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RESEARCH

Development Model of Renewable Energy Policy Based On Social Forestry For Sustainable Biomass Industry

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Abstract

Renewable energy development strengthened due to considering Energy Act number 30 year 2007 article 21. Presidential Decree No. 5, 2006, mandate the target energy mix by 2025 to be 17% for new and renewable energy. Companies can contribute in terms of investment as Corporate Social Responsibility for Community Development interests. This study aimed to (1) formulate the development of renewable energy policy models, in particular biomass for rural electrification, (2) formulate the factors that influence the price of feed in tariff policy, in particular wood based biomass, (3) design the role of social forestry for raw materials biopelet industry in a sustainable supply chain. Research methods used techniques of Soft Systems Methodology, in the form of case studies supported by the literature to provide an alternative approach to solve the problems faced by leaders in the Indonesian Mining Company.

Keywords: Biomass, Feed in Tariff, Soft System Methodology, Policy

I. Introduction

Background

Fuel consumption in Indonesia is about 1.4 million BOPD (Barrel Oil per Day), while the production is only about 810 thousand BOPD. The discrepancy between consumption and production has resulted in enormous imports. Meanwhile in 2013, subsidies for fuel and electricity were over 300 trillion rupiahs, putting a notably heavy weight on government finance.

To guarantee the security of energy supply, the government has established the national energy policy. One of the strategies to develop national energy is to increase energy diversification activities by utilizing renewable energy. Indonesia has relatively abundant renewable energy, starting from wind, solar power, hydro-energy, biomass, geothermal to ocean energy. But their utilization in installed capacity is less than their real potential. National new and renewable energy potential and its utilization in installed capacity can be seen in Table 1.

Table 1. National Renewable Energy Potential

Non-fossil Energy	Resources	Equal	Installed Capacity
Hydro Power	845.00 million BOE	75.67 GW	6.65 GW
Geothermal	219.00 million BOE	29.04 GW	1.12 GW
Mini/micro Hydro	0.77 GW	0.77 GW	0.23 GW
Biomass	288.50 million BOE	49.81 GW	0.3 GW
Solar	-	4,80 Kwh/m^2/day	0.02 GW
Wind Power	9.29 GW	9.29 GW	0.002 GW

Source: Handbook of Energy and Economic Statistic of Indonesia, 2011

Problem Identification

Energy policies in Indonesia are among others Energy Law No. 30 Year 2007, Presidential Decree No. 5 Year 2006, and the Regulation of the Minister of Energy and Mineral Resources No. 31 Year 2009 regulating the Feed-in Tariff, also a policy regarding the price of Green Energy. This regulation cannot be applied for all technologies of Green Energy due to its economical discrepancy. This decree is amended by the Regulation of the Minister of Energy and Mineral Resources No. 4 Year 2012, specifically concerned with biomass and the Regulation of Minister of Energy and Mineral Resources No. 19 Year 2013 regarding biomass from waste.

Based on the background described above, the research questions can be defined as follows:

1) How sustainable bio-pellet industry can be a solution in the community-based forest empowerment?
2) How development of rural electrification can improve energy farm, especially in supply chain system for bio-pellet industry?

Research Objectives

1) To design supply chain system for bio-pellet industry through the empowerment of sustainable community-based forest.
2) To develop a renewable energy policy model based on biomass industry for rural electrification.

Research Contribution

1) To provide recommendation for the government in formulating renewable energy development policy, especially biomass for rural electrification.
2) To provide system approach to establish a policy about biomass feed-in tariff as the green energy source that will encourage the achievement of energy mix in 2025 as mandated by the Presidential Decree No. 5 Year 2006.
3) To provide recommendation for electrification ratio improvement, currently fewer than 78% and electricity provision in rural areas.
4) To provide a design of developed green energy conversion and to utilize idle land in Indonesia.

II. Literature Review

Green Business

Human utilizes natural resources and minimizes environmental effect for all raw materials used. An architect named William McDonough and a scientist named Michael Broungart introduced the concept about reorganizing the way human creates something. This concept develops product recycle where the product is designed to imitate natural cycle of biological process. This process redesigns a product so that the product is not born then perish, but sustainable. It is called eco-effectiveness and it can make the system have closed and sustainable quality. This concept is called Green Business.

Stages in Green Business theory is a cradle to cradle design, as follow:

1) To develop environmental policy in company widely.
2) To communicate environmental purposes to every person in the company.
3) To apply clear and measurable target and objective.
4) To determine structure whose bearer of responsibility to achieve the target and objective is clear.
5) To give training and concern for every person in the company.
6) To record each business completely.
7) To develop emergency response plan.
8) To observe and measure the result.
9) To fix all deficiencies and keep all in line with the rule.

Community-based Forest (Social Forestry)

In Indonesian, the term social forestry is equivalent to perhutanan sosial or community forest in which forests are managed by the community as a source of family income. Community-based forest is a forestry intended for production fulfillment and recreation benefit for community. Meanwhile, Alam (2012) emphasizes community-based forest as activities such as planting, certain techniques in crop production, soil conservation, improvement of forest products utilization, etc., kinds of activities done by social group, where the main effect is the sufficiency of forest resources through utilizing land more intensively and efficiently. The new core of social forestry lies in the word 'social': programs, serving local necessity through active involvement of the users in the project and implementation of the effort of reforestation and utilize forest products together. It implies that the success of social forestry program depends on the respond of community living around the area of the program.

Social forestry is a system of forest and environmental management aiming to reach a better socio-economic condition for rural communities, especially community inside and around the forest. Local community is invited and given an opportunity to participate in forest management and utilization, in a more systematic and more responsible manner. Rather than isolating the local community, by involving local community the forest can be managed in a more sustainable manner. There are many things to do for sustainable forest management that is economically interesting for poor local community. In Indonesia, social forestry

is well known as Community-based forest (HTR). Most of forest land is actually owned by the government, when it is not, it is called Community-based forest.

Results of Previous Studies

Biomass is one of important renewable energy sources that will continue to be developed in the world. One good example is in China, where the development of biomass is about 3,511 Mtce (million ton of coal equivalent). The pattern of biomass distribution in China depends on the climate and geography in several provinces. To encourage the development of biomass, pricing policy and intensive policy (including feed-in tariff, subsidies for capital goods, subsidies for research and development cost, as well as intensive taxes) are required.

Geographically, biomass distribution in China is unbalanced since it depends on the location of the province. Sichuan, Yunnan and Tibet absorb 33.3 % of total biomass in China. Biomass product and conventional energy complete each other from one province to others. Great biomass potential locates in Tibet, Heilongjiang, Henan, Shandong, Hebei and Jilin. By-product biomass energy is variably distributed from one province to others with the highest consumption about 14.17 tee (ton energy equivalent) per capita in Tibet, and the lowest about 0.15 tee in Sechiang (Shen, *et al*.,2010).

Those studies are regional in nature and emphasize the role of the government in each country to encourage biomass utilization and decrease greenhouse effect as well as achieve mix energy target.

Sustainable Industry and Policy Model

The condition of biomass research in Indonesia focuses more on the raw materials and the process, yet does not relate to feed-in tariff. This research relates to supply chain system and empowerment of economic democracy and local policy. Jackson (2003) states that conceptually, pragmatic or mechanistic approach will not be effective to achieve the objectives and overcome complex situation.

Based on previous studies, renewable energy development requires technology certification (Ikeda, 2013). It is a domain of Central Government. Like in Australia, the mandatory between 5% to 10% bio-pellet utilization should be made (Craig, 2009). In conclusion, Agency for Assessment and Application of Technology (BPPT) as a research institution for Indonesian government together with its technology auditor have a right to give renewable energy technology certification before the technology application is implemented on the ground.

Supply Chain

The Ministry of Forestry assigns scientists to map the types of proper local woods to be planted for energy farm in several promising areas in Indonesia.

Table 2. Results of Previous Studies

Writer	Study
Feed -in Tariff	
Ikeda J. 2013. Japan	This research focuses on Feed-in Tariff in Japan, where renewable energy power plant facilities must be certified by the Minister. The study shows the alignment of Japan Government to advance Renewable Energy especially for solar. FIT program is very supportive in advancing new and renewable energy in Japan.
Danescu *et al.* 2011. Romania	This research discusses Medium-Term National Energy Strategy with three primary objectives: to prepare the energy sector finance, to start privatization process in distribution and subsequently electricity production sector, and to ensure functional and sustainable development in medium term by stimulating new investment in energy sector.
Social Forestry	
Merkle *et al.* 2011. United States	University of Georgia has conducted experiment to evaluate hybrid sweetgum and American chestnut for bio-pellet production, which in turn can be used to produce electricity through co-firing with coal or gasification.
Ravindranath. 2001. India	This research analyses sustainable forestry scenario aimed to meet the demand of biomass, stop deforestation and regeneration of degraded forest to be developed and analyzed for mitigation and cost effectiveness in India.
Supply Chain	
Jäppinen, 2011. Finland	This research presents two case studies from forest biomass supply 100 GWh. This study evaluates the effect of the local biomass availability and the property of road network on green-house gas emissions. The result emphasizes the fact that local condition must be taken into account when valuing the sustainability of biomass-based energy production.
Wuyuan Peng, 2006. China	After 2002, rural electrification system combined with urban electrification establishes a national-integrated system of administrative electricity in China.
Omer, 2012, Canada	Biomass technology should be encouraged, promoted, invested, and performed, especially in remote rural areas.

For that reason, it is necessary to conduct a research on types of proper woods for energy farm (Merkle, *et al.,* 2011). Nowadays, community-based forest has not been utilized yet as energy farm so that the arrangement of biomass-demand to stop deforestation and regeneration of degraded forest is important (Rabindranath, 2011).

Supply chain model is evaluated by using some criteria including the cost of raw materials delivered, energy consumption, and greenhouse gas (Zhang, *et al.,* 2011). The National Council for Climate Change (DPNI) is obliged to manage the balance criteria of biomass mixing with coal that does not damage the environment and greenhouse gas. Indonesia is a unique country and has a relatively complete strategic policy, but to be implemented effectively, the operational implementation requires support from many parties. According to Strategic Research Agenda of Bogor Agricultural University (IPB) for 2014 to 2020, there are three research agendas related to biomass energy, namely conservation and optimization in agricultural sector, bioenergy development and conversion as well as sustainability study and political economy of bioenergy development. The three agenda are followed up with several researches to develop biomass as mandated by the Deputy Minister for Economic Affairs of Indonesia who states that university and research institution should answer the challenge by performing a research capable to meet the needs of community and the market.

Research in Indonesia has already led to answer the challenges above. Research conducted by Romli (2014) answers the challenge of integration of energy production and processing of nutrient turning biomass into biogas. In addition, Setyaningsih (2014) has conducted several researches on conversion process of solid, gas and liquid biomass for electrification and fuel. Research by Simangunsong (2014) empirically studies the pattern of forest management and development for bioenergy. Sugema (2014) examines inexpensive and eco-friendly bioenergy with Asia Pacific countries as the scope of cooperation. It is recommended to change fuel with bio-pellet. Supriyanto (2014) examines the development of buckwheat-based biomass energy conducted in Dompu Regency. Buckwheat has great potential to produce bioethanol.

Great community participation and fragmented bureaucracy are characteristics of a developing country. One expectation from the results of this research is that the discrepancy between strategic policy and operational policy can be compatible with and support each other. Contribution of this research towards science is that all of given incentives such as the ease of licensing, feed-in tariff, and mandate for mix energy, like previous researches in several countries, will not give enough encouragement for advancement in renewable energy utilization in Indonesia if they are not supported with proper supply chain model by utilizing Community-based forest.

III. Research Method

This research applies system approach through soft system methodology (SSM) (Checkland dan Scholes 1990). System approach is attempted to understand complex and dynamic problems. Through observing the implementation of recent national energy policy, there is unstructured and non-linear problem. The solution of complex problem with system approach is required through analysis, design implementation, model engineering, implementation and operational process of the system. Principally, system method is conducted through six stages, namely: (1) analysis of needs, (2) problem formulation, (3) system identification, (4) formation of solution alternative, (5) determination and realisation and (6) validation. Point (2) and (3) utilize questionnaire.

The development of policy model based on the system framework is oriented to produce a solution. Expert survey and focus groups discussion (FGD) are held in the office of Regional Planning and Development Agency (BAPEDA) in Sumbawa Barat Regency. The FGD involves 15 people from several Heads of Department such as Regional Leader Consultative Forum (Muspida), Forestry Office, Indonesian Industry and Trade Service and Cooperation, Law Section, Indonesian Public Works Service, Indonesian Mineral and Energy Resources Service, Regional Planning and Development Agency, etc. They are held in Sumbawa Barat Regency due to the reason that the regency has available land, supporting environmental condition, and it can represent other potential areas. The survey is conducted to test and produce model assumptions through strategic assumption surfacing and testing (SAST) method by questionnaire for 12 experts. The experts come from Jakarta and Sumbawa Barat Regency consisting of academicians, businessmen, and government elements. Similarly, expert survey is conducted with interpretive structural modeling (ISM) method. Respondents of ISM are different from respondents of SAST, consisting of 14 experts with questionnaire.

Research Framework

Research framework can be seen in Figure 1. This research applies a research framework mainly affected by implementing factors of the development of sustainable renewable energy industry and external factors and renewable energy internal industry. In implementation stage, the research framework is explained through development diagram of conceptual and operational model as presented in Figure 2.

System Approach

Eriyatno (2012) concludes that there are three basic

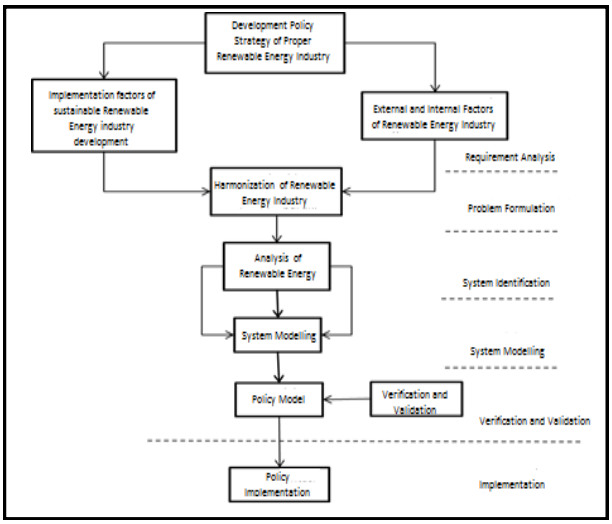

Figure1. Research framework.

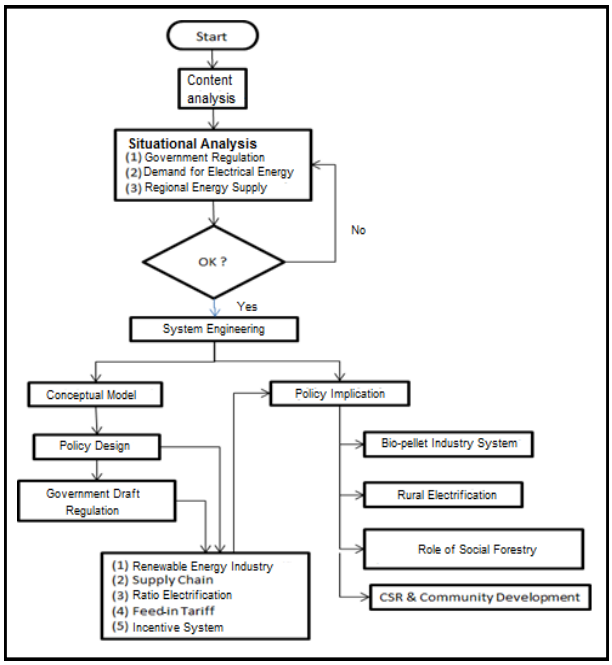

Figure 2. Flowchart of Engineering Design of Policy Model.

mindsets to design solutions for problems:

1) Cybernetic: orientation on objectives;
2) Holistic: intact perspective towards the integrity of the system;
3) Effectiveness: principle centered on operational effectiveness and it can be conducted from theoretical evaluation to reach the efficiency of decision.

This research is conducted by system approach framework as presented in Figure 3:

System Modeling

Various researches about policy, either academic or applicative research, often lead to a model presentation. Different from statistical approach that always results in or uses mathematical model in the form of equations, system approach generally designs or manipulates conceptual policy model, either diagrammatically or in narrative. Since both approaches have their own characteristics, i.e. statistical model based on "data" while conceptual model based on "knowledge", there are great differences in their modeling process. Figure 4 shows the system modeling consisting of input, transformation, output, validation and policy implication.

System modeling covering hard system methodology generally applies Engineering design of Decision Support System (DSS) and/or Dynamic System. Meanwhile system modeling aiming to produce policy model is a combination of two main references:

1) Logical Thinking Process (Dettmer, 2007)
2) Soft System Methodology-SSM (Checkland, 1990)

Research Location and Time

Research about model development of renewable energy industry policy based on sustainable biomass was carried out in Sumbawa Island. The location was chosen based on several considerations as follow:

1) Sumbawa Island has synergized system between mining company and community and the island is an example for the development of sustainable bio-pellet development policies.
2) Social structure involving academician, businessman, and government can be a fine example for other locations.
3) Mining energy source in Sumbawa Island becomes a central point of sustainable regional economic progress.

Data collection in West Sumbawa Regency and expert survey collection in the form of ISM questionnaire as well as validation in Jakarta was carried out on April 2013 to December 2013.

IV. Reseach Result and Discussion

Current Energy Condition

Based on the types of energy utilized in Indonesia, fuel still dominates the energy use with enormous subsidies, resulting in a very heavy burden for the country. In other side, biomass energy has a significant role and the utilization ranks second after fuel. This condition shows that biomass has great potential to be utilized more for industrial sector and household through rural electrification program. Energy consumption in Indonesia can be seen in the following table 3.

The role of mix energy policy in several countries varies, but generally similar in giving significant attention for the development of new and

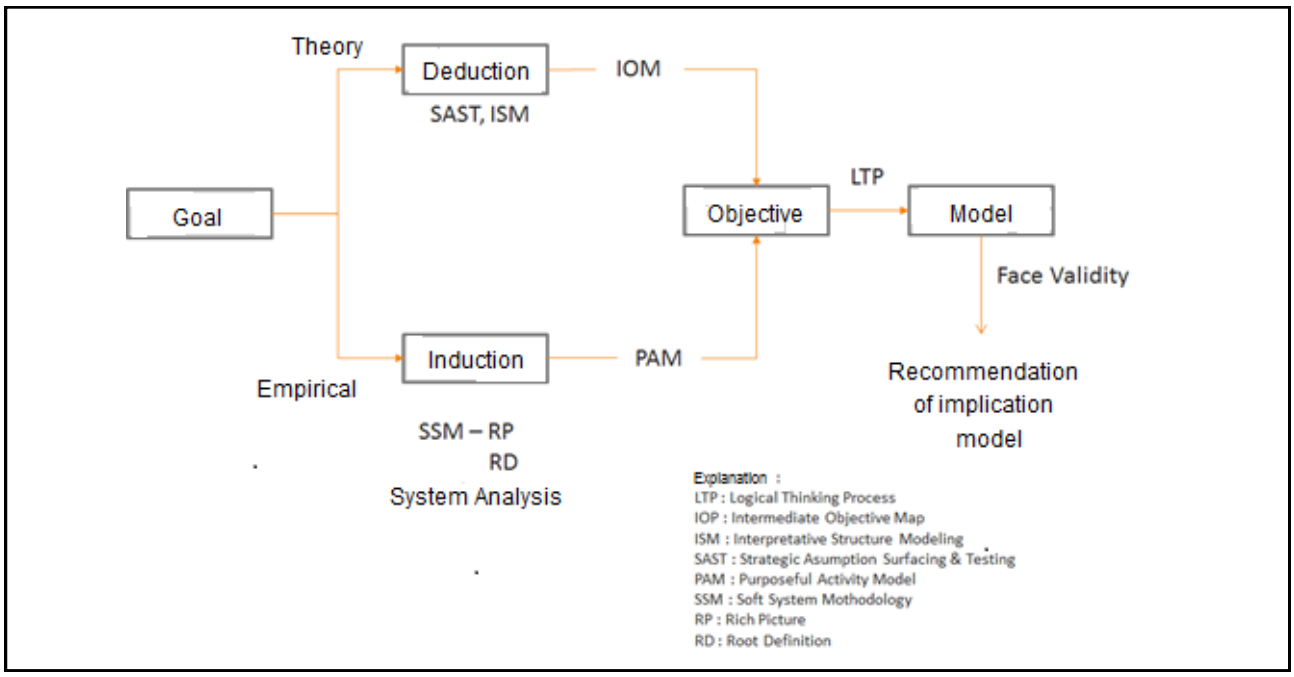

Figure 3. System Framework.

renewable energy utilization, ranging from 5% to 25% in 10 years ahead. This awareness is an investment for the future of world's energy and relates to energy security in a country.

An era to obtain inexpensive and convenient energy has begun to end, therefore, awareness to find alternative energy is an obligation. Environmental awareness has heightened; reduction of greenhouse emission has already been recognized as an important matter by world population and policy makers.

Renewable Energy Policy

Green Business is a business oriented to sustainable environmental conservation. Various types of Renewable Energy that can be utilized in Indonesia are solar energy, ocean energy, geothermal energy, hydro-energy, wind energy, as well as bioenergy consisting of biofuel and biomass. High diversity in

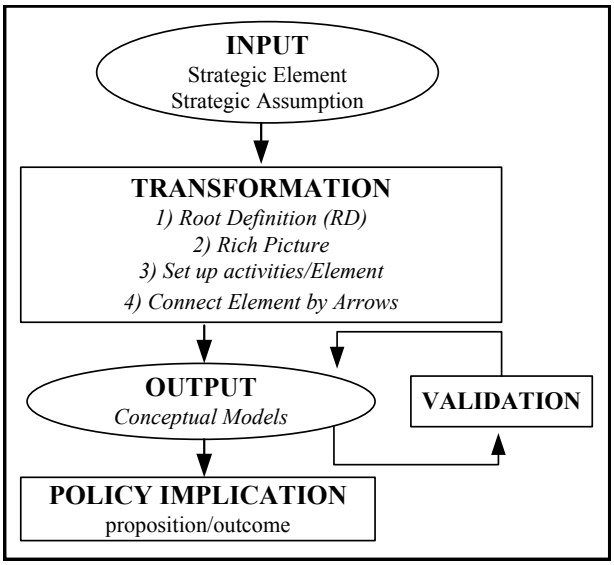

Figure 4. System modeling.

Table 3. Energy Consumption in Indonesia

Based on energy types			Energy consumption based on sectors		
Coal	136.54	MBOE			
Fuel	363.52	MBOE	Industry	355.76	MBOE
Gas	86.90	MBOE	Household	325.20	MBOE
Electricity	90.35	MBOE	Commercial	32.69	MBOE
Briquettes	0.29	MBOE	Transportation	255.83	MBOE
LPG	32.49	MBOE	Other Sectors	28.74	MBOE
Biomass	288.44	MBOE	Non-energy	82.91	MBOE
Total Energy Consumption	998.52	MBOE			

Source: Data and Information Centre of Ministry of Energy and Mineral Resources, 2011

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Indonesia results in more importance of biomass energy potential. Biomass is projected into renewable energy growth engine because of two main reasons: firstly, biomass generation can be developed almost anywhere; secondly, biomass energy can be produced as requested (Clair, 2009).

The geographical condition and amount of biomass source highly depend on agricultural zone and climate (Shen, 2010). Bio-pellet as one of biomass forms is an energy source in the form of pellet made of wood from eco-friendly energy farm. This energy farm can be made in a former mining land, such as gold mining, coal mining, etc. Big miners will leave excavated mine as a non-eco-friendly area and harm the nature; therefore, it is required to find a solution to reforestation and produce energy.

Commercial data shows that the price for bio-pellet in the world market moves from US$ 170 to 179 C&F per ton, while in Indonesia the price of FOB is about US$ 130 to 157 per ton. The price for bio-pellet in Sumatera rose drastically since the third quarter in 2012 from 200,000 to 300,000 rupiahs per ton to 600,000 to 800,000 rupiahs per ton. With the establishment of new Feed-in Tariff policy for biomass, there is an increase in biomass utilization for electricity generator in Indonesia. Indonesian State Owned Enterprises (BUMN) controls only 20% of total farms in Indonesia, and the rest is controlled by private institution. For that reason the management of pricing policy is important since private institution does not have obligation like Public Service Obligation (PSO).

Renewable Energy Policy in Indonesia is derived from the Presidential Decree No. 5 Year 2006, targeting 17% mix energy for renewable energy in 2025. Then a 25/25 vision proclaimed by the Directorate General of Renewable Energy and Energy Conversion states that in 2025 the mix energy for Renewable Energy is about 25%. The increase in percentage is strengthened by the Draft of Energy National Policy proposed by National Energy Council chaired by the President of Indonesia and approved by House of Representatives (DPR).

One of Government policies supporting the acceleration of Renewable Energy utilization is Feed -in Tariff policy, regarding the purchasing price by State Electricity Company (PLN) over the electricity generated by Renewable Energy generator owned by Independent Power Producers. Law No. 30 Year 2007 states that energy provision and utilization of new and renewable source energy is subject to financial aid and/or incentive from government and/or local government in accordance with their authority for certain period until the economic value is achieved (Article 20 Paragraph 5) (Kusdiana, 2008).

Feed-in Tariff regulation has experienced several changes, namely:

1) Decree of the Minister of Energy and Mineral Resources No 31 Year 2009 regarding the pricing of Renewable Energy for all types of Renewable Energies.
2) Decree of the Minister of Energy and Mineral Resources No.4 Year 2012, revising Decree of the Minister applied for biomass.
3) Decree of the Minister of Energy and Mineral Resources No. 19 Year 2013, adding the Decree of the Minister applied for biomass from waste.

The disadvantage of Feed-in Tariff policy in Indonesia compared to one in other countries:

1) Feed-in Tariff parameter in Indonesia is based only on location, technology type and capacity; meanwhile in other countries, the parameter is based on every type of technology used in details.
2) Feed-in Tariff in Indonesia only includes geothermal, micro hydro and general biomass; other Renewable Energies are not included yet. Meanwhile, in other countries it includes all of potential Renewable Energies in the country.
3) Feed-in Tariff in other countries is an input from various stakeholders, academician, business and government, meanwhile Feed-in Tariff in Indonesia is an input from association only and still requires better communication with the stake holder, academician, businessman and government.

The research was conducted in West Sumbawa Regency with a consideration that the area can represent other rich-in-natural-resources areas in Indonesia. The condition in West Sumbawa Regency can occur in various areas in Indonesia rich in mineral, oil, and gas.

The prominent natural resource in West Sumbawa Regency among others is gold. Therefore, this regency is well known as producer of gold managed by Newmont.

Current situation shows that the Regional Budget is 94% supported by Newmont's income. This certainly supports the welfare of the community there. However such condition leads to the dependence of community living in the regency on Newmont.

For that reason, it is required to have a program capable to encourage rural community to be more independent, a program that can anticipate when the management of Newmont's gold mining is finished. This program can include rural electrification, food security, and other various programs. However, the red thread is the economic empowerment of rural community involves the elements of Local Government, Private Institution, Newmont and Stakeholders of renewable energy. Local government has an important role in the sustainability of Locally Generated Revenue (PAD), private institution has an important role in the sustainability of business in the area, while

Newmont requires legal certainty and should lessen the risk of public intervention to the business.

SAST Result

Basic assumptions of model development of renewable energy policy based on community-based forest for sustainable biomass industry are obtained from Focus Group Discussion (FGD). It was held in West Sumbawa Regency by involving Local Government, Regional Planning Agency and Regional House of Representative (DPRD), community, Forestry Institution, Industry, NGO, and related agencies.

The identification result of FGD on development factor of renewable energy policy based on community-based forest for sustainable biomass industry is used as the material for expert discussion activity in order to arrange assumption alternative to be used for strategic model forming of renewable energy based on community-based forest for sustainable biomass industry. The above assumptions are categorized into 4 (four) aspects, namely: (1) environmental aspect; (2) economic aspect; (3) institutional aspect and (4) social aspect.

The FGD produces 27 alternative assumptions that can be seen in the following Table 4.

The results of alternative assumptions are made into a questionnaire and discussed to give importance and certainty value, referring to the following questions: (1) How important the influence of those assumptions is on success or failure; and (2) How far the certainty of those assumptions can be justified and its success can be ascertained. Based on Focus Group Discussion held in West Sumbawa Regency, it can be concluded that the most important basic assumption is the clear status of forest land and support from the public figures.

Table 4. FGD Result of Basic Assumptions for Model Development of Renewable Energy Policy

No	Assumptions
A.	Environmental Aspect
1.	Sufficient supply of raw materials (consideration of raw materials continuity)
2.	Availability of raw material alternatives for local potential biomass industry
3.	Reduction of environmental damage
4.	Region-based industrialization and supports from production centers
5.	Availability of production land
6.	Land and forest inventory
7.	Agro-climatic suitability
B.	Economic Aspect
8.	Infrastructure support from the government
9.	Incentive support of transportation cost from the government
10.	Capability to be used as a local new energy source
11.	Sincerity and commitment from investors
12.	Increase in income
13.	Potential for both local and export market (market assurance)
C.	Institutional Aspect
15.	Clear status of forest land
16.	Regulation of reforestation and forest management
17.	Regulation of partnership between community and company
18.	Regulation of clear pricing
19.	Support of investment regulation
20.	Regulation of community empowerment depends on position and function of community in the program
21.	Clear trade system
D.	Social Aspect
21.	Support from public figures
22.	Community is involved and participates in the implementation of the program
23.	The culture of the community
24.	Regulatory support from the central and local government
25.	Change in the mindset of the community in forest management
26.	Construction of project pilot to change community stance
27.	Information and socialization about biomass is well-distributed

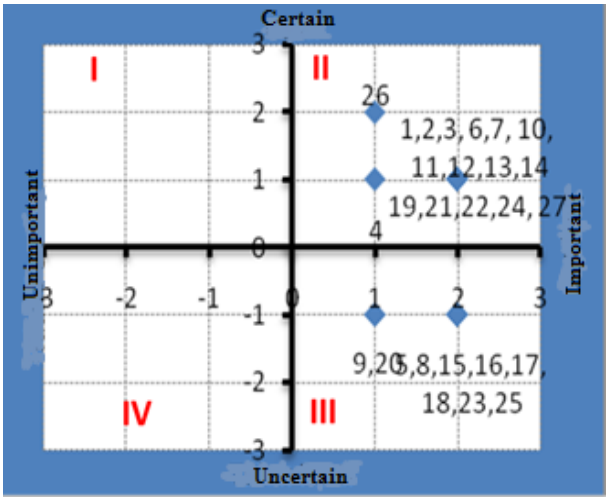

Figure 5. Analysis Result of SAST.

The assessment results of each participant are combined thus the position of each basic assumption in quadrant map of importance and certainty is obtained as shown in following Figure 4.

From Figure 5, it can be seen that after conducting sequences of discussion to determine the importance and certainty rate, those assumption alternatives are located in quadrant II and quadrant IV.

Assumptions located in quadrant II have high importance and certainty. By observing relationship of several assumptions located in quadrant II above, further synthesis is conducted to identify the most strategic assumptions, as follow:

a) In environmental aspect, strategic assumptions with high importance and certainty includes:
   (1) Sufficient supply of raw materials (consideration of raw materials continuity) (1);
   (2) Availability of raw materials alternative for local potential biomass industry (2);
   (3) Reduction of environmental damage (3);
   (4) Land and forest inventory (6);
   (5) Region-based industrialization and supports from production centers (4); and
   (6) Agro-climatic suitability (7).

b) In economic aspect, strategic assumptions with high importance and certainty includes:
   (1) Capability to be used as a local new energy source (10);
   (2) Sincerity and commitment from investors (11);
   (3) Potential for both local and export market (market assurance) (13);
   (4) Increase in income (12).

c) In institutional aspect, strategic assumptions with high importance and certainty includes:
   (1) Support of investment regulation (19);
   (2) Clear trade system (21).

d) In social aspect, strategic assumptions with high importance and certainty includes:
   (1) Support from public figures (21);
   (2) Community is involved and participates in the implementation (22);
   (3) Regulatory support from central and local government (24);
   (4) Information and socialization about biomass is well-distributed (27);
   (5) Construction of project pilot to change community stance(26).

Assumptions located in quadrant IV have high importance but low certainty, namely:

a) In environmental aspect, the alternative assumption is the availability of production land (5).

b) In economy aspect, those assumptions include:
   (1) Infrastructure support from the government (8);
   (2) Incentive support of transportation cost from the government (9).

c) In institutional aspect, those assumptions include:
   (1) Regulation of reforestation and forest management (16);
   (2) Regulation of partnership between community and company (17);
   (3) Regulation of community empowerment depends on the position and function of community in the program (20);
   (4) Regulation of clear price (18); and
   (5) Clear status of forest land (15).

d) In social aspect, those assumptions include:
   (1) The culture of the society (23);
   (2) Change in the mindset of the community in forest management (25).

The Result of Interpretive Structural Modeling

The element structuralization of model development system of renewable energy policy based on community-based forest for sustainable biomass industry is conducted by utilizing Interpretive Structural Modeling (ISM) technique. According to experts, six from nine elements are obtained to be examined in model development of renewable energy policy for biomass industry, namely: (1) element of program objectives; (2) element of program requirements; (3) element of community sectors; (4) element of main obstacles; (5) element of possible change; (6) element of related institutions. Those six elements are examined and explained into several different sub-elements.

Element of Program Objectives

Element of program objective has 10 identified sub-elements namely: Improvement of social welfare (G1), Utilization of community-based forest product (G2), Development of green SME (G3), Increase of Locally Generated Revenue (G4), Renewable energy availability (G5), Environmental preservation (G6), Determination of energy tariff (G7), Appropriate and sustainable biomass energy (G8), Employment extension (G9), and Community empowerment (G10).

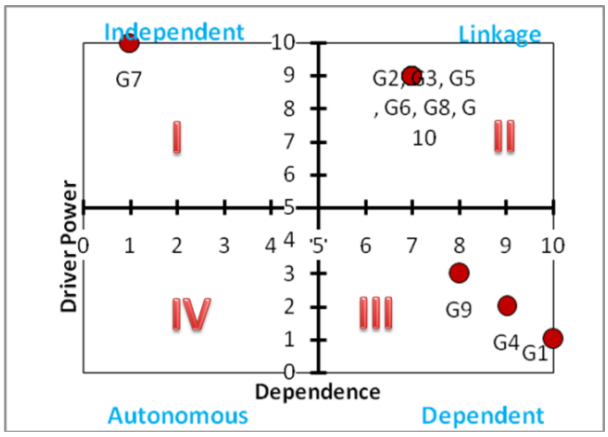

Figure 6. The Result of Drive Power (DP) and Dependence (D)Matrix of ISM.

Based on the value of Drive Power (DP) and Dependence (D), determination of energy tariff (G7) is located in independent sector with high drive power and low dependence. It means that the sub-element is a key sub-element with the highest driver power, thus, highly contributes to the objectives achievement of other sub-elements, yet hardly influenced by other sub-elements.

Analysis result with ISM technique states that the sub-element of energy tariff determination (G7) becomes a base for other sub-elements. When the objective is achieved, it will contribute to the achievement of the objective of community-based forest product utilization (G2), renewable energy availability (G5), appropriate and sustainable biomass energy (G8), development of green SME (G3), community empowerment (G10), and environmental preservation (G6).

Subsequently, when these seven objectives are achieved, they will contribute to reach the objective of employment expanding (G9). When these eight objectives are achieved, they will contribute to the goal accomplishment of rising the Locally Generated Revenue (G4). Finally, when the nine objectives are reached, they will contribute to achieve social welfare improvement (G1).

The form of the possible change is a separate element to be examined since rural electrification

Table 5. Summary of Interpretive Structural Modeling Result

Element	Key Sub-element	Contextual	Dependency
1. Program objective	Determination of energy tariff	Contribute to achieve the objective	Improvement of social welfare
2. Program requirements	a. Competent human resources b. Coordination between related Local Government Offices c. Community participation d. Funds & business investment e. Microfinance	Support	Industrial raw materials
3. Community sector	Public figures	Affect	Electricity consumer
4. Main obstacle	a. Status of forestry land b. Community-based forest policy	Lead to	a. Business investment b. High technology c. Limitation of regional infrastructure d. Skill and knowledge level of HR
5. Possible changes	Regional National Spatial Plan	Lead to	a. Increase of SMEs b. Entrepreneurship c. Work ethic d. Value added for community-based forest management e. Conversion of fossil energy source f. Rural electrification availability g. Industrial feasibility h. Optimization of land use
6. Related institution	a. Banking/Financial Institution b. NGO c. Professional association of energy	Support	a. Private companies / energy industry b. Local government

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program will be the benchmark for a country's welfare. Regional Spatial Plan and management will create Small Medium Enterprise with an entrepreneurial concept that will gradually motivate young generation to improve their work ethic. In West Sumbawa Regency, the work ethic is relatively low because of the abundant natural resources. However, through entrepreneurship and forest utilization program, there will be a motivation to manage community-based forest and obtain real result in the form of rural electrification. Snowball effect will increase the welfare of the rural community and give the community a spirit to develop the area.

The element of related institution shows the actors whose role is to accommodate the aspiration of rural communities and industry. In this element, Banking/Financial Institution is a key sub-element since one of the characteristics showing whether an area is advanced or not is the facility to access responsible funding. There are many NGOs around West Sumbawa Regency actively performing environmental demonstration with a motive to acquire fund from Newmont. These NGOs have a role to support every program submitted by and for community. This is not a minor role and should be directed into positive deeds such as supporting the role of private institution/local government to produce energy capable to ensure the welfare of rural community. Associations on Energy have an active role to determine the tariff proposition that shall be determined by Central Government.

Careful planning saves time, money and effort in the progress. Based on ISM result above, systematic and structured working pattern will be one of factors determining the success of the program mandated in mix energy policy, in accordance with Presidential Decree No. 5 Year 2006. Time limitation will affect program implementation, such as rural electrification, mix energy, and other programs involving community participation. This matter requires models that help in operational strategy to achieve major strategy as mandated by the President. Such working pattern should be a policy applied in various policies in general and energy policies in particular. The summary of interpretative

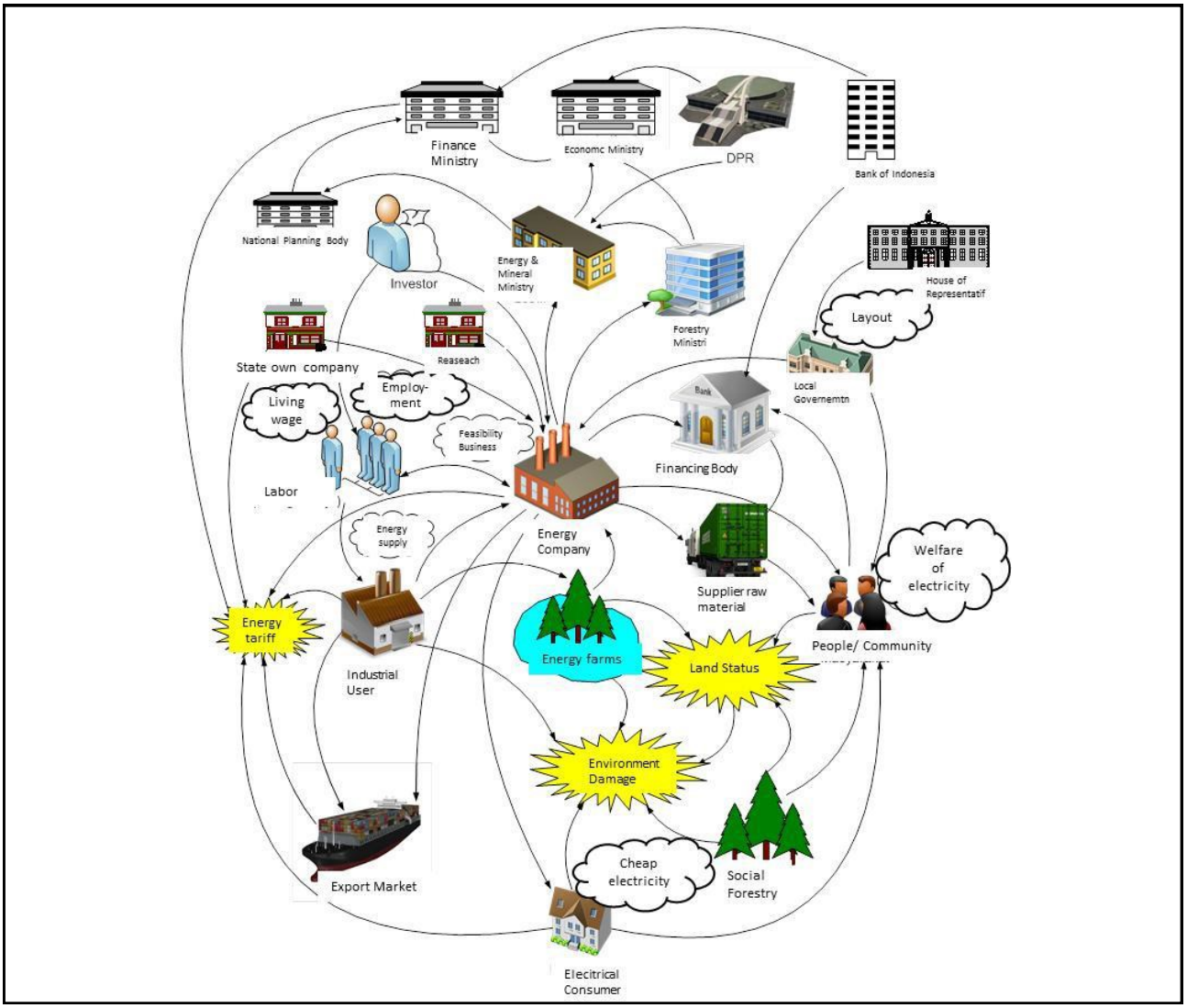

Figure 7. Rich Picture for Renewable Energy Policy.

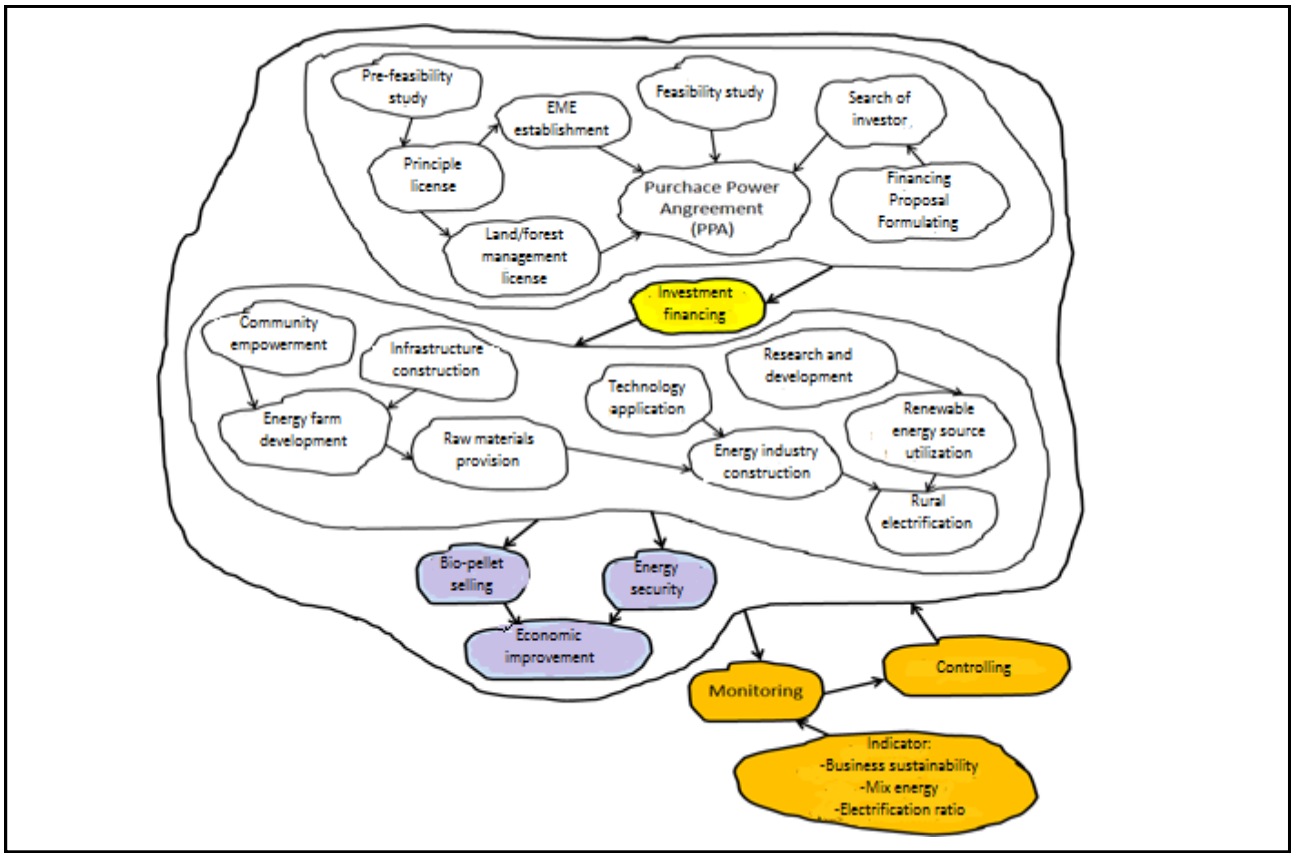

Figure 8. Purposeful Activity Model.

structural modeling result can be seen in Table 5.

Result and Discussion of Intermediate Objective Map

By observing strategic assumptions obtained from SAST method and key elements obtained from ISM method above, there are 5 (five) claims concluded as the objectives of model development of renewable energy policy based on community-based forest for sustainable biomass industry: (1) Conservation of forest resources; (2) Development of energy forest; (3) Bio-pellet industry as green business; (4) Proper bio-pellet industry, and (5) bio-pellet industry as an energy provider for rural electrification.

Result and Discussion of Rich Picture

This research results in Rich Picture, an overview of the condition of renewable energy policy in Indonesia at the present. Rich Picture of renewable energy policy based on biomass industry from community-based forest will show that there are many parties involved. Several problems emerge, such as energy tariff, environmental damage, and land status. Several involved parties are financing institution, supplier of raw materials, energy company, labor, Ministry of Forestry, Ministry of Energy and Mineral Resources, even House of Representatives. Export market and Industrial Users are important components since they are related to the business feasibility.

Others supporting parties are Research and Development sector, contributing to technology support. Incentives given by the Minister of Finance in supporting this industry shall be significantly influential. Energy farm is ignored in the feasibility study for this industry. However, from several cases occurred in Papua and Lampung Provinces, Energy Farm is proven to be very important and a key to success. This Rich Picture describes Renewable Energy Policy with a helicopter view, observing from the broad and not fragmented side. Careful planning will provide convenience in the implementation. Figure 7 shows the result of the Rich Picture for Renewable Energy Policy.

Result and Discussion of Root Definition

The root definition from this research is designing a policy of supply chain system for biomass industry as renewable energy source, based on bio-pellet produced from community-based forest through development of bio-pellet industry that is economically proper, eco-friendly, and involves business world, community and government to achieve business sustainability, community empowerment, as well as rural electrification to support national energy security. To provide content with formal model, we should know the nature of our system towards the model. In SSM, modeling is supported by root definitions.

Result and Discussion of Purposeful Activity Model

The result of Rich Picture and Root Definition produces Purposeful Activity Model. Objective condition shows that investment financing for energy industry is preceded by PPA (Purchase Power Agreement). Energy industry utilizing renewable energy from bio-pellet product will sustain rural electrification to increase energy security that in turn will produce economic improvement. The whole process is monitored by business sustainability indicator, mix energy, and electrification ratio. Purposeful Activity Model can be seen in Figure 8.

V. Policy Model and Implication

Result and Discussion of Conceptual Model

Policy model framework is constructed through the identification towards the actors and their functions, inter-institution coordination and cooperation, and activity program. Modeling result based on logical thinking process either empirically or theoretically can be seen in Figure 9 where there are three central points, namely Chain Supply, Community-based forest Empowerment, and Feed-in Tariff.

Result and Discussion of Investment Model of Bio-pellet Industry for Rural Electrification

Generally, the first sub model design, namely investment model of sustainable bio-pellet industry, is shown in Figure 10.

Result and Discussion of Supply Chain System and Community-based Forest Empowerment

Generally, the second sub model, the model of Supply Chain and Community-based Forest Empowerment, is shown in Figure 11.

Model Validation

Model validation is conducted by asking for opinions from experts either from Indonesia or other countries in International Seminar on Biomass namely Indonesian Biogas Forum 2014 at Grand Melia Hotel in Jakarta on February 28, 2014. There were approximately 100 experts representing academicians, businessmen, and government representatives from several countries. This international seminar on biomass was held by the Standing Committee of Renewable Energy of Indonesian Chamber of Commerce and Industry. The noted opinions from the experts produce several changes and become a model as shown in figure 14, 15 and 16. Experts evaluate that the constructed model represents their expectation to be a solution for the implementation of bio-pellet supply chain policy, determination of feed-in tariff, and empowerment of community-based forest.

Policy Implication

Policy implication is a logical consequence of a policy establishment. This research has formulated a

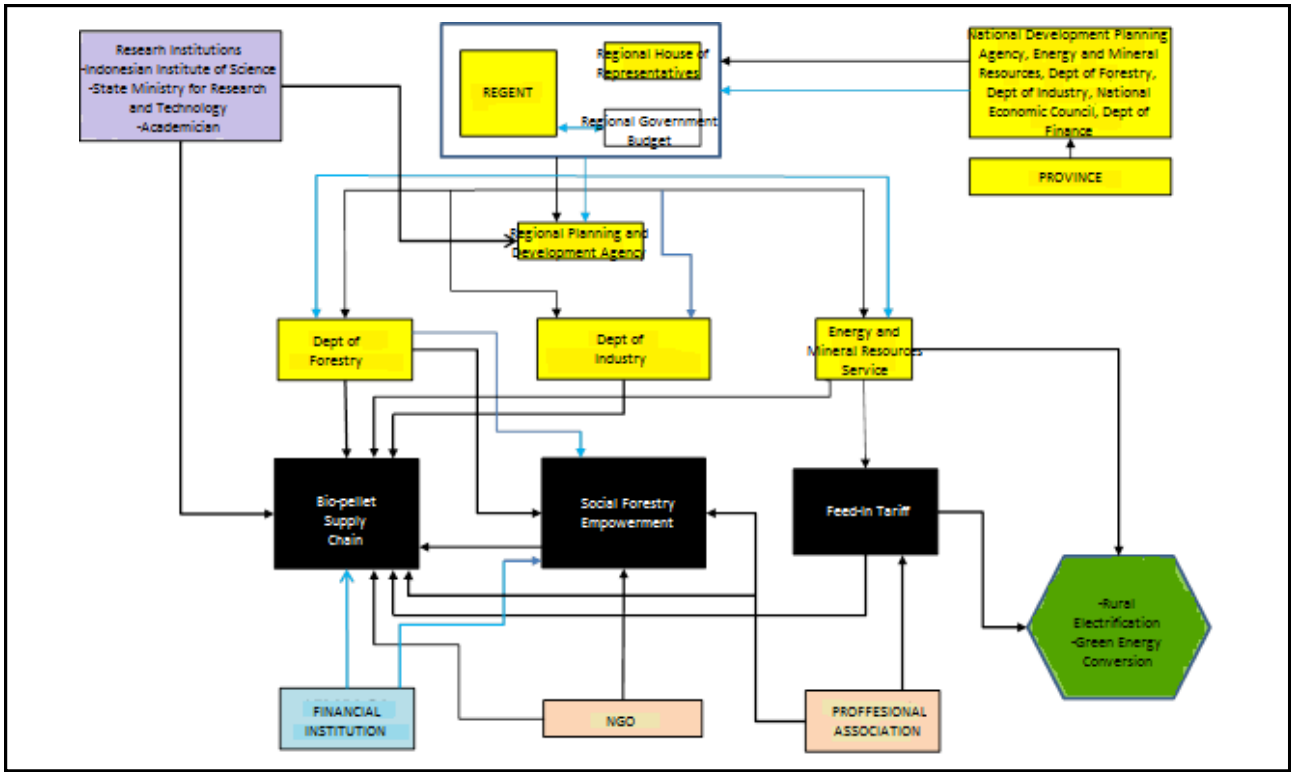

Figure 9. Policy Model of Renewable Energy Based on Biomass Industry.

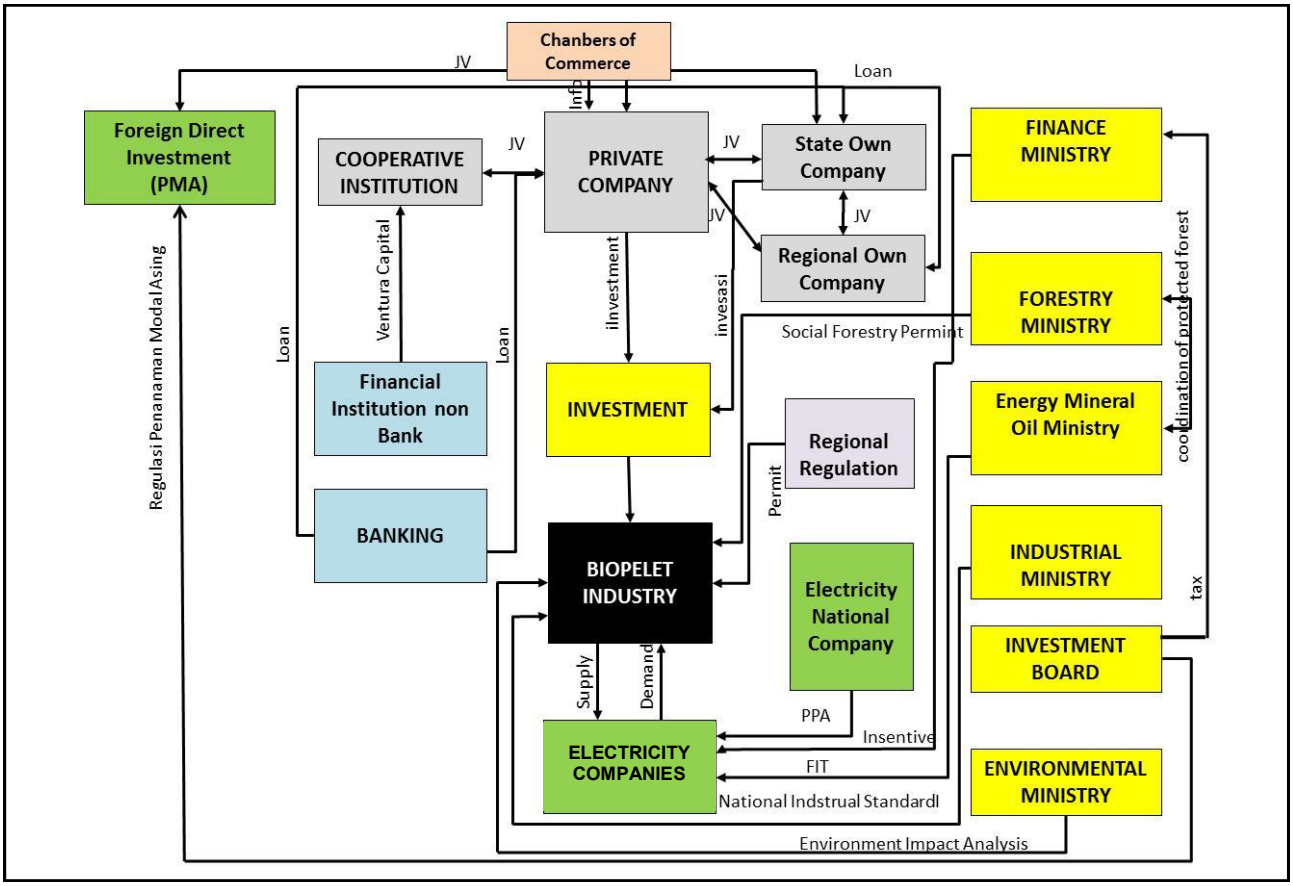

Figure 10. Investment Model of Sustainable Bio-pellet Industry.

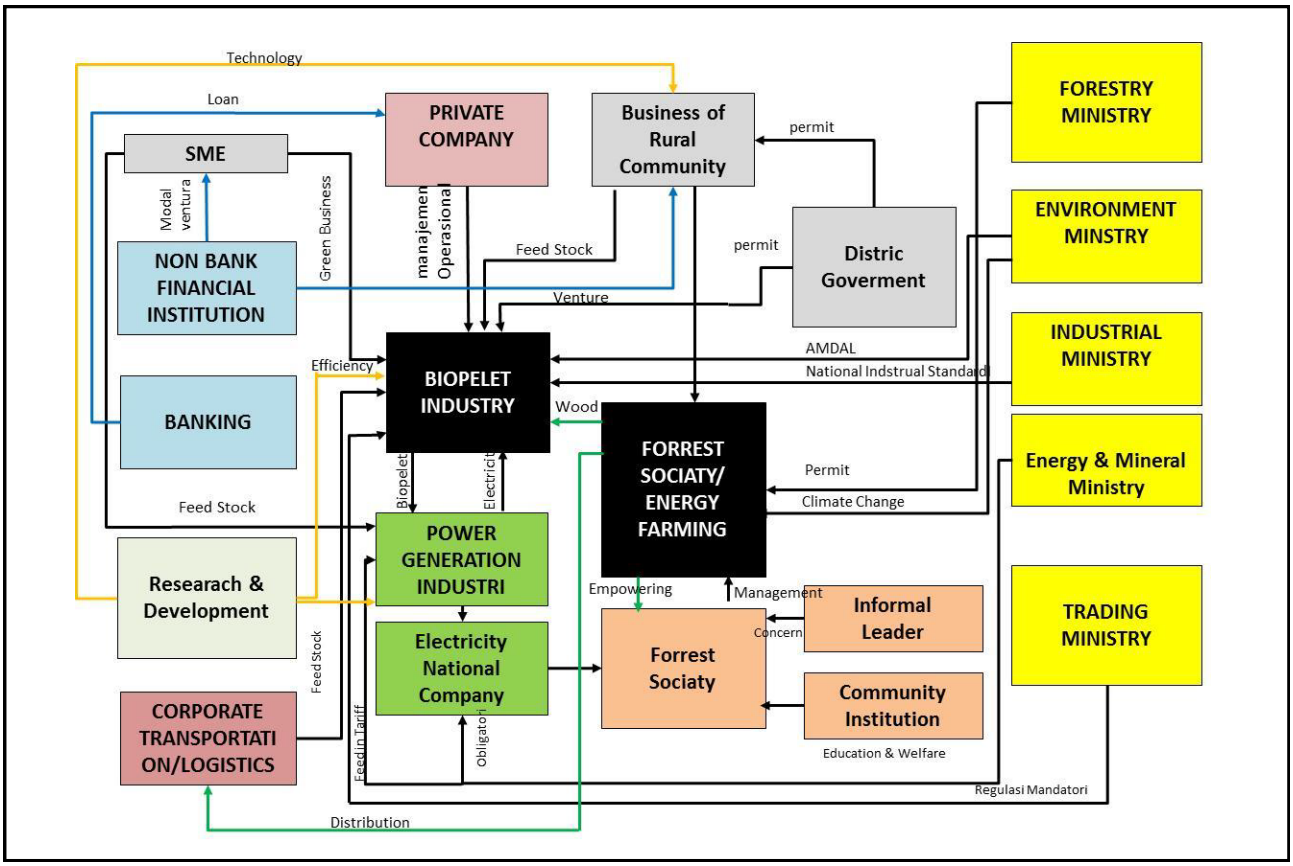

Figure 11. Model of Supply Chain and Community-based Forest Empowerment.

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Table 6. Feed-in Tariff Sensitivity

FIT (US$)	USD RATE (IDR)	IRR	BEP
11	11,643	13.67%	7.5 Years
12	11,643	15.32%	7 Years
14	11,643	18.45%	6 Years
11	10,000	12.76%	8 Years
12	10,000	14.46%	7 Years
14	10,000	17.66%	6 Years

model for renewable energy policy based on community-based forest for sustainable biomass industry. The feed-in tariff suggested is US$ 12 cent since the IRR required by National Electricity Company is 14%, in accordance with the sensitivity shown in Table 6.

VI. Conclusion and Recommendation

Conclusion

1. Supply chain model of bio-pellet industry with sustainable community-based forest empowerment needs to be supported by the following parties: (1) Central Government including Ministry of Forestry, Ministry of Environment, Ministry of Industry, Ministry of Energy and Mineral Resources, and Ministry of Commerce, (2) Local Governments (LG), (3) Financial Institutions, (4) Research Institutions as well as (5) Private Companies. The Central Government needs to support this system with various policies in order to maintain the sustainability of community-based forest bio-pellet industry.
2. The model of renewable energy policy based on biomass industry for rural electrification involves Small Medium Enterprises that highly depend on the funding from non-banking institution in order to perform feasibility study as a requirement of publication of Power Purchase Agreement by National Electricity Company (PLN). Funding access is important for the next stage until the rural electrification is achieved as described in Rich Picture.
3. In accordance with the developed structural model, Independent Power Producer (IPP) becomes a model for the growth of green business for idle land utilization all over Indonesia and former mining land. Based on the result of the applied SAST and ISM method that produce a model, IPP can be implemented only when private parties get full support from public figures and community institution to guarantee the implementation of sustainable energy farm.

Recommendation

1. The government needs to determine the appropriate tariff for bio-pellet energy to encourage sustainable biomass-based energy industry, that is, by determining fixed price to guarantee business certainty that is agreed by banking and financial institution. It is recommended to have this regulated in the Decree of the Minister of Energy and Mineral Resources and mandated to National Electricity Company.
2. It is necessary to facilitate access to banking/ financial institution to finance biomass-based energy industry by involving Non-Bank Financial Institution with Venture Capital scheme. Banking and Financial Institution are expected to fund green energy with incentive in the form of 2% lending rate under the rate of Bank of Indonesia. It is also necessary for Banking Financial Institution to determine green banking principles and for renewable energy developer to obtain incentive with more interesting landing rate under market lending rate in order to obtain inexpensive source of fund for renewable energy.
3. Local Government is expected to establish obvious Spatial and Regional Planning so that businessman and community have legal protection in utilizing Community-based forest. In addition, Ministry of Forestry is expected to establish the license for utilizing Community-based forest written in the Decree of the Minister. It is expected that the decree includes at least the minimum 20% of the community-based forest utilized for Energy Farm. It is expected that Local Governments give an education about Energy Farm to local communities.
4. It is expected to conduct further research on every type of renewable energy technology based on the magnitude of power, location for electricity power plant, and the technology used. The suggested follow-up is for the Ministry of Forestry to make improvement in the process of giving license to utilize forest land to be cultivated into energy forest. It is also expected that Research Institution of Ministry of Forestry conduct further research in order to obtain the mapping of recommended types of plant in various areas in Indonesia for energy farm. It is expected that Ministry of Energy and Mineral Resources establish a policy about feed-in tariff for the price of electricity in rural areas generated by green energy. Alignments through green banking especially for bio-pellet industry are expected to reduce rent seeking practice. It is recommended to conduct further research to examine rent seeking and bureaucracy coordination for the development of renewable energy, especially bio-pellet in Indonesia, and to

determine the percentage of domestic market obligation for bio-pellet.

5. It is recommended to conduct further research to determine domestic market obligation policy for bio-pellet such as the percentage of domestic marketing, minimal standard for amount of calories per kilogram, as well as minimum percentage of local content in the development of bio-pellet industry.

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