



POLICY BRIEF

Rationalization of Energy Mix and Transformation of Biofuel Governance in Indonesia



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Executive Summary

Rationalization of Energy Mix and Transformation of Biofuel Governance in Indonesia

Biofuels are an important component in achieving national energy sovereignty and supporting the transition to renewable energy in Indonesia. However, current biofuel development policies are still heavily dependent on palm oil as the main source of raw material for biodiesel. Although the development of biodiesel provides significant economic benefits, it also poses various environmental, social, and economic risks.

Key Issues:

The Indonesian government has set a biodiesel blending rate of 40% (B40) in biosolar by 2025. To meet the biodiesel requirements in the B40 program, 14.2 million tons of CPO raw material will be needed. If the target for 2026 is a 50% blend (B50), it is projected that approximately 17.93 million tons of CPO will be needed. The increase in CPO demand for the biodiesel industry has the potential to expand oil palm plantations to more than 6 million hectares. This expansion could lead to deforestation, increased carbon emissions, land conflicts, and excessive economic dependence on palm oil. In addition, uncontrolled expansion of palm oil plantations has triggered around 1,000 agrarian conflicts, threatening social stability.

Policy Dilemma:

The Business as Usual (BAU) scenario in meeting the biodiesel blending target will lead to oil palm land expansion and increased social and environmental costs. Meanwhile, the Intervention scenario, which prioritizes a local approach by opening opportunities for the development of raw materials other than oil palm or strengthening independent oil palm plantations, can offer increased productivity without land expansion and greater economic benefits.

Policy Recommendations:

- 1. Palm Oil Land Expansion Moratorium:** Increasing CPO demand to achieve biodiesel blending targets cannot be addressed by opening new land for palm oil plantations. According to environmental carrying capacity analysis, the maximum threshold for oil palm coverage is 18.15 million hectares. Therefore, it is necessary to set a maximum cap of 18.15 million hectares for national oil palm land coverage in accordance with the results of the Environmental Carrying Capacity study.
- 2. Increasing Palm Oil Productivity:** Prioritizing intensification and replanting programs to achieve a productivity of at least 5-6 tons/ha, especially for independent palm oil plantations through programs carried out by the Plantation Fund Management Agency (BPDP).

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3. **Decentralization of community-based energy and bioenergy:** Encourage the development of community-based bioenergy by utilizing used cooking oil, rubber seeds, and local plants such as nyamplung and castor beans as alternative raw materials for the development of biofuel to meet local needs in Indonesia.
 4. **Institutional and governance strengthening:** Optimizing the biofuel policy monitoring function by strengthening the capacity and authority of existing institutions, particularly the Directorate General of New, Renewable Energy and Energy Conservation (Ditjen EBTKE). Or through the formation of an independent cross-sector committee. This committee is specifically tasked with monitoring, evaluating, and reporting on the implementation of biofuel policies and the management of BPD PKS funds, in order to ensure transparency, accountability, avoid duplication of roles between institutions, and increase the effectiveness of public oversight and control.
 5. **Village Economic Development:** Revitalizing village-owned enterprises (BUMDes) and village cooperatives as centers for small-scale bioenergy production, which could contribute to increasing village community income by up to USD 2 billion.

Conclusion:

Indonesia has a great opportunity to achieve energy and food sovereignty without sacrificing environmental sustainability and social stability. By adopting a community-based approach and limiting palm oil expansion, Indonesia can create a biofuel industry that is not only economically resilient but also fair and sustainable.

Introduction

Strategy for Developing a Fair, Sustainable, and Deep-rooted Biofuel Industry in Indonesia

The biofuel industry in Indonesia has become an important pillar in the national energy transition strategy. The government targets a 5% share of biofuels in the energy mix by 2025 (Presidential Regulation No. 5 of 2006 on National Energy Policy), in line with the New and Renewable Energy (EBT) policy. This policy aims to reduce dependence on fossil fuels, increase energy independence, and reduce the trade deficit caused by fossil fuel imports.

However, this ambition is still heavily dependent on palm oil as the main raw material for biodiesel production. This approach is often claimed to provide economic benefits through reduced fuel imports and savings in foreign exchange of up to USD 7.9 billion or around IDR 120.54 trillion (Ministry of Energy and Mineral Resources, 2024). In addition, palm oil is also relied upon to support the stability of the crude palm oil (CPO) market in the global market and contributes significantly to Indonesia's Gross Domestic Product (GDP). Its contribution to national economic growth reached 4.95% in the third quarter of 2024, with the agriculture and plantation sectors growing positively by 1.69%, with palm oil being one of the main drivers (BPS, 2024). This strategic role further emphasizes Indonesia's economic dependence on palm oil, both in supporting energy security through biodiesel and in maintaining global trade stability.

However, excessive dependence on a single commodity carries risks from both a market and sustainability perspective. On the one hand, increasing energy needs and fuel blends will require more palm oil as a raw material. However, with national palm oil productivity still very low, the only option is to open up new land. However, expanding palm oil plantations to meet biodiesel demand has the potential to increase deforestation, carbon emissions, and socio-economic conflicts at the grassroots level. Moreover, opening up new concessions is not an economical move from the perspective of growers.

Increasing the biodiesel blend target from B20 to B100 has a significant impact on the demand for crude palm oil (CPO) and land use. Studies show that without increased productivity, land expansion will be the main consequence. For example, Kurniawan et al. (2018) projected an additional CPO requirement of 11.75 million tons for B100 in 2025, while Adiatma & Prasajo et al. (2021) estimated up to 17.93 million tons for B50 in 2024. When productivity is taken into account, as in the studies by Kurniawan et al. (2018) and Khatiwada et al. (2018), land requirements can be reduced. However, other studies that ignore productivity increases, such as Halimatussadiah et al. (2021) and Rahmadi et al. (2013), project land expansion of more than 6 million hectares.

With a baseline productivity of around 2.7-3.8 tons/ha, an increase to 6 tons/ha is needed to minimize land expansion. Without optimal intensification and replanting strategies, ambitious biofuel mix policies risk driving further deforestation. Therefore, productivity improvements must be an integral part of biofuel policies to prevent uncontrolled environmental impacts.

Table 1. Potential Increase in Palm Oil Land Requirements due to the Biodiesel Program

Research	Kurniawan et al (2018)		Halimatussadiyah et al (2020)			Rahmadi et al (2013)	Khatiwada et al (2018)		Adiatma & Prasoyo et al (2021)	
Biofuels Target Considered	B100		B20	B30	B50	B20	B30		B30	B50
Projection Year	2025		2025			2025	2025		2024	
			Blending initiated in:							
			2016	2020	2021					
Projected Additional CPO Demand	11.75		-	-	-	11.17	11.2		11.11	17.93
Total Projected CPO Demand	56.98		-	-	-		51.1		57.5	63.7
Potential Productivity Improvement	Considered		Not included in the modelling*			Not included in the modelling**	Considered		Not included in the modelling	
Productivity Scenario	Baseline Productivity	Productivity Level to be Achieved	Productivity Assumption			Productivity Assumption	Baseline Productivity	Productivity Level to be Achieved	Productivity Assumption	
	2.7 ton/ha	4.06 - 6 ton/ha	3.692 ton/ha			4.05 ton/ha	3.8 ton/ha	3.8-6 ton/ha	2.8 ton/ha	
Additional Land Requirements	Without Productivity Improvement	With Productivity Improvement	Without Productivity Improvement			Without Productivity Improvement	Without Productivity Improvement	With Productivity Improvement	Without Productivity Improvement	
	-	0 ha	0.339 million ha	5.25 million ha	9.3 million ha	3.67 million ha	3.67 million ha	6.7 million ha	4.1 million ha	6.4 million ha
* Potential productivity improvements through intensification and replanting are not considered; however, productivity increases based on previous trends are taken into account										
** Technological improvements affecting crop yields are excluded from the analysis period										

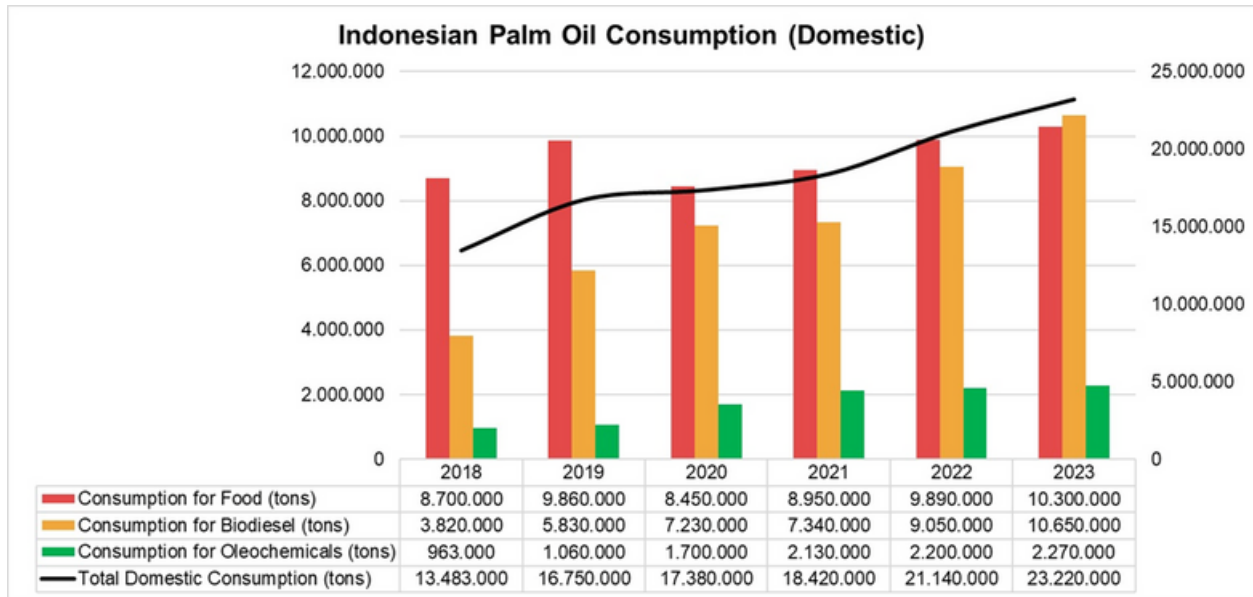
Source: Dynamics of the Biofuel Discourse in Indonesia in Ecological, Economic, and Social Contexts. Madani Berkelanjutan, 2022

Currently, the estimated area of oil palm coverage in Indonesia reaches around 17-18 million hectares. In fact, Sawit Watch in 2023 released that the area of oil palm plantations in Indonesia has reached 22.3 million hectares. A recent study on the palm oil threshold (CAP Sawit) indicates that Indonesia's optimal environmental carrying capacity for palm oil is a maximum of 18.15 million hectares (Lokahita et al, 2025). This study also highlights that adding oil palm area above this threshold will cause irreversible damage to the ecosystem. This means that oil palm plantation coverage in Indonesia is already at its maximum threshold, and has even exceeded it.

With a business-as-usual approach, the government's ambition to continue increasing the biodiesel blend without a clear direction will put significant pressure on the remaining available land. This not only increases ecological risks but also poses new challenges in social and economic aspects, including conflicts with indigenous peoples and increased carbon emissions, which are contrary to Indonesia's climate commitments. From an economic perspective, fulfilling this ambition would require sacrificing CPO exports, which have been one of the pillars of Indonesia's economy.

A dilemma also arises from the food aspect. As the main ingredient in cooking oil, palm oil is also a strategic commodity in meeting domestic food needs. In fact, the largest consumption of palm oil is currently for the domestic market, with 49% for food and 40% for energy (GAPKI, 2022). However, these figures are beginning to reverse, with CPO consumption for energy exceeding consumption for food.

Figure 1. Trends in Indonesian Palm Oil Consumption (Domestic) Based on Food, Biodiesel, and Oleochemical Needs, 2018–2023



Source: Indonesian Palm Oil Association (GAPKI) 2024, data processed by Madani Berkelanjutan

This has led to an increasingly high competing user ratio for palm oil, creating tension between energy and food needs. Ultimately, price stability will be disrupted by rampant speculation. Palm oil land clearing will become more sporadic, with land clearing carried out independently by the community, tempted by the illusion of consistently high palm oil prices.

Comparison of Business as Usual and Intervention Scenarios:

To provide a clearer picture of the comparison between the Business as Usual (BAU) scenario and the Intervention with Local Approach scenario, the following table compares the main economic components. This table helps to quickly show the impact of each scenario on the national economy, foreign exchange stability, and the rural economy.

However, before comparing the two scenarios, it is important to first understand what is meant by a local intervention approach. This approach is based on the assumption that the additional CPO requirements for mandatory biodiesel can be met without expanding land area, but rather through intensification strategies: such as rejuvenating smallholder palm oil, increasing productivity, and using high-yield seeds. In addition, this scenario also proposes the redistribution of economic value through strengthening the role of local actors such as BUMDes, cooperatives, or other village business units as part of the national biodiesel value chain.

By managing a small portion of biodiesel production (e.g., 10%) through local business models, the potential for village economic income can be generated without burdening the ecosystem and causing social conflict. This approach is not only technical but also institutional, requiring ensuring that the energy transition also targets equitable benefits and capacity building at the grassroots level.

Table 2. Scenarios Between Business as Usual (BAU) and Intervention (Local Approach)

Component	Business as Usual (BAU)	Intervention (Local Approach)
Palm Oil Land Expansion (Million Ha)	3.74 - 4.72	0
Oil Palm Productivity (Tons/Ha)	3.8	6
CPO Price (USD/Ton)	800	800
CPO Export Volume (Million Tons)	34	34
CPO Foreign Exchange Earnings (Billion USD)	27.2	27.2
Foreign Exchange Savings from Biofuel (Billion USD)	7.9	7.9
Village Economic Income (Billion USD)	0	2
Social & Environmental Costs (Billion USD)	3.74 - 4.72	0
Total Economic Benefits (Billion USD)	30.38 – 31.36	37.1

The comparison scenario between BAU and intervention was used with key assumptions that took into account palm oil productivity, social and environmental costs, and local economic potential. In the BAU scenario, the high demand for palm oil land expansion caused social and environmental costs to reach USD 3.74 - 4.72 billion, mainly due to deforestation, social conflict, and environmental degradation. In contrast, the intervention scenario with a local approach successfully reduced these costs to zero through increased oil palm productivity, prevention of land expansion, and village economic empowerment through village-owned enterprises (BUMDes).

Business as Usual (BAU) Scenario

In the BAU scenario, the development of the biofuel industry focuses on increasing the biodiesel blend while continuing to rely on palm oil as the main raw material. Although it provides short-term economic benefits, this approach requires an additional 3.74 to 4.72 million hectares of oil palm land expansion to meet the biodiesel demand target, assuming an average productivity of 3.8 tons/ha. Through this approach, Indonesia can maintain foreign exchange earnings from CPO exports of USD 27.2 billion and achieve foreign exchange savings from biofuel of USD 7.9 billion. However, this scenario also results in significant social and environmental costs, estimated at between USD 3.74 and 4.72 billion, mainly due to deforestation, environmental degradation, and potential social conflicts. Overall, the total economic benefits in this BAU scenario are projected to be in the range of USD 30.38 to 31.36 billion.

Intervention Scenario with a Local Approach:

Unlike the BAU scenario, the intervention scenario offers a more rational and sustainable approach. By increasing palm oil productivity to 6 tons/ha, Indonesia would not need additional palm oil land expansion (0 hectares), thereby maintaining ecological balance and reducing social risks.

This approach also involves local business units such as BUMDes and village cooperatives in the bioenergy production chain, assuming management of 10% of total national biodiesel production. This scheme provides an additional economic contribution of USD 2 billion to rural communities over the next 10 years, supporting the creation of a community-based energy economy.

Without the need for land expansion, social and environmental costs can be significantly reduced to USD 0 billion in this scenario, unlike the BAU scenario which incurs ecological costs.

Overall, this intervention scenario generates total economic benefits of USD 37.1 billion, which is much higher than the BAU scenario.

In this situation, Indonesia needs a more comprehensive and equitable strategy to manage the nexus between energy, food, and forest ecosystems. An approach that focuses only on increasing production without considering environmental carrying capacity and social impacts can pose a major risk to sustainable development. Therefore, a new paradigm is needed in the formulation of biofuel implementation policies in Indonesia that are oriented towards ecological sustainability, social justice, and economic equity.

Unraveling the Challenges:

Since the initial implementation of the biofuel policy in Indonesia, its journey has often been marked by various economic, social, and environmental challenges. In fact, the initial idea behind the implementation of biofuels in Indonesia was based on the spirit of addressing economic issues through Presidential Decree No. 10 of 2006 on the National Team for the Development of Biofuels to Accelerate Poverty and Unemployment Reduction. Thus, the initial spirit of introducing biofuels in Indonesia was not purely as part of energy policy. To this day, economic aspects also often color the Indonesian biofuel industry.

The difference is that currently, macroeconomic aspects play a greater role in the dynamics of Indonesia's biofuel policy. Meanwhile, when the idea of developing biofuels in Indonesia first emerged, the focus was more on microeconomics. This is evidenced by the dominance of palm oil as the main raw material for biofuels in Indonesia. This step was taken to guarantee market absorption for CPO products and stocks in Indonesia.

This is because, over the past five years, palm oil exports have faced challenges from increasingly demanding international regulations on sustainability. In addition, the Indonesian palm oil industry is not supported by a well-thought-out plan. The policy that emerged since the actualization of the blend program in 2015 only determines the mandatory biofuel blends content. However, it does not provide a clear and measurable roadmap regarding the ultimate goal of the biofuel policy implementation. Ultimately, the national biofuel implementation policy has only become a temporary solution to absorb the Indonesian palm oil industry, which is currently facing international market challenges. So far, the two have always gone hand in hand because they complement each other. As a consequence, Indonesia's biofuel policy has only become emotional rhetoric that is often brought up in various speeches.

This means that if Indonesia is serious about implementing the biofuel policy, it needs careful planning that takes various aspects into consideration. The main thing that needs to be considered is developing Indonesia's biofuel industry as part of a just energy transition without sacrificing forest ecosystems and food security. To achieve this, solutions need to start from the community. This is because Indonesia is essentially a country based on mutual cooperation, where the spirit of community is the greatest social capital.

The development of the national biofuel industry must begin at the community level, as was originally envisioned when the program was launched in 2006. The failure to implement the biofuel policy at that time was not due to its community-based business model. Rather, it was due to the government's inconsistent attention, which gradually declined and then disappeared (Madani & Mongabay, 2022). To this day, many communities continue to operate and pin their hopes on the development of community-based bioenergy.

A community-based bioenergy development approach is key to creating a more equitable and sustainable biofuel industry. The potential of alternative raw materials such as used cooking oil, biomass residues, jatropha, and nyamplung provides a great opportunity for regions to contribute to the energy transition. This approach not only optimizes local resources but also empowers communities to be part of the solution.

Developing a Fair and Sustainable National Biofuel Industry

At the end of 2024, Madani initiated a series of three focused discussions among stakeholders from various backgrounds. These discussions specifically addressed the nexus between energy, food, and forests in relation to Indonesia's palm oil commodities. The first series focused on the upper limit (CAP Sawit) and other ecological challenges. The second series raised issues of governance, corruption, and subsidy inequality (including economic perspectives). In the third series, the discussion emphasized aspects of technology-based solution integration, market efficiency, and energy diversification.

We have compiled the main points of these discussions into this document, which aims to provide a framework for the government in directing Indonesia's biofuel policy towards equitable sustainability. It is hoped that this document can be taken into consideration by the government in formulating a more equitable, sustainable, and deeply rooted strategy for the implementation of the national biofuel industry.

Through an analysis of the challenges and opportunities that have been identified, this document offers strategic recommendations that can serve as a basis for the government to set clear limits on palm oil expansion, integrate community-based alternative raw materials into the national biofuel strategy, and build business models that empower local communities. With this approach, Indonesia has the opportunity to utilize raw material diversification to create a resilient, competitive, and sustainable biofuel industry, not only for the present but also for future generations.

Systemic Risks of Palm Oil Expansion

Palm oil expansion to support Indonesia's biofuel industry poses a dilemma, because to meet the 50% biodiesel blend ambition, 20 million kL of CPO per year is needed (Ministry of Agriculture, 2024). Meanwhile, Indonesia's palm oil productivity is still very low, with a national average of 3,630 kg/hectare/year (Ministry of Agriculture, 2023). This means that to achieve the volume needed for the implementation of B50%, the government will be faced with the choice of expanding palm oil coverage to compensate for low productivity. However, this option will have a significant impact on environmental and social aspects. To date, the government's data on oil palm coverage has reached 17.3 million hectares (BIG, 2024), with great pressure on natural forests, peatlands, and marginal lands.

This situation has resulted in high carbon emissions due to deforestation and peatland drainage. Based on regional data, around 57% of peatlands with protective functions that were burned have been converted into oil palm plantations (Pantau Gambut, 2024). Without strict restrictions, the expansion of oil palm plantations will further increase massive carbon emissions, posing a threat to the achievement of Indonesia's climate commitments as outlined in the NDC (Nationally Determined Contribution) document.

The expansion of oil palm plantations in Indonesia has reached a critical point that triggers significant ecological risks. Based on research conducted on the analysis of Environmental Carrying Capacity and Capacity (D3TLH), the upper limit (cap) of the national oil palm plantation area is 18.15 million hectares. Data shows that this area has been almost fully utilized, with an existing area of 18.22 million hectares in 2022. This imbalance indicates that some areas have exceeded their ideal environmental capacity, potentially damaging the balance of the ecosystem (Lokahita et al, 2025).

The ecological impacts of oil palm expansion include the loss of primary and secondary forest cover, peatland degradation, and a decline in environmental services, including carbon sequestration and hydrological cycle regulation. In addition, carbon emissions from land converted to oil palm plantations threaten the 2030 FOLU Net Sink and Enhanced NDC 2030 targets. Madani's analysis shows that from 2020 to 2023, deforestation of natural forests in oil palm concessions has consistently ranked among the top three each year. Furthermore, of the total 24.2 million hectares of peat ecosystems in Indonesia, 5.7 million hectares are located within oil palm concession areas. Of this figure, 1.3 million hectares are natural forests in peat ecosystems, which are essential for the environment.

As stated in the FOLU Net Sink 2030 commitment document, the forestry and land sector must achieve net sink status by 2030, which can be achieved if Indonesia can reduce the rate of natural forest loss. However, Indonesia's deforestation up to 2019 has reached 4.8 million hectares. This means that Indonesia's deforestation quota has been exceeded by 577,000 hectares.

This means that deforestation is no longer occurring. However, in the ENDC document, this plan has not been harmonized because it still allows for 3.59 million hectares of deforestation by 2030. (Indonesia's FOLU Net Sink, 2022). Meanwhile, throughout 2022, there are 907,310 hectares of natural forest still located within oil palm concessions throughout Indonesia.

Not only from an ecological perspective, the expansion of oil palm plantations will also increase the potential for conflict, especially in areas where land use overlaps. The Agrarian Development Consortium recorded 108 conflicts related to the palm oil industry in 2023. Between 2010 and 2022, the total number of conflicts related to oil palm plantations reached 1,073. This number of conflicts will continue to increase if oil palm plantation expansion remains the chosen option. Academic foundations and data-based considerations are absolutely essential for the government in determining future biofuel implementation strategies. Therefore, the expansion of oil palm plantations can no longer be an option.

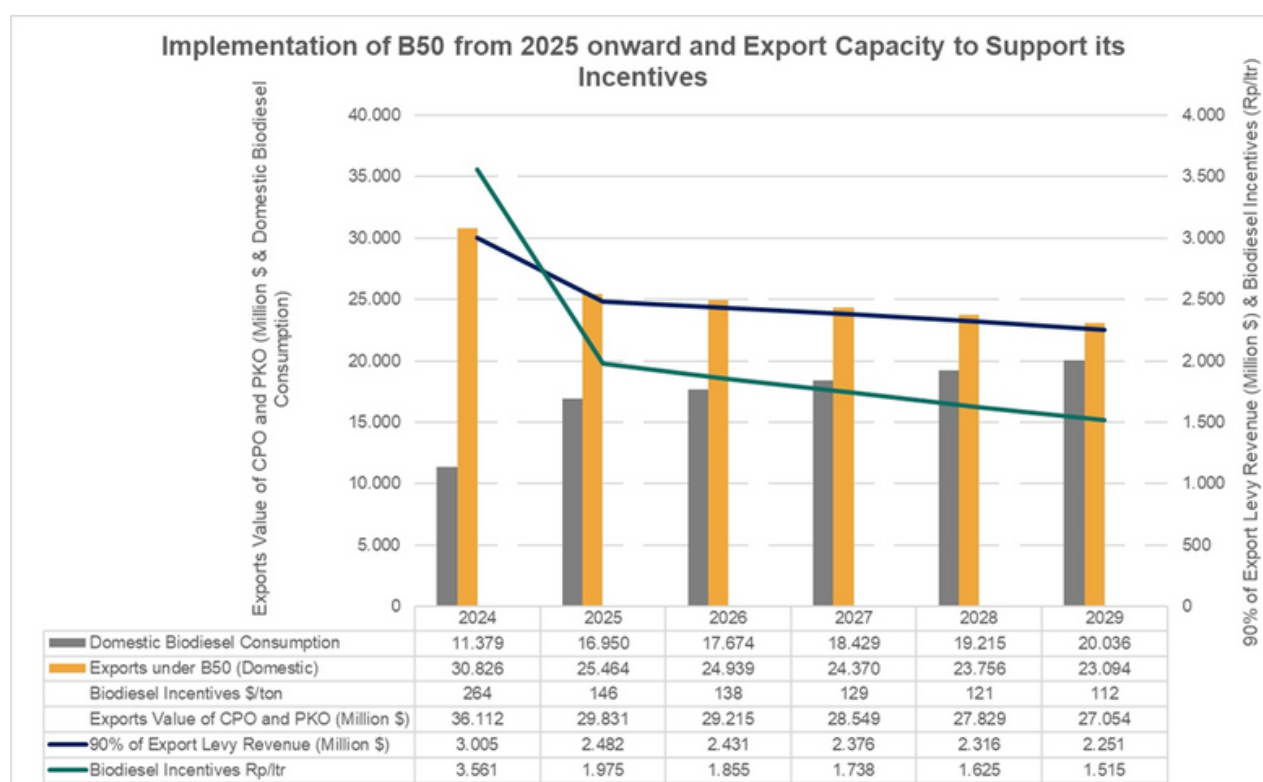


Economic Vulnerability and Market Dynamics

The economic dimension is an important aspect to consider, especially when relying on palm oil for the national biofuel industry. Although palm oil biodiesel contributes significantly to the national economy, this dependence creates significant risks. As a commodity used for food and energy, its importance will be a tug of war. When the demand for palm oil for food increases during certain periods (such as holidays), the demand for biofuel will decrease. Conversely, when CPO reserves are high, biofuel will become the solution. It will become a market that absorbs CPO reserves.

When Indonesia decided to increase the biodiesel blend to B50, the consequences went beyond the energy aspect. There are complex dynamics that need to be carefully unraveled. From the FGD series, it was found that domestic consumption in 2025 is projected to surge to 5.05 million tons of CPO. This surge is influenced by the ambition to increase the national biodiesel blend. This situation will sacrifice foreign exchange earnings from exports. Export volumes will shrink dramatically. The value of exports is estimated to fall from \$36 billion in 2024 to only \$27 billion in 2029. At the same time, revenue from export levies (PE) will also weaken, falling from \$3 billion to \$2.8 billion. This decline may seem small, but it has major implications for fiscal stability.

Figure 2. Projected Implementation of B50 (2025–2029) and Export Support for Biodiesel Incentives



Source: Results of FGD organized by Madani Berkelanjutan, 2024

Furthermore, export market dynamics are also highly volatile, especially with various new policies that demand ecosystem sustainability in palm oil derivative products. Regulations in the European Union (Renewable Energy Directive - RED), for example, limit imports of palm oil-based biodiesel due to concerns about deforestation and sustainability. The latest European Union regulation (European Union Deforestation Regulation - EUDR) even expands the scope of commodities that can enter the European market. This price and market volatility weakens the competitive aspect of biofuel. This condition makes the national biofuel industry, instead of being a strategic policy towards a just energy transition, only a temporary solution to overcome various economic problems in the palm oil market and its derivative products.

In the context of the economy and the market, ambitions to increase the blend without careful calculations will pose major challenges for the private sector. Currently, refineries in Indonesia are operating at 85% capacity, which is sufficient to support B40 production. However, if this is increased to B45, the refineries will approach maximum capacity, increasing the risk of damage. To achieve a higher blend, there are only two options: increase refinery capacity or adopt new technology. Both will require significant additional funding.

In terms of funding, nearly 95% of the funds managed by the Palm Oil Plantation Fund Management Agency (BPDPKS) are allocated to biodiesel subsidies. There is little room available to improve the upstream palm oil sector, especially for independent smallholders. This contradicts the original spirit of the BPDPKS's establishment, which was intended to support capacity building in the plantation sector, such as the procurement of high-quality seeds, increased productivity, and plantation rejuvenation. From 2015 to 2022, the funds disbursed for biodiesel subsidies reached 142.8 trillion rupiah, out of a total fund collection of 165.8 trillion rupiah. Ironically, this massive allocation has actually benefited large companies, such as Wilmar and Musim Mas, which control almost half of the market. Meanwhile, small farmers have to struggle with low productivity, lack of access to infrastructure, and high operational costs.

Looking at this situation, it seems that the development of the biofuel industry in Indonesia has become "bigger than the tree it grew from." Instead of benefiting Indonesia, it has brought various uncertainties that have made things difficult for many parties. Several rounds of discussions with palm oil and environmental practitioners have highlighted that domestic energy needs, especially for the transportation and small industry sectors, could be a catalyst for more stable growth in the biofuel industry. However, this requires policies that support the use of local raw materials and the provision of infrastructure that enables raw material processing at the regional level.

Governance, Trade, and Transparency

Challenges in governance, trade, and transparency remain obstacles to achieving a sustainable biofuel industry. Every actor in the supply chain plays an important role and faces challenges that need more attention so that the benefits of the biofuel industry can be felt more equitably. Although biodiesel has great potential to support national energy independence, its current implementation has not been able to provide equitable benefits, especially for smallholders who manage around 40-42% of oil palm land throughout Indonesia. Independent farmers, who are the backbone of the upstream sector, are often in the most vulnerable position.

A 2019 survey in Berau revealed that the majority of smallholders are unable to set aside funds for plantation rejuvenation due to a lack of financial support and adequate infrastructure. On the other hand, funds from the Palm Oil Plantation Fund Management Agency (BPDPKS), which should be allocated to strengthen the upstream sector, are mostly used for biodiesel subsidies. Ironically, this policy mostly benefits large companies that control 50% of the biodiesel market. This subsidy scheme was designed to keep biodiesel prices affordable by compensating for the difference between CPO and diesel prices, especially when CPO prices are high and fossil diesel prices are low. However, due to the highly concentrated structure of the biodiesel industry, the majority of these incentives tend to be absorbed by large FAME producing companies. In fact, the initial mandate of BPDPKS was to support small farmers through the provision of high-quality seeds, capacity building, and infrastructure development.

Trade imbalances are increasingly apparent in the biodiesel program. Although this program was designed to absorb domestic palm oil stocks and reduce dependence on fossil fuel imports, its impact on smallholders has been very limited. The price of fresh fruit bunches (FFB) at the farmer level is not always directly proportional to the increase in biodiesel consumption. In fact, the price determination mechanism at the factory level is often not transparent, so that farmers' profit margins remain small.

Based on an independent audit and analysis conducted by the Corruption Eradication Commission (KPK) in 2022, transparency is a crucial issue that needs to be addressed immediately. The process of determining the Market Index Price (HIP) for biodiesel is often not based on comprehensive and open studies. This difference stems from the discrepancy between the conversion cost of CPO into biodiesel based on factual calculations (market price) and the conversion cost set by the Ministry of Energy and Mineral Resources each month. This condition opens up opportunities for corruption and abuse of authority. In addition, the BPDPKS fund management mechanism does not yet fully involve transparent public oversight, resulting in low accountability.

On the other hand, the implementation of the biodiesel program is often marred by various inefficiencies. Inadequate logistics infrastructure, such as a lack of ships to transport raw materials, and unmet technical standards, are obstacles to creating an effective industrial supply chain. A total overhaul of governance and trade is a necessity if Indonesia truly wants to build a fair, sustainable, and deep-rooted biofuel industry. At the very least, this needs to start with opening access to data and information to all stakeholders. This includes transparency in pricing, fund allocation, and the results of biodiesel program performance evaluations. The government also needs to strengthen regulations to ensure that every process, from production to distribution of biodiesel, meets strict accountability standards.



Institutional

In the intersection of the energy, food, and forestry sectors, all of which converge on palm oil commodities, the institutional aspect becomes a task that must be completed. When talking about Indonesia's biofuel industry, there will be many ministries/agencies (K/L) involved, representing various sectors. For example, in the context of palm oil plantation expansion, where the situation has exceeded the environmental carrying capacity threshold, the Ministry of Agriculture, the Ministry of Environment, and the Ministry of Forestry are the sectors that have the authority to make policy decisions. If the context is expanded to include energy and food aspects, then the sectors that need to be involved will increase.

This happens because palm oil management in Indonesia is spread across various ministries and agencies with different mandates. The Ministry of Agriculture, for example, focuses on cultivation and production, while the Ministry of Environment focuses on environmental management and protection. On the other hand, the Ministry of Energy and Mineral Resources regulates bioenergy as part of the national energy mix. Meanwhile, the Ministry of Forestry is responsible for preserving and utilizing Indonesia's forest cover. Not to mention palm oil funding with institutions such as BPDP, which has its own policies. Instead of complementing each other, these approaches often run independently, creating overlapping or even contradictory policies.

This situation creates a vacuum at the implementation level. Palm oil intensification programs to increase productivity, especially at the independent farmer level, often do not receive adequate funding. In fact, the ambition to increase the biodiesel mix actually creates new fiscal space through savings on fossil fuel imports. However, this fiscal space has not been fully utilized to support rejuvenation and productivity improvements in the upstream sector. Instead, most of the funds are allocated to biodiesel subsidies, which are mostly enjoyed by large companies. As a result, smallholders, who should be the main beneficiaries, are trapped in bureaucratic complexity and have limited access to productivity funding. In fact, they play a key role in the national palm oil supply chain. This issue is not merely about how palm oil is managed, but is more fundamental. We must find a way for existing institutions to become the foundation for driving this sector effectively, fairly, and sustainably. Without strong institutions, let alone fragmented and sectoral ones, all grand ambitions, whether to increase productivity, achieve energy self-sufficiency, or maintain environmental commitments, will remain mere rhetoric.

Indonesia can learn a lot from institutional models such as FELDA (Federal Land Development Authority) in Malaysia. FELDA is designed to integrate various aspects of palm oil management, including empowering smallholders, increasing productivity, and economic sustainability. This institution not only acts as a supervisor but also as a facilitator that provides smallholders with access to technology, markets, and financing. With its integrated structure, FELDA is able to ensure that all stakeholders benefit fairly and that palm oil productivity is maintained.

Another example can be seen in the implementation of biofuel in Brazil, where the policy began in 1931. In the 1970s, Brazil introduced RenovaBio as a market-based incentive system that encourages the sustainable production and use of biofuels. Brazil's success can also be seen in its consistent and long-term policies. The government has set stable biofuel blending targets, such as 27% ethanol in gasoline and 12% biodiesel in diesel, providing certainty for industry and investors. Thus, it is not based solely on ambition.

In Indonesia, a similar model can be adapted to create a centralized institution that not only serves as a bridge between sectors but also directly oversees policy implementation. This institution needs to have a strong mandate, sufficient resources, and the flexibility to adapt to evolving challenges. In addition, a participatory approach must be at the core of management, where small farmers are directly involved in decision-making and supply chain management.

Learning from Malaysia and Brazil also means building institutional structures that encourage smallholder involvement in downstreaming. By establishing community-based cooperatives or fair partnership schemes, smallholders can improve their bargaining position in the market. This will not only reduce dependence on large corporations but also create a more inclusive and sustainable supply chain.

Institutional challenges in Indonesia's palm oil sector cannot be resolved with partial improvements or short-term policies. A comprehensive transformation is needed, where all parties work under the same framework to achieve common goals. By adopting lessons from models such as FELDA and integrating data-driven, participatory, and sustainable approaches, Indonesia can build palm oil governance that is not only more effective but also capable of responding to global challenges.

Indonesian palm oil is not just about production figures or land area, but about how to build a system that is fair, transparent, and empowering for all. Now is the time for Indonesia to set new standards in palm oil governance that will serve as a model for the world.

Developing Strategic Steps for Indonesia's Biofuel Industry

Blueprint for Indonesia's Plantation Industry and Biofuels

Indonesia once had a blueprint for the biofuel industry for 2006-2025. Today, this document is no longer important for policy makers. However, it is important to look at the initial spirit of how Indonesia viewed the domestic biofuel industry. Now, it is necessary to expand its scope so that it is not only a blueprint for the biofuel industry, but also for the plantation sector in Indonesia. This is because the two cannot be separated and must be planned in parallel to maintain harmony.

The formulation of Indonesia's plantation and biofuel blueprint must include the fundamental objectives of Indonesia's plantation development. What is the strategic direction of Indonesia's plantations, so that they not only grow the national economy but also provide value for the environment and society? Its formulation needs to be based on scientifically sound principles and clear implementation measures. This is so that it does not become a plan that is only strong on paper.

To that end, this blueprint also needs to cover institutional aspects that can oversee the plantation industry and its various derivative products, including the development of biofuels. Thus, the planning of the energy mix from biofuels is not only based on rhetoric, but also on mature planning and measurability. To enable the blueprint to be measured, institutional aspects are a must.

A strong institution is not just about the necessary organization and structure. The direction and function of the institution must also be clearly outlined in the blueprint. With the world's largest oil palm coverage and huge plantation commodity potential, the role of regulators and monitoring is greatly needed. We cannot rely solely on sectors that are still fragmented and have their own agendas. There needs to be coherence in the management of Indonesian plantations to ensure that planning and implementation can run smoothly.

Intensifying Productivity and Maintaining the Stability of Biofuel Raw Materials

Low productivity is one of the main challenges that needs to be addressed first, as it is the antithesis of extensification. Although so far, plantation intensification has been talked about more than it has been implemented, this does not mean it cannot be done. The ambition to increase the blend must first be rationalized, and intensification strategies must be considered. This will ensure that the focus of policy-making is not fragmented.

When the ambition to increase the blend ratio continues to be echoed, the resources needed for intensification will be sacrificed. The strategic step that needs to be taken is to immediately calculate the rationalization of the national biofuel blend ratio by considering the production capacity of biofuel and its various supporting infrastructures. This needs to look at the aspect of productivity and calculate the proportion of funding needed to support intensification.

This step means that the government is making an effort to maintain the stability of raw materials while also considering intensification. It is not just unilaterally and ambitiously pushing for an increase in the blend. If the vision to be achieved is energy self-sufficiency with biofuel, then intensification is the most rational choice.

Establishing a National Palm Oil Area Upper Limit Policy (CAP)

Extensification (land expansion) can no longer be an option for biofuel development, as this will cause irreversible damage to the ecosystem. Currently, calculations of the carrying capacity and environmental capacity for palm oil are already at a critical threshold. This condition cannot be exacerbated by the addition of new land. The government needs to immediately establish an upper threshold policy (cap), as this is mandated by Article 8 of Law No. 32 of 2009 concerning Environmental Protection and Management (UUPPLH).

The use of technology for real-time monitoring is also necessary to ensure that the carrying capacity and environmental capacity are not exceeded. This will guarantee that there is no illegal expansion that has the potential to damage the ecosystem. In addition, the government must strictly enforce the law against land expansion violations, while providing incentives to companies and farmers who comply with sustainability regulations, in order to encourage more responsible plantation practices.

Establishing a cap policy for palm oil commodities could pave the way for comprehensive plantation management reform. This means that Indonesia's plantation sector could be run with a spirit of long-term and strategic planning, taking into account economic growth, social conditions, and ecosystem sustainability.

Creating Enabling Conditions for Energy Decentralization

To increase energy independence at the local level, strengthening community-based energy systems is a strategic step that must be taken. Villages need to be empowered to manage their own energy resources by utilizing existing plants such as rubber and nyamplung, whose seeds can be used as bioenergy raw materials, while the trees also have a land rehabilitation function. By building small-scale bioenergy infrastructure in villages, communities can develop sustainable energy models that are not dependent on centralized supplies. This can also revitalize Village-Owned Enterprises (BUMDes), which will boost the village economy.

In addition, policies that support energy decentralization must be promoted to enable each village to have the capacity to produce and manage energy independently. This requires a regulatory framework that ensures community-based energy management can operate legally and economically. To support this implementation, the government must provide structured training and assistance to village communities in managing local energy resources, so that sustainability and community welfare can be maintained through an inclusive and independent energy system.

Reform of Governance and Trade in Indonesia's Plantation and Biofuel Industries

Transparency, accountability, and professionalism are the three keywords for reforming the governance and trade of Indonesia's plantation and biofuel industries. This is because making improvements alone is not enough. Since 2010, the spirit of improving governance and trade in the land sector has often been echoed through various government programs. However, their implementation has never been effective. Therefore, a fundamental reform is needed to improve the current situation.

The aspects of governance and trade referred to here are not merely institutional, but rather systemic aspects of the industry. The government can learn from the success of Malaysia, which has experience in establishing FELDA (Federal Land Development Authority). However, the most important thing is to ensure a transparent system that enables accountability. This means that the governance and trade referred to here are not a matter of institutional form. Rather, it is about overhauling the current closed and unaccountable system, moving towards a system that can maintain professionalism through transparency and accountability.

This also means that the system must be based on good and enforceable standard operating procedures (SOPs). This includes regular audits by independent auditors and the imposition of sanctions for violations.

Developing a Safeguard Framework for Indonesia's Plantation and Biofuel Industry

Cases of social conflict at the grassroots level due to plantation sector development must be resolved. To prevent environmental, social, and economic risks, a strong safeguard framework system is needed to address the negative impacts that may arise from plantation expansion and biofuel industry management. This step includes implementing risk mitigation policies, protecting the rights of local communities, and strictly monitoring practices that could damage ecosystems and socioeconomic resilience in affected areas. This includes implementing Free, Prior, and Informed Consent (FPIC) before undertaking any activities.

Every industry player must meet strict sustainability standards to protect ecosystems and local communities, so that the industry continues to provide benefits without causing long-term negative impacts. In addition, the government must prepare a crisis response mechanism that includes the provision of reserve funds and agricultural insurance to deal with the risks of fluctuating commodity prices and the impacts of climate change. Multi-stakeholder involvement is a crucial factor, where all parties, including the government, indigenous communities, small farmers, and academics, must be involved in policy formulation and evaluation to ensure sustainability and fairness in this sector.

Conclusion

Biofuel policy in Indonesia is at a critical juncture. On the one hand, there is a great ambition to increase energy independence and reduce dependence on fossil fuels. On the other hand, an approach that is too focused on palm oil as the sole source of raw material has created a structural dilemma: between environmentally destructive land expansion, pressure on food commodities, and economic inequality.

This document offers two contrasting policy scenarios: a Business as Usual (BAU) approach that will amplify ecological and social pressures, and a Local-Based Intervention scenario that enables energy targets to be achieved without sacrificing sustainability and equity. By increasing productivity, developing local raw material alternatives, and strengthening the role of communities and governance, Indonesia can redesign its biofuel strategy to not only meet energy mix targets but also strengthen social and ecological resilience.

Corrective measures must be taken immediately. Setting a maximum limit on national oil palm coverage, reforming the distribution of BPD PKS funds, and empowering villages through community bioenergy must be top priorities. Without targeted and comprehensive intervention, biofuel policies have the potential to become a double burden, both on the environment and on society.

Indonesia has a significant opportunity to position biofuel as a pillar of a just energy transition, rooted in local strengths and aligned with national climate commitments. This momentum must not be wasted. Today's decisions will shape the future of our energy industry and social ecosystem for decades to come.

Appendix 1

Methodological Explanation and Assumptions for the Business as Usual (BAU) and Intervention (Local Approach) Scenarios

1. Palm Oil Land Expansion Component

Component	Business as Usual (BAU)	Intervention (Local Approach)
Palm Oil Land Expansion (Million Ha)	3.74 - 4.72	0

- **BAU (3.74 - 4.72 Million Ha)**

- Formula Calculation

$$\text{Additional land area (ha)} = \frac{\text{Additional CPO requirement (tons)}}{\text{Productivity (tons/ha)}}$$

- Using data on the assumed additional CPO requirement of 14.2 million tons of CPO (B40) with an assumed productivity of (3.8 tons/ha)

$$\frac{14,200,000 \text{ tons}}{3.8 \text{ tons/ha}} = 3,736,842 \text{ ha (approximately 3.74 million ha)} \rightarrow \text{for a minimum}$$

- Using data assuming CPO demand of 17.93 million tons of CPO (B50) with an assumed productivity of 3.8 tons/ha

$$\frac{17,930,000 \text{ tons}}{3.8 \text{ tons/ha}} = 4,718,421 \text{ ha (approximately 4.72 million ha)} \rightarrow \text{for maximum}$$

2. Palm Oil Productivity Component (Tons/Ha)

Component	Business as Usual (BAU)	Intervention (Local Approach)
Oil Palm Productivity (Tons/Ha)	3.8	6

- The figure of 3.8 is based on the assumption that the current national palm oil productivity is 3.8 tons/ha (Ministry of Agriculture, 2023).
- The figure of 6 tons/ha is obtained from the assumption of realistic optimal productivity potential achieved through intensification, replanting, and the use of certified superior seeds.

3. CPO Price Component (USD/Ton)

Component	Business as Usual (BAU)	Intervention (Local Approach)
CPO Price (USD/Metric Ton)	800	800

- CPO prices in USD/metric tons have been highly volatile over the past five years. Therefore, a CPO price assumption of 800 USD/metric tons has been made.
- Avoiding bias towards extreme years such as 2020 (decline), 2021 (surge), and 2025 (decline).
- Source: APKASINDO, Ministry of Trade, BPDP

4. CPO Export Volume Components (Millions of Tons)

Component	Business as Usual (BAU)	Intervention (Local Approach)
CPO Export Volume (Million Tons)	34	34

- The assumption of 34 million tons as the export volume in this document is based on the actual average palm oil product exports over the past five years. This figure reflects the stability of national palm oil exports, which have consistently exceeded 32 million tons per year and remained high despite disruptions such as the COVID-19 pandemic and the export ban policy in 2022.

Year	Export Volume (million tons)	Source
2019	36.18	GAPKI Annual Report
2020	34.02	GAPKI Annual Report
2021	33.67	GAPKI Annual Report
2022	33.31	GAPKI Annual Report
2023	32.23	GAPKI Annual Report

- Average (mean): $(36.18 + 34.02 + 33.67 + 33.31 + 32.23) / 5 = 33.88$ million tons, rounded to **34 million tons**.

5. CPO Foreign Exchange Revenue Components (Billion USD)

Component	Business as Usual (BAU)	Intervention (Local Approach)
CPO Foreign Exchange Earnings (Billion USD)	27	27.2

- Calculated from the multiplication of CPO export volume of 34 million metric tons with an assumed CPO price of USD 800 per metric ton:
 $34,000,000 \times 800 = 27,200,000,000$

6. Biofuel Foreign Exchange Savings Component (Billion USD)

Component	Business as Usual (BAU)	Intervention (Local Approach)
Foreign Exchange Savings Component (Biofuel) (Billion USD)	7.9	7.9

- Foreign exchange savings of USD 7.9 billion are calculated from the value of fossil fuel imports that can be replaced by domestic biodiesel (based on data from the Ministry of Energy and Mineral Resources, 2024)

7. Village Economic Income Components (Billion USD)

Component	Business as Usual (BAU)	Intervention (Local Approach)
Village Economic Income (Billion USD)	0	2

- The figure of USD 2 billion in the intervention scenario comes from projections of the economic added value of villages if a small portion of the biodiesel production chain is managed directly by local business units such as village-owned enterprises, farmer cooperatives, or hybrid partnerships.
- The basic assumptions are as follows:
 - Local production share: 10% of the total national biodiesel production volume (conservative estimate of 10 million KL → 1 million KL).
 - Local net business margin: USD 200 per kiloliter. This is based on the results of Madani's FGD discussions and findings from mini biodiesel factory practices in Sumatra and Kalimantan, which recorded an average net margin after deducting raw material, operational, and distribution costs.
 - Therefore, the estimated annual revenue that can be obtained is: $1,000,000 \text{ KL} \times \text{USD } 200 = \text{USD } 200 \text{ million/year}$, or **USD 2 billion over a period of 10 years.**
- This simulation is intended to demonstrate the significant potential for economic value redistribution if the bioenergy production approach is directed towards local actors. In addition to reflecting monetary value, this estimate also shows the important role of BUMDes and village cooperatives as alternative economic actors: from small offtakers, intermediate processors (pre-refineries), to owners of local biodiesel production units with adequate institutional and technical support.

8. Social & Environmental Cost Components (Billion USD)

Component	Business as Usual (BAU)	Intervention (Local Approach)
Social & Environmental Costs (Billion USD)	3.74 - 4.72	0

- BAU (USD 3.74 - 4.72 billion):** This estimate was calculated by multiplying the estimated area of oil palm land to be expanded in the business as usual (BAU) scenario based on additional CPO requirements for the B40 and B50 programs by a conservative ecological loss value per hectare of USD 1,000 (source: KLHK 2018) estimates that the ecosystem services of Indonesia's tropical forests are valued at between USD 400–900/ha/year, depending on the type of land cover).
 - Ecosystem value = USD 500–900/ha/year
 - We assume 1–2 years of total value loss:
 - USD 500/ha × 2 = USD 1,000/ha
 - This is the figure used as an indicative value
 - Therefore, the total ecological loss projection is:
 - Minimum: 3,740,000 ha × USD 1,000 = USD 3.74 billion
 - Maximum: 4,720,000 ha × USD 1,000 = USD 4.72 billion
- Intervention (local approach):** In this assumption, because the land expansion component (see point 1) has an intervention (local approach) value of 0, using the same calculation as the BAU scenario, the intervention (local approach) scenario also has a value of 0.

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