

**FROM POLICY TO PRACTICE:
IMPLEMENTING CLIMATE-CO
THROUGH PENTAHHELIX COLLABORATION
FOR WASTE MANAGEMENT IN INDONESIA**



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FROM POLICY TO PRACTICE: IMPLEMENTING CLIMATE-CO THROUGH PENTAHELIX COLLABORATION FOR WASTE MANAGEMENT IN INDONESIA

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ABSTRACT

Waste accumulation in Indonesia has become an increasingly urgent issue over the past five years. Population growth, urbanization, and rising consumption patterns have led to a significant increase in waste production. According to data from the Ministry of Environment and Forestry (KLHK), the total volume of waste generated in 2023 reached approximately 68.5 million tons, up from 64 million tons in 2018. Plastic waste is difficult to decompose and has negative environmental impacts about 15-20%. Therefore, a collective commitment is needed to address the increasingly troubling waste issues.

The Pentahelix concept presents a collaborative approach involving five key actors: government, academia, business, community, and media, to tackle waste problems. Each actor plays a strategic role that complements one another in creating holistic and sustainable solutions. The implementation of the Pentahelix concept is expected to create synergy among these actors, which can accelerate the achievement of sustainable waste management. With effective collaboration, waste management becomes a collective responsibility rather than the duty of a single entity, involving all components of society.

Market strategies include leveraging the Pentahelix model by involving investors, media, academic institutions, government, and businesses to promote the adoption of our solution. To address this issue, the author recommends "ClimateCo," a solution that uses an application as a case study for the Pentahelix model to convert waste into e-coin balances. ClimateCo will operate as an intermediary platform connecting the Pentahelix actors.

Therefore, this paper aims to build trust and ensure smooth operations. This innovative business model will also include partnerships with several e-wallet companies in Indonesia to convert waste into e-coin balances, which can be used for various transactions. Additionally, the paper presents a financial plan covering initial capital, operational costs, and profit calculations. It includes positive profit projections with detailed financial metrics, including Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period. These calculations are prepared to ensure the continuity and sustainability of ClimateCo as a long-term environmental solutions.

Keywords: *Pentahelix, Waste, Collaboration, Sustainable, e-Coin, Business, Environment, Society*

INTRODUCTION

Yogyakarta city as one of Indonesia's major tourist cities, faces serious challenges related to the high volume of waste due to population growth, industrial activities, and the rapidly expanding tourism sector. According to data from BAPPEDA (Badan Perencanaan Pembangunan Daerah) DIY, the volume of waste production has continuously increased, from 644.69 tons per day in 2019 to 1,231.55 tons per day in 2023. The majority of this waste originates from households, shops, and other business sectors. Waste management in Yogyakarta has become a primary focus for the local government, with efforts to improve waste management infrastructure and raise public awareness about the importance of reducing, recycling, and responsibly managing waste.

The largest contributor to plastic waste comes from household waste. The accumulation of plastic waste from households is influenced by factors such as the number of household members, education level, and income (Sujauddin et al., 2008). On a larger scale, the volume of plastic waste increases in line with population growth, particularly in major cities like Yogyakarta. According to data from the Yogyakarta City Environmental Agency (DLH), the volume of waste increases annually by an average of 11.53% per year. If the growing volume of plastic waste is not managed properly, it will

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have negative impacts on humans, animals, and the environment. The issue of plastic waste in Yogyakarta is being addressed through the establishment of waste banks in several neighborhoods. Waste management activities at these waste banks, such as Reduce, Reuse, and Recycle (commonly known as the 3Rs), need to be carried out through smart, efficient, and well-planned efforts (Kementerian Lingkungan Hidup, 2012).

The main challenge Yogyakarta faces is the limited capacity for waste management, including insufficient waste processing facilities to handle the ever-increasing volume of waste. Additionally, environmental education and public habits regarding waste disposal need to be improved to reduce the negative impacts on the environment, such as soil, water, and air pollution. Strategic efforts have been made, including community-based waste management programs, campaigns to reduce single-use plastics, and investments in green technology for waste processing. However, more work is needed to achieve sustainable and environmentally friendly waste management targets in Yogyakarta.

LITERATURE REVIEW

1. Waste Management

The issue of waste management is becoming an increasingly urgent environmental concern, particularly in urban areas like Yogyakarta. According to the World Health Organization (WHO), waste is defined as something that is unused, unwanted, or discarded as a result of human activities and does not occur naturally (Chandra, 2006). According to the Republic of Indonesia Law No. 18 of 2008 on Waste Management, waste is the residue from human daily activities and/or natural processes in solid form. Waste can originate from human activities, animals, and nature. As population growth and urbanization continue, the volume of waste generated by society keeps increasing, while effective waste management remains a significant challenge (Hoornweg & Bhada-Tata, 2012).

On the other hand, the Theory of Indonesian Community Behavior towards Waste Management suggests that waste management behavior is influenced by several factors, such as economic incentives and environmental awareness (Badan Lingkungan Hidup Yogyakarta, 2015). Economic incentives, such as waste bank programs or other financial rewards, can motivate people to sort and recycle waste. Meanwhile, high environmental awareness drives individuals to behave more responsibly towards the environment by disposing of waste properly and reducing waste production.

2. Pentahelix as Collaboration Concept

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The Pentahelix framework brings together five distinct groups such as academia, business, community, government, and media as a way of picturing how collaborative efforts can be organized ideally when tackling complex problems. Its central purpose is to provide a structure that helps government bodies at every level coordinate with other important stakeholders across sectors, ultimately strengthening how programs are designed and carried out (Winarno et al., 2021). Each of the five actors contributes a distinct function within this collaborative structure. Academic institutions serve as conceptual architects, responsible for shaping and standardizing business processes while certifying both products and workforce competencies; they function as a reservoir of up-to-date, relevant knowledge and theoretical grounding. The business sector operates as an enabler, functioning as the entity that runs operational processes to generate added value and sustain long-term growth. Communities take on the role of accelerators, positioning themselves as intermediaries that connect stakeholders sharing common interests tied to the advancement of a particular enterprise. Government functions in a dual capacity as both regulator and supervisor, holding the authority and obligation to formulate policies that support the same collective goals. Finally, media serves as an amplifier, contributing through publication support and promotional efforts that help build and reinforce brand image (Diana et al., 2023).

RESEARCH METHOD

In this study, the research method for examining business innovation involves a mixed-methods approach such as combining both qualitative and quantitative techniques to gain a comprehensive understanding of the innovation processes. The data collected from both phases are then analyzed by using many data through various news reports and other references.

RESULT AND DISCUSSION

1. Policy Foundations for Waste Management in Indonesia within the Pentahelix Framework

Waste management in Indonesia cannot be separated from the layered regulatory framework that has been built up from laws (undang-undang), to government regulations (peraturan pemerintah), to presidential regulations (peraturan presiden). This framework forms an essential foundation for implementing the pentahelix collaboration model which involves government, academia, business, community, and median in addressing waste issues alongside the closely intertwined issue of climate change.

At the highest level, Undang-Undang Nomor 18 Tahun 2008 tentang Pengelolaan Sampah serves as the constitutional reference that mandates shared responsibility among the central

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government, regional governments, and the public. This law implicitly opens space for multi-stakeholder involvement by positioning waste reduction and waste handling as the two main pillars that cannot be addressed by government alone. This provision was further reinforced through Peraturan Pemerintah Nomor 81 Tahun 2012, which sets out the technical details of managing household waste and waste similar to household waste, and which also serves as the legal basis for subsequent national strategic policies.

The pivotal point in this policy framework lies in Peraturan Presiden Nomor 97 Tahun 2017 tentang Kebijakan dan Strategi Nasional Pengelolaan Sampah Rumah Tangga dan Sampah Sejenis Sampah Rumah Tangga (Jakstranas). This regulation not only sets quantitative targets 30% waste reduction and 70% waste handling by 2025, but also explicitly affirms that achieving these targets requires cross-sector synergy. In practice, Jakstranas is subsequently translated into Jakstrada at the provincial and district/city levels, and becomes the institutional space in which pentahelix collaboration grows in various regions, as found in case studies in Kupang City, Banyumas Regency, Bekasi City, and Karawang Regency. These findings consistently show that although the regulatory framework is already in place, implementation on the ground still faces limitations, particularly regarding the legal instruments for collaboration, which are often merely memoranda of understanding (MoUs) or temporary decisions rather than a legally binding, long-term framework.

The Climate Dimension in Waste Policy

The "Climate" dimension in this research framework intersects directly with Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup, which serves as the general umbrella for controlling environmental impacts, including greenhouse gas emissions from the waste sector. More specifically, Peraturan Presiden Nomor 98 Tahun 2021 tentang Penyelenggaraan Nilai Ekonomi Karbon opens opportunities for the waste management sector to contribute to carbon trading mechanisms and carbon taxation—for example, through methane-capture projects at final disposal sites (landfills), waste-to-energy power plants, and refuse-derived fuel (RDF) production. This framework is reinforced by Peraturan Presiden Nomor 61 dan 71 Tahun 2011 tentang Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca dan Inventarisasi Gas Rumah Kaca Nasional, which position the waste sector as one of the sectors counted toward Indonesia's Enhanced Nationally Determined Contribution (ENDC) targets.

This linkage between climate policy and waste policy affirms that waste management is no longer merely a matter of urban cleanliness, but an integral part of the national climate change mitigation strategy. As a result, pentahelix collaboration in waste management should not only be

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oriented toward technical and operational aspects, but also toward measurable climate outcomes that can be reported under the carbon economic value scheme.

The Role of Supporting Regulations in Strengthening Multi-Stakeholder Collaboration

Beyond the main framework described above, a number of derivative regulations further strengthen the legal basis for the involvement of each pentahelix element. Undang-Undang Nomor 23 Tahun 2014 tentang Pemerintahan Daerah provides the basis for regional governments' authority to build cross-sector cooperation in waste management, while Peraturan Menteri LHK Nomor P.75 Tahun 2019 tentang Peta Jalan Pengurangan Sampah oleh Produsen provides legitimacy for the Extended Producer Responsibility (EPR) scheme, which directly involves the business/industry sector as a strategic partner in the pentahelix. This regulation aligns with findings from Waste4Change and various other studies showing that business sector involvement through digital EPR schemes can help ensure that post-consumer products do not end up in landfills.

Meanwhile, Peraturan Presiden Nomor 83 Tahun 2018 tentang Penanganan Sampah Laut demonstrates a precedent of formal collaboration across ministries/agencies, academia, business, and civil society, which can serve as a replicable model for pentahelix-based domestic waste management. In addition, Undang-Undang Nomor 11 Tahun 2020 tentang Cipta Kerja, together with Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup, further opens broader space for private investment in the waste management sector through the simplification of environmental permitting.

2. ClimateCo's Business Strategies through Pentehelix Model

To running this green business innovation, we have several stakeholders who act as partners in our business strategy, collaborating with ClimateCo. The pentahelix model is highly suitable as a collaborative framework between various societal elements to realize a policy that can be jointly implemented.

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Picture 1. Pentahelix's Model for Waste Management In Indonesia

Government

The government plays a primary role as a regulator in policy formulation. In Indonesia, regulations related to waste management are governed by several laws, such as Undang-Undang Dasar No. 18 tahun 2008 on Waste Management and various related Government Regulations. Both central and local governments are responsible for organizing the waste management system, providing management infrastructure, and ensuring law enforcement against violations of waste management regulations, particularly for companies or individuals who fail to comply with waste or waste management rules.

The central and local governments are mandated to finance the implementation of waste management, with funding coming from the national and regional budgets (APBN and APBD). The central and local governments, either independently or jointly, may provide compensation to communities affected by the negative impacts of waste processing activities at final waste disposal sites. Such compensation may take the form of relocation, environmental restoration, health care costs, treatment, and other forms of compensation (Kemenkeu, 2022). In addition, the government can also offer further support for implementing waste reduction policies, at a minimum through policies aimed at reducing the use of single-use plastics and promoting the 3R system (Reduce, Reuse, Recycle).

Business

In the Pentahelix concept, the business sector must contribute to waste management by applying sustainable business principles, as outlined in Undang-Undang Dasar No. 40 Tahun 2007 tentang Perseroan Terbatas, specifically Pasal 74, which mandates that Limited Liability Companies involved in or related to natural resources are required to implement their sustainable

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responsibility. In addition, Indonesia has regulations under Undang-Undang No. 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup (UU PPLH), specifically Pasal 68, which mandates that any individual or business entity engaging in activities that have a significant impact on the environment is required to manage waste and fulfill the obligation of environmental restoration.

At its core, corporate social responsibility (CSR) reflects the degree to which a company's principles and operational practices are shaped by the interests of those it serves and interacts with. This stakeholder group is broad, encompassing not only customers and shareholders but also workers, supply-chain partners, local communities, government regulators, advocacy organizations, and the public at large. Viewed this way, CSR represents a company's pledge to remain answerable for its actions toward all of these parties. Practically speaking, this means firms are expected to take ownership of the economic, social, and environmental consequences that stem from their operations, working to strengthen the positive effects while curbing any negative ones. The scope of CSR typically touches on several interconnected areas, how a company is governed, how it manages its environmental footprint, the quality of its engagement with stakeholders, its labor practices, the strength of its ties to employees and local communities, the fairness of social outcomes it promotes, the ethics behind its sourcing decisions, and its regard for human rights (Beal, 2014).

One concrete way businesses put this into practice is through Extended Producer Responsibility (EPR), a scheme that holds manufacturers accountable for their goods throughout the full product lifecycle, starting from manufacturing and continuing all the way to disposal. Firms may also choose to channel resources into developing new waste-handling technologies and materials that carry a lighter environmental footprint. Within Indonesia specifically, the responsibilities assigned to the business sector along these lines are formally established through the country's existing regulatory framework.

Community

In this context, the focus is specifically on environmental enthusiast communities, which act as stakeholders driving the promotion of proper waste management to the public. Activities carried out by these environmental groups, such as environmental education and household waste management, are considered effective in changing public attitudes towards waste, turning it into a valuable resource. The management of waste within communities can be influenced by various factors, with one of them being the involvement of these communities or social groups (Ismiarta et al., 2021). Their participation has a significant impact based on their roles and functions, creating

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broader networks and deeper understanding within the community, particularly concerning waste management and environmental awareness.

Through their collaborative efforts, these communities can enhance public involvement in reducing the environmental impact of waste, as well as create new and sustainable economic opportunities through waste recycling. Consequently, environmental enthusiast communities play a crucial role in preserving ecosystems and improving the quality of life for the public.

Academics

Academics also play a significant role, similar to other stakeholders. Through research, innovation, and technology development, academics support more effective and efficient waste management (Departemen Sosiologi Unair, 2022). They contribute by identifying key issues in waste management and providing science-based solutions. Additionally, academics are involved in educating the public through outreach activities, training, and environmental campaigns, thereby raising awareness about waste issues.

Academics are also flexible in their roles as stakeholders, able to collaborate with community organizations or other groups to strengthen public awareness. Research findings, innovations, and developments from academics can serve as valuable considerations or solutions for the government in addressing waste-related problems. Furthermore, academics can utilize media as a platform for outreach, training, and campaigns to educate and engage the broader public. This flexibility and collaboration create a better synergy in waste management, contributing to environmental preservation and the development of a sustainable economy.

Media

In an era characterized by instant, fast, and easy access, media plays a crucial role, especially in conveying information to the broader public. With the rapid advancement of technology and the internet, social media has a significant impact on shaping public awareness and actions regarding environmental sustainability (Pratiwi et al., 2023). Through social media, information related to environmental issues can spread quickly, and content that supports sustainability has the potential to go viral, thereby influencing public views and behaviors.

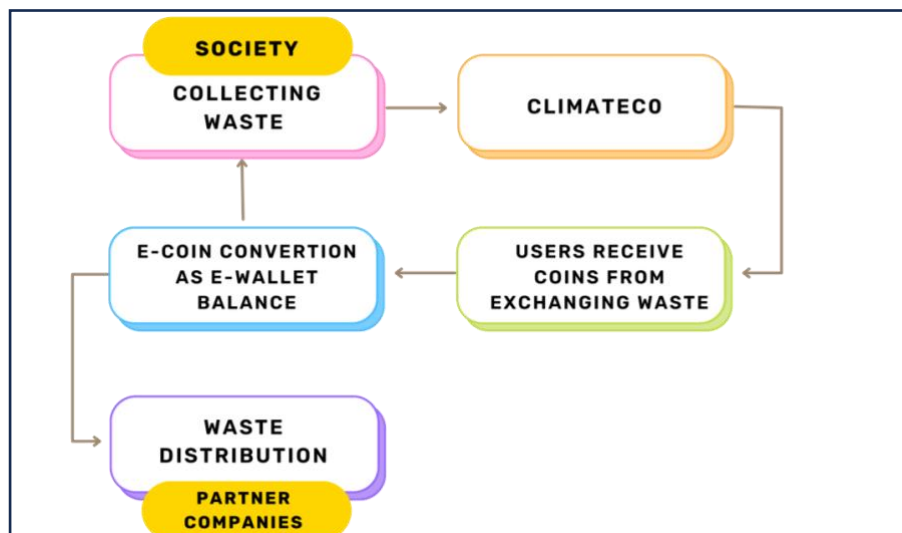
Additionally, media serves as a monitor and intermediary between the public, government, and industry players on waste management issues. By reporting on environmental pollution caused by poor waste management, media can push the government and private sector to take more decisive actions. Media also often provides a platform for experts, activists, and academics to discuss waste management solutions, fostering productive public dialogue. Through its broad role,

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media can influence public policy and strengthen the movement for more responsible waste management in Indonesia.

3. *ClimateCo as our Green Business Innovations*

ClimateCo is an application designed to help reduce the waste emergency in Yogyakarta and provide benefits to its users by facilitating the exchange of waste for e-Wallet balances, in line with modern payment advancements. The "ClimateCo" app will offer waste exchange services at several locations in Yogyakarta, making it easier for local residents to exchange waste for E-coins through partnerships with E-Wallet companies. The implementation of the "ClimateCo" application is expected to create a cleaner Yogyakarta and enhance community engagement in modern digital payment. This is our Business Innovations flowchart:



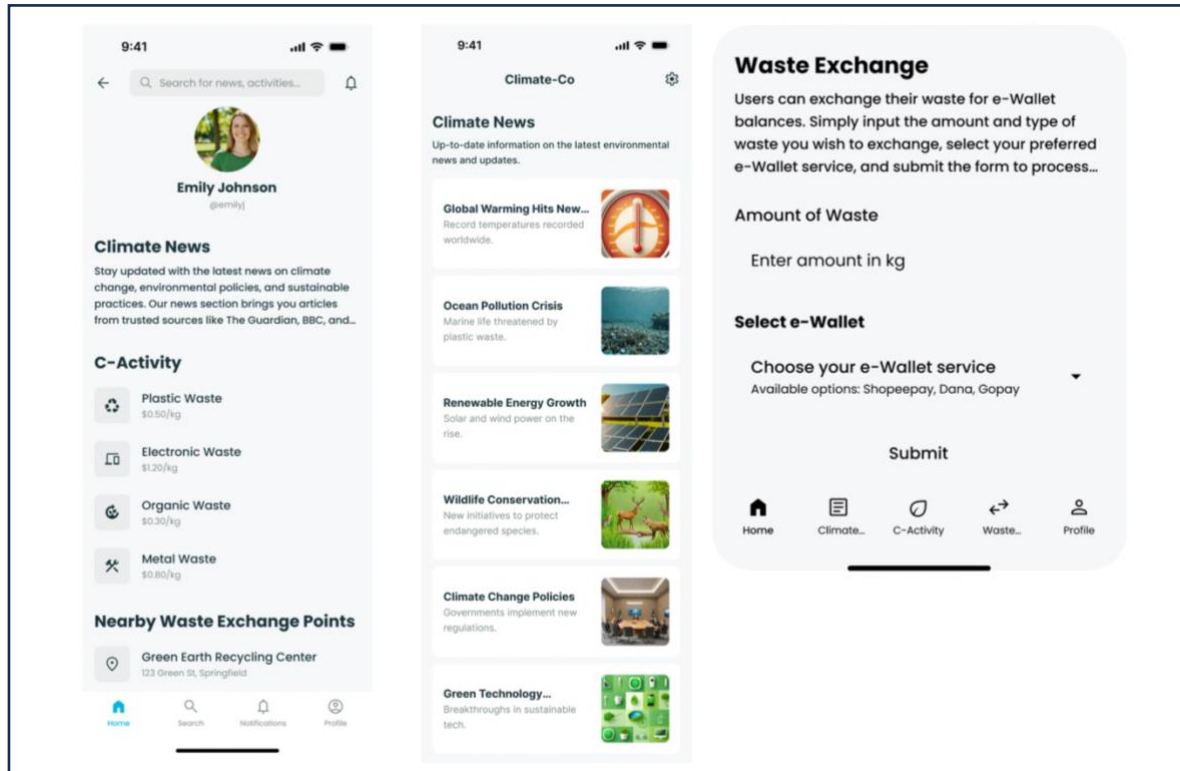
Picture 2. Waste Exchange and Distribution Scheme.

ClimateCo will provide an easily accessible application for users. Features available in this app include Climate News, which will serve as a source of up-to-date information on environmental news and updates. Additionally, there will be advanced features such as C-Activity, which will provide information on waste prices and the locations of nearby waste exchange points. Furthermore, to operate its business, ClimateCo will collaborate with several stakeholders, including the government (Dinas Lingkungan Hidup), media and community groups, academics, investors, and e-Wallet companies.

The business model of ClimateCo begins with waste collected by the society. The community can then exchange this waste at the nearest ClimateCo outlet. The outlet staff will weigh and convert the waste into e-Coins through partner e-Wallets, according to consumer preferences. The converted

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waste is then distributed to partner companies that require raw materials such as plastic bottles, cardboard, metal, and glass for their production processes.



Picture 2. ClimateCo's User Interface

As an initial step, the business will be established in Yogyakarta. Once targets are met, there is significant potential for expansion to other cities as part of business growth. In addition to business expansion, establishing branches in other cities is also expected to address the waste emergency issue, thereby improving the quality of life for communities in Indonesia.

3. ClimateCo's Market Analysis

Environmental Conditions

As an initial step, ClimateCo is targeting the Yogyakarta area, which faces significant waste management issues. ClimateCo app aims to help the problems caused by waste. ClimateCo app is an innovative solution, as there has no application specifically designed for waste management. However, the community's lack of awareness may pose a challenge too for us. Therefore, our strategy is to collaborate with village officials to conduct outreach efforts, ensuring a better understanding of how to use and benefit from the app we provide.

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Competitor Analysis

Until today, waste management applications like 'ClimateCo' are still limited and not yet widely adopted by the community. Our analysis shows that our competitors consist are not mainly direct as individual waste collectors and communities. Meanwhile, our application specifically focuses on waste managemen with strong collaboration with the government and village officials will facilitate the acceptance of this application by the community. Through this integrated collaboration, we hope we can build trust from customers in this business.

ClimateCo's Market Strategy

Market segmentation is useful to ensure ClimateCo app will success. The market segmentation for the ClimateCo app includes all segments of society, such as students, communities, and media, who use waste as a means to earn coins that can help reduce waste problems in Yogyakarta. Since we are collaborating with the government, media, and all parties involved in the Pentahelix model, the introduction of the application will becomes easier. ClimateCo app positions as an intermediary between the government, students, communities, the public (sellers), and buyers, as well as all parties involved in this operation, to enhance activity in digital wallet usage and environmental awareness

ClimateCo's Risk Mitigation Simulation

ClimateCo focused on environmental care, we have provided several alternatives for risk mitigation in the table below:

Table 1. *ClimateCo's Risk Mitigation Simulation*

No	Risk	Solution
1.	Waste exchange activities are decrease	Enhancing collaboration with various Pentahelix stakeholders, especially with the government through the creation of regulations, is a crucial first step in familiarizing the community with waste management practices
2.	Fluctuation in waste prices	Always update waste prices on social media and the official ClimateCo website
3.	Number of competitors are increase	Regularly updating ClimateCo services and offering attractive promotions, such as cinema discount vouchers or price cuts at partner stores.
4.	The amount of waste at each outlet exceeds the maximum limit	Expand the outlet warehouses and regularly send waste to partner companies, while continuously broadening partnerships with waste management companies to turn waste into marketable goods.

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4. Estimation of ClimateCo's Budget Analysis Simulation

Capital

Table 2. *ClimateCo's Capital Estimation*

No	Sources of Capital	Accumulation	Amount
1	Investor	35%	Rp 207.900.000
2	Bank Funds	25%	Rp 148.500.000
3	Corporate Social Responsibility (CSR) from any Companies	20%	Rp 237.600.000
Total		100%	Rp 594.000.000

Operational Cost Simulation

Table 2. *ClimateCo's Operational Cost Estimation*

No	Needs	Qty	Each Price	Amount
Fixed Cost				
1	Computer Set	4	Rp 4.500.000	Rp 18.000.000
2	Weighing Scale	4	Rp 1.000.000	Rp 4.000.000
3	Maintenance	4	Rp 5.000.000	Rp 20.000.000
4	Domain and Hosting	1	Rp 2.500.000	Rp 2.500.000
6	Chair and Table Set	4	Rp 1.500.000	Rp 6.000.000
7	Fronted Developer	1	Rp 2.100.000	Rp 2.100.000
8	Backend Developer	1	Rp 2.100.000	Rp 2.100.000
9	Office Accessories	4	Rp 500.000	Rp 2.000.000
10	Renting a Place	4	Rp 15.000.000	Rp 60.000.000
12	Certification and Legality	1	Rp 4.200.000	Rp 4.200.000
Variable Cost				
1	Marketing Staff	36	Rp 2.150.000	Rp 77.400.000
2	Finance Staff	36	Rp 2.150.000	Rp 77.400.000
3	Operational Staff	146	Rp 1.500.000	Rp 219.000.000
4	Social Media	36	Rp 1.500.000	Rp 54.000.000
6	Internet Service	36	Rp 200.000	Rp 7.200.000
7	Trash Bags	7200	Rp 3.000	Rp 21.600.000
8	Ads	36	Rp 400.000	Rp 14.400.000
Total				Rp 591.900.000

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Break-Even Point (BEP) Analysis Simulation

Table 3. *ClimateCo's BEP Analysis Simulation*

Month		Admob		Waste Exchange		Total		Balance
Month 1	Rp	500.000	Rp	9.080.000	Rp	9.580.000	Rp	9.580.000
Month 2	Rp	1.000.000	Rp	10.820.000	Rp	11.820.000	Rp	21.400.000
Month 3	Rp	1.500.000	Rp	12.560.000	Rp	14.060.000	Rp	35.460.000
Month 4	Rp	2.000.000	Rp	14.300.000	Rp	16.300.000	Rp	51.760.000
Month 5	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	70.300.000
Month 6	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	88.840.000
Month 7	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	107.380.000
Month 8	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	125.920.000
Month 9	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	144.460.000
Month 10	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	163.000.000
Month 11	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	181.540.000
Month 12	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	200.080.000
Month 13	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	218.620.000
Month 14	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	237.160.000
Month 15	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	255.700.000
Month 16	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	274.240.000
Month 17	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	292.780.000
Month 18	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	311.320.000
Month 19	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	329.860.000
Month 20	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	348.400.000
Month 21	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	366.940.000
Month 22	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	385.480.000
Month 23	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	404.020.000
Month 24	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	422.560.000
Month 25	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	441.100.000
Month 26	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	459.640.000
Month 27	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	478.180.000
Month 28	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	496.720.000
Month 29	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	515.260.000
Month 30	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	533.800.000
Month 31	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	552.340.000
Month 32	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	570.880.000
Month 33	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	589.420.000
Month 34	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	607.960.000
Month 35	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	626.500.000
Month 36	Rp	2.500.000	Rp	16.040.000	Rp	18.540.000	Rp	645.040.000

The Break-Even Point (BEP) is a method used to determine whether a product being sold can be profitable for the company. By using BEP, the company will find it easier to decide on the next steps. (Sampoerna University, 2022). From the result, ClimateCo is projected to reach the Break-Even Point (BEP) in the 34th month, where total revenue will balance with total operational costs, resulting in neither profit nor loss for the company.

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Net Present Value (NPV) Simulation

Table 4. *ClimateCo's NPV Analysis Simulation*

Year	Df = 10%	PV Net Cash		PV Investment	
0	1	-Rp	591.900.000	-Rp	591.900.000
1	0,9	Rp	200.080.000	Rp	180.072.000
2	0,82	Rp	222.480.000	Rp	182.433.600
3	0,75	Rp	222.480.000	Rp	166.860.000
4	0,68	Rp	222.480.000	Rp	151.286.400
NPV				Rp	88.752.000

From the results, the NPV obtained is 88,752,000, which can be expressed as $NPV > 0$ or positive. Based on these calculations, the ClimateCo investment is considered **good** to proceed.

Internal Rate of Return (IRR) Simulation

IRR is the discount rate that equates the present value (PV) of cash flows with the PV of the investment; it is the discount rate that results in an NPV of zero. If the calculated IRR is greater than the discount factor, the investment is considered viable. If it is equal to the discount factor, the investment will break even, while if the IRR is less than the discount factor, the investment is deemed unviable. The results of the calculations are as follows:

Table 5. *ClimateCo's IRR Analysis Simulation*

IRR = 12%					
0,89	Rp	200.080.000	Rp	178.071.200	
0,79	Rp	222.480.000	Rp	175.759.200	
0,71	Rp	222.480.000	Rp	157.960.800	
0,63	Rp	222.480.000	Rp	140.162.400	
IRR = 12%			Rp	651.953.600	
IRR = 13%					
0,88	Rp	200.080.000	Rp	176.070.400	
0,78	Rp	222.480.000	Rp	173.534.400	
0,69	Rp	222.480.000	Rp	153.511.200	
0,61	Rp	222.480.000	Rp	135.712.800	
IRR = 13%			Rp	638.828.800	

From the calculations above, the IRR that most closely aligns with an NPV of 0 or a break-even point (BEP) of Rp 591,900,000 is 13%. Since the IRR of 13% is higher than the discount factor (DF) of 10%, this investment is also considered **good** to proceed.

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Payback Period Simulation

The investment will be recovered in 2 years and 10 months from the start of the investment. To determine whether this investment is viable, it is necessary to first establish the payback period expected by management. For example, if management sets the desired payback period at 3 years, then the investment can be considered **good**. Meanwhile, if the expected payback period is 2 years, so the investment is deemed not good.

CONCLUSIONS

Waste-related problems and the lack of public education on the importance of waste management mean that large volumes of waste remain unprocessed, posing a looming environmental disaster. This is not merely a local issue confined to Yogyakarta, but a challenge shared by cities worldwide. Addressing it therefore requires genuine collaboration between the community and the government to prevent the problem from escalating into a larger-scale crisis in the future.

Drawing on findings from various studies (Arumsari et al., 2025; Fadhlán, 2025; Rahayu, 2024; Fitriana, 2026), a consistent pattern emerges: Indonesia's national regulatory framework from Law No. 18/2008 through Presidential Regulation No. 97/2017 has provided an adequate legal foundation for encouraging pentahelix collaboration. However, an implementation gap persists, as cooperation instruments at the operational level (MoUs, cooperation agreements, temporary decrees) still lack the binding force of formal legal products such as regional regulations. This is consistent with findings from the case of Kupang City, where limited human resources, transportation facilities, and budget allocation were further compounded by the fact that the waste management roadmap had not yet been widely disseminated to all stakeholders.

Within this context, ClimateCo offers a concrete solution to the problem. Guided by the vision of being "not only a sustainable business but also a sustainable impact," ClimateCo is committed to creating positive change for the community. The convenience of outlets spread across multiple locations, combined with a modern e-coin conversion system that simplifies transactions, gives consumers a new incentive to turn their waste into a balance they can spend an approach that directly embodies how pentahelix collaboration can be put into practice through a community-based business model.

It can therefore be concluded that the successful implementation of Climate-CO through pentahelix collaboration in Indonesia's waste management depends on three key factors: (1) strengthening the legal basis for cooperation at the regional level so that it is no longer ad hoc in nature; (2) more explicit integration between waste management policy (Jakstranas/Jakstrada) and

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carbon economic value policy (Presidential Regulation No. 98/2021); and (3) optimizing the role of each pentahelix element such as government as regulator, academia as the provider of scientific grounding, business as a partner in investment and innovation (as demonstrated by ClimateCo), the community as the frontline implementer, and the media as a driver of public education and accountability.

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