Study of social and economic aspects of renewable energy policies

R Effendi¹, R Maryani¹, and A Justianto²

¹Center for Research and Development on Social, Economy, Policy and Climate Change, Jl. Gunung Batu No. 5, Bogor, West Java, Indonesia
²Forestry and Environment Research, Development and Innovation Agency, Ministry of Environment and Forestry, Jl. Gunung Batu No. 5, Bogor, West Java, Indonesia

email: rch_167@yahoo.com

Abstract. Energy from wood, as renewable energy, sourced from forest biomass is urgent to be developed because its availability is decreasing. The study focused on the socio-economic and policy aspects of biomass energy so that the development of plantation forests is more optimal to support energy security. The study was conducted in Jakarta and West Java provinces especially in Bandung in 2017 to provide information on social economic situation in developing policy for renewable energy sourced from forest biomass. The two locations are selected because they are the national and the provincial capitals that are rich with information and data related to existing regulations/policies for the development of renewable energy. Economic and financial analysis is conducted to see the feasibility of developing a forest biomass energy business. The results show that the potential for renewable energy from forest biomass is very large in the forms of feedstocks. Forest areas in Indonesia are very strategic for providing biomass-based energy resources. Energy Plantation Forest (HTE) is a potential and reliable energy source to be developed as a source of sustainable raw materials. This can accelerate the commitment of the MOEF in achieving renewable energy based on forest biomass that will contribute 5% to the national energy mix in 2025. It is recommended to: 1) provide policy support in the common vision of developing a renewable energy industry from forest biomass, 2) formulate policies on upstream-downstream HTE development policies, and 3) increase the competitiveness of HTE wood species for the utilization of forest biomass energy.

1. Introduction

Seeing forests as a foreign exchange machine by clearing wood has resulted in the destruction of forest resources because of overcutting. Energy development from wood is one of the most important development alternatives in the cultivation of forests and forest products. The economic benefits of cultivating energy-producing plants, the supply/utilization of wood waste and processing of forest biomass energy can create jobs and increase income for community and residents around the forest[2].

Timber energy is an urgent commodity to be developed in the Forestry Sub Sector given the declining role of the wood based industries which have been the backbone in the future, in the sense that its contribution to foreign exchange will increase. Government policy in banning log exports is intended to encourage the development of an efficient wood processing industry by developing Energy Plantation Forests (HTE) and utilizing wood waste to produce energy from wood[4&5]. Under the
influence of Kyoto Protocol, the Indonesian government introduces a policy to promote development of forest biomass fuels. In this way, it can help to ease pressures on energy use and carrying capacity of the environment. On January 31, 2012, the Indonesian government issued several tax subsidies for the development of bio-energy, bio-gas and the reuse of other solid waste. Wood processing industry both upstream and downstream industries must respond to national policies including activities in developing HTE and processing industrial waste for energy[3].

Current energy development policies have not been supported by economic policies that favor small and medium enterprises and cooperatives (SMEs), as well as promoting equal employment and opportunities for communities, whereas most business actors utilizing timber forest products are groups of small, medium enterprises and cooperatives with a business scale spread in small units and involving large numbers of business actors.

On the other hand the National Energy policy (KEN) as a guideline in national energy management is currently oriented towards Renewable Energy (RE), where forest biomass energy has not yet received a proper place, even though the potential is very large and the location of forests is very strategic[1]. One reason is that information on the real and measurable potential of forests is not as good as oil palm plantations.

Based on Presidential Instruction No. 1 of 2006 concerning Provision and Utilization of Biofuel as Other Fuels, biomass is one of renewable energy sources originating from natural resources[7]. Energy crops can basically come from forest biomass, namely woody plants and raw materials for biofuel, such as hedgerows, which are useful in supporting efforts to realize national energy supply security, which today still relies heavily on energy of oil, gas and coal.

In relation to these problems in short, medium and long term periods, this paper is intended to provide information as an idea in developing renewable energy sourced from forest biomass. The study focuses on socio-economic aspects and policies of forest biomass energy as renewable energy in an effort to equalize perceptions in the development of forest biomass energy. In addition to the wood processing industry, it can recycle wood waste for renewable energy such as wood pellets so that they can get more benefits from existing activities.

This information is expected to be an input in the formulation of government policies on empowering and improving forest resources, people's economy, upstream-downstream incentive systems and increasing foreign exchange for the state, so as to increase the bargaining position of local economic actors in managing HTE and wood waste as forest biomass energy sources in a fair and sustainable manner. This information is needed as a means of communication and information in developing energy from wood in Indonesia for both domestic and export markets. This research aims to: provide information as input in developing renewable energy sourced from forest biomass. The specific objectives of the study is to:(1) Provide information on social, economic and forest biomass energy management policies as renewable energy (RE), (2) Increase industrial competitiveness and trading of biomass energy sourced from timber forest products and forest products industry waste for domestic and export markets, and (3) Increase the role of forest biomass energy on renewable energy production.

2. Research method

2.1. Data collection
Primary data collection includes a) forms of forest biomass energy supply, b) wood/wood waste used as a source of forest biomass, c) costs and revenues of energy wood for the utilization of forest biomass energy. Data is collected based on the results of interviews and Focus Group Discussions (FGD) with participants from Research, Development and Innovation Agency of Ministry of Environment and Forestry (BLI-MOEF), Indonesian Forest Concession Association (APHI), Indonesian Forest Biomass Energy Activist Community (MAPEBHI), Directorate General (DG) of Plantations, DG of Production Forest Business, Association of Indonesian Bioenergy Experts (IKABI), Ministry of Energy and Mineral Resources, and West Java Provincial Forestry Service. While secondary data include regulations/policies on renewable energy and energy plantations within
the scope of the Ministry of Environment and Forestry (MOEF), the Ministry of Energy and Mineral Resources (ESDM), APHI, DG of Plantations and the clarification of data from research resulted from the BLI-MOEF. Data collection started from August to November 2017.

2.2. Data analysis
Data are analysed qualitatively and quantitatively related to social, economic, and policy aspects of Forest Biomass Energy (FBE) for renewable energy (RE). As for the policy aspects of supplying FBE, a qualitative analysis is conducted. Descriptive analysis is carried out to determine scenarios and action plans for the development of renewable energy from forest biomass, especially wood pellets. Economic and financial analysis are carried out to investigate the feasibility of developing a forest biomass energy business from cultivation to products outputs, one of which is wood pellets. The results of this analysis are used to plan the development of the forest biomass energy industries. Finally, a descriptive analysis is carried out to develop recommendations for developing strategies on waste processing and wood energy cultivation for renewable energy from forest biomass. Economic analysis of the development of the forest biomass energy processing industries, especially wood pellets, is carried out using a business feasibility analysis.

3. Result and discussion
3.1. Form of Forest Biomass Energy Supply
Energy Forest biomass as a renewable energy source produced from processing energy wood can be in the form of solid, liquid or gas. Solid forms include firewood, chips, pellets or briquettes and charcoal. Whereas the liquid ones include wood oil, tar and alcohol; and gas-based energy sources are wood gases, namely CO, CH4 and others [1]. Types of energy produced from these materials can be in the form of heat, electricity and mechanical power.

Utilization of Energy can be used for sectors of household, industries, transportations and trade. In the household sectors, for example, the energy could be utilized for cooking and lighting in accordance with the availability of development of processing equipment and cultures that are suitable, especially in rural communities. For industrial sector, it requires energy in the form of heat, electricity or propulsion which also requires appropriate equipment engineering to produce optimal production capacity. In transportation sectors, wood energy for propulsion power is needed in both rural and agricultural plantation/fishery areas [6].

Some ideas as the follow up to the development of forest biomass energy as a renewable energy source should be followed up so that government programs, especially the Ministry of Environment and Forestry which has to realize future energy supply security, can be achieved. It seems urgent when it is considering that the Ministry of Environmental and Forestry (MOEF) has the commitment with the establishment of forest biomass-based Renewable Energy will contribute 5% of the energy mix in 2025 by 23% and 10% in the mix of 31% in 2050 [8&9]. In addition, it also provides dual benefits both in the context of HTE development and in increasing added value for rural communities in particular and holders of Timber Forest Production Business License (UPHHK) - HTE [12].

3.2. Socio-Economic Aspects
Wood as feedstock used as raw material for forest biomass energy that can be obtained from:

a. Logging waste, with a potential of 20% to 40% of the total timber stand;
b. Wood processing industry waste consisting of primary industrial waste (plywood, sawing, etc.), downstream industries (furniture, home components etc.). Primary industrial waste can raise from 20% to 50% of the total production in the form of powders, chips, chips and pieces of wood;
c. Timber Production Forest Energy (HTE);
d. Timber production from Village Forests;
e. Timber production from Customary/Community Forests;
f. Production of wood from reforestation plants (1 billion/year);
g. Timber production from Agroforestry;

h. Timber production from HTI Land Clearing, Mines and Gardens.

Overview Profitability of energy wood species utilization for energy forest biomass are respectively for fuelwood, wood pellet and electricity (household and industry) as it is presented in the following figure:

![Figure 1. Overview Profitability Wood Energy Utilization][2]

Based on the picture above, it can be observed that the level of business profit for utilizing energy wood when it is used for fuelwood ranges from 166 to 1,192 USD per ha with a yield of 4 years with plants that are widely used by communities and industries to produce energy from wood namely gamal and turi wood species. The cost of cultivation of the two wood specie is as it is shown in Table 1 below:

| No. | Description                                      | Cost (USD/ha) | Revenue (USD/ha) | Gross Profit (USD/ha) | Remark                                                                 |
|-----|--------------------------------------------------|---------------|------------------|-----------------------|----------------------------------------------------------------------|
| 1.  | Wood energy Forest Plantation (HTE, ha)         | 782,22        | 948,15           | 165,92                | Production of 160 m3/ha Price of log 5.83 USD/m3 Yield (T) = 4 years Species of Gamal |
| 2.  | Wood energy Forest Plantation (HTE, ha)         | 1,030,59      | 2,222,22         | 1,191,63              | Production of 120 m3/ha Price of log 18.52 USD/m3 Yield (T) = 4 years Species of Turi |

Source: primary data processed

The profit level of energy wood if it is used for Wood Pellet ranges around 8,000 USD per ha with a 4-year cycle of gamal wood species. The production costs and revenue are presented in the following Table 2.
Table 2. Costs and Revenues of Energy Wood for Wood Pellet Utilization

| No. | Description                        | Amount   | Remark                                      |
|-----|------------------------------------|----------|---------------------------------------------|
| 1.  | Production KE (ha)                 | 160 ton  | Species of Gamal, t = 4 years               |
| 2.  | Production Wood pellet (WP) (85% yield) | 136 ton  |                                              |
| 3.  | Cost Prod per ton                  | 61 USD   |                                              |
| 4.  | Total Cost Prod                    | 8.296 USD|                                              |
| 5.  | Selling price per ton              | 120 USD  |                                              |
| 6.  | Revenue                            | 16.320 USD|                                              |
| 7.  | Gross Profit per ha                | 8.024 USD|                                              |

source: primary data processed

The profit level of energy wood when it is used for household electricity ranges from 3.077 - 11.770 USD per ha, whereas if it is used for industrial electricity, the range is around 31,506 USD per ha with a 4-year cycle plant species of gamal; the production cost and revenue are presented in the following Table 3.

Table 3. Costs and Revenues of Wood pellets for Electricity Utilization

| No. | Description                     | Amount       | Remark                                      |
|-----|---------------------------------|--------------|---------------------------------------------|
| 1.  | Production : 1 kg WP            | 4.32 KWH     | Mixed Species                               |
| 2.  | Raw material Cost of WP per ha  | 13.600 USD   | Production 136 ton wp/ha                    |
|     |                                 |              | Domestic Price 100 USD/ton                  |
| 3.  | Electricity Production per ha   | 587.520 KWH  |                                             |
| 4.  | Cost of Electricity Production  | 11.750,4 USD| 0.02 USD/KWH                                 |
| 5.  | Total Cost Electricity          | 25.350,4 USD |                                             |
| 6.  | Revenue (Household)             | 28.428,4 USD | Price 0.0484 USD/KWH                        |
| 7.  | Revenue (Industry)              | 56.856,8 USD | Price 0.097 USD/KWH                         |
| 8.  | Gross Profit (Household)        | 3.078 USD    |                                             |
| 9.  | Gross Profit (Industry)         | 31.506 USD   |                                             |

source: primary data processed

The results of the economic study show that plantation Forest Business Energy as a forest biomass for renewable energy is quite profitable and feasible to be developed financially & economically. Several economic and institutional factors that have a significant effect on the competitiveness of plantation forests are the price of logs, policy of prohibiting log exports, guarantee of bank loans (bankable), transaction costs and timber administration.

The idea of utilizing forest biomass energy for renewable energy will have an impact on increasing economic activity. The social aspects of the utilization include the empowerment of communities around the forest, increasing employment, waste utilization, capacity of Natural Resources (SDA) and Human Resources (HR); adoption of innovation and development of forest biomass energy is also one of the strategies for climate change action plans (11)[11]. Energy wood management both from the aspects of cultivation for the purposes of supplying raw materials and industry processing, both in large and small scale, can have an impact on the condition of the community and the surrounding environment. Based on the results of interviews in the Forest Service of Bandung and the Directorate General of Production Forest Business of the MOE, some positive impacts of the development of energy wood into renewable energy from the social aspect are:

a. Utilization of wood waste (waste of forest exploitation and wood processing industry);

b. Creation/Absorption of labor for cultivation, supply of raw materials, labor for industry processing which will ultimately improve the welfare of the community;
c. Increasing the capacity of natural and human resources;

d. Adoption of new innovations in the form of cultivation and knowledge of farmers about the species of wood as raw material for forest biomass energy;

e. Increasing economic activity in local area which has an impact on social and religious activities for the surrounding community.

3.3. Policy Aspects

The potential of forest biomass energy is very large in terms of feedstock and in the distribution of the locations in Indonesia, it is very strategic as a real and measurable potential. The potential of the forest is not as good as that of oil palm plantations that have been estimated so that the National Energy Policy (KEN) is oriented more towards renewable energy sourced from oil palm. At present, the development of HTE continues to be encouraged [10]

HTE is a potential and trusted energy source to be developed as a sustainable source of feed (feed stock) compared to palm oil which collides with food. The Ministry of Environment and Forestry (MOEF) has committed with forest biomass-based Renewable Energy (ET) to play 5% in 2025 energy mix of 23% and 10% in a mix of 31% in 2050.

From the technical aspects, namely the crop cycle and silviculture system, HTE must be in short-cycle Short Rotation Forestry (SRF) so that it is easier to obtain financing from financial institutions, but on the other hand SRF is not good at environmental aspects and drains land fertility and it will not produce carbon credit. If HTE have a long cycle, this would have an impact on the decline in the Internal Rate of Return (IRR), in the increase in the need for working capital, in investment and this will not bankable.

The "Green Economy" paradigm in which business actors voluntarily internalize two environmental and social externalities into their production costs bring results in fair feed stock prices and it will ensure the sustainability of their supply.

Presidential Instruction (INPRES) No. 1 of 2006 concerning the Supply and Use of Biofuel as Other Fuels needs to be revised immediately because it limits the role of the forestry sector in the development of biofuels. The Inpres instructs the Coordinating Minister for Economic Affairs and 12 other Ministers (including the Minister of Forestry at that time) as well as the Governor and Regent/Mayor in district areas to take necessary steps in order to accelerate the supply and utilization of biofuels. In the Inpres, the role of LHK Ministry only has a mandate related to provision of land for development on unproductive land[7]. It should be improved to encourage the acceleration of its mandate including:

1) Provision of raw materials for biofuel (BBN), namely the Development of Energy Plantations;
2) Preparation of processing technology;
3) Development of alternative energy based forest plants.

Thus the policy is not effective for the Ministry of LHK, although currently it is effectively participating in the initiation of the development of Energy Independent Villages (DME) from nyamplung raw materials in several districts in Java, Sumatra and Sulawesi.

Forestry minister's regulation number P.18 / Menhut-II / 2011 about Borrowing with Forest Areas and P.12 / Menlhk-II / 2015 Concerning timber estate (HTI) Development are grouped into 3 groups, namely: (a) woody forest plants producing wood, food & energy; (b) annual cultivation of woody plants producing wood, food and energy; and (c) other crops producing food and energy. So various types of plantation forest, namely HTI, village forest, community forest plantation (HTR), non timber forest plants and community forest (HKm) can be managed to produce a variety of products, including energy.

Integrative Research Plan (RPI) Forestry Research and Development Agency in 2010 had a policy to develop HTE, including the existence of a research title, including those related to energy. The RPI is an elaboration of the 2010-2025 forestry research and development roadmap approved by the Minister of Forestry. The results of the study recommends four types of fast-growing trees that are
potential to be developed as energy biomass timber estate, namely: akor, gamal, kaliandra and lamtorogung, and three types of biofuel producing plants, namely: nyamplung, bintaro and malapari.

Regulation of the Ministry of Environment and Forestry number P. No.2 of 2015 concerning the Plan and Strategy of Ministry of LHK in 2015 - 2019 states that the Energy Plantation Forest (HTE) area in 2019 is targeted to increase by 100,000 ha. Until now, there are 32 units of Business License Concession-Timber Forest Products (IUPHHK) of timber estate (HTI) covering the area of ± 1.1 million hectares which support the construction of HTE consisting of:

a. IUPHHK-HTI which at the beginning starts from 10 units of energy with an area of permit ± 297,645 ha and the width covers ± 87 thousand hectares;
b. IUPHHK-HTI that has committed to energy as many as 22 units with a permit area of ± 79 thousand hectares.

The development of forest biomass energy from the cultivation of wood energy for the renewable energy processing industry is very important, because many parties are involved in the business thus making it difficult to handle and develop, needs prolong marketing processes and leads to high costs and brings to threatened sustainability. Therefore, in developing forest biomass energy, some constraints emerge, including:

a. The existence of forest land conflicts with the community so that the expansion of land for energy plantations is difficult to obtain in clear and clean areas. This has an impact on unsustainable feedstock production;  
b. Discrepancy between HTE locations and PLN network locations, where at present HTE construction is linked to the PLN network development plans at that location;  
c. The selling price of biomass products such as wood pellets can be more beneficial for HTE entrepreneurs compared to feedstock for electrical energy or liquid energy from wood;  
d. The low price of electricity generated from forest biomass received by PLN is around 0.1111 USD to 0.1481 USD per kwh, where the price has been set by PLN. This price is less than the cost of electricity production from forest biomass, which ranges from 0.4 USD to 0.6 USD per kwh, so it is not attractive to HTE entrepreneurs.

4. Conclusion and recommendation

4.1. Conclusion

a. Social aspects of the utilization of forest biomass energy for renewable energy namely the empowerment of communities around the forest, increasing employment, increasing the capacity of natural resources (SDA) and human resources (HR), and the adoption of technological development innovations need consideration to develop.
b. Energy Forest Plantation Business as a renewable forest biomass is quite profitable and feasible to be developed financially and economically for the production of renewable energy.
c. The potential of forest biomass energy is very large in terms of feedstock and the spread of forest location is very strategic and measurable so that the upstream-downstream policy of HTE development can benefit all parties.
d. In enhancing the competitiveness of HTE businesses for forest biomass energy, there is a need for equality in the selling price of logs between domestic and export, the sustainability of the log export ban policy, the suitability of the price of electricity supply received by PLN and guarantees for granting investment credit.
e. Increasing the role of forest biomass energy in renewable energy production, the INPRES NO. 1 of 2006, demand the role of MOEF to accelerate the mandated task in the supply of energy raw materials from HTE development as feedstock, preparation of processing technology and development of alternative energy based on forest plantations.
4.2. Recommendation

a. It is time for the whole range of related parties under the coordination of the Ministry of Environment and Forestry to discuss issues of developing this HT so that the committed target of the Ministry of Environment and Forestry can be realized.

b. Increasing the competitive opportunity business of HT through optimizing the allocation of utilization of energy wood species as forest biomass energy sources both for export and domestic.

Acknowledgement

The authors would like to thank to Center for Research and Development on Social, Economy, Policy and Climate Change, Ministry of Environment and Forestry (MOEF), Ministry of Energy and Mineral Resources (ESDM), Forestry and Environment Research, Development and Innovation Agency of MOEF, DG of Plantations, DG of Production Forest Business, West Java Provincial Forestry Service, Indonesian Forest Concession Association (APHI), Indonesian Forest Biomass Energy Society (IFBES/MAPEBHI), and Association of Indonesian Bioenergy Experts (IKABI).

References

[1] Bustomi, S. dan Effendi R 2013 Wood Pellet Processing Socio-Economic Aspects.

[2] Effendi, R I B dan S A 2010 Financial Feasibility Analysis of Plantation and Plantation Enterprises. Report of Research and Development Research Center for Climate Change and Policy. Not Published. (Bogor).

[3] Effendi, R. S. Astana I B 2012 Financial Feasibility Analysis of Plantation and Plantation Enterprises. Report of Research and Development Research Center for Climate Change and Policy. Not Published. (Bogor).

[4] Effendi, R. I. Bangsawan dan R M M 2010 Analysis of stumpage value of plantation forests. Report of Research and Development Research Center for Climate Change and Policy. Not Published. (Bogor).

[5] Ahmad N R 2015 Forest Biomass Energy. Presented in the FGD on Effectiveness of Energy Plantation Forestry Policy (Jakarta).

[6] Indonesia I of the P of the R of 2006 Instruction of the President of the Republic of Indonesia No. 1 of 2006 concerning Provision and Utilization of Biofuel as Other Fuels (Indonesia).

[7] Effendi E al. 2014 Economic Prospects of Wood Energy (For Renewable Energy Business). Presentation of Energy Wood Development Forestry Research and Development Agency. (Bogor).

[8] LHK M of 2015 Ministry of LHK. 2015. Collection of LHK Ministerial Regulations (Indonesia).

[9] LHK M of 2014 Ministry of LHK. 2014. Collection of Forestry Ministerial Regulations (Indonesia).

[10] Syahadat, E O K yon. and N P 2010 Analysis of Plantation Forest Provision Policy. Report of Research and Development Research Center for Climate Change and Policy. Not Published (Bogor).

[11] Santoso H 2006 No Title Biological Energy as a Solution to the Energy Crisis: Opportunities and Challenges in Indonesia. (Surakarta).

[12] Indonesia P R of the R of 2006 Presidential Regulation of the Republic of Indonesia No. 5 of 2006 concerning National Energy Policy (Indonesia).