022.2092763.

Liu, Y., Li, Y., Jiang, F., Yin, Sh. (2024), "Diversifying natural resources for green recovery in China: Strategies and solutions", *Resources Policy*, Vol. 88, 104399, https://doi.org/10.1016/j.resourpol.2023.104399.

Long, X., Naminse, E. Y., Du, J., Zhuang, J. (2015), "Nonrenewable energy, renewable energy, carbon dioxide emissions and economic growth in China from 1952 to 2012", *Renewable and Sustainable Energy Reviews*, Vol. 52, pp.680-688, https://doi.org/10.1016/j.rser.2015.07.176.

Majeed, M.T., Anwar, A., Luni, T. (2021), "The impact of renewable and non-renewable energy consumption on economic growth: A global perspective with developed and developing economies", available at, https://share.google/0Ka4b0x2qjOU4ggKx, referred on 3/11/2025.

Martínez-Lage, I., Vázquez-Burgo, P., Velay-Lizancos, M. (2020), "Sustainability evaluation of concretes with mixed recycled aggregate based on holistic approach: Technical, economic and environmental analysis", *Waste Management*, Vol 104, pp.9-19, https://doi.org/10.1016/j.wasman.2019.12.044.

Mata, M.N., Oladipupo, S.D., Husam, R., Ferrão, J. A., Altuntaş, M., Martins, J. N., Kirikkaleli, D., Dantas, R. M., Lourenço, A. M. (2021), "Another Look into the Relationship between Economic Growth, Carbon Emissions, Agriculture and Urbanization in Thailand: A Frequency Domain Analysis", *Energies*, Vol. 14, No 16, 5132, https://doi.org/10.3390/en14165132.

Mattas, K., Loizou, E., Tzouvelekas, V. (2009), "Rural Development Through Input-output Modeling", in: P. Papajorgji, (ed.), *Advances in Modeling Agricultural Systems. Boston*, MA: Springer US, pp.273-295, https://doi.org/10.1007/978-0-387-75181-8_13.

McEwen, T. (2013), "An Examination of the Barriers That Impact the Implementation of Environmental Sustainability Practices in Small Businesses", *Journal of Business and Entrepreneurship*, available at, https://www.semanticscholar.org/paper/An-Examination-of-the-Barriers-That-Impact-the-of-McEwen/e6f8a6bd8e1475bcabb92079bcb01ada165e93ee, referred on 3/11/2025.

Meglin, R., Kytzia, S, Habers, G, (2021), "Regional circular economy of building materials: Environmental and economic assessment combining Material Flow Analysis, Input-Output Analyses, and Life Cycle Assessment", *Journal of Industrial Ecology*, available at, https://onlinelibrary.wiley.com/doi/10.1111/jiec.13205, referred on 6/02/2026.

Mercenier, J., Schmitt, N. (1995), "On Sunk Costs and Trade Liberalization in Applied General Equilibrium", *Federal Reserve Bank of Minneapolis*, available at, https://doi.org/10.21034/sr.188, referred on 13/11/2025.

Miśkiewicz, R. (2020), "Efficiency of Electricity Production Technology from Post-Process Gas Heat: Ecological, Economic and Social Benefits", *Energies*, Vol. 13, No 22, 6106, https://doi.org/10.3390/en13226106.

Mohamed, M.S., Sun, H., Tariq, G. (2023*), Clean Energy Consumption and Economic Growth: Using Obor Countries*, available at, https://share.google/pI0CnHeHADYGEzyp2, referred on 13/11/2025.

Moins, B., France, C., Van den bergh, W., Audenaert, A. (2020), "Implementing life cycle cost analysis in road engineering: A critical review on methodological framework choices", *Renewable and Sustainable Energy Reviews*, Vol. 133, 110284, https://doi.org/10.1016/j.rser.2020.110284.

Morosan-Danila, L., Grigoras-Ichim, C.-E. (2020), "Cost-Benefit Analysis - Between Opportunity and Limits", *Asociaţia de Cooperare Cultural-Educaţională Suceava*, No 2, available at, https://www.ceeol.com/search/article-detail?id=1051558, referred on 05/01/2026.

Musharavati, F., Sajid, K., Anwer, I., Nizami, A.-S., Javed, M.H., Ahmad, A., Naqvi, M (2023), "Advancing Biodiesel Production System from Mixed Vegetable Oil Waste: A Life Cycle Assessment of Environmental and Economic Outcomes", *Sustainability*, Vol. 15, No 24, 16550, https://doi.org/10.3390/su152416550.

Navarrete-Molina, C., C.A. Meza-Herrera, M.A. Herrera-Machuca, N. Lopez-Villalobos, A. Lopez-Santos, F.G. Veliz-Deras, (2019), "To beef or not to beef: Unveiling the economic environmental impact generated by the intensive beef cattle industry in an arid region", *Journal of Cleaner Production*, Vol. 231, pp.1027-1035, https://doi.org/10.1016/j.jclepro.2019.05.267.

Neary, J.P. (2002), *The road less travelled: Oligopoly and competition policy in general equilibrium*, University College Dublin, Department of Economics, Dublin, available at, https://www.econstor.eu/bitstream/10419/72318/1/356590321.pdf, referred on 01/01/2026.

Neugebauer, S., Forin, S., Finkbeiner, M. (2016), "From Life Cycle Costing to Economic Life Cycle Assessment—Introducing an Economic Impact Pathway", *Sustainability*, Vol. 8, No 5, 428, https://doi.org/10.3390/su8050428.

Nkoro, E., Uko, A.K. (1995), *Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation*, available at, https://share.google/tbGgPuFUOBKr3kbHy, 10/07/2025.

Ntanos, S., Skordoulis, M., Kyriakopoulos, G., Arabatzis, G., Chalikias, M., Galatsidas, S., Batzios, A., Katsarou, A. (2018), "Renewable Energy and Economic Growth: Evidence from European Countries", *Sustainability*, Vol. 10, No 8, 2626, https://doi.org/10.3390/su10082626.

Nunkoo, R., Ramkissoon, H. (2012), "Structural equation modelling and regression analysis in tourism research", *Current Issues in Tourism*, Vol. 15, No 8, pp.777-802, https://doi.org/10.1080/13683500.2011.641947.

Okuyama, Y. (2004), "Modeling spatial economic impacts of an earthquake: input-output approaches", *Disaster Prevention and Management*, Vol. 13, No 4, pp.297-306, https://doi.org/10.1108/09653560410556519.

Omri, A., Ben Mabrouk, N., Sassi-Tmar, A. (2015), "Modeling the causal linkages between nuclear energy, renewable energy and economic growth in developed and developing countries", *Renewable and Sustainable Energy Reviews*, Vol. 42, pp.1012-1022, https://doi.org/10.1016/j.rser.2014.10.046.

Ondrich, J., Ruggiero, J. (2002), "Outlier detection in data envelopment analysis: an analysis of jackknifing", *Journal of the Operational Research Society*, Vol. 53, No 3, pp.342-346, https://doi.org/10.1057/palgrave.jors.2601290.

Oosterhaven, J. (2017), "On the limited usability of the inoperability IO model*", *Economic Systems Research*, Vol. 29, No 3, pp.452-461, https://doi.org/10.1080/09535314.2017.1301395.

Page, M.J., Moher, D. (2017), "Evaluations of the uptake and impact of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement and extensions: a scoping review", *Systematic Reviews*, Vol. 6, No 1, 263, https://doi.org/10.1186/s13643-017-0663-8.

Peçe, M.A., Ceyhan, S., Kamacı, A., Cengiz, V. (2023), "The effects of renewable energy sources on Turkiye's economic growth: ARDL estimation", *Environmental Science and Pollution Research*, Vol. 30, No 15, pp.45112-45122, https://doi.org/10.1007/s11356-023-25479-7.

Pegkas, P. (2020), "The impact of renewable and non-renewable energy consumption on economic growth: the case of Greece", *International Journal of Sustainable Energy*, Vol. 39, No 4, pp.380-395, https://doi.org/10.1080/14786451.2019.1700261.

Pelletier, N., Ardente, F., Brandão, M., Camillis, C., Pennington, D. (2015), "Rationales for and limitations of preferred solutions for multi-functionality problems in LCA: is increased consistency possible?", *The International Journal of Life Cycle Assessment*, Vol. 20, No 1, pp.74-86, https://doi.org/10.1007/s11367-014-0812-4.

Pierson, C.A. (2009), "The PRISMA Statement: What does it mean for nurse authors, reviewers, and editors?", *Nurse Author & Editor*, Vol. 19, No 4, pp.1-2, https://doi.org/10.1111/j.1750-4910.2009.tb00101.x.

Rahman, M.M., Velayutham, E. (2020), "Renewable and non-renewable energy consumption-economic growth nexus: New evidence from South Asia", *Renewable Energy*, Vol. 147, pp.399-408, https://doi.org/10.1016/j.renene.2019.09.007.

Razzaq, A., Sharif, A., Najmi, A., Tseng, M., Lim, M.K. (2021), "Dynamic and causality interrelationships from municipal solid waste recycling to economic growth, carbon emissions and energy efficiency using a novel bootstrapping autoregressive distributed lag', Resources", *Conservation and Recycling*, Vol 166, 105372, https://doi.org/10.1016/j.resconrec.2020.105372.

Rovithis, D. (2013), "Do health economic evaluations using observational data provide reliable assessment of treatment effects?", *Health Economics Review*, Vol. 3, No 1, 21, https://doi.org/10.1016/j.resconrec.2020.105372.

Sahani, S.K., Jha, A., Sahani, K., Prasad, K.S. (2023), "Economic Insights Unveiled: A Journey through Input-Output Analysis in Non-Linear Mathematics", *Journal of Multidisciplinary Science: MIKAILALSYS*, Vol. 1, No 3, pp.240-259, https://doi.org/10.58578/mikailalsys.v1i3.1865.

Sahlian, D.N., Popa, A.F., Creţu, R.F. (2021), "Does the Increase in Renewable Energy Influence GDP Growth? An EU-28 Analysis", *Energies*, Vol. 14, No 16, 4762, https://doi.org/10.3390/en14164762.

Salari, M., Kelly, I., Doytch, N., Javid, R.J. (2021), "Economic growth and renewable and non-renewable energy consumption: Evidence from the U.S. states", *Renewable Energy*, Vol. 178, pp.50-65, https://doi.org/10.1016/j.renene.2021.06.016.

Saltelli, A., Czarnecka, M.K., Piano, S.L., Lorincz, M.J., Olczyk, M., Puy, A., Reinert, E., Smith, S.Th., Sluijs, J. (2022), *A New Gaze for Impact Assessment Practices in the European Union*, Rochester, NY: Social Science Research Network, https://doi.org/10.2139/ssrn.4157018.

Samnani, S., Vaska, M., Ahmed, S., Turin, T.C. (2017), "Review Typology: The Basic Types of Reviews for Synthesizing Evidence for the Purpose of Knowledge Translation", *Journal of the College of Physicians and Surgeons--Pakistan : JCPSP*, available at, https://www.semanticscholar.org/paper/Review-Typology%3A-The-Basic-Types-of-Reviews-for-for-Samnani-Vaska/439e140795c1a3d15226fd0416c198ce09d59869, referred on 8/08/2025.

Sard, M., Valle, E. (2024), "Tourism degrowth: quantification of its economic impact", *Current Issues in Tourism*, Vol. 27, No 22, pp.3786-3801, https://doi.org/10.1080/13683500.2024.2316201.

Sarkodie, S.A., Owusu, P.A. (2020), "How to apply the novel dynamic ARDL simulations (dynardl) and Kernel-based regularized least squares (krls)", *MethodsX*, Vol. 7, 101160, https://doi.org/10.1016/j.mex.2020.101160.

Scown, C.D., Baral, N.R., Yang, M., Vora, N., Huntington, T. (2021), "Technoeconomic analysis for biofuels and bioproducts", *Current Opinion in Biotechnology*, Vol. 67, pp.58-64, https://doi.org/10.1016/j.copbio.2021.01.002.

Scrieciu, S. (2007), "How Useful are Computable General Equilibrium Models for Sustainability Impact Assessment?", in: Impact Assessment and Sustainable Development. Edward Elgar Publishing, available at, https://china.elgaronline.com/edcollchap/9781845427870.00016.xml, referred on 19/11/2025.

Shakelly, N., Li, Zh., Deng, S., Sutherland, J.W. (2024), "Effect of key economic uncertainties on the techno-economic performance of the production of high energy-content jet fuel blending components derived from bio-ethanol", *Sustainable Energy Technologies and Assessments*, Vol. 65, 103747, https://doi.org/10.1016/j.seta.2024.103747.

Sheng, Y., Yu, Y. (2024), "Evaluating the Economic Impact of Special Economic Zones on GDP per Capita in China: A Difference-in-Differences Approach", *Transactions on Economics, Business and Management Research*, Vol. 8, pp.327-337, https://doi.org/10.62051/1yp6kr18.

Syzdykova, A., Abubakirova, A., Erdal, F.B., Sarapova, A., Zhetbayev, Zh. (2021), "Analysis of the Relationship Between Renewable Energy and Economic Growth in Selected Developing Countries", *International Journal of Energy Economics and Policy*, Vol. 11, No 1, pp.110-116.

Telly, Y., Liu, X. (2023), "Analysis of the impact of renewable energy use on GDP and employment in Angola: An error correction model approach", *Journal of Economics and International Finance*, Vol. 15, No 1, pp.22-36, https://doi.org/10.5897/JEIF2023.1189.

Tennakoon, W.D.N.M.S., Janadari, M.P.N., Wattuhewa, I.D. (2024), "Environmental sustainability practices: A systematic literature review", *European Journal of Sustainable Development Research*, Vol. 8, No 3, em0259, https://doi.org/10.29333/ejosdr/14604.

Tennakoon, W.D.N.S.M., Janadari, M.P.N. (2022), "Measuring Economic Sustainability: Are we doing it Right?", *Sri Lanka Journal of Social Sciences and Humanities*, Vol. 2, No 1, https://doi.org/10.4038/sljssh.v2i1.53.

Tomarken, A.J., Waller, N.G. (2005), "Structural Equation Modeling: Strengths, Limitations, and Misconceptions", *Annual Review of Clinical Psychology*, Vol. 1, No 2005, pp.31-65, https://doi.org/10.1146/annurev.clinpsy.1.102803.144239.

Tuna, G., Tuna, V.E. (2019), "The asymmetric causal relationship between renewable and non-renewable energy consumption and economic growth in the ASEAN-5 countries", *Resources Policy*, Vol 62, pp.114-124, https://doi.org/10.1016/j.resourpol.2019.03.010.

Udeagha, M.C., Ngepah, N.N. (2021), *A step Towards Environmental Mitigation In South Africa: Does Trade Liberalisation Really Matter? Fresh Evidence From A Novel Dynamic ARDL Simulations Approach*, Research Square, https://doi.org/10.21203/rs.3.rs-419113/v1.

Ukpoju, E.A., Adefemi, A., Adegbite, A.O., Balogun, O.D., Obaedo, B.O., Abatan, A. (2024), "A review of sustainable environmental practices and their impact on U. S. economic sustainability", *World Journal of Advanced Research and Reviews*, Vol. 21, No 1, pp.384-392, https://doi.org/10.30574/wjarr.2024.21.1.2717.

Uku, S., Shehu, E. (2024), "Theoretical Background of Input-Output Analysis and its Application in Albania", *European Scientific Journal*, ESJ, Vol. 20, No 16, pp.161-161, https://doi.org/10.19044/esj.2024.v20n16p161.

United Nations (2025), *Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development,* United Nations Environment Programme, Renewable Energy and

Finance Unit, available at, https://unstats.un.org/sdgs/indicators/Global-Indicator-Framework-after-2025-review-English.pdf, referred on 12/02/2026.

Van, M.H. (2021), "The Role of Financial Development in the Relationship Between Income Inequality and Economic Growth: Evidence from Method of Moments Quantile Regression", *İzmir İktisat Dergisi*, Vol. 36, No 3, pp.725-737, https://doi.org/10.24988/ije.202136315.

Wang, J., Zhang, S., Zhang, Q. (2021), "The relationship of renewable energy consumption to financial development and economic growth in China", *Renewable Energy*, Vol 170, pp.897-904, https://doi.org/10.1016/j.renene.2021.02.038.

Wang, S., Li, W., Zhang, Y., Song, M., Chen, X., Cui, L. (2024), "The impact of a natural resource protection policy on economic development: Based on a policy evaluation of China's coal resource tax reform", *Energy Policy*, Vol. 192, 114213, https://doi.org/10.1016/j.enpol.2024.114213.

Wei, X., Mohsin, M., Zhang, Q. (2022), "Role of foreign direct investment and economic growth in renewable energy development", *Renewable Energy*, Vol. 192, pp.828-837, https://doi.org/10.1016/j.renene.2022.04.062.

Wei, Y., Zhang, L., Guo, X., Yang, T. (2021), "A theoretical and simulation analysis on the power of the frequency domain causality test", *Statistics & Probability Letters*, Vol. 170, 108970, https://doi.org/10.1016/j.spl.2020.108970.

Weisbrod, G., Simmonds, D., Consultancy, D.S. (2011), *Defining Economic Impact And Benefit Metrics From Multiple Perspectives: Lessons To Be Learned From Both Sides Of The Atlantic*, available at, weisbrod-simmonds-etc-oct2011r.pdf, referred on 09/01/2026.

Wyk, L.V., Saayman, M., Rossouw, R., Saayman, A. (2015), "Regional economic impacts of events: A comparison of methods", *South African Journal of Economic and Management Sciences*, Vol. 18, No 2, pp.155-176, https://doi.org/10.4102/sajems.v18i2.593.

Xiang, H., Ch.P., Nawaz, M.A., Chupradit, S., Fatima, A., Sadiq, M. (2021), "Integration and economic viability of fueling the future with green hydrogen: An integration of its determinants from renewable economics", *International Journal of Hydrogen Energy*, Vol. 46, No 77, pp.38145-38162, https://doi.org/10.1016/j.ijhydene.2021.09.067.

Xu, X., Xu, X., Chen, Q., Che, Y. (2015), "The impact on regional "resource curse" by coal resource tax reform in China—A dynamic CGE appraisal", *Resources Policy*, Vol. 45, pp.277-289, https://doi.org/10.1016/j.resourpol.2015.06.007.

Yang, L., Shahzadi, I., Feng, X., Nassani, A.A. (2024), "Do climate change policies, and environmental regulations affect the financial performance: policy-based analysis in context of green innovation", *Environment, Development and Sustainability*, Vol. 26, No 12, pp.32137-32161, https://doi.org/10.1007/s10668-024-04834-9.

Yang, R., Kang, S., Ozer, H., Al-Qadi, I.L. (2015), "Environmental and economic analyses of recycled asphalt concrete mixtures based on material production and potential performance", *Resources, Conservation and Recycling*, Vol. 104, pp.141-151, https://doi.org/10.1016/j.resconrec.2015.08.014.

Yang, X., Zhang, Ch., Li, X., Cao, Zh., Wang, P., Wang, H., Liu, G., Xia, Zh., Zhu, D., Chen, W. (2024), "Multinational dynamic steel cycle analysis reveals sequential decoupling between material use and economic growth", *Ecological Economics*, Vol. 217, 108092, https://doi.org/10.1016/j.ecolecon.2023.108092.

Yao, S., Zhang, S., Zhang, X. (2019), "Renewable energy, carbon emission and economic growth: A revised environmental Kuznets Curve perspective", *Journal of Cleaner Production*, Vol. 235, pp.1338-1352, https://doi.org/10.1016/j.jclepro.2019.07.069.

Yazdizadeh, B., Majdzadeh, R., Salmasian, H. (2010), "Systematic review of methods for evaluating healthcare research economic impact", *Health Research Policy and Systems*, Vol. 8, No 1, 6, https://doi.org/10.1186/1478-4505-8-6.

Ye, M., Wang, K., Wang, X. (2023), "Green finance, economic growth, and carbon emissions: a PVAR analysis", *Environmental Science and Pollution Research*, Vol. 30, No 56, pp.119419-119433, https://doi.org/10.1007/s11356-023-30719-x.

Ye, M., Ching, T.C. (2022), "Research economic impact of big data technology on sustainable production and consumption in live streaming e-commerce consumer behaviors", in: International Conference on Cyber Security, Artificial Intelligence, and Digital Economy (CSAIDE 2022). International Conference on Cyber Security, Artificial Intelligence, and Digital Economy (CSAIDE 2022), SPIE, pp.521-536, https://doi.org/10.1117/12.2646275.

Yıldırım, D.Ç., Yıldırım S., Demirtas I. (2019), "Investigating energy consumption and economic growth for BRICS-T countries", *World Journal of Science, Technology and Sustainable Development*, Vol. 16 No 4 pp.184-195, https://doi.org/10.1108/WJSTSD-12-2018-0063, referred on 13/02/2026.

Yin, X., Xu, Z. (2022), "An empirical analysis of the coupling and coordinative development of China's green finance and economic growth", *Resources Policy*, Vol. 75, 102476, https://doi.org/10.1016/j.resourpol.2021.102476.

Yong, Z.J., Bashir, M.J.K., Hassan, M.S. (2020), "Assessment of environmental, energy and economic prospective of anaerobic digestion of organic municipal solid waste in Malaysia*", IOP Conference Series: Earth and Environmental Science*, Vol. 463, No 1, 012054, https://doi.org/10.1088/1755-1315/463/1/012054.

Yu, H. (2018), "A review of input-output models on multisectoral modelling of transportation–economic linkages", *Transport Reviews*, Vol. 38, No 5, pp.654-677, https://doi.org/10.1080/01441647.2017.1406557.

Zeraibi, A., Balsalobre-Lorente, D., Murshed, M. (2021), "The influences of renewable electricity generation, technological innovation, financial development, and economic growth on ecological footprints in ASEAN-5 countries", *Environmental Science and Pollution Research*, Vol. 28, No 37, pp.51003-51021, https://doi.org/10.1007/s11356-021-14301-x.

Acknowledgements

During the preparation of this work, the author(s) used ChatGPT to polish some formulations in the text. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the article. Author contributions: Rimantė Balsiūnaitė: conceptualization, methodology, formal analysis, investigation, writing - original draft, writing - review & editing, visualization. Vidas Lekavičius: methodology, review & editing. Irma Petrusevičienė: review & editing.

APLINKOS TVARUMO PRAKTIKŲ EKONOMINIO POVEIKIO VERTINIMAS: SISTEMINĖ LITERATŪROS APŽVALGA

Rimantė Balsiūnaitė, Vidas Lekavičius, Irma Petrusevičienė

Santrauka. Straipsnyje apžvelgiama metodologija, kurią sudaro metodai, taikomi aplinkos tvarumo praktikos ekonominiam poveikiui įvertinti. Atliekama sisteminė literatūros apžvalga, taikoma SALSA sistema ir PRISMA gairės. Analizė atskleidė, kad dauguma tyrimų yra sutelkti į tokias sritis kaip atsinaujinančiosios energijos naudojimas, atliekų tvarkymas, aplinkosaugos mokesčiai ir žiedinė ekonomika, o energijos vartojimo efektyvumas bei žaliasis finansavimas sulaukia palyginti mažiau mokslininkų dėmesio. Apžvalgoje taip pat atkreipiamas dėmesys į nedidelį skaičių tyrimų, kuriuose tiesiogiai lyginamas skirtingas tvarumas. Dažniausiai taikomi analitiniai metodai apima ekonometrinę analizę, skaičiuojamus bendrosios pusiausvyros (BPT) modelius ir gyvavimo ciklo metodus – gyvavimo ciklo sąnaudų apskaičiavimą (LCC) ir gyvavimo ciklo vertinimą (LCA). Ekonometriniai metodai plačiai pasitelkiami statistiniams ryšiams ir priežastiniam poveikiui nustatyti, LCC ir LCA suteikia produkto lygmens įžvalgų apie aplinkosauginį ir ekonominį veiksmingumą, o BPT modeliai fiksuoja visos ekonomikos poveikį ir sektorių sąveiką. Tyrimo metu nustatytos kelios metodologinės spragos, tarp jų – ribota holistinė ekonometrinė analizė, integruotų metodologinių sistemų, sujungiančių kelis metodus, trūkumas ir nepakankamas tvarumo praktikos, sprendžiančios pasaulinius aplinkosaugos iššūkius, lyginamasis vertinimas.

Reikšminiai žodžiai: aplinkosaugos atskaitomybė (ER); įmonių socialinė atsakomybė (CSR); įmonių valdymas (CG); suinteresuotųjų šalių teorija.