

Designing an Integrated Circular Economy Model for Angola (MIECA): Environmental Innovation, Green Job Creation, and Economic Diversification

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Abstract

This article offers a critical synthesis of *Conceção de um Modelo Integrado de Economia Circular para Angola* (Komba Muizu, 2026), which designs an Integrated Circular Economy Model for Angola (MIECA). In response to Angola's persistent dependence on oil revenues and the limited valorization of secondary resources, the author proposes a systemic framework articulating eight components—natural resources, production systems, responsible consumption, collection and reverse logistics, recovery, research and innovation, governance and financing, and monitoring and evaluation. A mixed-methods approach (qualitative and quantitative), deployed across five phases, produced four operational instruments: the National Map of Material Flows (NMMF), the Angolan Sectoral Circularity Matrix (ASCM), the Angola Circular Economy Index (ACEI), and the National Circularity Dashboard (NCD). The model underwent an exploratory, illustrative application in the province of Lunda Norte, selected for its representativeness across mining, agriculture, and urban activity; as the source manuscript does not report a realized sample size, response rate, or statistical outputs for this application, it is presented here as a proof-of-concept rather than as a statistically validated result. The findings point to a high potential for valorizing Angola's resources, conditional on strengthening environmental infrastructure, institutional governance, and applied research. The article discusses the scientific and practical scope of MIECA, its methodological limitations, and directions for future research, including its extension to Angola's twenty-one provinces.

Keywords

Circular Economy, Angola, Economic Diversification, Green Jobs,

1. Introduction

1.1. Background and Problem Statement

The twenty-first century is marked by a convergence of environmental, economic, and social crises that call into question development models built on the linear extraction of resources: extract, produce, consume, discard (Nações Unidas, 2015; PNUMA, 2024). Although this linear model sustained industrial growth for several decades, it now displays structural limitations: depletion of natural resources, growing waste production, and mounting pressure on ecosystems (Ellen MacArthur Foundation, 2015; Comissão Europeia, 2020).

The circular economy is increasingly asserting itself as an alternative paradigm capable of reconciling economic growth, technological innovation, social inclusion, and environmental protection, by favoring reduced resource consumption, reuse, recycling, and the regeneration of natural systems (Geissdoerfer et al., 2017; Kirchherr et al., 2017).

For Angola, this transition carries strategic significance. The country holds substantial mineral, agricultural, forestry, fishery, and energy assets, yet its economy remains structurally dependent on oil extraction, exposing it to fluctuations in international markets and constraining the diversification of its productive base (Banco Africano de Desenvolvimento, 2024; Banco Mundial, 2024). Rapid urbanization, growing pressure on public infrastructure, and the limited valorization of urban, agricultural, industrial, and mining waste compound these challenges.

The author further notes the absence, in the existing scientific literature, of an integrated model specifically designed for Angola's realities: available studies tend to focus on isolated sectoral aspects—solid waste management, environmental protection, resource efficiency—without a systemic articulation of the economic, environmental, social, and institutional dimensions of circularity (Kirchherr et al., 2017; Geissdoerfer et al., 2017).

1.2. Research Question

The book formulates the following central question: how can an Integrated Circular Economy Model be designed that is adapted to Angola's economic, social, environmental, and institutional realities, capable of fostering environmental innovation, creating green jobs, increasing efficiency in the use of natural resources, and contributing to the sustainable diversification of the national economy?

1.3. Hypotheses

The general hypothesis holds that implementing the Integrated Circular Economy Model for Angola (MIECA) will foster more efficient use of natural resources,

reduce waste generation, strengthen environmental innovation, stimulate green job creation, and contribute to the sustainable diversification of the Angolan economy. Four specific hypotheses follow, addressing respectively 1) waste valorization as a source of new value chains, 2) the articulation between scientific research, technological innovation, and the productive sector, 3) the strengthening of the institutional framework and governance mechanisms, and 4) increased investment in circular value chains as a lever for reducing oil dependence.

1.4. Objectives

The overall objective is to design MIECA, adapted to national realities, in order to promote environmental innovation, encourage green job creation, and contribute to the sustainable diversification of the Angolan economy. The specific objectives are to:

- analyze the scientific and conceptual foundations of the circular economy;
- assess the potential of the main material and waste flows in Angola;
- identify strategic sectors capable of integrating circular value chains;
- design the architecture, guiding principles, and operating mechanisms of the model;
- develop a framework of monitoring indicators;
- propose strategic recommendations for the various stakeholders.

1.5. Originality of the Research

The main originality of the book lies in the integration of eight interdependent components—natural resources, production systems, responsible consumption, collection and reverse logistics, recovery and transformation, research/innovation/technology, governance and financing, and monitoring/evaluation/continuous improvement (detailed in the MIECA architecture section below)—within a single system, supported by four original operational instruments: the NMMF, the ASCM, the ACEI, and the NCD. These tools are designed to translate the theoretical principles of the circular economy into concrete mechanisms for planning, monitoring, and evaluation adapted to the Angolan context.

1.6. Nature and Scope of This Synthesis

This article is a critical synthesis of an unpublished manuscript by [Komba Muizu \(2026\)](#); it is not an independent empirical study, and the present author have not independently collected or verified the underlying data. All descriptions of the model's architecture, methodology, and pilot application in Lunda Norte reproduce, and critically discuss, what is reported in that source. Where the source manuscript describes an intended methodological protocol (e.g., sampling, questionnaire, interviews, Cronbach's alpha, factor analysis) without reporting the corresponding realized sample size, response rate, or statistical outputs, this synthesis reports that gap explicitly rather than inferring or estimating figures on the source's behalf (see Method and Limitations, below).

2. Method

2.1. Epistemological Paradigm

The study adopts a pragmatic perspective, holding that the complex problems of sustainable development require combining several scientific methods. According to Creswell and Creswell (2023), a mixed-methods approach allows for a fuller understanding of the phenomena under study by combining the interpretive depth of qualitative data with the generalizability of quantitative data. In the Angolan case, this choice is justified by the fact that economic circularity depends not only on statistical indicators but also on institutional capacity, the behavior of economic agents, and environmental and technological culture.

2.2. Type of Research

The research is exploratory in nature (identifying existing initiatives and institutional gaps through document analysis and interviews), descriptive (characterizing material flows, resource use, and productive practices in the mining, agriculture, energy, construction, and urban waste management sectors), analytical (establishing relationships between resource exploitation, economic efficiency, environmental impacts, and circularity levels), and applied, insofar as it aims to develop a concrete planning tool.

2.3. Five-Phase Methodological Strategy

The construction of MIECA proceeded through five phases. Phase I consisted of an in-depth literature review covering the circular economy, sustainable development, ecodesign, life cycle assessment, and circularity indicators, drawing on documents from the United Nations, the European Union, the World Bank, the Ellen MacArthur Foundation, and the OECD.

Phase II carried out a diagnostic assessment of the circular economy in Angola, through analysis of national material flows (domestic extraction, imports, transformation, consumption, exports, waste generation) using the NMMF, along with the development of the ASCM to assess six sectors (mining, agriculture, energy, construction, industry, municipalities).

Phase III focused on building the model itself, integrating a circular database with an indicator system synthesized in the Angola Circular Economy Index (ACEI), calculated using the following general formula:

$$ACEI = \sum_i W_i (\sum_j w_{ij} N_{ij})$$

where W_i represents the weight assigned to each dimension (economic, environmental, social) and N_{ij} the normalized value of each indicator comprising that dimension. The source manuscript proposes that dimension and indicator weights be validated through expert consultation (Delphi method) and the Analytic Hierarchy Process (AHP), and that indicators be normalized on a common scale prior to aggregation; it does not, however, specify a procedure for handling missing data, which we flag here as a gap in the source rather than resolve, since no such

procedure is proposed therein.

For clarity, the two remaining instruments introduced above are defined as follows. The Angolan Sectoral Circularity Matrix (ASCM), developed in Phase II, is the tool used to assess circularity across the six sectors listed above (mining, agriculture, energy, construction, industry, municipalities); it is therefore a sectoral-assessment instrument rather than a composite index. The National Circularity Dashboard (NCD), introduced in Phase V, is intended to track economic, environmental, social, and institutional indicators at national and provincial level, complementing the ACEI's single synthetic score with a fuller, disaggregated performance picture; the source manuscript does not, however, specify the NCD's indicator set or update frequency in further detail.

Phase IV carried out the empirical validation of the model, combining a qualitative validation (semi-structured interviews with government officials, academics, environmental experts, business representatives, and civil society) and a quantitative validation (a structured questionnaire on a five-point Likert scale addressing the importance of the circular economy, institutional capacity, technological availability, business participation, and the viability of the model).

Phase V, finally, allowed the model's architecture to be adjusted and finalized on the basis of the results obtained.

2.4. Population, Sampling and Instruments

The target population comprises public institutions, private companies, universities, environmental organizations, and local communities involved in natural resource management. Sampling combines a purposive approach for experts with a stratified approach across economic sectors. Data collection drew on documentary research (Angolan legislation, institutional reports, national and international statistics), semi-structured interviews, a quantitative questionnaire, and direct sectoral observation.

Qualitative data were analyzed through content analysis and thematic categorization, while quantitative data were processed using descriptive statistics, mean analysis, internal consistency analysis (Cronbach's alpha), and, where applicable, exploratory factor analysis. Content validity was ensured through expert review, methodological validity through triangulation of documentary sources, interviews, and questionnaires, and reliability through Cronbach's alpha coefficient. The study adheres to the ethical principles of informed consent, data confidentiality, and respect for participating institutions. It should be noted that, while the source manuscript specifies this sampling and instrumentation strategy in detail, it does not report the realized number of participants (overall or by stakeholder group and sector), the questionnaire response rate, or the numerical results of the Cronbach's alpha and exploratory factor analysis it describes. In the absence of these figures in the source, the validation reported below (Results, and the Lunda Norte case in particular) should be read as a qualitative, exploratory account rather than as a reproducible statistical validation.

3. Results

3.1. Strategic Diagnosis of Angola's Natural Resources

Angola ranks among the African countries richest in natural resources: oil and gas reserves, diamonds, metallic minerals, extensive farmland, forests, fishery resources (more than 1600 km of coastline), and high potential for renewable energy—hydroelectric, solar, and wind (Agência Internacional de Energia, 2024). This wealth, however, remains insufficiently converted into diversified development: a significant share of the secondary resources generated by agricultural, industrial, mining, and urban activities remains underutilized or is simply discarded as waste.

Sectoral analysis identifies specific circularity opportunities across each strategic sector: valorizing organic residues into fertilizers, compost, biogas, and bioenergy in agriculture; recovering metals and rehabilitating exploited sites environmentally in mining; ecodesign, secondary raw materials, and industrial symbiosis in manufacturing; strengthening selective collection, sorting, and energy recovery in urban centers; and expanding renewable energy alongside the energy recovery of waste in the energy sector.

A SWOT analysis confirms this reading. The identified strengths include an abundance of natural resources, a predominantly young population, and strong renewable energy potential. Weaknesses relate to the low level of industrialization, limited collection and recycling infrastructure, oil dependence, and insufficient environmental statistics. Opportunities concern the creation of green jobs, economic diversification, and the attraction of green investment, while threats stem from climate change, volatility in raw material markets, and the uncontrolled growth of waste production. Six priority sectors emerge from this analysis: agriculture, mining, manufacturing, energy, waste management, and the urban economy (see **Figure 1**).

3.2. MIECA Architecture

MIECA is defined as an integrated system of governance, production, consumption, innovation, and sustainable resource management, organizing flows of materials, energy, information, and knowledge so as to keep resources in circulation for as long as possible. The model rests on eight guiding principles: efficient use of resources, waste prevention, valorization of secondary raw materials, ongoing innovation, collaborative governance, social inclusion (integration of the informal economy), territorial resilience, and continuous monitoring and evaluation.

Its architecture is organized into eight interdependent components: 1) natural resources; 2) production systems; 3) responsible consumption; 4) collection and reverse logistics; 5) recovery and transformation; 6) research, innovation, and technology; 7) governance and financing; 8) monitoring, evaluation, and continuous improvement. Four cross-cutting flows ensure the system's integration: material flows, energy flows, information flows, and knowledge flows (see **Figure 2**).

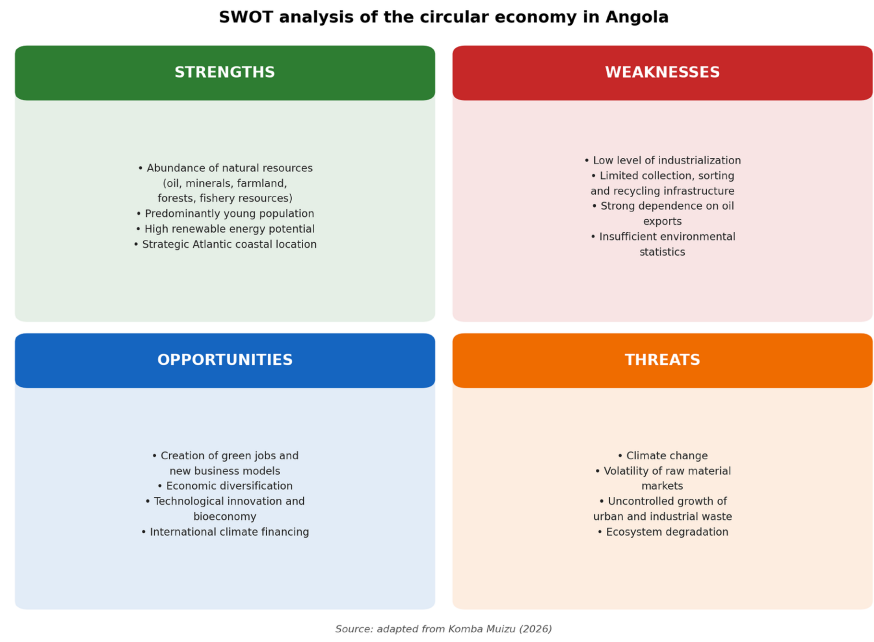


Figure 1. SWOT analysis of the circular economy in Angola. Adapted from Komba Muizu (2026).

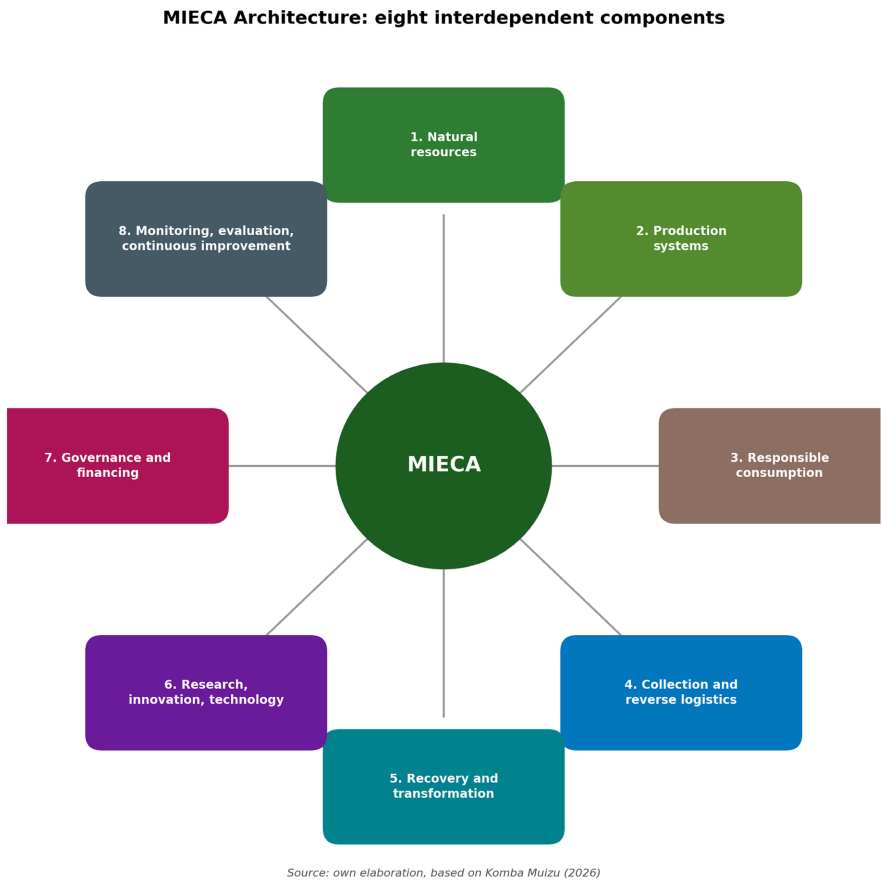


Figure 2. MIECA architecture: eight interdependent components. Own elaboration, based on Komba Muizu (2026).

The model's operational functioning follows a seven-step cycle, from the identification of resources and flows (supported by the NMMF) to institutional learning and continuous improvement, passing through responsible production, selective collection, sorting and recovery, the reintegration of materials into value chains, and performance assessment through indicators (ACEI, ASCM, NMMF, NCD) (see **Figure 3**).

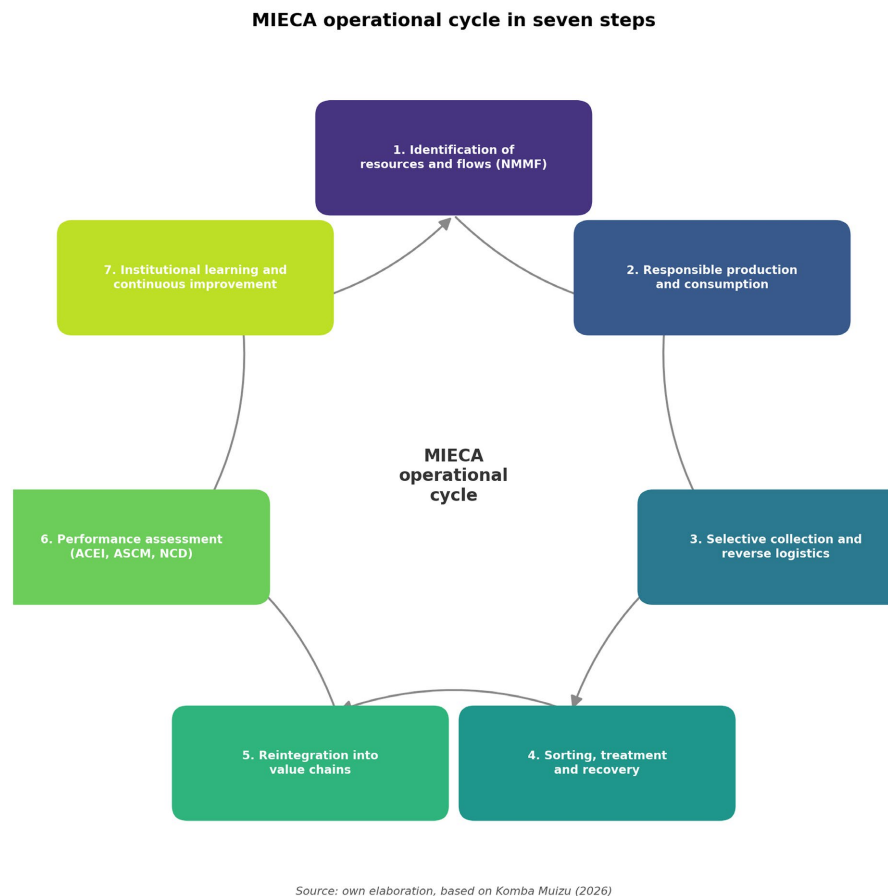


Figure 3. MIECA operational cycle in seven steps. Own elaboration, based on Komba Muizu (2026).

The model engages a broad set of actors—central government, provincial governments, universities, research centers, public and private enterprises, cooperatives, informal-economy operators, financial institutions, and international partners—within a logic of collaborative governance. The author emphasizes that MIECA's scientific added value lies in moving beyond a vision of the circular economy centered solely on recycling, toward an explicit articulation between public policy, clean technologies, research, value chains, green financing, and the integration of the informal economy.

3.3. Empirical Validation: The Lunda Norte Pilot Study

The model was tested, on an exploratory basis, in the province of Lunda Norte,

chosen for its strong mining activity (diamond extraction), its still underexploited agricultural potential, the accelerated urban growth of its capital, Dundo, and its potential for decentralized renewable energy (solar, biomass). The province was treated as a “territorial laboratory of circularity,” allowing observation of cross-sector complementarities: agricultural residues able to feed energy production, urban waste becoming secondary raw material, and the proximity of Lueji A’Nkonde University facilitating applied research.

The sectoral application of MIECA in the province was structured around four priority sectors—mining, agriculture, urban/waste management, and energy. For the mining sector, the proposed strategies include the valorization of mining residues, circular management of industrial water (closed-loop treatment and reuse), the progressive environmental rehabilitation of exploited areas, and the integration of mining with other productive chains, for example the reuse of treated water for agricultural or industrial purposes.

The territorial diagnosis confirms the coexistence of high potential (diamonds and recoverable residues, agricultural biomass, renewable resources, a young population) and structural challenges (extractive dependence, limited local processing, constrained environmental infrastructure, and the need to strengthen human capacities). The author notes that this empirical validation remains exploratory and is intended primarily to demonstrate the model’s operational feasibility rather than to produce definitive statistical results.

4. Discussion

4.1. Scientific and Practical Scope

The findings confirm that Angola possesses favorable natural and strategic conditions for a circular transition, but that realizing this potential remains conditional on strengthening public policy, improving environmental infrastructure, investing in research, and securing the active involvement of the private sector and civil society—a conclusion consistent with international work on resource-dependent economies (OCDE, 2024; PNUMA, 2024). MIECA distinguishes itself from earlier approaches, often centered on sectoral waste management (Kirchherr et al., 2017), through its attempt at systemic integration of the economic, environmental, social, technological, and institutional dimensions, as well as through its explicit recognition of the role of the informal economy—a structuring factor in many African contexts, but one rarely integrated into Western circular-economy models.

The articulation of four complementary operational instruments (NMMF, ASCM, ACEI, NCD) constitutes a notable methodological contribution, as it turns a conceptual framework into a steering tool capable of supporting public decision-making at both national and provincial levels. The choice of Lunda Norte as a pilot site appears sound given the diversity of its economic activities, but it should be noted that the representativeness of a mining, border province for all twenty-one Angolan provinces—whose economic profiles vary considerably—remains to be demonstrated.

4.2. Limitations

The author acknowledges several limitations: the limited availability of harmonized statistical data on material flows in Angola, the absence of sufficiently long historical series for some indicators, the exploratory rather than statistically generalizable nature of the empirical validation, and the need to test the ACEI across all provinces before any generalization. The rapid evolution of circular-economy technologies and policies will also require periodic updates to the model. A further limitation, specific to this synthesis, is that the source manuscript does not report, for the Lunda Norte application, the number of participants, their allocation by stakeholder group and sector, or the response rate of the questionnaire; this absence means the claimed validation cannot, at present, be independently reproduced or statistically assessed, and it should be read as an illustrative case rather than as a completed empirical validation. These limitations suggest that MIECA should be regarded as an evolving reference framework rather than a definitive measurement instrument.

4.3. Implications for Public Policy

The book recommends, among other measures, the adoption of a National Circular Economy Strategy and a corresponding framework law, the establishment of a National Circular Economy Observatory, the integration of the ACEI into the national statistical system, the creation of tax incentives for circular businesses, and the strengthening of cooperation among the State, universities, the private sector, provincial authorities, and international partners. These recommendations align with international guidance on circular-economy governance (Ellen MacArthur Foundation, 2019; OCDE, 2024), while adapting it to Angola's specific institutional context.

5. Conclusion

This synthesis has presented the main contributions of the book devoted to designing the Integrated Circular Economy Model for Angola (MIECA). In response to the structural limitations of Angola's linear economic model—oil dependence, limited waste valorization, and the fragmentation of existing initiatives—the author proposes a systemic framework articulating eight interdependent components, four cross-cutting flow principles, and four original operational instruments (NMMF, ASCM, ACEI, NCD), complemented by a National Circular Economy Governance Framework. The exploratory, illustrative application described for Lunda Norte suggests the model's operational feasibility, without, however, constituting a statistically generalizable, or currently reproducible, empirical validation at the national scale.

The book claims five original scientific contributions: the design of MIECA itself; the creation of the ACEI as a national instrument for measuring circularity; the joint development of the NMMF and the ASCM as decision-support tools; the proposal of a National Circular Economy Governance Framework; and the con-

struction of a replicable methodology, potentially transferable to other African countries sharing similar economic characteristics. The identified avenues for future research include the full statistical validation of the ACEI, the application of the model to Angola's twenty-one provinces, the development of sector-specific circularity indices, and the elaboration of prospective scenarios through 2050.

Ultimately, MIECA presents itself as a scientific, methodological, and operational framework capable of guiding the progressive transformation of the Angolan economy toward a more efficient, resilient, inclusive, and sustainable model—contingent on sustained political commitment, continuous institutional strengthening, and the systematic production of reliable data.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- Banco Africano de Desenvolvimento (2024). *African Economic Outlook 2024*. African Development Bank.
- Banco Mundial (2024). *Angola Economic Update*. World Bank.
- Comissão Europeia (2020). *A New Circular Economy Action Plan: For a Cleaner and More Competitive Europe*. Publications Office of the European Union.
- Creswell, J. W., & Creswell, J. D. (2023). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (6th ed.). SAGE Publications.
- Ellen MacArthur Foundation (2015). *Delivering the Circular Economy: A Toolkit for Policymakers*. Ellen MacArthur Foundation.
- Ellen MacArthur Foundation (2019). *Completing the Picture: How the Circular Economy Tackles Climate Change*. Ellen MacArthur Foundation.
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy—A New Sustainability Paradigm? *Journal of Cleaner Production*, 143, 757-768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the Circular Economy: An Analysis of 114 Definitions. *Resources, Conservation and Recycling*, 127, 221-232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Komba Muizu, A. (2026). *Conceção de um modelo integrado de economia circular para Angola: Inovação ambiental, criação de empregos verdes e diversificação económica*. Universidade Lueji A'Nkonde.
- Nações Unidas (2015). *Transformar o nosso mundo: Agenda 2030 para o desenvolvimento sustentável*. United Nations.
- Organização para a Cooperação e Desenvolvimento Económico OCDE (2024). *The Circular Economy in Cities and Regions*. OECD Publishing.
- Programa das Nações Unidas para o Meio Ambiente (PNUMA) (2024). *Global Waste Management Outlook 2024, ISWA, Nairobi, Kenya*.