

EKOR (CIRCULAR ECONOMY AND GREEN ECONOMY) IN THE PRACTICE OF UTILIZING YOUNG COCONUT WASTE AS ALTERNATIVE ENERGY: REGULATORY ANALYSIS AND IMPLEMENTATION IN INDONESIA

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Abstract. *The transformation towards sustainable development encourages a paradigm shift from a linear economy to the integration of a circular and green economy (EKOR) as a strategic framework for resource and energy management. Indonesia, as an agrarian country, produces large amounts of biomass waste, including young coconut waste, which has not yet been optimally utilized as an alternative energy source. This study aims to analyze the utilization of young coconut waste from the EKOR perspective and to evaluate the regulatory framework and the dynamics of its implementation within the renewable energy system in Indonesia. The research method uses a normative juridical approach with a descriptive-analytical specification, enriched through a conceptual approach and qualitative analysis of legislation, public policy, as well as implementation practices in the agricultural and energy sectors. The research results indicate that normatively, Indonesia already has a relatively progressive regulatory framework to support the circular economy and renewable energy. However, implementation still faces various obstacles, including cross-sector regulatory fragmentation, complexity of licensing, limitations of biomass conversion technology, unclear aspects of ownership and access to waste, as well as weak integration in supply chain governance. This research offers novelty in the form of an integrative EKOR approach based on coconut biomass that connects the dimensions of environmental law, energy policy, and circular economy within a single systemic analysis framework. The resulting policy recommendations include the harmonization of cross-sector regulations, environmental risk-based permit reform, strengthening of ecological performance-based fiscal and non-fiscal incentives, and the development of national technical standards for waste-to-energy utilization. Thus, this study provides theoretical and practical contributions to strengthening strategies for utilizing young coconut waste as a sustainable, inclusive, and equitable alternative energy source.*

Key Words: Circular Economy; Green Economy; Biomass Energy; Environmental Law; Governance.

I. INTRODUCTION

The global environmental crisis, climate change, and increasing pressure on natural resources have driven a transformation in development paradigms from a linear economic

model to a more sustainable approach. The linear economic model, which is oriented towards a take–make–dispose pattern, has proven incapable of addressing the challenges of resource limitations and environmental degradation. In this context, the circular economy and green economy have emerged as strategic approaches that not only emphasize resource use efficiency but also integrate the dimensions of environmental sustainability, economic growth, and social justice.

Ekonomi sirkular berfokus pada upaya mempertahankan nilai material dan energi dalam siklus produksi selama mungkin melalui prinsip *reduce, reuse, recycle*, dan *recovery*. Sementara itu, ekonomi hijau menitikberatkan pada pembangunan rendah karbon, efisiensi sumber daya, dan inklusivitas sosial. Integrasi kedua konsep tersebut dalam kerangka EKOR (Ekonomi Sirkular dan Ekonomi Hijau) menjadi pendekatan komprehensif yang relevan dalam menjawab tantangan pengelolaan limbah dan kebutuhan energi berkelanjutan, khususnya di negara berkembang seperti Indonesia. Sebagai negara agraris dan maritim, Indonesia memiliki potensi biomassa yang sangat besar, termasuk dari sektor perkebunan kelapa. Limbah kelapa muda, yang meliputi tempurung, sabut, dan residu organik lainnya, seringkali belum dimanfaatkan secara optimal dan cenderung menjadi sumber pencemaran lingkungan. Padahal, secara teknis limbah tersebut memiliki nilai kalor yang tinggi dan berpotensi dikonversi menjadi berbagai bentuk energi alternatif, seperti briket biomassa, biochar, maupun biogas. Pemanfaatan limbah kelapa muda sebagai sumber energi tidak hanya mendukung diversifikasi energi nasional, tetapi juga memperkuat ketahanan energi berbasis lokal serta mendorong ekonomi sirkular di tingkat masyarakat. In fact, the waste has a high calorific value and can be converted into various forms of alternative energy, such as biomass briquettes, biochar, and biogas. Utilizing young coconut waste as an energy source not only supports national energy diversification but also strengthens locally-based energy resilience and promotes a circular economy at the community level.

On the other hand, the Indonesian government has shown commitment in promoting sustainable development through various policies, including the development of renewable energy and waste management based on a circular economy. Regulatory frameworks such as the Environmental Protection and Management Law, the Waste Management Law, as well as national energy policies have provided a normative foundation for the development of biomass-based energy. Nevertheless, the implementation of these policies still faces various challenges, including regulatory fragmentation, complexity of licensing, technological limitations, and suboptimal governance of the waste supply chain.

A number of previous studies have examined the circular economy in waste management and biomass energy development, but most are still sectoral and have not integrated legal, economic, and environmental aspects comprehensively within a single analytical framework. In addition, studies on the use of young coconut waste as an alternative energy source are still limited, particularly from the integrative EKOR perspective, which emphasizes the link between regulation, policy incentives, and field implementation.

Based on this, there is a significant research gap in understanding how the EKOR concept can be effectively operationalized in the utilization of coconut biomass waste, particularly from the perspective of law and governance. This study offers novelty in the form of an integrative approach that connects circular economy, green economy, and the renewable energy regulatory framework in the context of utilizing young coconut waste as an alternative energy source.

Thus, this study aims to: (1) analyze the potential utilization of young coconut waste as an alternative energy source from the EKOR perspective; (2) examine the regulatory framework governing waste and renewable energy management in Indonesia; and (3) identify challenges and formulate effective implementation strategies to support the sustainable development of biomass-based energy. The approach used in this study is expected not only to provide theoretical contributions to the development of the EKOR concept but also practical contributions in formulating more integrated, adaptive, and sustainability-oriented policies.

Literature Review

State of the Art Research

Studies on the circular economy and green economy over the past decade have shown significant developments, particularly in the context of waste management and sustainable energy transition. Research by Kirchherr et al. (2017) emphasizes that the circular economy focuses on creating a closed-loop system capable of minimizing waste and maintaining the value of resources within the production cycle. Meanwhile, the green economy approach popularized by the United Nations Environment Programme (UNEP) emphasizes low-carbon development, resource efficiency, and social inclusiveness.

In the context of energy, various studies have examined the use of biomass as an alternative energy source, especially in developing countries that have abundant biological resources. Biomass is considered a strategic solution to reduce dependence on fossil energy while also addressing organic waste problems. However, most studies are still sectoral and fragmented, focusing only on either technical energy aspects or circular economy aspects separately. Research that integrates legal, public policy, and governance aspects within the framework of circular economy and biomass energy is still relatively limited. In addition, specific research on the use of young coconut waste as an alternative energy source from the perspective of circular economy and green economy in Indonesia is also still rarely found.

Therefore, this study fills that gap by offering an integrative EKOR approach that connects the legal, economic, and energy dimensions within a single systemic analysis framework.

Circular Economy and Green Economy Theory (EKOR)

Circular economy is an economic paradigm that aims to eliminate the concept of waste through the design of sustainable production and consumption systems. The main principles of the circular economy include: Resource efficiency, Product life extension, Value recovery of materials and energy. In this context, waste is no longer seen as a residue that must be discarded but as a resource with economic value. Meanwhile, the green economy focuses on creating an economic system that is low-carbon, resource-efficient, and socially equitable. The green economy places environmental sustainability as the main foundation for economic development. The integration of the circular economy and the green economy (EKOR) produces a conceptual framework that is not only oriented towards material efficiency but also towards ecological sustainability and social welfare. In this context, the utilization of biomass waste as an alternative energy source is a concrete form of EKOR implementation.

Environmental Law Theory and Resource Regulation

From a legal perspective, waste management and the utilization of renewable energy cannot be separated from environmental law principles. Some of the main relevant theories include:

a. Principle of Sustainable Development

This principle emphasizes a balance between economic, social, and environmental aspects in development. In the context of EKOR, this principle serves as a normative basis for utilizing waste as an energy source without harming the environment.

b. Precautionary Principle

This principle requires preventive actions in facing potential environmental damage, even if there is not yet absolute scientific certainty. In biomass processing, this principle is important to ensure that the technology used does not cause new negative impacts.

c. Polluter Pays Principle

This principle emphasizes that the party generating waste is responsible for its management. Within the framework of the circular economy, this principle has evolved into the extended producer responsibility (EPR) approach, where producers are responsible for the entire life cycle of their products.

d. Responsive Law Theory

According to Nonet and Selznick, responsive law emphasizes the ability of the law to adapt to social needs. In the context of the circular economy, the law must be able to encourage innovation, provide incentives, and facilitate collaboration among stakeholders.

e. Governance Theory

The management of resources and energy does not rely solely on formal regulations, but also on governance involving various actors, including the government, the private sector, and society. Transparency, accountability, and participation become key elements in implementing the EKOR policy.

Biomass Energy and Waste-to-Energy Theory

Biomass energy is energy produced from organic materials, including agricultural and plantation waste. In the context of a circular economy, biomass plays a crucial role as a naturally renewable energy source.

a. Characteristics of Coconut Biomass

Coconut waste has several advantages:

- High lignocellulose content
- Relatively high calorific value
- Sustainable availability

b. Energy Conversion Technology

Coconut waste can be utilized through various technologies, including:

- Pyrolysis → produces biochar and bio-oil
- Gasification → produces synthetic gas (syngas)
- Anaerobic digestion → produces biogas
- Densification → produces biomass briquettes

c. Waste-to-Energy (WtE) Concept WtE is an approach that converts waste into energy through thermal and biological processes. Within the EKOR framework, WtE serves not only as an energy solution but also as a strategy for waste reduction and economic value enhancement.

Research Conceptual Framework

Based on the theoretical review above, this research develops the following conceptual framework:

- Input: Young coconut waste (biomass)
- Process: Technology-based energy processing (WtE)

- Regulation: Environmental law + energy policy
 - Approach: EKOR (circular economy + green economy)
 - Output: Sustainable alternative energy + economic value + social benefits
- This framework emphasizes that the success of EKOR implementation is largely determined by the interaction between regulatory, technological, and governance aspects.

Research Position and Contribution

This research holds a strategic position in the literature because:

1. It integrates the circular economy and the green economy within a single ETEK framework.
2. It specifically examines the use of young coconut waste as an alternative energy source.
3. It comprehensively connects legal, policy, and implementation aspects.
4. Therefore, this research contributes: Theoretical: development of the biomass-based ETCO concept
 - Normative: more integrated regulatory analysis
 - Practical: implementation policy recommendations

II. RESEARCH METHOD

Research Design

This research uses a normative-judicial design with descriptive-analytical specifications. It aims to systematically examine the regulatory framework and implementation of young coconut waste utilization as an alternative energy source from a Circular Economy and Green Economy (EKOR) perspective. This approach was chosen because the research focuses on analyzing legal norms and public policies, and their alignment with field practices.

To enhance the depth of analysis, this research also integrates conceptual and qualitative interpretive approaches, allowing for exploration of the interrelationships between legal norms, circular economy theory, and biomass energy utilization practices.

Research Approach

This research uses several main approaches, namely:

1. Statute Approach
Used to analyze various laws and regulations related to:
 - Waste management
 - Environmental protection
 - Renewable energy and biomass
2. Conceptual Approach
Used to examine the EKOR concept as an integration of the circular economy and the green economy, and its relevance to sustainable development.
3. Analytical Approach
Used to evaluate the consistency, synchronization, and effectiveness of regulations in supporting the implementation of coconut waste utilization as an alternative energy source.
4. Limited Comparative Approach
Used selectively to compare circular economy and biomass energy policy practices in other countries as a normative benchmark.

Data Types and Sources

This research uses secondary data consisting of:

- a. Primary Legal Materials
 - Laws related to the environment and waste management
 - Regulations related to renewable energy and biomass
 - National policies (RPJMN, LCDI, etc.)
- b. Secondary Legal Materials
 - Reputable international journal articles
 - Environmental and energy law textbooks
 - Reports from international institutions (UNEP, World Bank, etc.)
- c. Tertiary Legal Materials
 - Legal dictionaries
 - Encyclopedias
 - Other supporting documents

Data Collection Techniques

Data were collected through:

- Library research
- Searching legal and policy documents
- Reviewing indexed scientific literature (Scopus, WoS, etc.)

To strengthen empirical relevance, this research also included:

- Case-based reviews of biomass waste utilization practices in the tropical agricultural sector.

Data Analysis Techniques

Data analysis was conducted qualitatively with the following stages:

1. Regulatory inventory and classification. Grouping regulations by sector (environment, energy, economics).
2. Legal interpretation. Using the following methods:
 - a. Grammatical
 - b. Systematic
 - c. Teleological
3. Regulatory synchronization and harmonization analysis. Identifying:
 - a. Overlapping regulations
 - b. Legal gaps
 - c. Policy inconsistencies
4. Policy implementation analysis. Examining the gap between norms and practice (law on the books vs. law in action).
5. Conceptual analysis of the EKOR. Integrating the results of the legal analysis with circular economy and biomass energy theory.

Research Validity and Reliability

To ensure scientific quality, this research applies:

1. Source triangulation: Using various legal references and academic literature
2. Consistent normative analysis: Based on standard legal interpretation methods
3. Academic audit trail: Developing a transparent and traceable analysis flow

Research Limitations

This research has several limitations, including:

1. It focuses on normative and conceptual analysis, thus not including empirical quantitative measurements.
 2. The implementation study is based on literature and limited case studies.
 3. It does not discuss the technical aspects of energy engineering in depth.
- However, these limitations do not diminish the research's contribution in providing a comprehensive legal and policy analysis.

Research Analysis Framework

This research uses the following integrative analysis framework:

1. Input Aspect: Young coconut waste as biomass
2. Regulatory Aspect: Environmental law and renewable energy
3. Process Aspect: Energy conversion technology
4. Approach Aspect: EKOR (circular economy + green economy)
5. Output Aspect: Sustainable alternative energy and economic value

This framework enables a multidimensional analysis that systematically links legal norms, public policies, and implementation practices.

III. RESULT AND DISCUSSION

Analysis of Indonesian Regulations (Article-by-Article Normative Approach)

The regulatory framework for the use of young coconut waste as an alternative energy source in Indonesia is not regulated by a single legal instrument, but rather is scattered across various sectoral regulations. Therefore, a systematic analysis of relevant norms was conducted.

Law Number 32 of 2009 concerning Environmental Protection and Management

This law serves as the primary legal umbrella for environmental management in Indonesia. Article 1, number 3, affirms the concept of sustainable development as an integrated effort between environmental, social, and economic aspects.

Analysis:

This concept serves as the normative basis for the implementation of EKOR, as it positions waste utilization as part of sustainability.

Article 2, letters a and b (Principles of State Responsibility and Sustainability) Analysis:

The state has an obligation to ensure that biomass waste is utilized responsibly and sustainably.

Article 67 regulates the obligation of every person to maintain environmental sustainability.

Implication: Unmanaged coconut waste can be considered a violation of legal obligations.

Article 69 paragraph (1) prohibits actions that result in pollution and/or environmental damage.

Critical analysis: The lack of coconut waste processing can be categorized as a potential source of pollution, so its use as energy is a preventative solution.

Law Number 18 of 2008 concerning Waste Management

1. Article 3 states that waste management aims to improve public health and environmental quality and to transform waste into a resource.

Analysis:

This provides a direct basis for a circular economy, including the use of coconut waste as energy.

2. Article 12 regulates the obligation to reduce and handle waste.

Implications:

Coconut waste should be included in reduction schemes through energy conversion.

3. Articles 19–22 (3R-based waste management) Analysis:

This norm still focuses on conventional management and does not explicitly accommodate the waste-to-energy concept comprehensively.

Law Number 30 of 2007 concerning Energy

Article 3, letter b, emphasizes the provision of sustainable energy.

Article 20, paragraph (2), encourages the use of new and renewable energy.

Analysis:

Biomass, including coconut waste, is categorized as renewable energy, but implementation remains limited due to the lack of specific derivative regulations.

National Energy Policy and RPJMN

1. National policy has targeted an increase in the renewable energy mix.

2. The Low Carbon Development Initiative (LCDI) program integrates the circular economy.

Analysis:

At a macro level, policies already support the EKOR, but they have not been operationally integrated at the sectoral level.

Analysis of Real-Life Implementation and the ETOR Model

Real-Life Implementation in the Field

The utilization of young coconut waste in Indonesia is still sporadic and not yet structured nationally. Some practices found include:

1. Production of coconut shell briquettes by MSMEs
2. Utilization of coconut fiber for biochar
3. Processing organic waste into compost

However, its use as an alternative energy source still faces obstacles:

1. Small production scale
2. Technological limitations
3. Limited market access

The EKOR Model for Coconut Waste Utilization

This research proposes the following implementation model for EKOR:

Integrative EKOR Model Based on Coconut Waste

1. Upstream Stage (Production)
 - a. Coconut farmers/sellers generate waste
 - b. Waste collection and classification
2. Processing Stage (Conversion)

Processing into:

 - a. Briquettes
 - b. Biogas
 - c. Biochar
3. Downstream Stage (Energy Distribution)

4. Energy is used for:
 - a. Households
 - b. Small-scale industries
 - c. Micro-scale power plants
5. Governance
 - a. Government: regulations and incentives
 - b. Private sector: investment and technology
 - c. Community: production and distribution

EKOR Values:

- a. Circularity: waste becomes a resource
- b. Sustainability: reducing emissions
- c. Inclusivity: improving the local economy

Critical Legal Analysis

Based on the analysis, there are several fundamental weaknesses:

1. Regulatory Fragmentation
 - a. Regulations are scattered across various sectors without clear integration. Impact: ineffective and overlapping policies.
 - b. Lack of Specific Norms
2. There are no specific regulations regarding:
 - a. Coconut biomass utilization
 - b. Waste ownership status
3. Impact: legal uncertainty for business actors.
 - a. Licensing Complexity
 - b. The biomass energy licensing process remains complicated and multi-layered.
4. Impact: hinders investment.
Weak Economic Incentives
 - a. Minimal subsidies
 - b. No special pricing scheme for biomass energy
5. Impact: less economically attractive.
Limited Technical Standards
6. There are no national standards for:
 - a. Biomass production
 - b. Energy qualityImpact: inconsistent quality.

Policy Solutions and Recommendations

1. Harmonization of EKOR Regulations
 - a. Integration of environmental, energy, and industrial laws
 - b. Establishment of specific regulations for the circular economy
2. Licensing Reform
 - a. Risk-based system (risk-based approach)
 - b. Simplification of biomass business procedures
3. Strengthening Incentives
 - a. Fiscal incentives (tax holidays, subsidies)

- b. Non-fiscal incentives (technology access, training)
- 4. Development of National Standards
 - a. Biomass production standards
 - b. Alternative energy certification
- 5. Village Empowerment Model
 - a. Villages as centers of the circular economy
 - b. Community-based energy development

Synthesis and Discussion

The analysis shows that the successful implementation of EKOR in utilizing young coconut waste depends heavily on three main factors:

1. Strength of the regulatory framework
2. Technological readiness
3. Effective governance capacity

Without the integration of these three aspects, the EKOR concept will be difficult to implement optimally.

IV. CONCLUSION

This research confirms that the use of young coconut waste as an alternative energy source is a concrete manifestation of the integration of the circular economy and the green economy (EKOR) within the framework of sustainable development. Conceptually, the EKOR approach can transform biomass waste into an economically valuable resource while reducing environmental burdens, thus aligning with the principles of resource efficiency, low carbon, and social inclusiveness.

From a normative perspective, Indonesia already has a relatively progressive regulatory foundation through various legal instruments in the areas of the environment, waste management, and energy. However, research findings indicate that this regulatory framework remains sectoral and has not been systemically integrated to support EKOR implementation. Policy fragmentation, the lack of specific norms related to coconut biomass, and the complexity of licensing are contributing factors.

The main factors hindering the optimization of waste utilization as an alternative energy source. At the implementation level, the practice of utilizing young coconut waste is still limited to a small scale and has not been institutionalized in the national energy system. Technological limitations, minimal economic incentives, and weak supply chain governance are significant structural obstacles. Furthermore, unclear ownership and access to waste also create legal uncertainty for businesses and the public.

Thus, this study confirms that the successful implementation of EKOR in the context of biomass energy depends not only on the existence of regulations, but also on cross-sector policy integration, technological readiness, and the effectiveness of adaptive and responsive governance.

Recommendation

Based on the findings and analysis, this study proposes several strategic recommendations, as follows:

1. Regulatory Harmonization and Integration. The government needs to develop an integrated regulatory framework that integrates environmental law, energy policy, and the circular

- economy into a single, coherent system. Establishing specific regulations regarding the circular economy or biomass could be a strategic step to address policy fragmentation.
2. **Licensing System Reform.** Simplification of the licensing mechanism through a risk-based licensing approach is needed to support biomass energy development. This reform must reduce bureaucratic barriers without neglecting environmental protection aspects.
 3. **Strengthening Economic Incentives.** The government needs to provide competitive fiscal and non-fiscal incentives, such as:
 - a. Tax breaks and investment subsidies
 - b. Green financing schemes
 - c. Biomass energy price guaranteesThis step is crucial to increasing the attractiveness of investment in the waste-based energy sector.
 4. **Developing Standards and Infrastructure.** The development of national standards related to biomass conversion technology and the quality of the energy produced is necessary. Furthermore, strengthening waste processing and energy distribution infrastructure is a key prerequisite for scaling up implementation.
 5. **Strengthening Governance and Supply Chains.** The development of collaborative governance models between the government, the private sector, and communities needs to be strengthened to ensure transparency, accountability, and equitable distribution of benefits. The affirmation of waste rights and resource access mechanisms must also be clearly regulated.
 6. **Community and Village Empowerment.** A community-based approach needs to be developed by making villages the center of EKOR implementation. Training programs, technology transfer, and business mentoring can increase community capacity in managing waste into energy.

Research Contribution Confirmation

This research contributes:

1. Theoretically: strengthening the EKOR concept as an integrative framework between the circular economy, green economy, and biomass energy
 2. Normatively: identifying weaknesses and the need for regulatory reform in Indonesia
 3. Practically: providing an implementation model and applicable policy recommendations
- Therefore, this research is expected to serve as a reference in developing more integrated, sustainable, and equitable waste-based renewable energy policies in Indonesia.

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