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Assessment of Policy Implementation for Palm Oil-Based Bioenergy Development in Indonesia

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Abstract. This paper assessed the policy implementation in this sector to identify the reasons behind the remaining challenges in palm oil-based bioenergy in Indonesia by combining renewable readiness assessment with policy indicators. The use of multiple theories allowed this study to address the holistic aspects of the policy implementation within four pillars—national energy policy and strategy, institutional framework, economic instruments, and infrastructure. A qualitative analysis was used to assess the current policy implementation and provide a discussion within each pillar. The basic policy and strategy have existed along with the institutional framework and price-based economic instrument. At the same time, the infrastructure pillar fell behind due to a lack of government support regarding the widespread issues. Although the readiness assessment result was considered suboptimal, the assessment and discussion were still expected as the first step toward proposing bioenergy development strategies that will contribute to the energy resilience of Indonesia.

Keywords: Bioenergy · Policy · Palm oil

1 Introduction

Indonesia is rich in energy resources—which comprise coal, oil, and natural gas—including RE resources with the largest global potential for geothermal energy (23.9 GW), the potential for hydropower (94 GW), biomass (32.6 GW), biogas (200,000 barrels/day), wind energy (60.6 GW), solar energy (208 GW), and ocean and tidal energy (17.9 GW) [1]. To contribute to global efforts to combat climate change by utilizing the enormous RE potential, the country has set a target of 23% of total primary energy supply by 2025 and 31% by 2050 in the National Energy Policy (NEP) [2]. However, Indonesia still needs to work on the implementation to meet the ambitious target, departing from its current RE share of only 11.2% [3].

A study by IRENA (2017) [2] concluded that bioenergy would continue to play an important role in Indonesia's use of RE, among other RE resources. More than

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half of the energy used in 2030 would come from bioenergy used for process heat in industry or as liquid biofuels in transport. Bioenergy was estimated to comprise 13% of the total, contributing the most significant portion among the other renewable energy sources of the national primary energy supply. As the world's biggest producer of palm oil, this commodity also became the largest domestic bioenergy resource within the country, with the production of nearly 52 million tons of crude palm oil (CPO) and palm kernel oil (PKO) in 2019. Recognizing the potential for large-scale development of palm-oil-based bioenergy to meet national RE targets, the Indonesian government has introduced various supporting regulations, primarily to fulfill energy use in the transport sector and for industrial process heat [2]. Even within the most progressive mandate in the use of renewable energy, several challenges remained as barriers to increasing its installation related to unsupportive regulations, e.g., unattractive tariffs and unbalanced risk allocations, which resulted in a lack of investor confidence in the sector [4].

Considering the crucial role of policy, an assessment of current RE policy implementation is important to track how well Indonesia has progressed in creating the regulatory environment needed to accelerate RE deployment, mainly focused on palm oil-based bioenergy. Accordingly, this study will adopt the renewable readiness assessment by IRENA (2013) [5] with policy indicators from the OECD (2007) [6] and World Bank (2018) [7] to design a novel approach to assessing policy implementation. The versatile readiness assessment and regulatory indicators within RE will enable this study to address the holistic aspects of the palm-oil-based bioenergy policies in Indonesia. The assessment will use qualitative analysis to identify areas for policy and regulatory reform in support of palm oil-based bioenergy development in Indonesia. The paper first presents a literature review of palm oil-based bioenergy development in Indonesia. Then, a theoretical framework for formulating the indicators by combining theories from relevant sources is elaborated. The policy implementation assessment will finally be presented, following the stated pillars.

2 Theoretical Framework

Bioenergy is a complex sector characterized by inter-sectoral, interdisciplinary, and heterogeneous dynamics [8]. This complexity is accommodated by using multiple theories to be applied in the theory triangulation method [9, 10]. The indicators used in this study are determined by selecting those that converge on the existing theories from the Renewable Readiness Assessment (RRA) by IRENA (2013) [5], the Regulatory Indicators for Sustainable Energy (RISE) by the World Bank (2018) [7], and the OECD Contribution to the United Nations Commission on Sustainable Development 15 by the OECD (2007) [6]. The IRENA report and RISE provide RE readiness indicators that take a holistic approach to the core elements, whereas the OECD report and RISE provide RE policy assessment indicators. The RISE developed by the World Bank is categorized into four pillars based on energy types. As a result, the legal framework within the renewable energy pillar is adapted as a policy framework in this study.

Meanwhile, the OECD report focused on the learnings from applied policy and regulation compiled in a policy toolbox that complements the other indicators.

Table 1. Theoretical Renewable Energy Policy Readiness Indicators and Sub-Indicators

References			Synthesized Indicators	Synthesized Sub-Indicators
RRA (IRENA, 2013) - Country Overview - Energy Resources, Technologies, Market, and Infrastructure - National Energy Policy and Strategy - Institutions and Regulation - Capacity Needs - Business Model	RISE (World Bank, 2018) - Electricity Access - Clean Cooking - Renewable Energy - Energy Efficiency	OECD Contribution to the United Nations Commission on Sustainable Development 15 (OECD, 2007) - Regulation and Standards - Economic Instruments - Subsidies - Investment - Partnerships and Voluntary Agreements - Research and Development - Information and Communications - Assessments and Scenarios - National Strategies	National Energy Policy and Strategy	1. Regulation and Renewable Energy Policy Strategy 2. Standard and Labelling Systems
			Institutional Framework	1. Stakeholder Mapping 2. Institutional Coordination & Collaborations
			Economic Instruments	1. Market Condition 2. Price-Based Instruments 3. Investment Policy 4. Financial & Fiscal Incentives 5. Carbon Market

(*continued*)

Table 1. (*continued*)

References			Synthesized Indicators	Synthesized Sub-Indicators
			Infrastructure	1. Data and Information 2. Research and Development 3. Distribution Infrastructure

Based on these theories, the RE policy implementation assessment is divided into four pillars: national energy policy and strategy, institutional framework, economic instruments, and infrastructure. These pillars are further broken down into sub-indicators by listing the sub-indicators within each pillar that are over-represented in the theories (Table 1). The indicators are chosen based on their importance as stated in the reports and findings. For instance, the IEA and OECD found that high levels of policy effectiveness are linked to the co-existence of three factors that are also addressed in this study: policy ambition, a well-designed incentive scheme, and the capacity of the system to overcome noneconomic barriers that may hinder the market's function. By investigating these pillars, this study will discuss the policy implementation of the core indicators stated by the majority. Thus, the result would provide insights into the current condition of each indicator and discuss the challenges to be addressed.

3 Methodology

The data were gathered from in-depth interviews and by sifting through official policy documents related to palm-oil bioenergy in Indonesia within the period of August to November 2020. Sample actors include: six governmental institutions, six private institutions, one international actor, and seven research institutes or academicians, totaling 20 institutional representatives that are relevant to the bioenergy topics, including financing aspects. The sample was selected through purposive sampling and followed by the snowball method, which relies on the suggestions and cooperation of the previous interviewees and is integrated with the pre-formulated list [8].

The readiness of the RE policy will be determined by assessing the enabling factors for RE deployment in terms of four pillars (Table 1). The pillars and sub-indicators are determined by the theory triangulation method, as explained in the theoretical framework. The study uses a qualitative research methodology to evaluate the sub-indicators within each pillar. The analysis applied a descriptive data analysis method, which refers to a process of sifting through a body of collected data and searching for patterns and relationships to gain insights about the phenomena the data describe. Stakeholder analysis is used for the institutional framework pillar to identify their roles, interests, knowledge, hopes, and influences related to existing policies.

4 Results and Discussion

4.1 National Energy Policy and Strategy

It is noted that a comprehensive and suitable combination of policy tools is an essential aspect of sustained renewable energy deployment [6, 7, 11, 12]. National energy policy and strategy include the necessary policy tools, i.e., agreed government norms for the production and use of energy and environmental protection, targets and implementation, roadmaps and action plans, energy performance standards and labeling systems, and tools to monitor or assess progress.

Regulations and Renewable Energy Policy Strategy—the framework for the RE policy strategy to reach the target is mapped in Fig. 1. The target implementation strategy is further elaborated in the National Energy General Plan (RUEN), which describes several short- and mid-term programs to reach the NEP. Specifically for the operation of biofuels, MEMR regulates the provision, utilization, and commercialization of biofuels as alternative fuels in the form of biodiesel (B100), bioethanol (E100), and pure vegetable oils (0100). Meanwhile, regarding the operation in the electricity sector, the general plan for electricity supply (RUPTL) from 2019 to 2028 is issued by MEMR, including the purchase mechanism of electricity from biomass power plants (PLTBm) and biogas power plants (PLTBg) by PT. PLN. Besides, in terms of funding, the Ministry of Finance, and the Indonesian Palm Oil Plantation Fund Management Agency (BPDPKS) mainly control the collection and use of palm oil plantation funding used for human resources development, R&D, rejuvenation of palm oil plantations, infrastructure, and to pay for the cost difference of biofuel raw materials.

In implementing the policy plan for bioenergy development in the RUEN, there are still significant gaps towards fulfilling the 2025 RUEN target [13]. This indicates the existence of challenges found during the implementation. There is a bioenergy development focus imbalance with a tendency over biofuels.

"The growth of RE is greatly helped by biofuel. In the (biopower) generation, the RUEN target was not achieved, but the share from the mandatory B30 really helped achieve the RE target. Currently, it is only biofuel that is being considered. For biomass and biogas, there is still no special policy or institution to pay attention to those, while in palm oil, we already have BPDPKS. Apart from (biogas and biomass) being more difficult to develop, the scale has not been felt as significant for state finance. On the other hand, the benefits from biofuel can be felt from how much foreign exchange can be saved." (N. Marizi, personal interview, June 5, 2020)

Moreover, the dependence on political support for bioenergy development could become a barrier.

"Energy is a vital thing under a regime that is heavily regulated. Therefore, strong support is needed for the development of this sector." (P. Tjakrawan, personal interview, June 4, 2020)

"It depends on who is in power and whether the focus is on developing clean or fossil energy. This can be contextualized in the political system in Indonesia, which changes every five years and might affect the changing policies or focus of development related to energy. The policy inconsistency can reduce the attractiveness of businesses in the bioenergy sector." (B. Yusuf, personal interview, June 8, 2020).

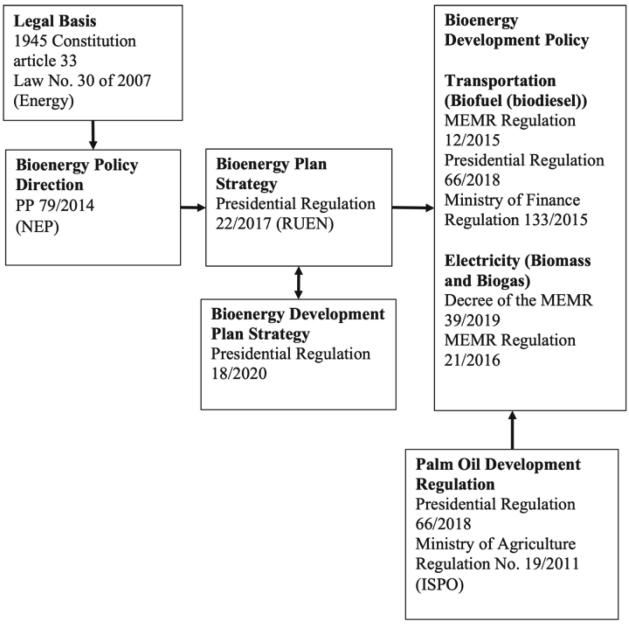

Fig. 1. Bioenergy Development Policy Framework in Indonesia

Standards and Labeling System: Supporting policy is needed to regulate the energy performance and emissions standard along with the labeling system to identify synergies and trade-offs across the economic, environmental, and social impacts of energy policy options [6]. The RE standards and labeling system policies in Indonesia can be divided into two focuses: sustainability and technology standards. Sustainability Standards. In the palm-oil bioenergy context, the sustainability aspect becomes necessary to support national environmental acts. Accordingly, the Indonesian government has facilitated the certification of Indonesia Sustainable Palm Oil (ISPO) to assist with the requirements about feedstock security, either in the electricity or transportation sectors. While at the international level, the certification is given by Roundtable Sustainable Palm Oil (RSPO). Both certifications have a component for palm oil waste management, which includes water source and quality conservation, a technical guide for waste processing, and utilization. Further indicators are elaborated in the RSPO, including protection and conservation of ecosystems, recycling strategies, and efficiency in fossil fuel and RE uses. In the field, instead of pushing their productivity, those above certification policies become a barrier for local farmers to obtain financial support because certification is one of the prerequisites for obtaining financial support, but it is expensive and unevenly distributed.

"While every time there is financial assistance, a certificate must be attached. In addition, certificates are expensive, and the distribution of certificates by BPDPKS to farmers is not even." (E. Wibowo, personal interview, May 20, 2020)

Technology Standards: In regulating the implementation of renewable energy technology (RET) in the green industry, Law No. 3 of 2014 sets the standardization of

technology use in related business sectors. Because the bioenergy industry is burdened on state-owned enterprises (SOEs) or *Badan Usaha Milik Negara* (BUMN), it is regulated in SOE Ministerial Regulation No. 8 of 2019, which prioritizes the use of local components and products in the procurement of goods and services (TKDN), though TKDN currently only regulates RE sources such as solar, geothermal, and hydroelectric for 40–60%, not specifically for bioenergy. To speed up the development of the electricity infrastructure based on bioenergy, the specification and price standards for transmission towers and product conductors have been established. Furthermore, there are several obstacles in the implementation of the legal basis and standards for bioenergy development that the local components have not been able to overcome yet with the imported product.

"It is a big dilemma in implementing policies and standards for the use of domestic technology components of at least 40% for the development of bioenergy or RE at competitive prices; usually local products are more expensive and not proven, while usually foreign products are of high quality, beneficial long-term, and more efficient." (Z. Manggau, personal interview, May 16, 2020)

4.2 Institutional Framework

Institutional framework is considered as the most important criteria in achieving policy implementation and performance [7, 14]. This pillar will include the structured roles of international actors and non-government institutions, institutional capability, and collaborations. Stakeholder Mapping: In the Innovation Policy for Bioenergy Development document by the Directorate General of New, Renewable Energy, and Energy Conservation (EBTKE) (2018) [13], there is a model of ABGC (academy, business, government, and community) synergy that includes four key actors. As the government has guiding and monitoring roles, business entities or financial institutions act as developers or operators of bioenergy financing. The third actor, the research institute, has roles in innovation, technological efficiency improvement, and capacity building. The last actor is the community, which is the benefit receiver and is also actively contributing to maintaining the sustainability of bioenergy implementation. However, in this study, based on the stakeholders' analysis, the stakeholders are classified into three actor groups: government, private, and foreign actors, while the research institution and community will be included in the private actor group (Fig. 2).

Institutional Coordination and Collaboration: The Ministry of PPN/Bappenas initiates the coordination in all sectors as the responsible institution in development plans, either in the National Long-Term Development Plan (RPJPN) or the Medium-Term Development Plan (RPJMN). The plans are allocated to related institutions in charge of the technical aspects of each specific policy based on tasks and functions. Following that, there is a financing coordination, followed by policy implementation and spatial policy coordination. Other challenges exist as the performance indicator is still not integrated across ministries, with different key performance indicators (KPIs) or policy targets being unsynchronized throughout the institutions. In addition, conflict of interests among the key stakeholders involved follows as an obstacle that examines the balance between meeting energy security targets and company profits.

"The coordination problem is caused by sectoral egos that hinder the synergy between institutions in implementing the bioenergy policy." (B. Yusuf, personal interview, June 8, 2020)

"There is still a conflicting orientation between PLN or MEMR and SOE in which the first has targets for fulfilling energy security while the latter is more profit-oriented." (N. Marizi, personal interview, June 5, 2020)

Coordination of Budgeting: Budgeting coordination is related to the financing framework for bioenergy development that is centralized in the Ministry of Finance as the hub or PIC of project financing, including bioenergy projects. In both the upstream and downstream of the transportation sector, BPDPKS acts as the public service entity (BLU) to accelerate the financing target of palm oil plantations to increase the quality and productivity of the palm oil industry. In the context of the electricity sector, the coordination mechanism process related to financing is also centralized in the Ministry of Finance, then directly with PT. PLN as the single offtaker in this sector. Other budgeting coordination involves banking institutions and foreign actors as investors in financing bioenergy development projects. OJK becomes the institution in charge of regulating the policy of the financing procedures. Although there is a clear coordination system for the financing policy of palm oil plantations, sufficient capacity at each institution involved is still needed.

"An obstacle exists in the electricity sector as institutional capacity gaps are still identified. This affects investment in bioenergy development as it hinders asset transfer." (E. Wijaya, personal interview, June 10, 2020)

Coordination of Technical Assistance—within the transportation sector, the coordination of technical assistance may take the form of feasibility study assistance for companies or developers of palm oil (PKS) to gain financing access. This technical assistance is initiated by private actors such as PT. SMI. In addition, other technical assistance, such as capacity building, is given by research institutes, the Ministry of Agriculture, and BPDPKS for PKS to increase the productivity and sustainability of palm oil plantations. While in the electricity sector, technical assistance is delivered in the form of capacity building by research institutes, MEMR, and PT. PLN to developers to increase the capacity to conduct sustainable bioenergy development. The lesson learned for technical assistance also sometimes takes the form of a practical feasibility study conducted by certain biopower developers. In its implementation, there are no serious issues regarding coordination mechanisms. There is already a mechanism of steering committee meetings for private actors, such as GGGI, to evaluate the effectiveness of training or capacity building programs for bioenergy development, both in the upstream biofuels and electricity sectors related to the government.

"We have a steering committee meeting once a year. During the steering committee meeting, we have to report every year to the local government what we have done. There are representatives from the regional and central governments, donors from NGOs, as well as experts to give feedback to our reports." (B. Yusuf, personal interview, June 8, 2020)

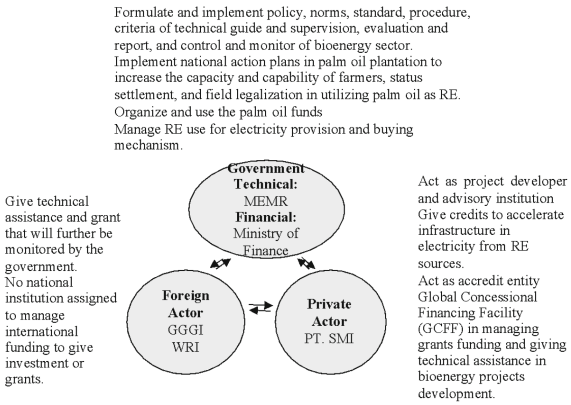

Fig. 2. Stakeholder mapping of bioenergy development in Indonesia

Coordination of Spatial Planning: Spatial planning coordination manages the use of spatial data or other spatial information, such as zoning, to manage the palm oil plantation for bioenergy development. It is centralized in the Geospatial Information Agency (BIG) regarding the one-map policy that will serve as the doorway to spatial information. The Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), as the ministry in charge, coordinates intensely with the Ministry of Environment and Forestry (KLHK), the Ministry of Agriculture, and the Ministry of Home Affairs for the regional implementation. A barrier is found related to the lack of data synchronization between different ministries.

"Sometimes it is difficult for us to obtain interministerial data; that is a classic problem. It is the reason why the government boosts one data integration; therefore, inter-institutions are interrelated and connected in such a way that every data update can be accessed by everyone." (N. Marizi, personal interview, June 5, 2020)

Policy Implementation Coordination: Coordination is regulated in Inpres No. 6 of 2019 in the upstream transportation sector to expedite the obligation fulfillment of palm oil plantation management and development, as well as to socialize ISPO. In the downstream sector, the coordination is centered on the MEMR, BPDPKS, and biofuels business entities. As no challenges are mentioned in the transportation sector, the coordination of policy implementation is considered properly managed. While in the electricity sector, coordination is centered on the MEMR, PT. PLN, and the biopower providers. Based on the results of the identification of roles and conditions of inter-institutional coordination, some obstacles were found, such as conflicts of interest.

"The government talks about benefits, the SOEs talk about profits, and sometimes there are policies that don't match. For example, in this context, if CPO is expensive, why should we buy it if oil is cheaper? The MEMR is pushing for the fulfillment of RE as fast as possible, but if we talk about the market under the SOEs, they must earn profits. The problem is how to synchronize government policies with clear benefits while also making them profitable." (B. Setiawan, personal interview, May 22, 2020)

4.3 Economic Instrument

Price-based instrumentation: Price-setting policies are often adopted to reduce cost and pricing-related barriers by establishing favorable price regimes for RE relative to other sources of power generation [7]. Indonesia adopts feed-in tariffs (FiT) as a price-based setting instrument for RE-based electricity. To accommodate the local price variation, the electricity generation basic cost (BPP) is stated in MEMR Regulation No. 4 of 2020. If the local BPP exceeds the national BPP, the highest value is set at 85% of the local BPP. If the local BPP is equal to or less than the national BPP, the value is settled by PT. PLN and the IPP. Aside from the price, the buying mechanism for biomass (PLTBm) and biogas (PLTBg) by PT. The whole process is called the power purchasing agreement (PPA) mechanism. Aside from PPA, the regulation explains the tariff for PPA and excess power. The other biopower purchasing mechanism is a guaranteed purchase of electricity generated from RE sources to comply with the NEP. Also mentioned are the collaboration types of the electricity buying mechanism with PLTBm or PLTBg, such as build-own-operate (BOO) or build-own-operate-transfer (BOOT).

In the transportation sector, the price-setting instrument is regulated by MEMR, which includes the market price index (HIP) of biofuel that is mixed in certain petroleum-based fuels as well as the freight cost within the equation. This price will determine the subsidy amount from BPDPKS funds allocated for PSO sectors to support the RE mix. This becomes a problem when the global oil price goes down and the subsidy increases accordingly.

"The difference in HIP is not capped, so if the difference is large, it can disrupt the cash flow. For example, when the price of oil is going down and biofuel (biodiesel) is not going down, the limited funds (for subsidy) must be managed" (C. Wibowo, personal interview, June 5, 2020).

"The problem is when the price of fossil oil falls. When the gap is quite high, it becomes the government's homework to ensure the sustainability of this program." (N. Marizi, personal interview, June 5, 2020)

Market Condition (Transportation Sector): The market infrastructure of biofuels is already facilitated by BPDPKS, which includes promotions and international road shows each month. However, the market is still facing many challenges, as discussed below. In the international market, there is market backlash as it faces black campaign acts regarding sustainability criticism, e.g., deforestation and emission problems.

"I wonder why they are fussing about the environment when, only considering the land need (without counting the emission cycle), environmentally speaking, it is better to use palm oil. For the sake of a trade war, they are using NGOs and the Indonesian people to run a negative campaign." (P. Tjakrawan, personal interview, June 4, 2020)

The European Union restricts palm oil imports due to the inability to provide traceability information for the biofuels produced. Another way to see it is that the restriction opens potential for the domestic market.

"There are many aspects of regulation still in need of improvement because the EU has banned the use of CPO with unclear traceability. By the standard of the EU, the traceability of the CPO itself still cannot be categorized as RE, as clean energy, or one with low emissions." (C. Wibowo, personal interview, June 5, 2020)

Market Condition (Electricity Sector): The electricity sector is faced with the challenge that the set FiT hardly fits the BPP. The geographical factor or regional condition in determining the RET tariff or cost is the source of this mismatch. Even though the policy might seem to be supportive of investment, the empirical findings show an unmatched condition. The initial capital investment of a bio-refinery or power plant establishment is expensive compared to conventional energy, e.g., coal or other fossil fuels (T. Dilisusendi, personal interview, May 28, 2020). In addition, it is highlighted that the subsidy given for fossil fuels further lessens the competing power of bioenergy (General Explanation of PP No. 79 of 2014 concerning National Energy Policy).

"The ESDM Ministerial Regulation No. 4 of 2020 (in lieu of No. 50 of 2017) is attractive for eastern regions with high BPP. But on the other hand, the resources for PLTBm and PLTBg are in Kalimantan and Sumatra." (N. Marizi, personal interview, June 5, 2020.

Financing Mechanism: In bioenergy development, or RE in general, there is no need for a policy that specifically regulates the financing mechanism in this sector because, otherwise, it will hinder the flexibility of related projects. It is instead realigned in the financing mechanism as being included in green finance since it is a part of sustainability finance under OJK Regulation (POJK) No. 51 of 2017. The reason that bioenergy is not included in conventional finance is that the condition is deemed uninteresting for business. The regulation instructs financial services institutions (LJK) within the banking sector, capital market, insurance, finance, and others to support sustainable finance in creating economic growth. These institutions are guided to make sustainable finance action plans, either short- or long-term, along with an implementation strategy and risk management. Not only LJK but also the issuer and public company have been given instructions. Those who implement the instruction will be given incentives by OJK in the form of human resources capacity building or a sustainable finance award. According to the reporting mechanism, those who do not comply will receive administrative sanctions. However, this mechanism is still unable to bind the banking sector, especially in the country.

"The instructions in POJK No. 51 are rather administrative, the sanctions are loose, and the output is limited only to reports from the financial institutions." (E. Sitinjak, personal interview, June 5, 2020; Isti, personal interview, June 10, 2020)

The disinterest of the banking sector is mainly because many of them still view business in this bioenergy sector as a high-risk business with a long payback period due to the limited availability of related information. Only pioneer banks (e.g., Mandiri and BRI), international banks (HSBC, BNP Paribas), or other LJKs such as PT. SMI give green credit through a loan mechanism to support POJK No. 51. Mainstreaming project financing structure is also relatively difficult in terms of LJK capacity since the initial structure that is commonly used is corporate financing.

"Because the financing structure in Indonesia is based on corporate finance rather than project finance, adequate LJK competency is always a challenge." (E. Wijaya, personal interview, June 10, 2020)

The lack of capability causes the feasibility study to often become incomprehensible, making it difficult to be granted the credit. Moreover, the initial capital is limited on the developer side because the proposed conventional credit must fulfill the 30:70

ratio. Additionally, for international finance, there is still no specific mechanism except POJK No. 60 about green bonds, although it is more focused on the national market. Other financing mechanisms, such as green *sukuk,* are also not regulated. Accessing international finance sources is difficult because the traceability issue of local palm oil is opposed by international environmental standards (B. Setiawan, personal interview, May 22, 2020).

Financial and fiscal incentives: Reducing taxes on RETs is one strategy for encouraging investment in bioenergy development [13]. In PP No. 70 of 2009 about energy conservation, it is explained that incentives such as a low interest rate, an income tax reduction, local tax exemptions or reductions for energy-saving products, and an energy audit within a partnership scheme with the government are given to the development of RE projects. Other tax incentive regulations are found in PP No. 78 of 2019 about the income tax facility for capital investment in RE businesses. The facility is provided by granting local income tax benefits via accelerated intangible tax amortization and a customs facility for resource utilization. In implementing the ease of duties and taxes related to the technology used, there are errors that have an impact on bioenergy development related to the competition with energy procurement from fossils. It indicates that the existing regulations regarding customs facilities have not considered the specialized technical standards based on the business field as well as how to monitor the use of technology in this sector. Because when the duty exemption or incentive facility given is not targeted, the government also loses the potential for funding income to be used in development (N. Marizi, personal interview, June 5, 2020).

Carbon Market—carbon emission transactions could be an alternative to overcome cost barriers associated with RE technologies. It is used to account for the externality of raising the price of conventional fossil fuels relative to RE [6, 7]. As many countries are now considering using carbon taxes to promote more sustainable energy systems, the carbon market in Indonesia is still in its early development phase as the institution set to manage the carbon tax mechanism was just formed in 2019. Thus, this section will only be briefly explained. The institution mentioned is the Environmental Fund Management Agency (BPDLH), which is included as a public service entity (BLU) and is aimed to later manage funds related to the sustainability sector from abroad as well as funds obtained through any form of carbon or emissions trading, including carbon tax, carbon cap-and-trade, and carbon credit mechanisms.

4.4 Infrastructure

Infrastructure is crucial in creating a supportive environment for RET implementation [7, 14]. The infrastructure includes data and information, research, and development (R&D) that is either public, private, or government-funded, as well as incentives and funds to promote energy innovation.

Data and Information: There is still no regulation regarding the information and communication system that specifically addresses bioenergy development. The management and utilization of MEMR sector data, based on the 2018 MEMR Data Center and Information Technology Document [15], has three main activities in the field of data management: statistical, upstream oil and gas, and spatial. The bioenergy sector

itself is included in statistical and spatial data management activities. Other than internal data management, data utilization mechanisms are also regulated for research or investment purposes. Within RE, only geothermal energy has specific regulations and mechanisms regarding the management and utilization of data. In the implementation of the information and communication system within the bioenergy sector, there are still some challenges. In the field of electricity, the quality of the data or information available in the Electricity Supply Business Plan (RUPTL) is poor, specifically in terms of data projections related to energy achievement targets.

"What we lack is the existence of an energy plan. PLN has RUPTL, but a 10-year study is not an easy thing. PLN does have experience, but the reality is that forecasting is not an easy thing, so usually the quality is not good. Sometimes in the RUPTL there are a lot of failures; in my opinion, the government is very weak in data management. The policy is already good, but when it is implemented, it is a bit challenging because the data management is difficult." (R. Rotty, personal interview, June 3, 2020)

Although the RUPTL cannot provide the expected information or related data management, it is the only source of information for the electricity sector.

"The information in the RUPTL is the only information that can be used by developers to determine where and what projects are being developed by PLN, whether IPP or PLN EPC." (Z. Manggau, personal interview, May 16, 2020)

Research and Development—in the transportation sector, the R&D regulation is available with research related to feedstock efficiency, palm oil processing as an energy source, and the sustainability of this sector. This has been contained in Presidential Decree No. 66 of 2018, and the related activities will be funded by BPDPKS. As conveyed by the Head of Sub-Directorate of DPKE, BAPPENAS, and Energy Access Program Lead, WRI, in an interview, the R&D of bioenergy in the electricity sector is still not optimal due to the lack of government focus on biomass or biogas.

"Attention is paid to biofuel, but there is no special policy or institution to pay attention to biomass and biogas." (N. Marizi, personal interview, June 5, 2020)

Moreover, international funding also lacks interest in this sector. The limited funding is worsened by the other obstacles regarding the bioenergy R&D focus in Indonesia. Many researchers focus more on research for international publications than on implementation in a more effective and efficient way, so that in practice, the existing research has not effectively supported the development of bioenergy (T. Hernas, personal interview, June 15, 2020).

"Non-CPO research funds are still small because no one is funding it anyway. If, for example, there is a grant from abroad, they will choose technologies such as wind and solar." (C. Wibowo, personal interview, June 5, 2020)

The institutions that regulate R&D affairs are mentioned in the Innovation Policy Document for bioenergy development (EBTKE, MEMR in 2018). However, institutional problems were still found, for example, at the Agency for the Assessment and Application of Technology (BPPT) and the Indonesian Institute of Sciences (LIPI), which were directed to become pioneer institutions related to research and development, but in practice their contribution is still considered minimal (C. Wibowo, personal interview, June 5, 2020). There is no technical guideline in infrastructure procurement, both on

the biodiesel side and in the upstream sector of palm oil procurement itself. The limited funding for supporting infrastructure causes the developers to have to develop it independently (T. Hernas, personal interview, June 15, 2020). Other obstacles related to supporting infrastructure are discussed in the problems and issues of managing and utilizing other renewable energy implicit in the 2020 RPJMN, including inefficiency in the provision of energy infrastructure due to differences between the location of energy production and utilization and the quality and reliability of energy distribution, especially outside Java.

5 Conclusion

The renewable energy policy implementation of palm oil-based bioenergy in Indonesia is considered suboptimal, as seen from the challenges and obstacles being faced in various indicators. It needs a strong commitment from each stakeholder involved in creating a conducive environment for sustainable bioenergy development in Indonesia. This paper has limitations in its attempt to provide an assessment of policy implementation due to the lack of foreign actors represented to provide and validate the information. Also, the literature specific to the bioenergy sector is limited since this study adapts the pillars of renewable energy in general. This study could be developed with a deeper approach within each pillar and a more specific study case area to see the policy performance vertically.

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