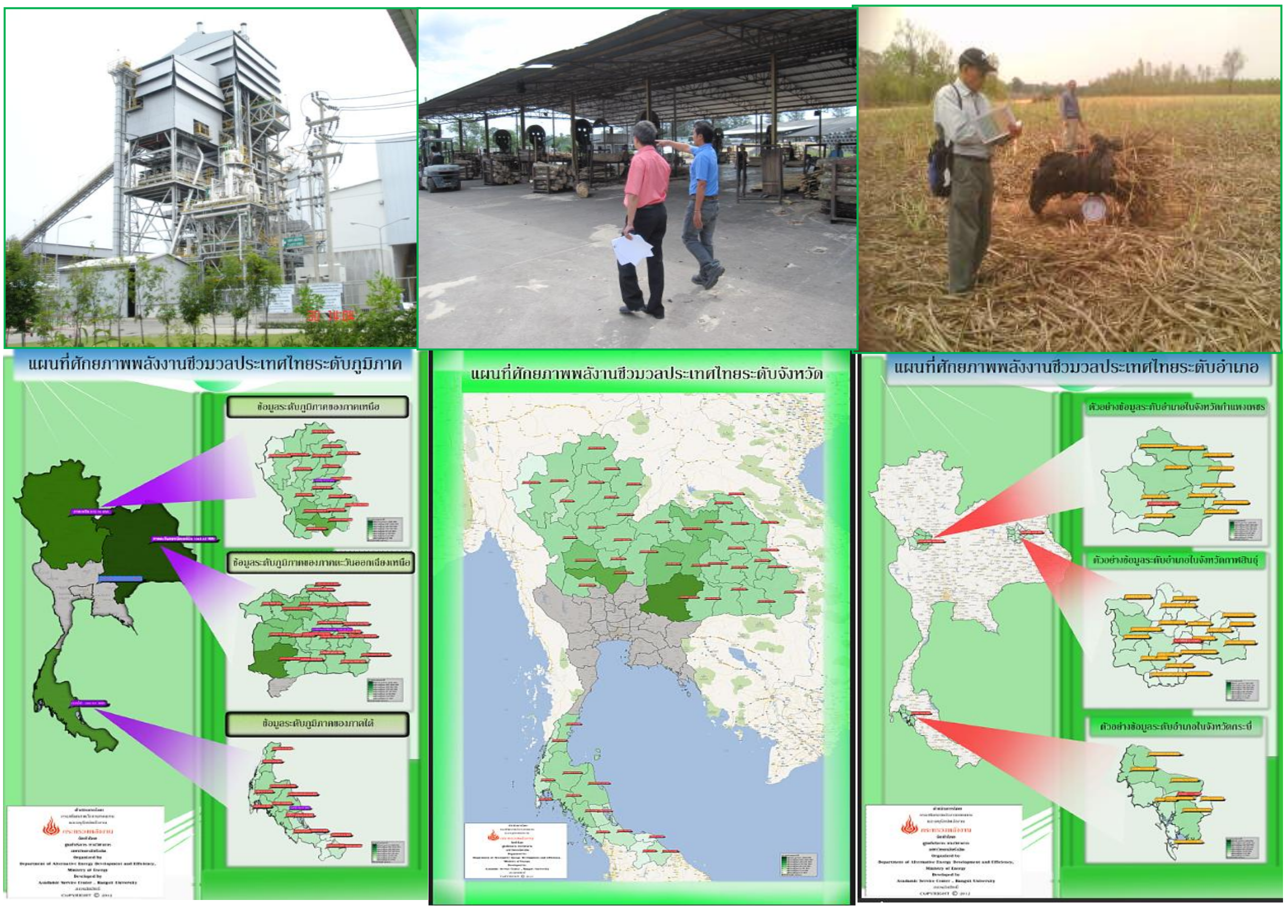

แผนที่ศักยภาพพลังงานชีวมวลประเทศไทยระดับภูมิภาค
ข้อมูลระดับภูมิภาคของภาคเหนือ
ข้อมูลระดับภูมิภาคของภาคตะวันออกเฉียงเหนือ
ข้อมูลระดับภูมิภาคของภาคใต้
แผนที่ศักยภาพพลังงานชีวมวลประเทศไทยระดับจังหวัด
แผนที่ศักยภาพพลังงานชีวมวลประเทศไทยระดับอำเภอ
ตัวอย่างข้อมูลระดับอำเภอในจังหวัดกำแพงเพชร

Biomass Database Potential in Thailand

1. Background

Thailand is an agricultural country, after harvesting there will be a large amount of agricultural waste left which could be use as biomass energy. Biomass is the production of industrial-agricultural waste such as rice husk, bagasse fiber and palm shell. Usually, industrial sectors use fossil fuels, including fuel crude oil, diesel, cooking gas (LPG), coal because of its high heating value, its being convenient to use and to transportation, and fuel prices are not high. Ten years ago, petroleum price has increased accordingly to the fuel price mechanism in the global market. As a result, industrial sectors, instead of using petroleum fuel, used biomass fuel to replace petroleum fuels to reduce cost of production and to eliminate waste in the plant. At the present time, industrial plants and power plants have increased their demand for biomass and as a result, prices increased dramatically and biomass and fuel shortages have been experienced in many areas. Therefore, factories and power plants using biomass have to stop operation due to lack of sufficient biomass fuel.

Biomass database is necessary for the policy / strategy and action plan to promote renewable energy. In order to promote the use of renewable energy in potential areas, people who work with policy makers need to realize the potential of renewable energy in that particular area, the use of biomass in the area and its vicinity to set guidelines / measures to promote the use of biomass energy and to set an appropriate action plan. Moreover, other businesses can also benefit directly from the database in order to know the size and capacity of biomass fuel in areas that are suitable to invest.

Of such reasons, Department of Alternative Energy Development and Efficiency(DEDE) needs to study the potential of biomass database development in order to determine the amount of biomass available in different areas as well as to see the use of biomass for energy production. The application of GIS technology is needed to develop biomass database system to be accurate and reliable for investment decisions and for government agencies in the formulation of policies / measures to promote the use of biomass to be consistent with the master plan for development of alternative energy all over the country.

2. Objectives

1. To collect data for biomass potential in Thailand and study the use of biomass for power generation / thermal power plants or factories in Thailand.
2. Study the potential to improve the availability of biomass by using geographic information systems and / or other appropriate technology.
3. To build awareness about the potential of biomass data for biomass energy study and for personnel of the Department of Energy and Energy Conservation.

3. Mission

The Department of Alternative Energy Development and Efficiency studied the development of renewable energy and energy conservation in 2005, studying the evaluation of potential biomass resources in Thailand and collected data on biomass potential and its amount, the result of this study was a database of potential biomass and the biomass potential data, however, the biomass productivity in the agriculture and industry sectors have changed in biomass cultivation and its use. Therefore, it is necessary to conduct another continuing study, gather information and assess the potential of biomass in the country again. Also to improve biomass database ready for investors.

Mission and activities in this project include;

- Biomass data collection from various departments.
- Survey biomass in targeted areas. Collect biomass data used in power plants and factories Analysis of the use of biomass energy production.
- Develop a database of geographic information technologies.
- Import data to develop the database
- Activities, training, data import and use the information for workers associated with biomass energy.

4. Scope of Work.

1. The collection and analysis of biomass in the database developed by The Development of Renewable Energy and Energy Conservation Department and other agencies in order to develop biomass database for users and administrators.

2 . Collect data on biomass and spatial (Area base) data of the agricultural area, at least three potential areas in the region dating back at least five years and to analyze and evaluate the potential of biomass which can be used to produce energy.

3. Collect and compile data on industrial sources of biomass such as rice, palm crude oil, sugar crushing mills and other industries. Each source of biomass must comprise of area of production, technology and machinery for the properties of the biomass (the amount of heat, humidity, etc.), the biomass utilization and purchase-selling price. Study the evaluation of the residual biomass of each plant.

4. Collection and survey biomass power plant in Thailand. It will contain important information such as the production volume, type of fuel, sources, prices and transportation costs, the technology used in production and other necessary information.

5. Gather information and explore potential plants which use biomass to produce electricity and / or heat such as sugar industry, palm crude oil industry, paper industry, cement industry, food industry, processing / baking timber industry. starch industry, chemical / textile industry, ethanol production industry and rice industry by surveying the status of the biomass used for energy production and energy production from biomass in each industry.

6. Gather information and explore the use of technology. (To determine the proportion of biomass technology in use in Thailand. The biomass index of the minimum requirements for each type of technology. To determine the minimum adequate amount of biomass used as feedstock for the production of biomass energy technologies) and to determine the index of energy consumption per unit of the plant which will be studied in 1.4. 4 and 1.4.5

7. Collect and analyze and explore the links between topics 1.4.2-1.4.5, respectively, and the factors that affect the promotion of the collection and use of biomass to produce electricity and thermal energy.

8. Designing, developing the potential of biomass in the database using geographic information and any other appropriate technology which is available and appropriate to the original database of the Department of Alternative Energy Development and Efficiency, or further improved. Importing data according to topic 2-6 by the database system must meet, at least ,the following criteria;

- Supportive system for data import, editing and running the data through the Internet. Can access the information by system administrator and general users.
- The display of the potential of biomass by type of biomass and must represent the source of each type.
- The display of energy production from biomass must be divided into the use of biomass for power generation and use of biomass to produce thermal energy.

- information must be published quickly and complete. .
- can be linked to the main system (The website of the Department of Energy and Energy Conservation.)

9. Provide instruction in the use of surveyed data and imported data. Provide instruction manual in maintaining the database and the database of potential biomass, in both print and electronic media

10. Training on surveying and data importing, maintenance of the database to relevant personnel including personnel of the Department of Energy and Energy Conservation, Energy Province with at least 100 participants. The consultants can provide training in one or small group training as appropriate. The adviser must obtain approval from the Department of Energy and Energy Conservation before the implementation of training.

11. Public presentation of the project by inviting a number of government agencies, private institutions and other interested participants, not less than 150 persons

5. Scope of Study and collection of biomass potential in Thailand.

5.1 area of study

The study gathered data on biomass and spatial (Area base) of the agricultural area from the past five years and analyzed and evaluated the potential of biomass which can be used to produce energy. It is found that the maximum potential of the biomass consists of three regions ;

Northeast 20 provinces

(1.) Kalasin

(2.) Khon Kaen.

(3.) Chaiyaphum

(4.) Nakhon Phanom.

(5.) Nakhon Ratchasima.

(6.) Burirum

(7.) Bueng Kan

(8.) Maha Sarakham

(9.) Mukdahan

(10.) Yasothon

(11.) Roi Et

(12.) Loei

(13.) Si Sa Ket

(14.) Surin

(15.) Skon Nakhon

(16.) Nong Khai

(17.) Nong Bua Lam Phu

(18.) Amnat Charoen

(19.) Udon Thani

(20.) Ubon Ratchathani

North 17 provinces

(1.) Kamphaeng Phet

(2.) Chiang Rai

(3.) Chiang Mai

(4.) Tak

(5.) Nakhon Sawan

(6.) Nan

(7.) Phayao

(8.) Phichit

(9.) Phitsanulok

(10.) Phetchabun

(11.) Phrae

(12.) Mae Hong Son

(13.) Lampang

(14.) Lamphun

(15.) Sukhothai

(16.) Uttaradit

(17.) Uthai Thani

South 14 provinces

(1.) Krabi

(2.) Chumphon

(3.) Trang

(4.) Nakhon Si Thammarat

(5.) Narathiwat

(6.) Pattani

(7.) Phangnga

(8.) Phatthalung

(9.) Phuket

(10.) Yala

(11.) Ranong

(12.) Songkhla

(13.) Satun

(14.) Surat Thani

Total 51 provinces. For the rest, 10 provinces in The Central Part, 8 provinces in The East and other 8 provinces will be studied next.

5.2 Biomass in the study

The study gathered data on biomass and spatial (Area base) of the agricultural area from the past five years, analyzed and evaluated the potential of biomass which can be used to produce energy. It is found that the maximum potential of the biomass consists of 9 types of plants, 19 types of biomass as following;

1. Rice, biomass from rice is
    - Rice Straw.
    - Rice Husk.
2. Sugar cane , biomass from sugar cane is
    - Sugar cane leaves and tops.
    - Bagasse.
3. Corn , biomass from corn is
    - Stems, leaves, and corn.
    - Corn cob
4. Cassava , biomass from cassava is
    - Cassava roots.
5. Palm crude oil tree , biomass from palm crude oil tree is
    - Palm trunk.
    - Palm leaves.
    - Palm shell
    - Palm fiber.
    - Palm shell.
6. Rubber tree , biomass from rubber tree is
    - The roots and leaves of branches.
    - Small rubber wood.

- Slab rubber wood.
- rubber wood chips and sawdust.

7. Soy bean , biomass from soy bean is
    - Top, leave and stem
8. Mung bean , biomass from mung bean is
    - Top, leave and stem
9. Peanut , biomass from peanut is
    - Top, leave and stem

5.3 Process of study

1. specify types of biomass to study

(1.) Biomass from agricultural waste

- Rice straw is the material remaining in the harvest area.
- Leave and stem of sugar cane from harvest area
- Leave and stem of corn from harvest area
- Cassava root from harvest area
- Palm tree from harvesting area
- Leave and stem of palm tree from harvesting area
- Root,leave and stem of rubber tree from harvesting area
- Leave and stem of sugar cane from harvesting area
- top of rubber tree from harvesting area
- Leave and stem of soy bean from harvesting area
- Leave and stem of munk bean from harvesting area
- Leave and stem of peanut from harvesting area

(2.) Biomass from remaining material in factories

- Husk Rice is the material remaining in the mill
- Bagasse is the material remaining in sugar factory
- Corn cob in corn mill
- Palm fiber is the remaining material in the palm crude oil mill.
- Palm shell as remaining material in the palm crude oil mill.
- Wood slab in the wood processing industry.
- Woodchips and sawdust as remaining material in the wood processing industry and production of furniture and furnishings

Identify methods to obtain the information needed to study the different types of biomass by (1.) included.

- Calendar of biomass planting for each species, the calendar of planting and harvesting rice. Calendar of planting and harvesting sugar cane. Calendar of planting and harvesting corn. Calendar of planting and harvesting potatoes. Calendar of crude oil palm trees. Calendar of fresh palm fruit harvesting. Calendar of harvesting rubber stem. Calendar of growing and harvesting soybeans. Calendar of planting and harvesting beans. Calendar of planting and harvesting peanuts.
- Biomass crops area include rice growing areas. Sugar cane plantations. Maize growing areas. Cassava growing areas. Palm crude oil plantations. Rubber plantations. Soybean growing areas. Bean growing areas. Peanut-growing areas.
- The biomass crops harvesting area, including rice harvested area. The sugar cane harvest. Harvested area of maize. Harvested area of cassava. Harvested area of palm crude oil. Soybean harvested area. The green bean harvest. Peanut harvest area.
- Area of planning and deplaning palm crude oil tree and rubber tree
- The proportion of the yield of rice per hectare planted. Proportion of the sugar cane yield per hectare of land. Proportion of the yield of maize per hectare planted. Proportion of the yield per hectare of cultivated cassava. The proportion of stems per hectare of palm trees, palm crude oil. Portion of the stump. Roots, branches and stem wood per hectare of rubber. The proportion of stem wood per hectare of rubber. The area ratio of the rubber slab rubber stem. The proportion of sawdust and scrap wood per hectare rubber stem. Proportion of the yield of soybean planted area. Proportion of the yield per hectare of cultivated chickpea. Proportion of the yield per hectare of cultivated peanut.
- Plant biomass production and yield of rice and rice. Sugar cane production. Yield of maize. Yield of cassava. Production of palm crude oil. The amount of rubber trees. Yield of soybean. Green bean yield. Peanut yield.
- Proportion of the yield of paddy rice. The proportion of the total cane yield and sugar cane. The ratio of bagasse to produce sugar cane. Proportion of the total leaves and stems of corn yield of maize. Proportion of the maize cob yield. Proportion of the cassava root yield of cassava. The proportion of stems per hectare of palm trees, palm crude oil. The proportion of palm leaves and the fresh yield of palm. The ratio of empty to yield a crushing mill. Proportion of the crude oil palm fiber, palm yield fresh. Proportional to the quantity of palm shell crushing mill. Portion of the stump. Roots and branches in the area to be felled wood. Proportion of the wood at the base of the rubber trees per hectare. Portion of the slab at the base of the natural rubber latex per hectare. The proportion of sawdust and scrap wood at the base of the rubber trees per hectare.

Proportion of the leaves and stems of soybean to soybean yield. Proportion of the leaves and stems, green beans, green beans to yield. Proportion of the leaves and stems of peanut to peanut production.

(1.) Specify the study, data collection and utilization such as biomass to produce heat or used as fuel for power generation. Used as fuel to produce both electricity and thermal energy. Used in agriculture. In the household sector and other sectors. The amount remaining after deducting the purchase price to use - the potential for its use as fuel to produce energy and heat and electricity or combined heat and power. How to get rid of the remaining amount. The biomass of each species to be identified in accordance with (1.1)

(2.) Specify the study of utilization of biomass fuel to produce heat. Used as fuel for power generation. Used in agriculture, in the household sector and other sectors. Balance of purchase price - the potential for its use as fuel to produce energy and heat and electricity. How to get rid of the remaining amount. The biomass of each species to be identified in accordance with (1.2) in plant biomass, plant biomass, including sugar mills, rice mills, corn, crude palm crude oil mill. The wood flour mills. Wood furniture factory.

(3.) To study the utilization of biomass as a fuel to produce electricity, combined heat and power biomass power plant. The implementation of the biomass of each species are listed under (a).

(4.) The study of the utilization of biomass as a fuel to produce heat, combined heat and power industry. The implementation of the biomass of each species are listed under (1), namely. The study of the utilization of biomass as a fuel to produce heat, combined heat and power industry. The implementation of the biomass of each species are listed under (1), namely.

- The use of biomass in the rice industry.
- The use of biomass in the sugar industry.
- The use of biomass in the palm crude oil industry.
- The use of biomass in plants, rubber, wood and wood products.
- The use of biomass in plants and other types of wood and other products. Non-wood.
- The use of biomass in the paper industry.
- The use of biomass in industrial, chemical / leather.
- The use of biomass in the food industry.
- The use of biomass in industrial starch.
- The use of biomass in industrial production of ethanol.
- The use of biomass plants in other industries.

6. The result of the study of each type of biomass

6.1 Rice Straw

Rice straw is biomass crop in rice harvested area. In crop year 2552/2553 in the three regions surveyed, the total volume was 10,727,682.14 tons/year, equivalent to crude oil of 3,140.37 ktoe/year, equivalent to energy of 7,348,462,267.52 kW-h/year, equivalent to power 874.82 MW (at 20% efficient power plant operation 350 days/year), a compilation of surveys and analysis of its use as fuel and other benefits stated that its use was 10.1 percent of the total volume or used averagely of 1,086,774.12, therefore the remaining was 9,640,908.02 tons/year, equivalent to crude oil potential 2,822.23 ktoe/year, equivalent to energy. 6,604,021,992.72 kW-h/year, equivalent to 786.19 MW installed power in province. With the remaining rice in each province, potential energy is equivalent to Figure 2.

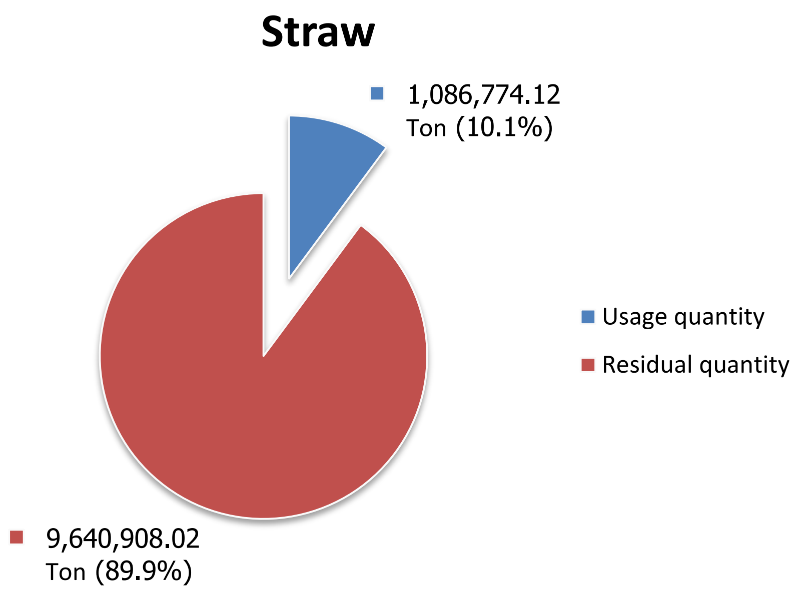

Figure 1 shows the amount of utilization of rice straw and the remaining amount

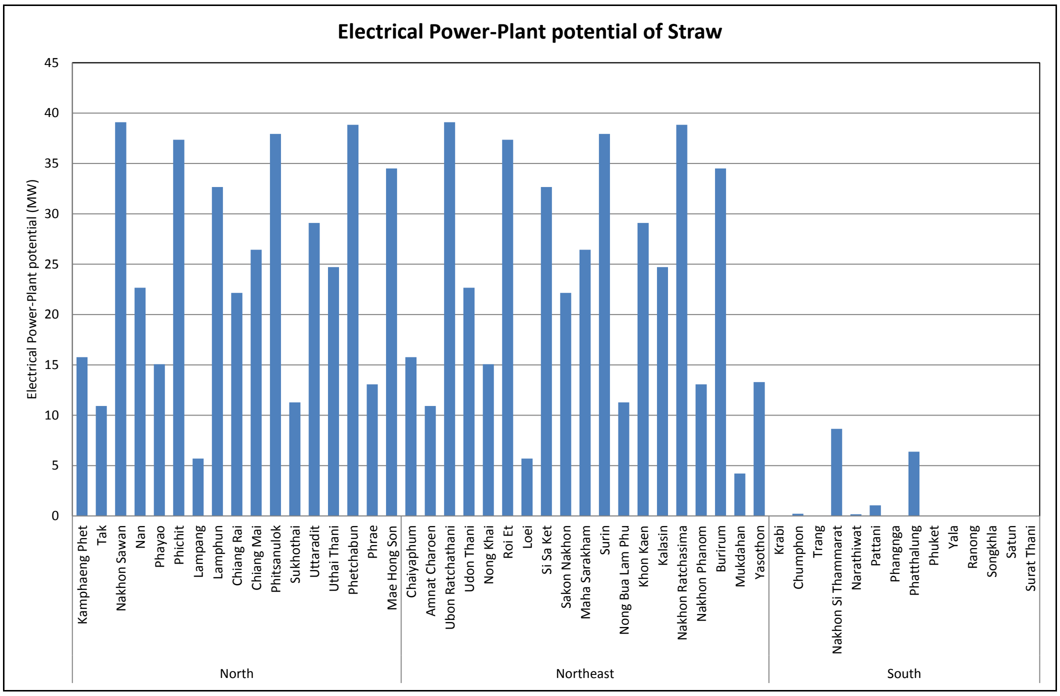

Figure 2 shows the electrical power-plant potential of the remaining rice straw in the each province.

6.2 Rice Husk

Rice Husk is the biomass at the rice mill, community rice mill and steamed rice mill. In crop year 2552/2553 in the three regions surveyed, the total amount of rice husk was 4,597,578.06 tons/year, equivalent to crude oil potential 1,475.77 ktoe/year, equivalent to electrical energy potential 3 ,453,291,965.83 kW-h/year, equivalent to the electrical power 411.11 MW (plant efficiency is 20% up 350 days/year), from the compilation of surveys and analysis of its use as fuel and other benefits, including;

(1.) Produce heat for the mill, approximately 15 percent of the volume equivalent to the amount of 689,636.71 tons/year

(2.) Produce thermal energy for use in brick, about 5.5 percent of the volume as the amount of 252,866.79 tons/year

(3.) Produce thermal energy for industrial use in cement, about 6.5 percent of the volume as the amount of 298,842.57 tons/year

(4.) Electric power generation and combined heat and power plant, about 35 percent of the volume. As the amount of 1,609,152.32 tons/year

(5.) Produce thermal energy for use in other industries, about 15 percent of the volume. As the amount of 689,636.71 tons.

(6.) Used in agriculture and livestock such as chicken farms, duck farms, about 6.5 percent of the volume. As the amount of 298,842.57 tons.

(7.) Proportional to the rice husk use, as mentioned above, the total amount of rice husk that has been used was 3,680,679.20 tons, representing 80.1 percent of the amount of the rice husk.

The remaining rice husks were 916,898.86 tons, representing 19.9 percent of the amount of rice husks , equivalent to 294.31 ktoe of crude oil or comparable energy, equivalent to 688,692,925.19 kW-h of electric power potential, equivalent to installed power 81.99 MW (plant efficiency is 20% up 350 days/year) in each province. With the remaining rice husk, potential energy is equivalent to Figure 4.

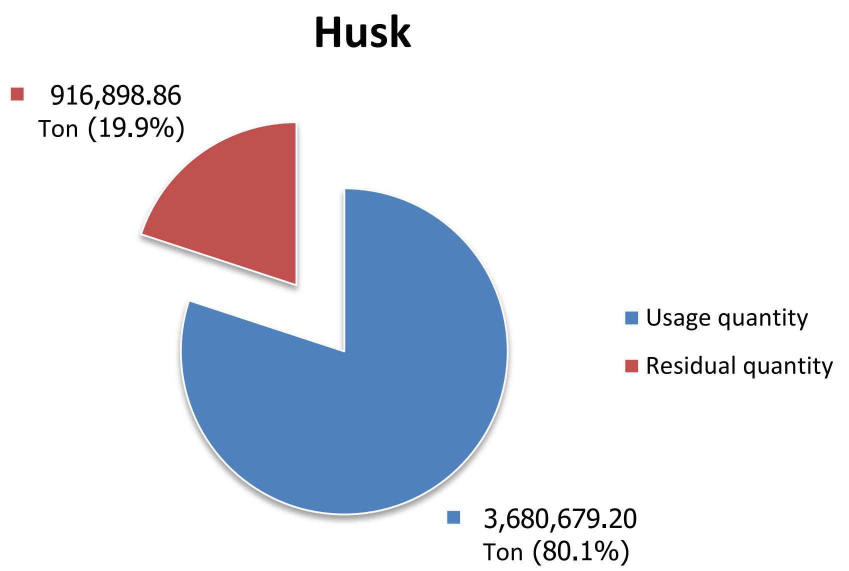

Figure 3 shows the amount of utilization and the remaining amount of rice husk

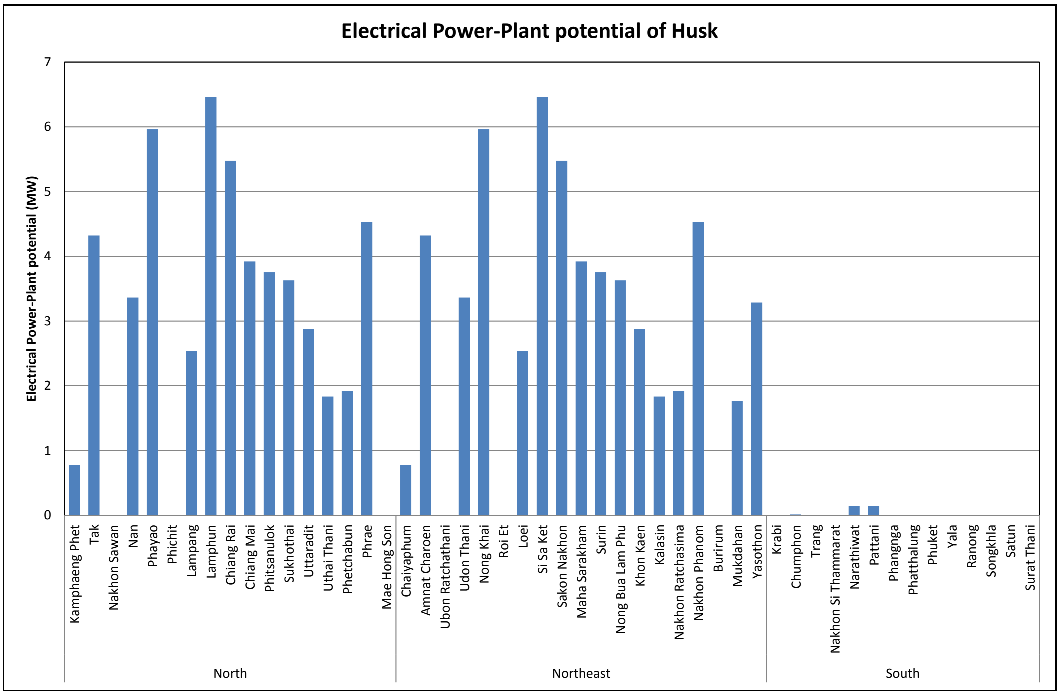

Figure 4 shows the electrical power-plant potential of the remaining rice husk in each province.

6.3 Sugar cane leaves and tops.

Leaves and tops of sugar cane biomass crop in the area of sugar cane harvested in the three regions of the surveyed data was 7,810,955.43 tons/year, equivalent to crude oil 2,870.69 ktoe/year or equivalent to electrical energy 6,717,421,669.80 kW-h/year, equivalent to the electrical power 799.69 MW (at 20% efficient power plant operation 350 days/year). From the compilation of surveys and analysis of its use as fuel and other benefits, the present average use is 10.4 per cent of the volume or to about 815,995.82 tons/year, so the balance of 6,994,959.61 tons/year, equivalent to crude oil potential 2,570.80 ktoe/year, equivalent to electrical energy 6,015,665,267.69 kW-h/year, equivalent to electrical power 716.15 MW (at 20% efficient power plant operation 350 days / year) in each province, with the remaining sugar cane leaves and tops potential energy is equivalent to Figure 6.

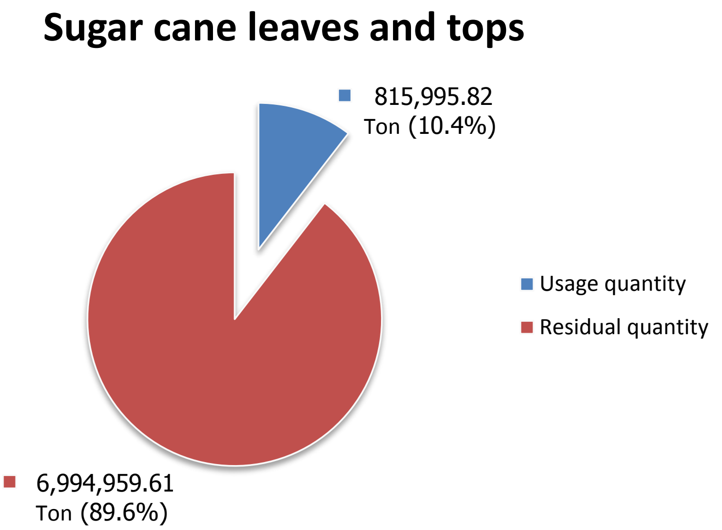

Figure 5 shows the amount, utilization and the amount of residual sugar cane leaves and tops.

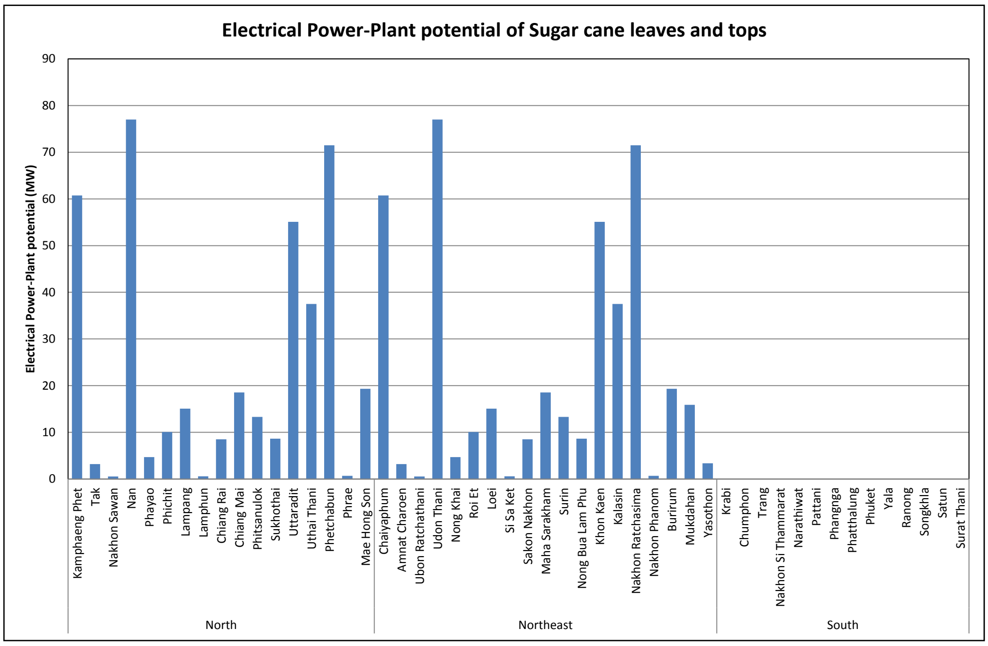

Figure 6 shows the electrical power-plant potential of the remaining sugar cane leaves and tops in each province.

6.4 Bagasse

Bagasse is the biomass of the sugar industry in three regions of the survey were made. 7,644,639 tons/year of crude oil equivalent potential 1,337.63 ktoe/year or equivalent to electrical energy 3,130,055,279.51 kW-h/year, equivalent to the electrical power 372.63 MW (at 20% efficient power plant operation 350 days / year), a compilation of surveys and analysis of its use as fuel and other benefits. The current is used in sugar mills to produce electricity and heat used in the plant itself, at nearly 99.9% of the volume. The remaining electricity is sold to PEA, therefore was few bagasse left.

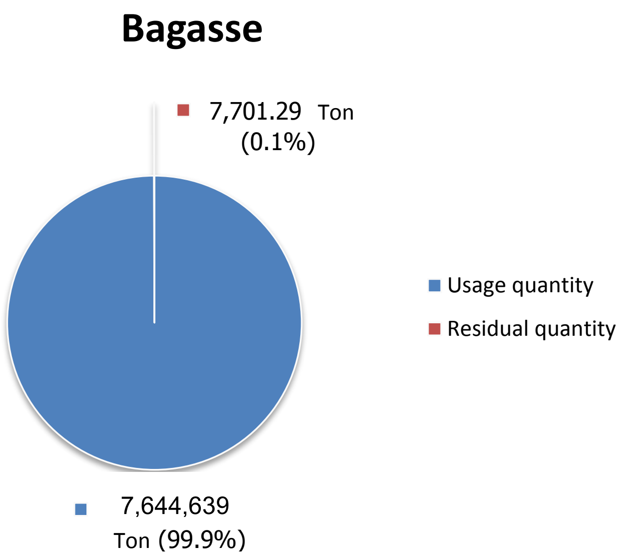

Figure 7 shows the amount, utilization of bagasse and the amount left.

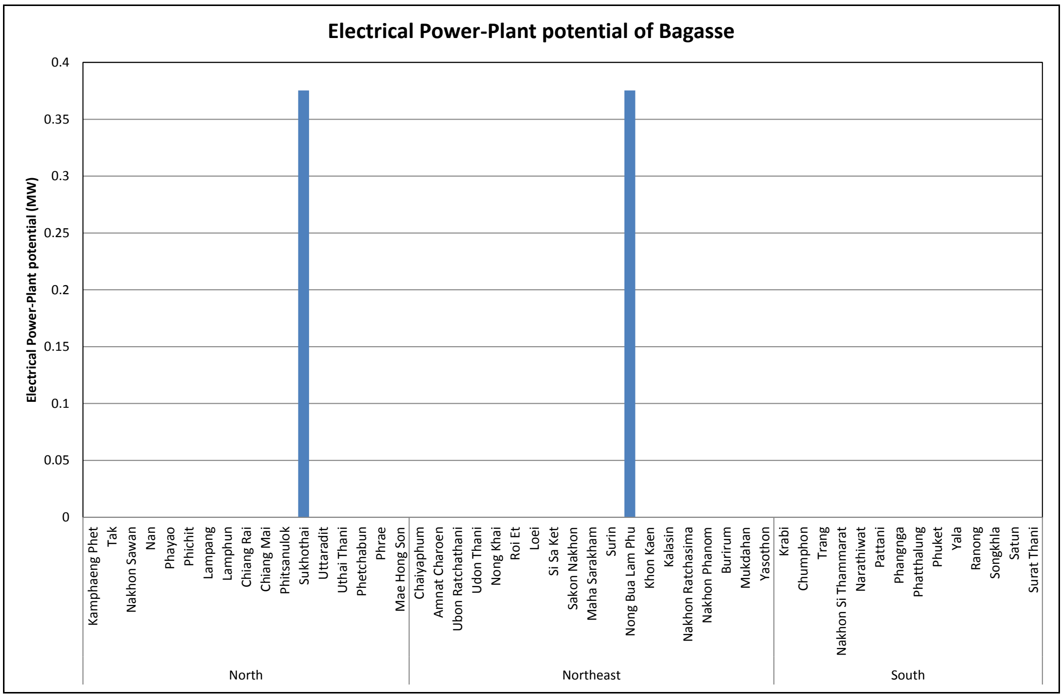

Figure 8 shows the electrical power-plant potential of the remaining bagasse in each province.

6.5 Leaves and stems of corn

Leaves and stems of corn are biomass in the area of corn harvest in three surveyed regions were 3,269,327.48 tons/year equivalent to crude oil potential 763.00 ktoe/year or equivalent to amount of electrical energy 1,785,416,062.69 kW-h/year, equivalent to electrical power of 212.55 MW (at 20% efficient power plant operation 350 days / year). A compilation of surveys and analysis of its use as fuel and other benefits founded that biomass has been used an average of 5 percent of total volume, used averagely 163,466.37 tons/year, thus remained 3,105,861.11 tons/year, equivalent to crude oil potential of 724.85 ktoe/year or equivalent to electrical energy 1,696,145,259.68 kW-h/year, equivalent to electrical power 201.92 MW (at 20% efficient power plant operation 350 days / year). In each province, the remaining sugar cane leaves and tops is equivalent to Figure 10.

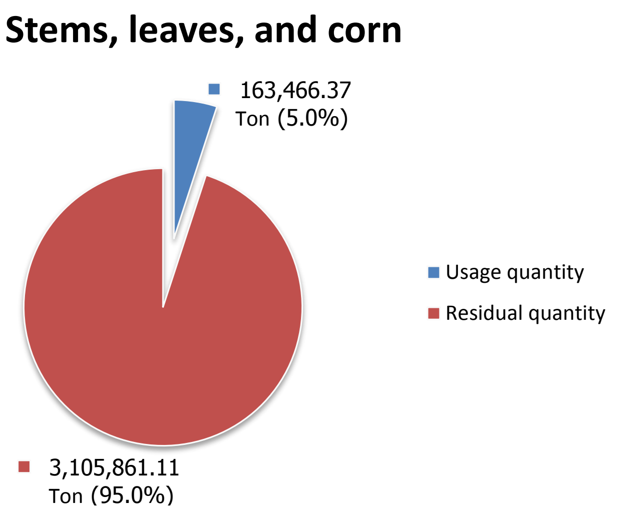

Figure 9 shows the amount of utilization and the amount of remaining leaves and stems of corn

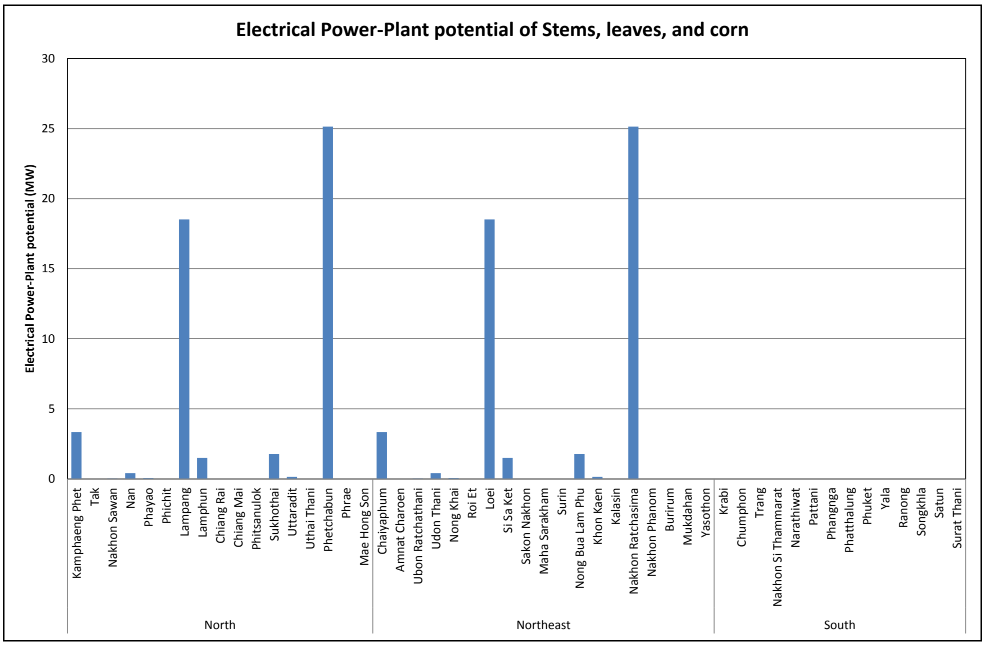

Figure 10 shows the electrical power-plant potential of the remaining leaves and stems of corn in each province.

6.6 Corn cobs

Corn cobs are biomass in the area of corn harvest, or corn silo. In three surveyed regions, the survey data of corn biomass was 956,876.34 tons/year, equivalent to crude oil equivalent 218.55 ktoe/year or equivalent to electrical energy of 511,397,243.93 kW-h/year, equivalent to electrical power of 60.88 MW (20% of the power plant running 350 days/year). A compilation of surveys and analysis of its use as fuel and other benefits founded that were 82.4 percent of total volume, average use was 788,822.04 tons/year, the average balance was 168,054.30 tons/year, equivalent to crude oil potential 38.38 ktoe/year or equivalent to electrical energy 89,815,689.10 kW-h/year, or an electrical power installed 10.69 MW (20% of the power plant running 350 days / year) in each province, with the remaining corn cobs. Potential energy is equivalent to Figure 12.

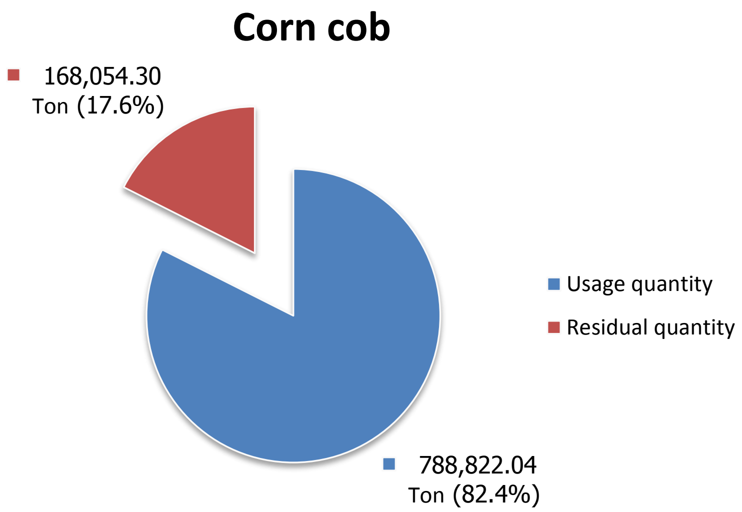

Figure 11 shows the amount of utilization and the amount of remaining of the corn cob.

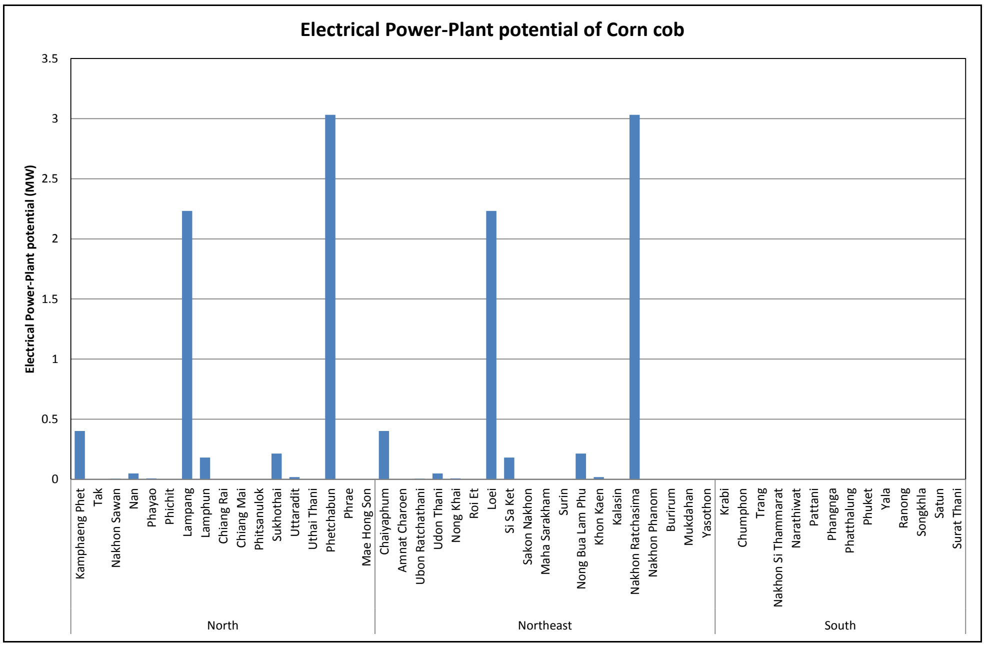

Figure 12 shows the electrical power-plant potential of corn cob in each province.

6.7 Cassava roots.

Cassava roots are biomass in the area of cassava harvest. In surveyed three regions, information showed that cassava roots were left as 4,171,526.33 tons/year, equivalent to crude oil potential 543.72 ktoe/year, or equivalent to amount of electricity. 1,272,315,530.65 kW-h/y or electric power installed approximately 151.47 MW (at 20% efficiency power plant operation 350 days / year), from the survey and analysis, cassava roots have not been used as fuel and other uses. In each province there are remaining cassava roots equivalent to the potential energy shown in Figure 14.

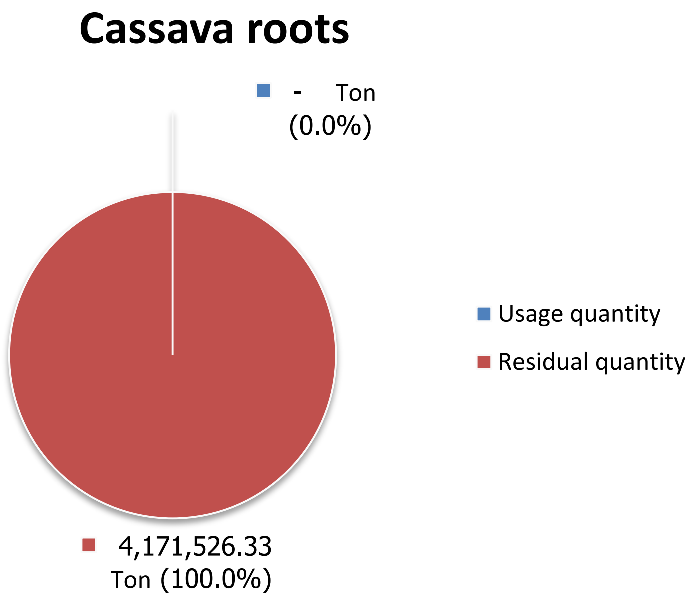

Figure 13 shows the amount of utilization and the amount of remaining of cassava roots.

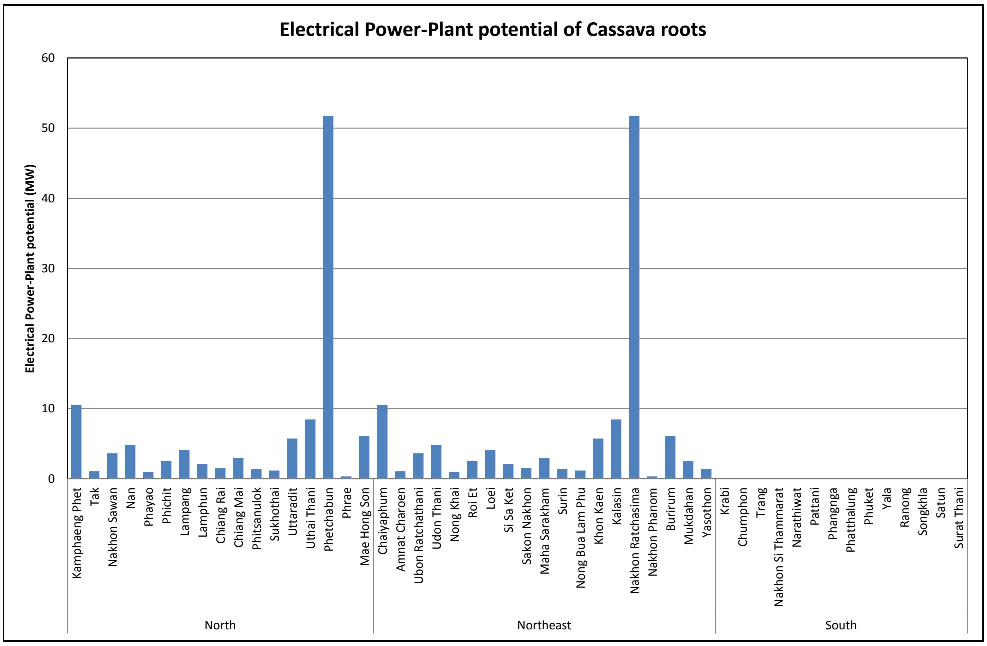

Figure 14 shows the electrical power-plant potential of the cassava roots remaining in the province.

6.8 Palm trunk

Palm trunk of the palm tree felled in the harvested area is biomass in the three regions, the volume were 1,441,884.50 tons/year, equivalent to crude oil potentials 258.12 ktoe/year or equivalent to electrical energy 603,989,396.11 kW-h/year, representing an installed electrical power of about 71.90 MW (at 20% efficient power plant operation 350 days / year), from the survey and analysis, palm trunks have not been used as fuel and other uses. In each province there are remaining palm trunk equivalent to the potential energy shown in Figure 16.

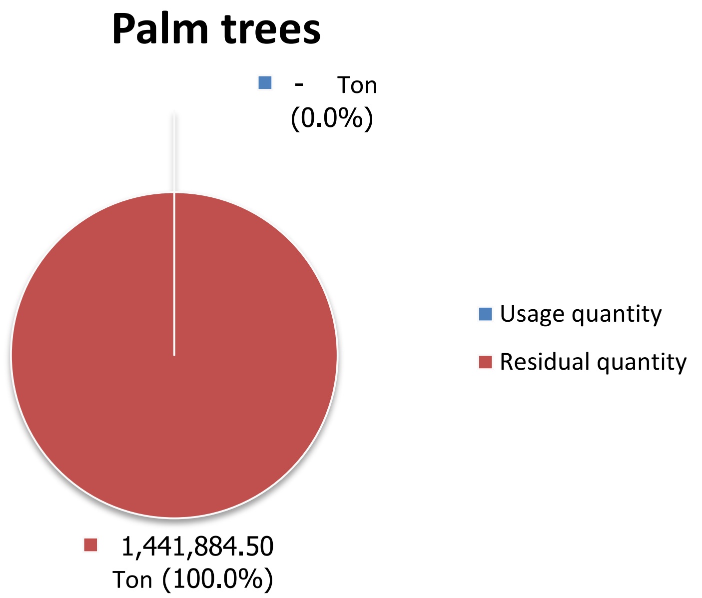

Figure 15 shows the amount of utilization and the amount of remaining of the trunk palm.

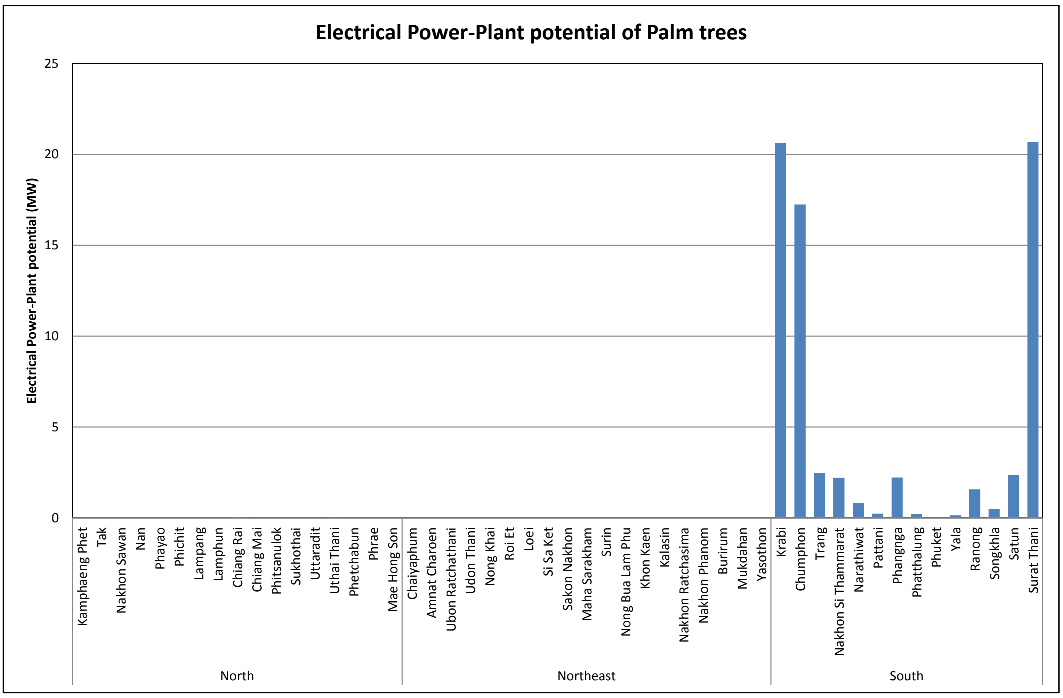

Figure 16 shows the electrical power-plant potential of palm trunk remaining in each province.

6.9. Palm leaves and branches

Palm leaves and branches are biomass from palm fruit harvested area. In three regions, the volume are 10,529,274.34 tons/year equivalent to crude oil potentials 439.97 ktoe/year or equivalent to electrical energy 1,029,529,046.58 kW-h / year, or an electrical power installed 122.56 MW (at 20% efficient power plant operation 350 days/year). From the survey and analysis, palm leaves have not been used as fuel or other uses, the average remaining balance was 326,451.31 tons. 10,202,823.03 tons/year of crude oil equivalent potentials 422.48 ktoe/year or equivalent to electrical energy 988,609,367.69 kW-h/year, or an electrical power installed 117.69 MW (at 20% efficient power plant operation 350 days/year) in each province, palm leaves and branches are equal to the potential of electrical power installed shown in Figure 18.

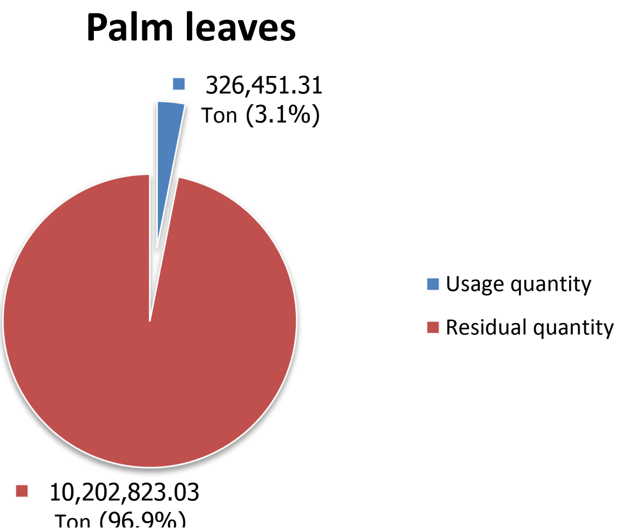

Figure 17 shows the amount of utilization and the amount of remaining of palm leaves and branches.

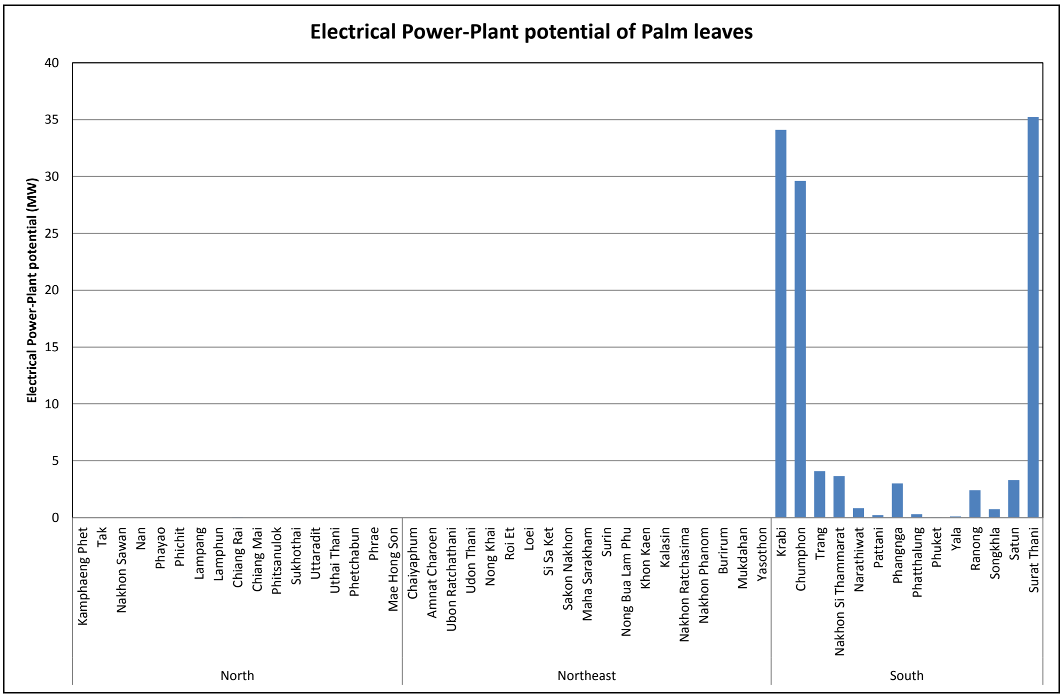

Figure 18 shows the electrical power-plant potential of palm leaves and branches in each provinces.

6.10 Palm empty bunch

Palm empty bunch is biomass from palm crude oil plant or crude palm patio in three regions, the volume occurs as 2,389,622.55 tons/year, equivalent to crude oil potentials 410.75 ktoe/year or equivalent to electrical energy 961,159,292.33 kW-h/year, representing an installed electrical power of approximately 114.42 MW (at 20% efficient power plant operation 350 days / year), palm empty bunch has been used 1,417,539.37 tons/year, so the average balance of 972,083.18 tons/year, equivalent to crude oil potentials 164.04 ktoe/year or equivalent to electrical energy 383,851,487.43 kW-h/year, or an electric power installation 45.70 MW (at 20% efficient power plant operation 350 days / year) This is equivalent to the potential energy shown in Figure 20.

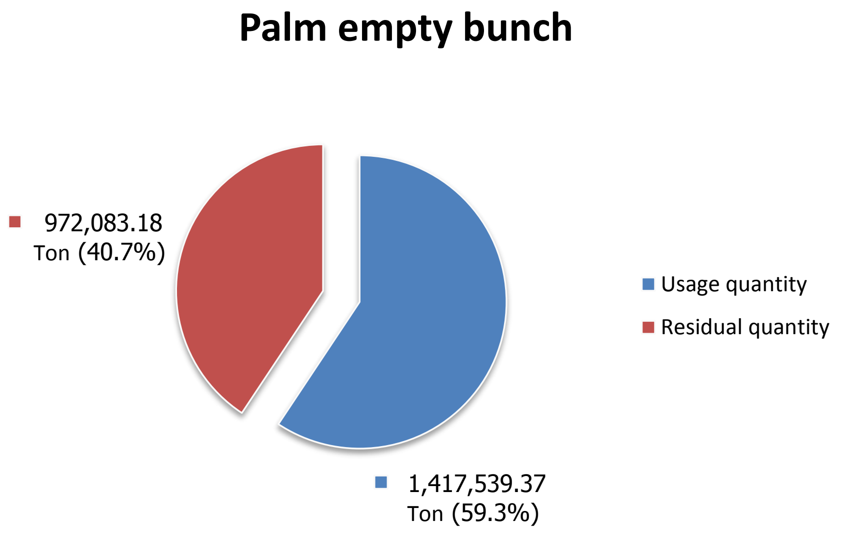

Figure 19 shows the amount of utilization and the amount of remaining of palm empty bunch

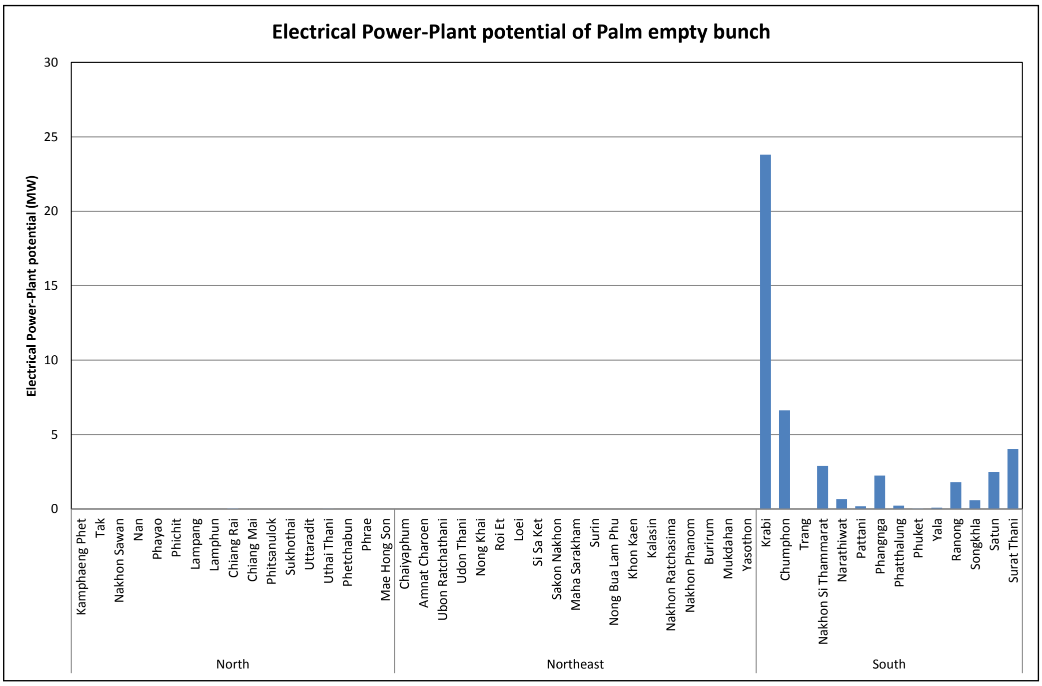

Figure 20 shows the electrical power-plant potential of palm empty bunch used in each province.

6.11 Palm fiber

Palm fiber is plant biomass resulting in the extraction of crude palm crude oil. In three regions, the volume occurs as of 1,418,838.39 tons/year of crude oil equivalent potentials 384.02 ktoe/year or equivalent electrical energy 898,597,647.00 kW-h/year, or an electrical power installed 106.98 MW (at 20% efficient power plant operation 350 days / year), the fiber is used in crude palm crude oil mill to produce electricity and heat for the plant to about 100% of the volume. Some of palm fiber are sold to power plants. The results of the survey showed that in each province there was no palm fiber left.

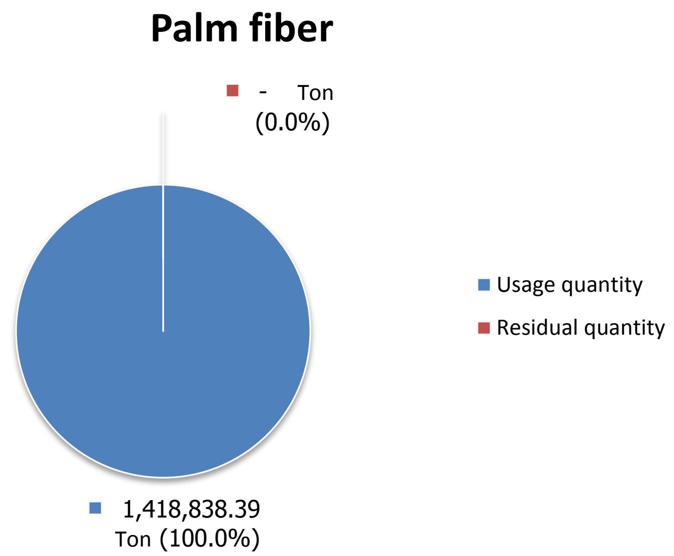

Figure 21 shows the amount of utilization and the amount of remaining of palm fiber.

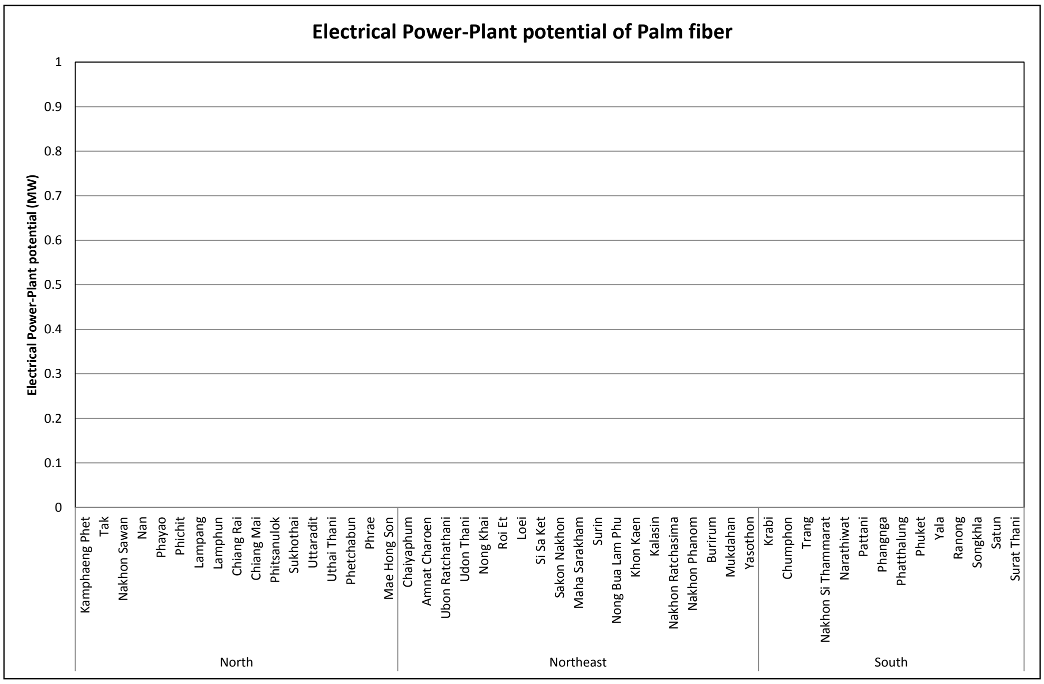

Figure 22 shows the electrical power-plant potential equivalent of the fiber palm with no balance in each province.

6.12 Palm shell

Palm shell is biomass from raw palm crude oil mill. In three regions surveyed, the amount was 298,702.82 tons/year of crude oil equivalent potentials 119.85 ktoe/year equivalent electrical energy. 280,448,758.78 kW-h / year, or an electrical power installation 33.39 MW (at 20% efficient power plant operation 350 days / year), which is used in crude palm crude oil mill to produce electricity and heat for industrial, average use is 5% of the volume. The rest sold to industry for use as fuel in crude oilers. The results gathered from the survey showed that the province does not have a palm shell left.

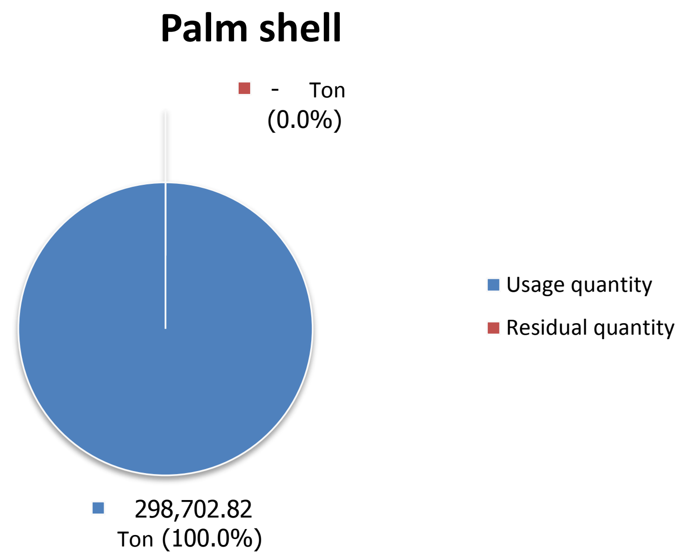

Figure 23 shows the amount of utilization and the amount of remaining of the palm shell

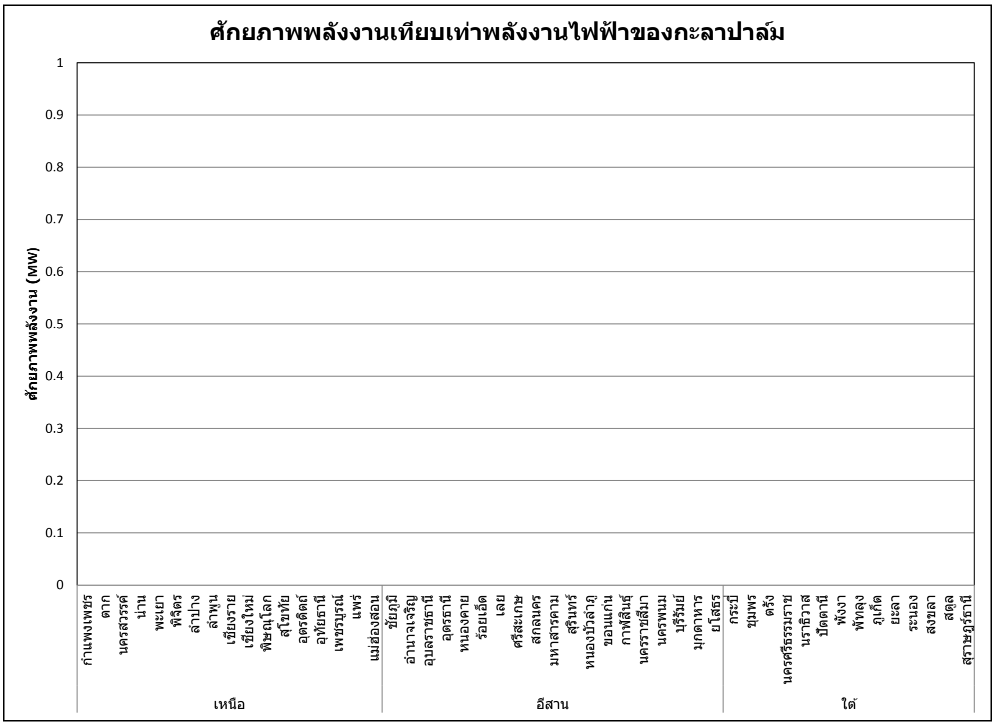

Figure 24 shows the electrical power-plant potential equivalent of palm shell at each province.

6.13 Root, stump and leaves rubber tree branches

Roots, stumps and leaves rubber tree branches from rubber trees are biomass. In the harvested area of the three regions surveyed, there were left as 808,025.00 tons/year, equivalent to crude oil potentials 126.04 ktoe/year of electrical energy, equivalent to approximately 294,929,125.00 kW-h/year, representing an installed electrical power of about 35.11 MW (at 20% efficient power plant operation 350 days/ year), which is used as fuel 8.7 percent of total volume 70,383.50 tons/year, equivalent to crude oil potential 10.98 ktoe / year, or the equivalent amount of electricity. 25,689,977.50 kW-h/year, representing an installed electrical power of about 3.06 MW (at 20% efficient power plant operation 350 days / year. Wood stumps and branches left were 737,641.50 tons/year, equivalent to crude oil potential averaged 115.06 ktoe/year, or the equivalent average electrical energy estimated 269,239,147.50 kW-h/year, representing an installed power of about 32.05 MW (at 20% efficient power plant operation 350 days/year), This is equivalent to the potential energy shown in Figure 26

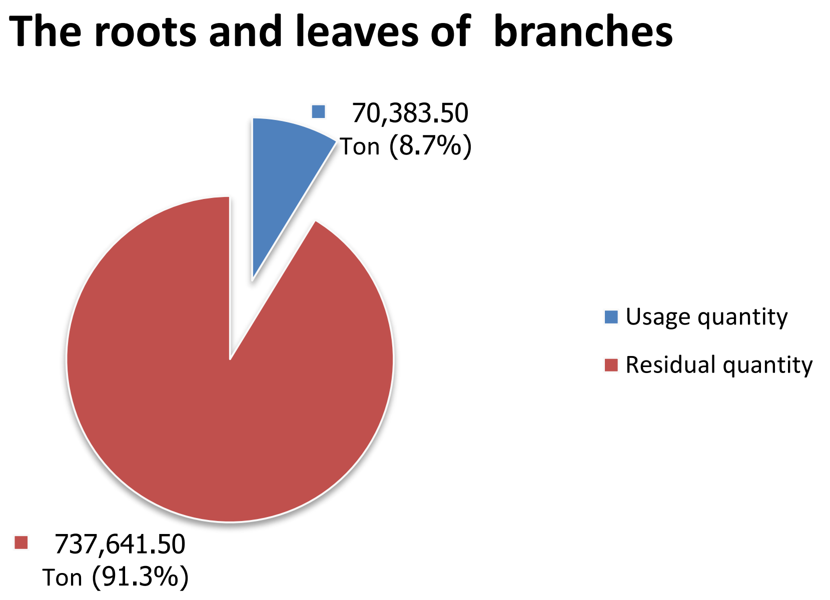

Figure 25 shows the amount of utilization and the amount of the remaining roots, and leaves rubber tree branches.

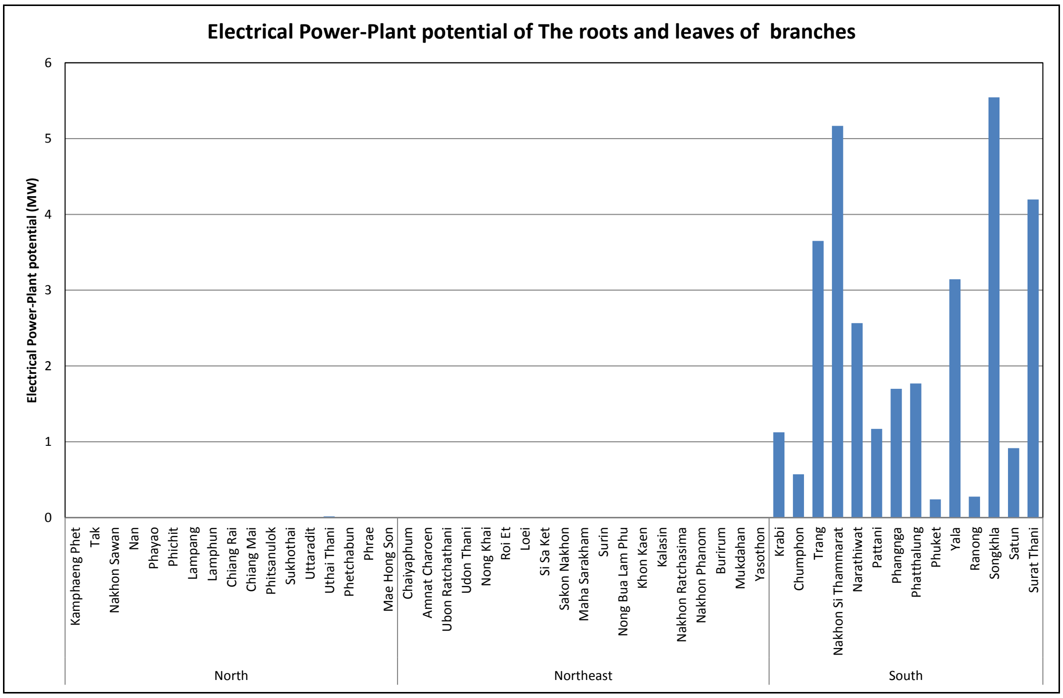

Figure 26 shows the electrical power-plant potential equivalent of roots, wood stumps and branches at each province.

6.14 Swarf rubber wood

Swarf rubber wood is biomass are in the harvested. In the area of the three surveyed regions, there were 1,939,260.00 tons/year of this biomass, equivalent to crude oil potentials 302.49 ktoe/year, or equivalent to the amount of electricity 707,829,900.00 kW-h/year, representing an installed power of about 84.27 MW (at 20% efficient power plant operation 350 days/year), Small rubber wood is used for fuel and other uses, including;

(1.) Thermal power plant in a timber for 25 percent of the volume. Volume was 484,815.00 tons/year.

(2.) Is used as raw material in the production of a piece of plywood (Particle Boards) and fiberboard production (Fiber Boards), about 50 percent of the volume. Volume was 969,630.00 tons/year.

(3.) Produce thermal energy for use in other industries, about 25 percent of that amount. The volume was 484,815.00 tons/year.

The sum of the amount of wood that has been used a total of 1,939,260.00 tons/year, equivalent to 100% of the volume of the wood. Therefore, there is not rubber tree wood chip left for further use as fuel.

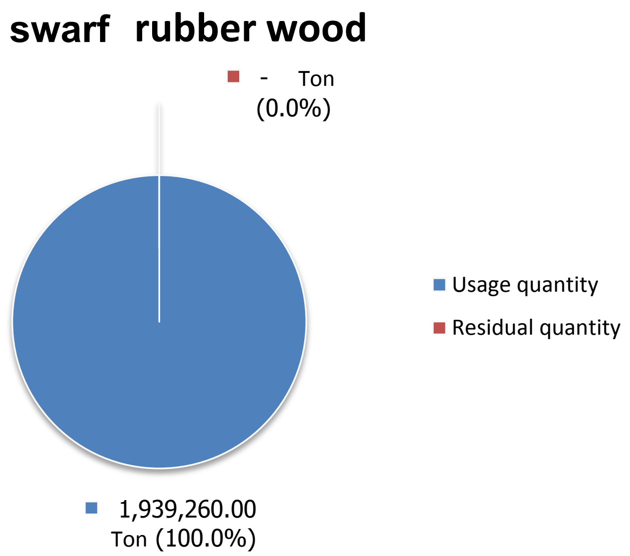

Figure 27 shows the amount of utilization and the amount of the remaining swarf rubber wood.

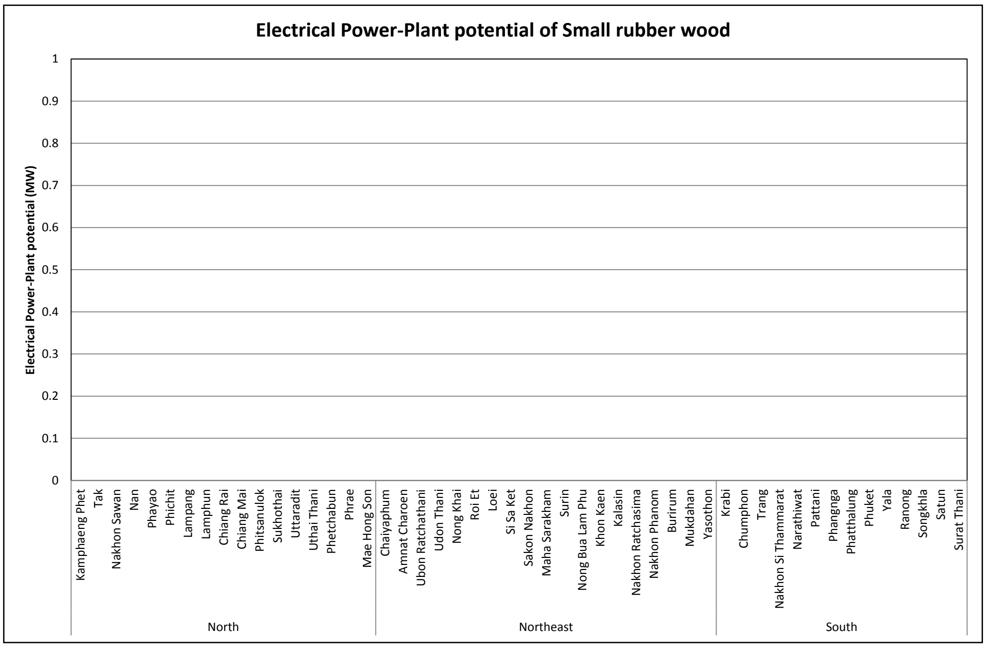

Figure 28 shows the electrical power-plant potential equivalent of swarf rubber wood with no balance in each province.

6.15 Slab rubber wood

Slab rubber wood is the biomass in the rubber wood processing industry in the surveyed three regions, the existing volume was 1,939,260.00 tons/year, equivalent to crude oil potentials 302.49 ktoe/year, or the equivalent to amount of electricity. 707,829,900.00 kW-h/year, representing an installed power of about 84.27 MW (at 20% efficient power plant operation 350 days / year), rubber wood slabs are used for fuel and other uses, including;

(1.) Produce thermal energy for use in wood processing plant to 39 percent of the volume. The volume was 756,311.40 tons / year.

(2.) Used as a raw material in the production of a piece of plywood (Particle Boards) and fiberboard production.(Fiber Boards) 50 percent of the volume. Volume was 969,630.00 tons / year.

(3.) Thermal power plant to the other 11 percent of the volume. The volume was 213,318.60 tons / year

The sum of the amount of wood that has been used was 1,939,260.00 tons, representing 100% of the volume of the wood. Therefore, there is not rubber wood slab left for other use.

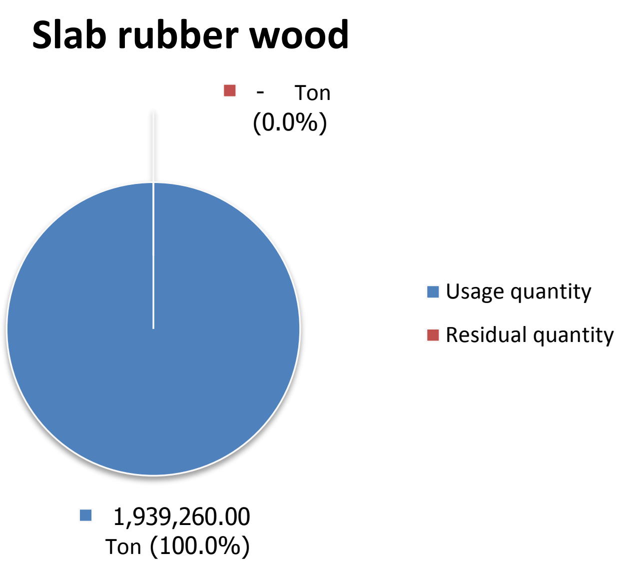

Figure 29 shows the amount of utilization and the remaining amount of slab rubber wood.

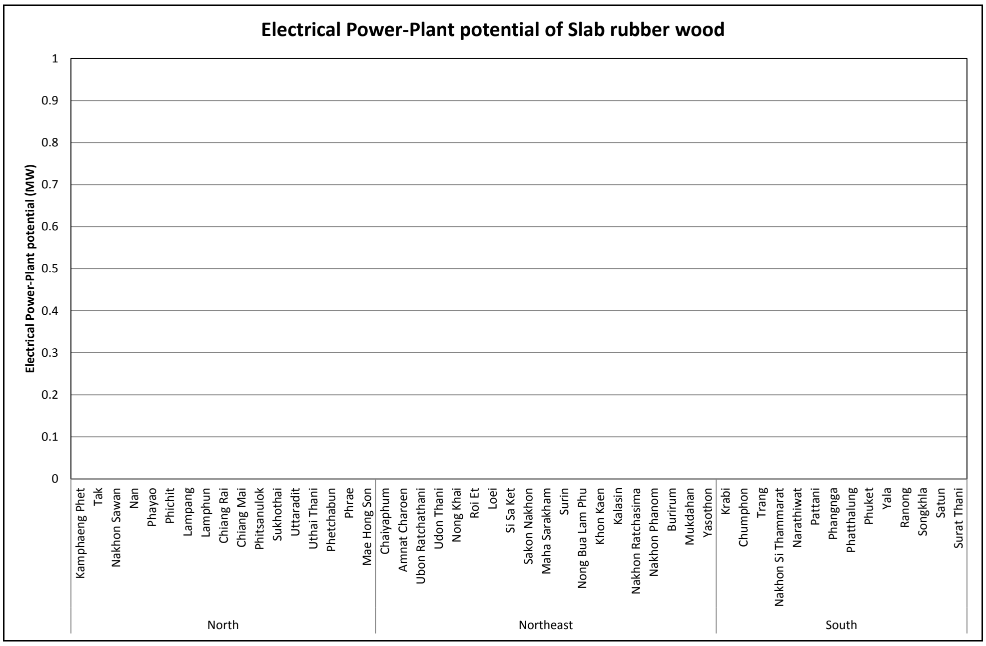

Figure 30 shows the electrical power-plant potential equivalent of the slab with no rubber left in the province.

6.16 Rubber Wood Chips and Sawdust.

Rubber Wood Chips and Sawdust are the biomass in the rubber wood processing industry in the three regions, the existing volume occurs 484,815.00 tons/year, equivalent to crude oil potential 75.62 ktoe/year, or equivalent to amount of electricity. 176,957,475.00 kW-h/year, representing an installed electrical power of about 21.07 MW (at 20% efficient power plant operation 350 days/year), which is used for fuel and other uses, including.

1. Thermal energy for use in processing plants for about 40 percent of the wood itself. Amount equal to the amount of 193,926.00 tons/year.

2. Produce thermal energy for use in other industries, about 60 percent of the volume. The volume was 290,889.00 tons/year.

The sum of the amount of saw dust and wood chips that have already been used are 484,815.00 tons /year, equivalent to 100% of the amount of total existing wood chips and saw dust. Therefore, there is no wood chip and saw dust left.

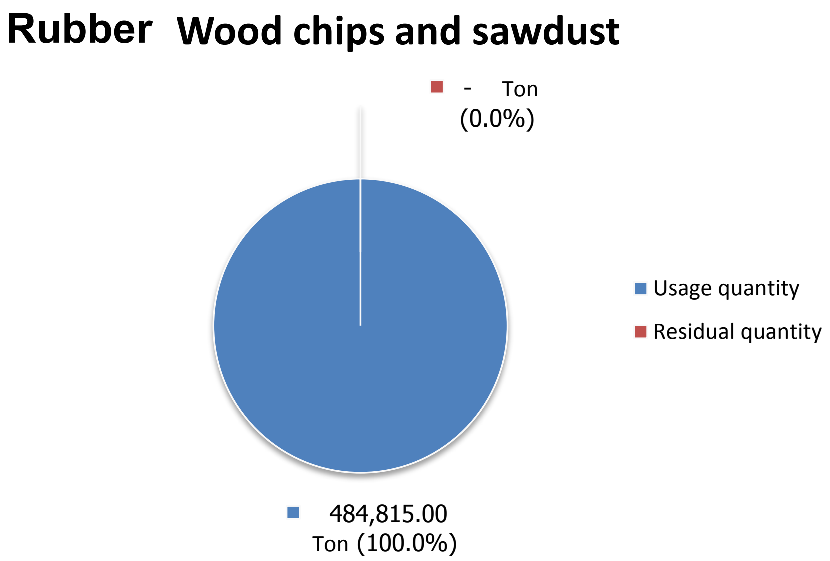

Figure 31 shows the amount of utilization and the remaining of rubber wood chips and sawdust.

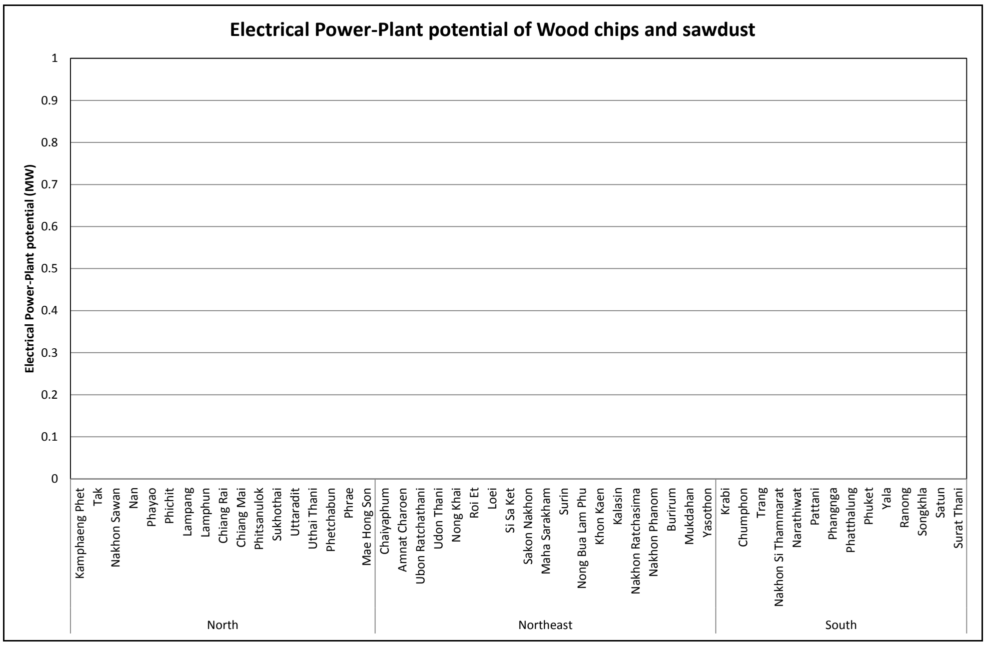

Figure 32 shows the electrical power-plant potential equivalent of rubber wood chips and sawdust that have remained in the province.

6.17 Soybean leaves and stems.

Leaves and stems of soybean biomass was harvested from soybean plant area. In the three regions surveyed. The amount of 205,600.03 tons/year equivalents to crude oil potential 79.22 ktoe/year, or equivalent to amount of electricity. 185,382,693.72 kW-h / year, representing an installed power of about 22.07 MW (at 20% efficient power plant operation 350 days/year), used as average balance 195,320.03 10,280.00 tons/year, equivalent to crude oil potential 75.26 ktoe/year, equivalent to electrical power 176,113,558.16 kW-h /year, or a power setup 20.97 MW (at the power plant, 20% up 350 days/year) in each province, with the leaves and stems of soybean remains a potential power as shown in Figure 34.

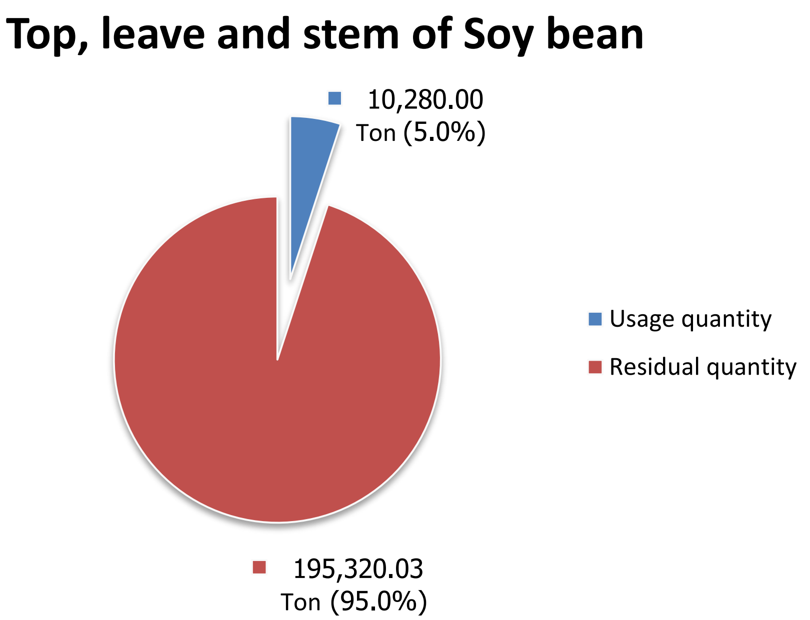

Figure 33 shows the amount of utilization and the amount of remaining leaves and stems of Soy beans.

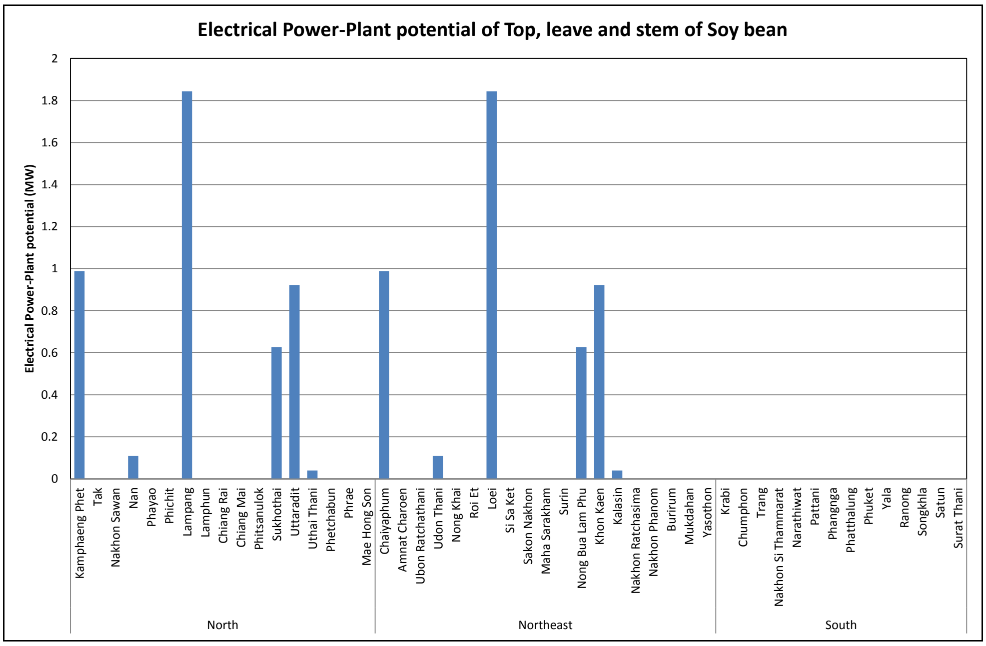

Figure 34 shows the electrical power-plant potential equivalent of leaves and stems of soybean stocks in each province.

6.18 Leaves and stems of mung beans.

Mung Bean leaves and stems are harvested biomass in mung bean plant area by the three regions surveyed, the existing amount was 110,838.59 tons/year, representing a potential 42.71 ktoe /year, equivalent to the electricity. 99,939,461.98 kW-h /year, representing an installed power of about 11.90 MW (at 20% efficient power plant operation 350 days/year).The average use was to 5,541.93 tons, the average balance of 105,296.66 tons/year, equivalent to crude oil potential 40.57 ktoe/year, equivalent to power 94,942,486.05 kW-h/year, or a power setup 11.30 MW (at the power plant, 20% up 350 days / year) in each province, with leaves and stems of mung beans, remaining a potential energy in Fig. 36th.

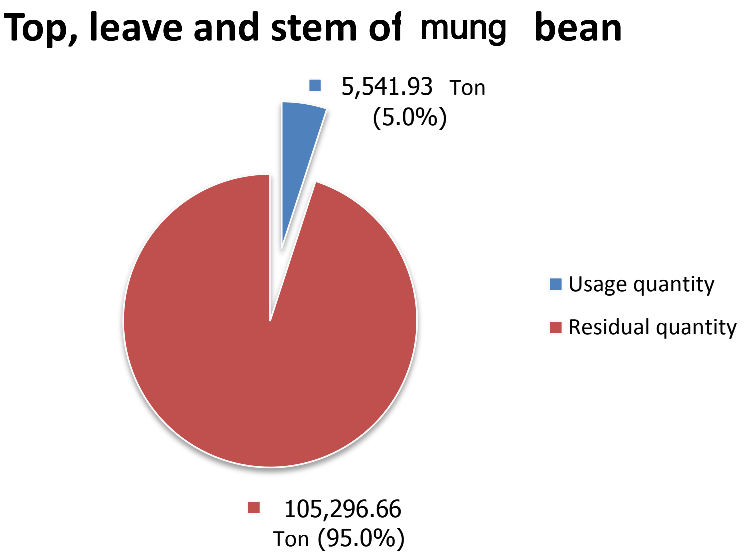

Figure 35 shows the amount of utilization and the amount of remaining leaves and stems of mung beans.

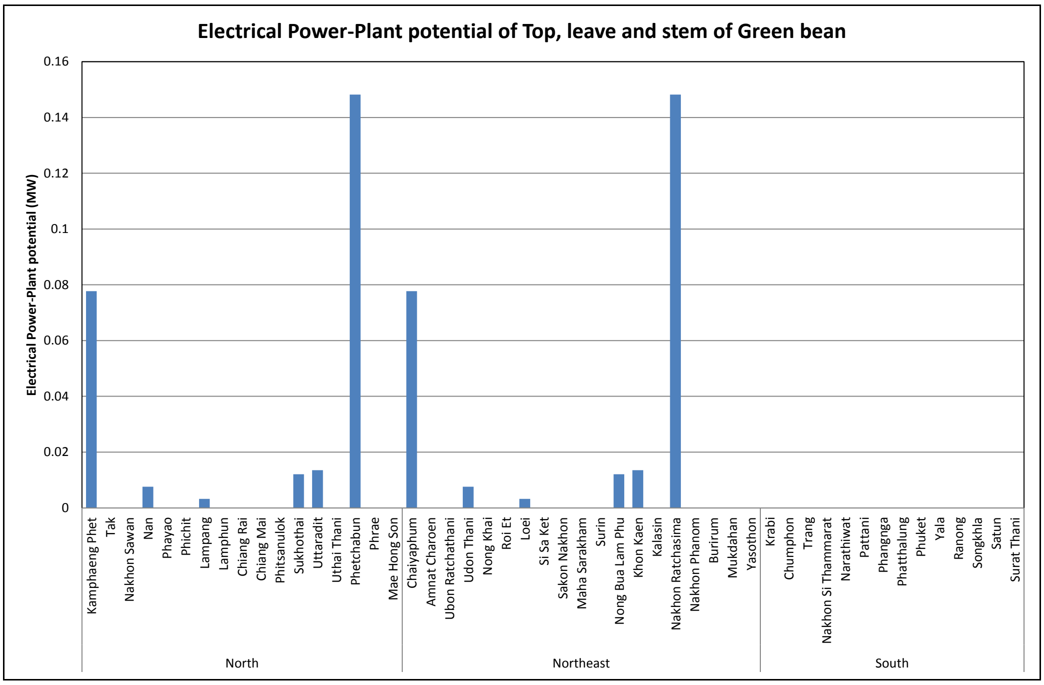

Figure 36 shows the electrical power-plant potential equivalent of leaves and stems of mung beans remaining in the province.

6.19 Leaves and stems of peanuts.

Leaves and stem of peanut is biomass from peanut harvest area in three regions in the survey, the amount of 48,074.41 tons/year equivalents to crude oil potential 18.52 ktoe/year, of electrical energy equivalent to approximately 43,347,093.02 kW-h/year, representing an installed power of about 5.16 MW (at 20% efficient power plant operation 350 days / year or an average of 2,403.72 tons per year to the average balance of 45,670.69 tons of crude oil equivalent per year, the potential 17.60 ktoe/year or equivalent electrical energy 41,179,737.05 kW-h / year, or an electrical power installed 4.90 MW (at 20% efficient power plant operation 350 days / year) in each province, with the remaining peanut leaves and stems. This is equivalent to the potential energy shown in Figure 38.

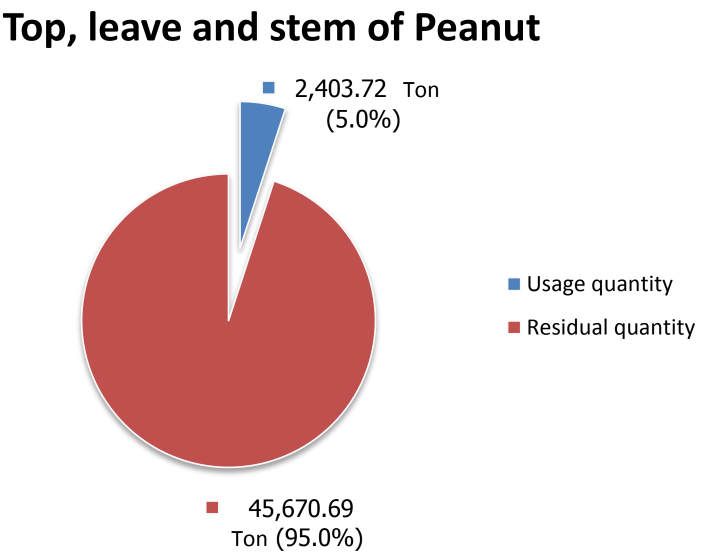

Figure 37 shows the amount of utilization and the amount of remaining leaves and stems of peanuts

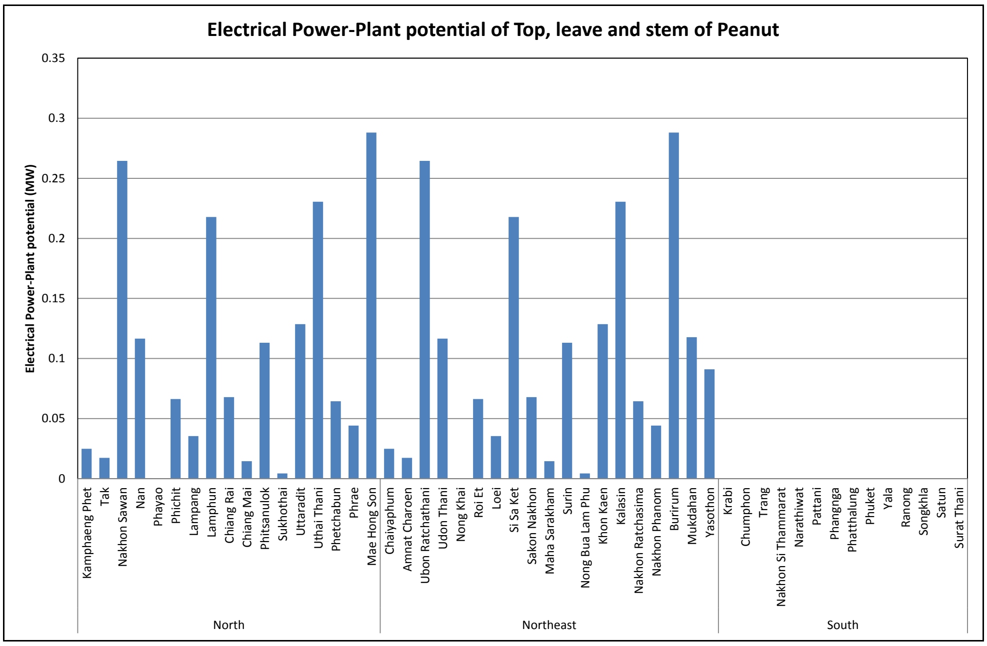

Figure 38 shows the electrical power-plant potential equivalent of leaves and stems of peanuts remaining in the province.

7. Conclusion of the potential of biomass types

A study on residual biomass. (The amount of biomass - biomass to be utilized), which has the potential to be used as fuel for energy production is summarized in Table.1

Table 1 summarizes the outstanding amount of each type of biomass used as fuel and as potential energy.

type of biomass	amount of biomass (ton/year)	biomass to be utilized (ton/year)	residual Potential (ton/year)	Moisture (%)	Low Heating Value (MJ/kg)	Crude oil Potential (ktoe)	Electrical energy potential (kW-h)	Electrical Power-plant potential (MW)
Rice Straw	10,727,682	1,086,774	9,640,908	10.00	12.33	2,822.23	6,604,021,992	786.19
Rice Husk	4,597,578	3,680,679	916,898	12.00	13.52	294.31	688,692,925	81.99
Cane leaves and tops	7,810,955	815,995	6,994,959	9.20	15.48	2,570.80	6,015,665,267	716.15
Bagasse	7,644,639	7,644,639.76	7,701.29	50.73	7.37	1.35	3,153,251	0.38
Leaves and stalks of corn	3,269,327	163,466	3,105,861	40.00	9.83	724.85	1,696,145,259	201.92
Corn cobs	956,876.34	788,822	168,054.30	42.00	9.62	38.38	89,815,689	10.69
Cassava roots	4,171,526	-	4,171,526	59.40	5.49	543.72	1,272,315,530	151.47
Palm trunk	1,441,884	-	1,441,884	48.40	7.54	255.76	598,471,791	71.25
Palm leaves and branches	10,529,274	326,451	10,202,823	78	1.76	422.48	988,609,367	117.69
Palm empty fruit bunch	2,389,622	1,417,539	972,083.18	58.6	7.24	164.04	383,851,487	45.70
Palm fiber	1,418,838	1,418,838	0	38.5	11.4	-	-	-
Palm shell	298,702.82	298,702	0	12	16.9	-	-	-
root, stump and rubber tree branches	808,025.00	70,383	737,641.50	55.00	6.57	115.06	269,239,147	32.05
branches rubber wood	1,939,260	1,939,260	0	55.00	6.57	0	0	0
Slab rubber wood	1,939,260	1,939,260	0	55.00	6.57	0	0	0
Rubber wood ship and sawdust	484,815	484,815	0	55.00	6.57	0	0	0
Leaves and stems of soybean	205,600	10,280	195,320	10.93	16.23	75.26	176,113,558	20.97
Leaves and stems of mung bean	110,838	5,541	105,296	10.93	16.23	40.57	94,942,486	11.30
Leaves and stems of peanut bean	48,074	2,403	45,670	10.93	16.23	17.60	41,179,737	4.90
Total Potential						8,083	18,922,217,491	2,252.65

8. Map showing the potential of biomass in Thailand.

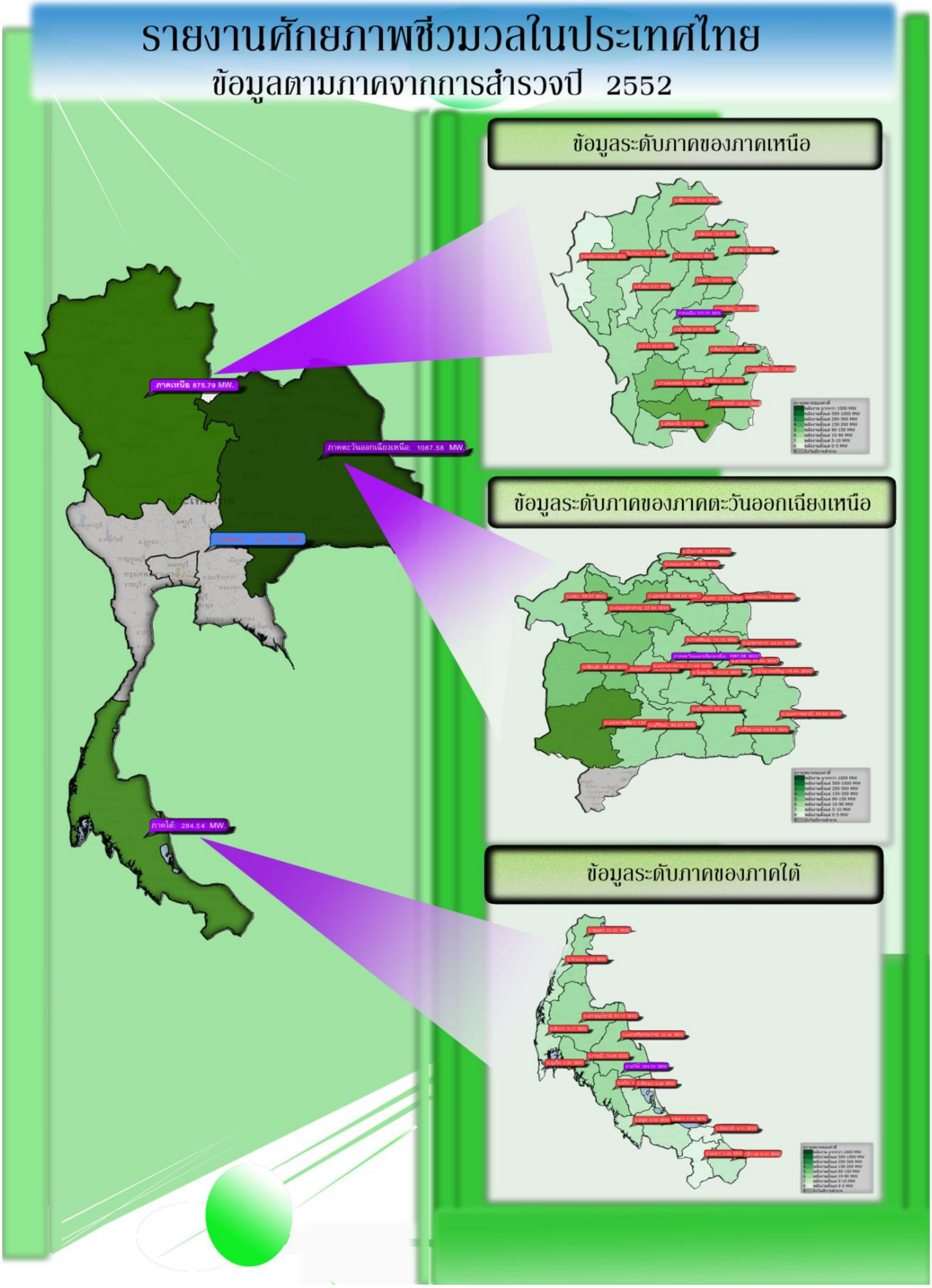

Figure 39 Map showing biomass potential in Thai regions in 2010 as shown in www.dede.go.th

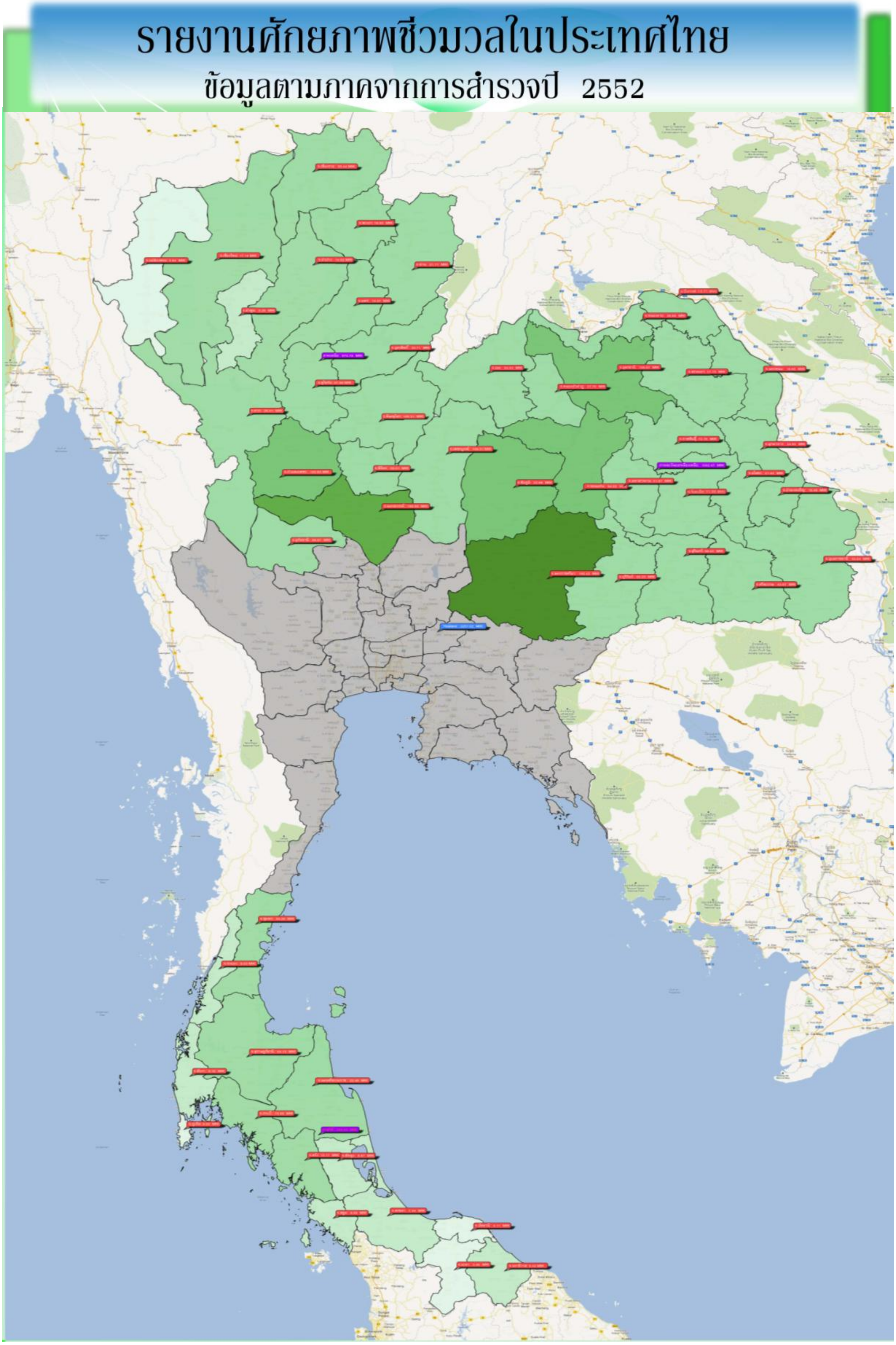

Figure 40 Map showing biomass potential in Thai province in 2010 as shown in www.dede.go.th

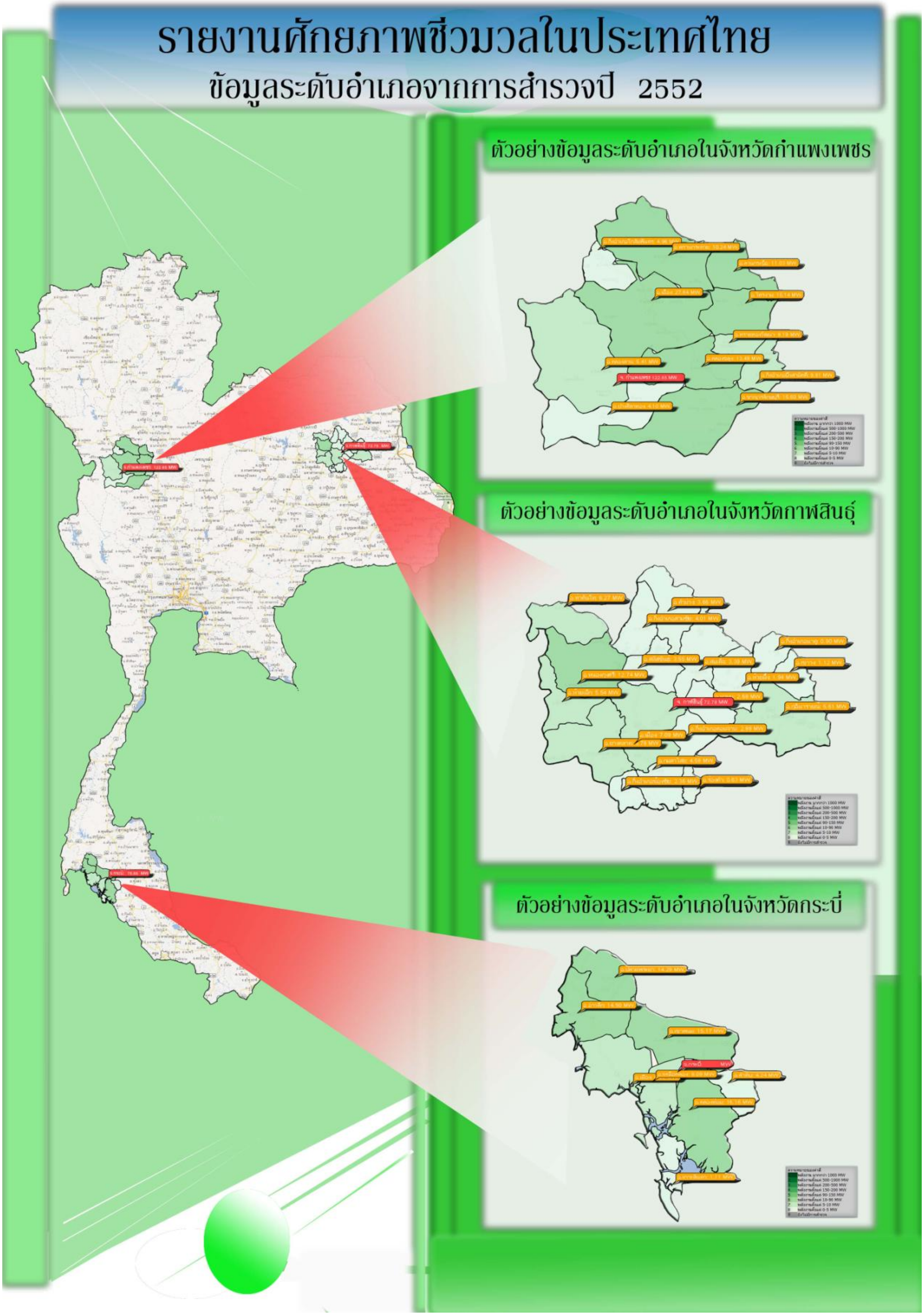

Figure 41 Map showing biomass potential in Thai districts in 2010 as shown in www.dede.go.th

9. Types of technology which can be used for biomass fuel.

The biomass used as fuel for power generation in the country has 3 forms.

(1.) Thermal power

(2.) Electric power

(3.) Produce both heat and electricity.

The process begins with the conversion of stored energy in biomass to heat and heat to further use. Major technology in energy conversion are 3 types;

1.Direct-Fired

2.Gassification

3.Pyrolysis

(1.) Direct combustion technology.

This system is used worldwide and is implemented widely in Thailand since it can be used with all types of biomass used as fuel. Currently, the technology is used more than 95 percent of the ignition system that is implemented in the country which can be divided as following;

1.Use man-power to feed the fuel

2.Stoker

3.Suspension

4.Cyclone

5.Fluidized Bed

1.Use man-power to feed the fuel

This system relies on skilled workers who will distribute fuel evenly on the iron stove which is made of cast sectioned iron. Air used for combustion is supplied from underneath the stove, the combustion efficiency of the furnace grate load of this system is relatively low.

2.Stoker

The system is implemented mostly in Thailand because the technology is being used widely. The system is stable and is suitable for all types of solid fuel biomass. The machine can be used to produce heat energy commonly used in steam bcrude oilers, heating furnaces and kilns. Burning perforation can be categorized by the following types of perforation as following;

1.Grate combustion system with fuel entered from the top (Overfeed Stoker) divided by the perforation into five types.

- Incline/Fixed Grate Stoker
- Traveling Grate Stoker

- Vibrating Grate Stoker
- Step Grate Stoker
- Spreader Grate Stoker

2. Grate combustion with fuel entered at the bottom (Underfeed Stoker.)

Fuel is fed into the furnace below. As a result, the fuel rail moves deeper into the oven at all times and the fuel pressure will occur in the lower part and the fuel will move upward. This way, the volatile compounds present in the fuel will move upward and will light easily and burns up completely. Fuel burning into ash which is at the top of the fuel will be pushed down into ash tray area. Combustion control system can be achieved by changing the stroke or The speed of the fuel pressure. The volume of air can be adjusted to fit the oven to heat the air inlet to the air entering the stove is burning fuel through the burner, channel or spout air (Tuyeres).

3. Combustion system with floating (Suspension).

Sometimes referred to as Pulverised system, the burning of fuel in the furnace occurs when fuel is suspended, so the fuel used in the kiln has to be small enough to be suspended in the air inside the oven. The air is heated before entering the oven first for drying fuel, the second part of the air will be sent directly into the ovens to help burn fuel completely. Ash from combustion is carried out of the furnace with heated gas from burning.

4 Cyclone

Fuel is fed into the furnace by gravity, similarly to Pulverised System. It does not need to grind the fuel to be small, thus it can reduce the cost to grind fuel. Combustion in the cyclone uses Horizontal water-cooled burner which is smaller than burner in Pulverised System on a per unit base. Volume of air will go into the furnace in the contacting line with the wall of combustion chamber, by this way fuel will move disorderly (Turbulence) in the combustion chamber, thus fuel will burn better. The temperature of the combustion system, in cyclone furnace is up to 1650 ° C, ash will be turned to liquid slag about 30 -50%, leftover ash of 70 -. 50% will be mixed and left with hot gas. liquid slag formed within the cyclone furnace system is released at the bottom of the furnace. Liquid slag left in cyclone can be let out by the lower part of burner.

5. Fluidized Bed

By this system, the air will flow through the fuel. And when increasing the speed of the air to a point, the fuel placed will float similarly to fluid. At the start of the stove, the bed will be heated from outside until the temperature reaches the ignition temperature of the fuel, then the fuel will enter continuously. Burning will occur generally around the stove, usually inert (Inert Material) such as sand or chemical reaction (Reaction Material), such as limestone (Limestone) or catalyst (Catalyst) will be added, which will assist in the heat transfer and clean the burner system.

Fluidized bed systems have been used mostly today. Because it can be used with any type of solid fuel since the oven temperature is always at a constant point, thus the burning rate of the fuel is regular. This system can burn fuels with very high moisture content also makes the constant temperature of the flame.

The advantage of this system is the added up of the inert material such as sand bed which will resulting in a better mixture of fuel and oxygen, fuel will burn easily and quickly. The bed will lock up the heat in the oven, make the heat stable and create a thorough combustion in the furnace. As a result, the temperature inside the kiln are equal and uniform. The fuel burn at a lower temperature (about 850 ° C), thus helps to solve the problem of air pollution. Since the compounds of nitrogen oxides (NOx) is a pneumatic system and less of mechanical systems (Mechanical System), it makes the control of the system easier. Fuel combustion in the furnace system will burn out within five seconds, which is less than the fuel used in the kiln, thus create a complete burn.

This type of oven is an important element of direct combustion technology. That is, technology or electricity, depending on the type of biomass used as fuel. For biomass with a relatively large pieces, Stoker Furnace system is more appropriate. While biomass fuel in small pieces or grains such as rice husks, sawdust, fluidized bed or cyclone is appropriate. Stoker can be used with a variety of fuel / size but responses relatively low to load change. Cyclone furnace systems respond to changes in system load better than Stoker system. Fluidized system is relatively new but flexible to changes in fuel quality and responses quickly to load changes.

(2.) Gassification

For the hot gas used in production or used to produce electricity and steam, today, the technology is called Gasifier. The reaction gas is called Gasification System, which gas is burned in the Gasifier by controlling air flow in limited amount, thus causing incomplete combustion which will resulting in carbon monoxide (CO), hydrogen (H2) as the core material and few methane (CH2) which can be heated directly or used as fuel for combustion engines. Power generation efficiency of the system is varied between 20 -30% depending on the technology, design and performance of the equipment used.

Gasification is suitable for small power plant not exceeding 1 MW, the disadvantage is that there will be tar mixed with gas causing this technology not widely used since there will be problems with crude oil cleaning in gas production. This system became unpopular for electricity production and development. If this system is to be used, it must find a way to eliminate or reduce tar. Appropriate biomass fuel, such as rice husk, wood chips and palm pulp must be in small size. Humidity should not exceed 50%. If too small, it will allow air to flow through it. If too large, it will not burn completely. Currently, Gasification is used to produce fuel gas for the internal combustion engine to produce electricity, using Downdraft Gasification to remove tar.

(3.) Pyrolysis

Pyrolysis system is used in modern technology to produce charcoal from wood, mangrove wood, etc., The production is still not an industrial scale but for household use only. Therefore, it is concluded that no technology of Pyrolysis system has been used for biomass energy in the country.

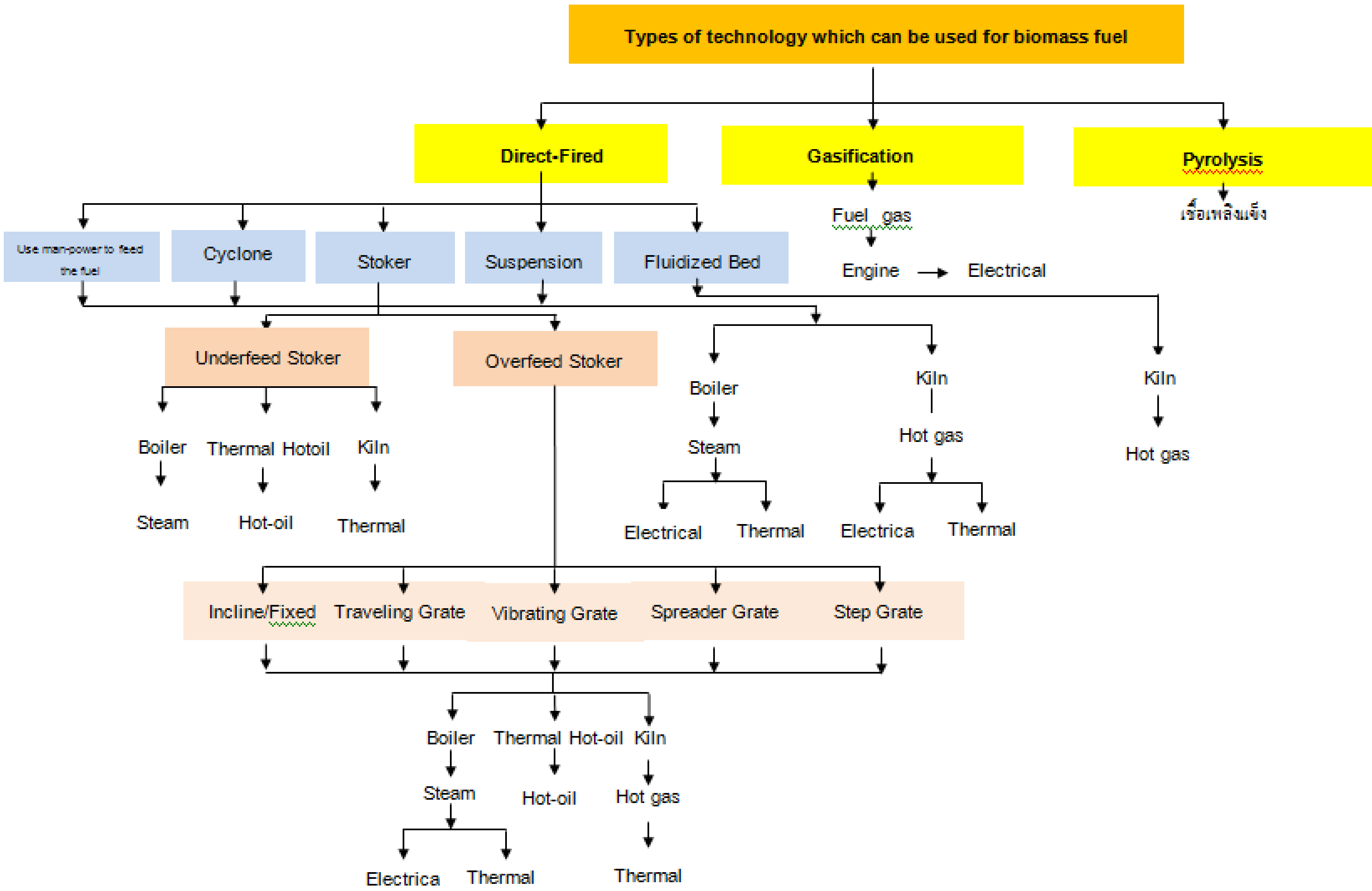

Figure 42 Diagram showing all technology can produce energy from biomass fuel

10. The promotion and regulate the use of biomass as fuel

It is already known that some current biomass is a fuel that is used as a commercial and trading as well as fuel crude oil or gas. While some types of biomass are left unused as fuel. Therefore, prior to determining the factors necessary to promote the production, collect and use each type of biomass for energy, the definition of biomass should be defined clearly before proceeding to determine the factors needed to promote adoption or appropriate supervision. So, in sum, this section will summarize the issues that need to manage biomass management.

- the definition of biomass.
- The type of biomass which needs controlling factors in the promotion.
- Types of biomass that must be controlled, regulated its use as energy.

10.1 The definition of biomass.

In order to determine the factors necessary to promote the production, collect and use each type of biomass to produce energy appropriately and be fair, the definition of biomass must be defined clearly for workers on biomass can use as guidelines

From the results of the study and analysis of biomass potential in Thailand. It is concluded that the available biomass in the country should be divided into five categories based on its nature

1. Biomass occurred after the harvest of crops each year, including stalks, rice straw, sugar cane, cassava leaves and shoots. Leaves and stalks of corn. Palm leaf and so on.
2. Biomass occurred after the processing of agricultural crops including bagasse, rice husk, corn cob, sawdust, slab palm fiber, palm etc.
3. Biomass of vegetation growing naturally such as trees along the highway or in deserted areas
4. Biomass resulting from trees plantation which will be used as raw materials in industry, such as Eucalyptus used as raw material for paper mills. And the remainder of it will be biomass.
5. Biomass resulting from trees plantation which will be used as fuel such as the giant acacia, giant rudder etc.

10.2 The factors necessary to promote the production, the collection and use of biomass for each type

The five types of biomass present in 10.1 is used as fuel differently, as follows.

1. . The amount of biomass each year and its consistency in the occurrence.
2. easy to assemble and transport.
3. Properties of the biomass, such as size, availability of use without pre-processing, moisture content, ash content and heating value. Impact on the environment.
4. suitable technology to be used.
5. community agreement of use

The results of a study on the exploration and analysis of potential biomass across the 50 provinces found that biomass is used widely popular. It needs all five factors to consider the use of biomass as appropriate fuel;

1. The amount of biomass in each year and its consistency in the occurrence.
2. easy to transport and convenient transportation.
3. The biomass comes in as an appropriate size and needs few pre-processing
4. Appropriate moisture content, ash content and heating value. Impact on the environment.
5. Technologies of the biomass used is suitable and is used widely, and no resistance from the community

10.3 Biomass to be used as fuel, and regulatory factors that should be directed.

Biomass are listed in Section 10.2, which is used as fuel for energy production, and are widely used;

1. Rice Husk.
2. Bagasse.
3. Cob corn.
4. Palm fiber.
5. Palm shell
6. Rubber wood swarf.
7. Rubber wood slab
8. Wood chips and Sawdust

Biomass and 8 species which are classified as Group 1 biomass are used and traded, as well as commercial fuels such as crude oil, gas and coal. It is used as fuel every year. And biomass of some species are insufficient that it needs to be imported from neighboring countries such as palm shell imported from Malaysia and Indonesia and wood from Burma. The purchase price will correspond to the demand as well as crude oil and coal. That is, if the demand is very high, the price will be high. And its price is related to crude oil and coal. That is, if crude oil prices are high, biomass prices would be high too. But there are differences in pricing, in areas where there are plenty of biomass, price will be lower due to less cost of transportation. There are 2 purchasing methods of buying biomass, one is the buyer and seller contact each other directly and the other is with sales representative, similarly to fuel and coal.

Information gathered from the survey mentioned above concludes that the eight kinds of biomass fuel is not necessary to have controlling factors necessary to promote the production, collected and used. It should be controlled in its use to be used appropriately, most effective and cause minimal impact.

10.4 Types of biomass should be encouraged to be used as fuel, and the factors that should be promoted.

The Biomass Group 2.

1. Rice Straw.
2. Cane leaves and tops.
3. Cassava roots.
4. Leaves and stalks of corn.
5. Stump and root of rubber wood branches.
6. Leaves and stems of soybean beans.
7. Leaves and stems of mung beans.
8. Leaves and stems of peanut beans.

The biomass is used as fuel in some types. From the study, it showed that this group has a very high potential but not used widely because;

1. Cannot be easily collected. Inconvenient transportation.
2. Scale is not appropriate to use. It needs too much pre-processing before they can be made into fuel which will costs expenses in the preparation.
3. some features are inappropriate such as high humidity or a lot of ash after burning.

factor in promoting the use of biomass as fuel in this group should proceed as follows;

1. It must be encouraged to study the feasibility and suitability of fuels used to produce electricity. For example, the Ministry has studied the possibility of introducing cassava rhizome is used as a fuel for electricity generation.
2. Government sector should invest in building biomass power plant that uses biomass as fuel in the two areas with high potential, to pave ways for investors who need to invest in electricity production.
3. Supports investors who wish to invest in biomass power plant , the supports must be both technical and financial in order to attract more investment to build power plants in areas such as adding money of Power Purchase (Adder).
4. Encourage studies and research related to the harvest, collection and processing such as briquette technique, convenient and cost effective transportation of fuels
5. Promote the study and research in the preparation of each type of biomass to be ready to use in the combustion chamber of the bcrude oiler proper and to be cost effective.
6. Encourage studies and research related to technology adoption which does not cause pollution or less pollution in order to reduce environmental problems and resistance from the community. By selecting the appropriate technology and the best implementation technologies such as combustion systems floating perforation (Suspension).
7. Further support for the research process to add value to fuel such as processed charcoal briquette. Properties of the fuel must be studied, so it can be used as fuel in industrial plants or power plants efficiently.
8. Promote and encourage the study of how to use ash from the combustion of biomass utilization, or find out how to properly dispose of ash.

In the last group of biomass.

1. Palm trunk
2. Palm leaves

This type of biomass is used less as fuel for energy production since there are several features that are not appropriate, such as high humidity and heat. Preparation of this type before entering the combustion chamber is difficult. However, the amount of this biomass available each year is always large and should be considered to be used as fuel. The factors necessary to promote the production, collected and used are as the following;

1. Encourage to study the feasibility and suitability of fuels used to produce electricity.
2. Promote the study and research how to prepare each type of biomass to be ready to enter the combustion chamber of the bcrude oiler proper and to be cost effective.
3. Encourage studies and research related to technology adoption as a fuel which cause less pollution to reduce environmental problems and resistance from the community. By selecting the appropriate technology and the best implementation technologies such as combustion systems floating perforation (Suspension).
4. Further support for the research process to add value as a fuel such as processed charcoal briquette. Properties of the fuel must be studied, so it can be used as fuel in industrial plants or power plants efficiently.
5. Promote and encourage the study of how to use ash from the combustion of biomass utilization, or find out how to properly dispose it
6. Government sector should invest in building biomass power plant that uses biomass as fuel in the two areas with high potential, to pave ways for investors who need to invest in electricity production.
7. Supports investors who wish to invest in biomass power plant , the supports must be both technical and financial in order to attract more investment to build power plants in areas such as adding money of Power Purchase (Adder).