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Article

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Energy Risk Management and Cost of Economic Production Biodiesel Project

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ABSTRACT

Although electricity in Thailand is still sufficient to provide services, but there may be a risk in future from relying solely only on oil energy. Therefore, alternative energy is a good way to distribute fuel. The growth rate of community brings higher levels of imported energy from foreign countries including expansion of large projects resulting in opening of exploration and production rights for petroleum to increase energy security and reduce domestic risks. This research aims study of economic production cost analysis for community biodiesel production from remained kitchen oil case of community management. The collecting information is on price and use of raw materials for biodiesel production to calculate. According to studies, it has been found that total variable cost of biodiesel production process for 1st time is equal to 33.42 baht/L comparing to 2nd time on total variable cost only 23.62 baht/L. Most of variable cost for 2nd time is used kitchen oil representing 51% of total cost price. This research analyzed production potential for the use of biodiesel B100 reflecting on reduction of diesel used in community's agricultural machine. It was found that community has potential to produce biodiesel for their own use causing savings within community around 134,220 baht per year if community produce 1,500 L. If the government encourages community members to understand and produce biodiesel for themselves, it will be able to reduce oil imports many million baht and overall positive impact on economic, social and environmental sectors of Thailand.

Keywords: Community Management, Cost Analysis, Economic Production, Energy Risk
JEL Classifications: Q55, D20

1. INTRODUCTION

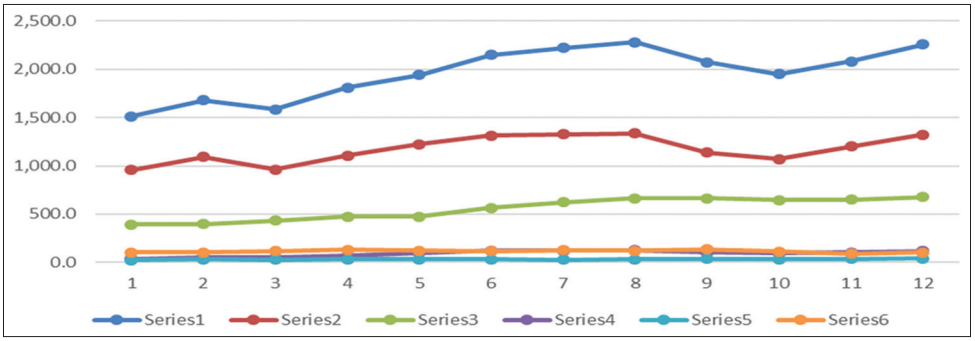
At present, the demand for energy around the world is increasing and mostly impact to the economic growth because of the degree of industrialization; moreover, the energy is one of the factors of input resources manipulated the expansion in manufacturing sector (Hong et al., 2019). Thailand uses electrical energy in both public sector and private sector served to illuminate the whole country shown in Figure 1.

Most of the industrial sector use electricity to drive machines including lighting. Furthermore, Government sector uses electric power in the foundation of various utilities supplied for society. So, the importance of electric energy has the beneficial effects and is an important foundation in basic development of Thailand. Day by day, the reserves of energy in Thailand will continue to decrease; oil prices have risen considerably. The fact also shows that the country's energy demand is high in both the transportation and industrial sectors. The highest power demand from 2016 to 2017 on average 182,620 and 185,065.60 GWh respectively (Energy Policy and Planning Office Ministry of Energy, 2018) shown in Figure 2.

To meet the energy needs and to provide sufficient energy sources cause Thailand relying on imports shown in Figure 3.

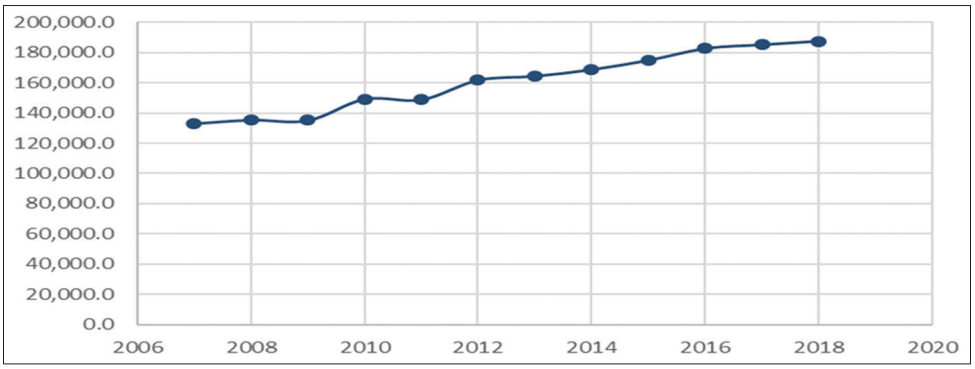
Moreover, to provide the sufficient energy sources, Thailand has to develop the renewable energy which it has potential in order to replace the fuel that is running out and to reduce dependence

Figure 1: Yearly final energy consumption value (Billion Baht) 2007-2018



Source: Department of Business Energy, 2018. (Series 1-6: Petroleum, Electricity, Natural Gas, Coal/Lignite and Renewable Energy)

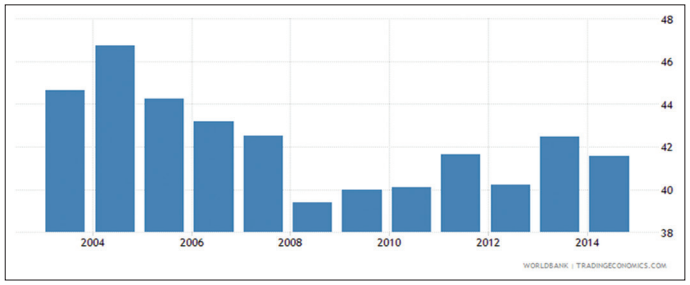
Figure 2: Yearly electricity consumption (GWh) 2007-2018



Source: Department of Business Energy, 2018

on foreign energy. Therefore, Thailand should find the alternative sources of crude oil and should increase the choices on variety of energy in the same time. In various countries around the world, including the United States, England, Belgium, Sweden, France, Australia or even Germany, renewable energy such as biodiesel has been used for quite a long time. (Energy Policy and Planning Office, 2017). In Thailand, the demand for cars has a higher percentage almost every year. Each car requires oil to drive, but oil resources in Thailand are not enough to meet the unlimited needs of the whole country. The imported proportion can be considered as a very high percentage. (Energy Policy and Planning Office, Ministry of Energy, 2017). Therefore, when considering the National Agenda Policy on using renewable energy, the government has tried to support the production and encourage people used the renewable energy in their communities. As it can be seen the development effort from stimulating to use the biofuels and biomass in all levels such as household, community, village and up to country. Besides the government has tried to make the public transportation sector using the natural gas systems; also, more further researches on the renewable energy in many forms. However, the acceptable clean alternative energy that has been used to replace oil in various countries around the world is "biodiesel." The rate of using biodiesel in the world is increasing, respectively every year. In the near future, the volume will be adjusted to almost half of the combined production and usage rates. Thailand, "biodiesel" will be used in two formulas: biodiesel B5, used with cars and biodiesel B100 or commonly called "Biodiesel Community." The biodiesel now a day is being considered as a very environmentally friendly energy resource compared to diesel.

Figure 3: Thailand–energy imports, net (% of energy use)



Source: Trading Economics, 2018

From agricultural waste materials, His Majesty King Rama IX Thailand Kingdom has initiated and experimented producing oil from plants or animal fat to produce the fuel for the car used. In order to be used in the future and to replace the import of oil from a large number in each year, the alternative energy is mentioned to replace the fuel energy such as biodiesel which it comes in the form of agricultural fuel (Jermsittiparsert, et al., 2019). To bring agricultural products or household waste into raw materials for energy production, it absolutely can support on reducing normal fuel and in the same time of contributing community economy to grow which it makes the more income and help reducing environmental problems (Tangjitprom and Romprasert, 2019; Mwanja, et al., 2018). The development of renewable energy in Thailand is increasing continuously. As a result of the renewable energy promotion policy produce, thermal power and biofuel will be selected in the form of substitute power. In 2014, Thailand consumed almost 10,000 tons of renewable energy equivalent

to crude oil increasing by more than 9% from the year 2013, or more than 10% of total final energy used (Energy Efficiency Plan: EEP 2015).

The use of biodiesel has increased significantly starting in 2011 when the Ministry of Energy added proportion of mixed biodiesel in diesel oil at the ratio of 5% and has increased the proportion of bio-mix diesel is not <7%. Renewable energy development is part of determining the overall energy policy that needs to be integrated with other energy plans. In order to be consistent in the preparation of the plan, AEDP2015 adopted the final energy demand forecast (Energy Efficiency Plan: EEP 2015). Therefore, the development of alternative energy from residual resources within the community such as rice straw can create an energy source called "fuel" for development into renewable energy for the community created the choice as a self-reliant sustainability. This approach is also creating energy security for Thailand in the long run. According to these information, the paper's objective is to study the use of renewable energy in community for solving the risk of fuel lacking in sense of cost analysis.

2. LITERATURE REVIEW

Energy is everywhere on this planet; it makes people being comfortable. The factory is able to operate the machine to produce products from electric power, but the alternative of sources can come from other energy such as oil, natural gas, coal and biodiesel. Particular the biodiesel which it is considered to be the modern in the group of alternative energy today because biodiesel can be used to replace diesel fuel. National Agenda in terms of policy, especially the renewable energy, has been supported by the government. Linking to build the national energy security for the reduction of environmental conditions or even providing benefits to farmers can meet the royal initiative in His Majesty King Rama IX. The plants that can be used in the production of biodiesel in Thailand being the palm oil, *jatropha*, sunflower seeds, castor, but oil palm is considered as an excellent main plant that can be used as raw material for biodiesel production. For community, the plant along the fence, such as *jatropha*, plays a secondary role be extracted as oil instead of diesel fuel in agricultural machinery. Besides, the community can use the remained oil from cooking in order to produce it as asternal, which it is considered be very close to diesel and community can use it to replace diesel oil. Therefore, it is known as "biodiesel" because people use only 11 L of vegetable remained oil extracted into biodiesel for approximately 1 L. From the above mentioned, it can answer to help reduced waste pollution to the Thai community as well. Paper uses both in theoretical: Balanced Score Card (BSC) and Strength, Weakness, Opportunity, and Threat (SWOT) Analysis and an empirical review for history articles to support the ideas on how to develop new alternative energy and how to solve the risk of lacking in fuel via the previous studies. BSC is a type of system or process that is based on determining key indicators (KPIs) as a mechanism. Kaplan and Norton provide the latest definition of the BSC saying that it is a management tool helping to implement the strategy into action or known as "Strategic Implementation" by measuring or evaluating. It also helps the organization to achieve unity and focuses on things that are important to the organization. It uses to connect to the others for success via strategic and management. It also monitors the step of working towards to target planning. It analyzes by four main perspectives as follows: Learning and growth perspective – concentrating in training in both individual and corporate improvement; business process perspective – letting the managers know to manage in well business; customer perspective – focusing on consumer satisfaction target; financial perspective – gauging the performance of business.

When the institution has adapted used the BSC Technique, it can help on the strategic plan (Intujunyong, 1993; Kaplan and Norton, 1996a; Kaplan and Norton, 1996b; Martinsons, et al., 1999; Milis and Marcken, 2004; Muhammad and Wizarat 2011). The BSC process consists of the following steps (1) Strategic analysis such as the SWOT Analysis to get clear direction and strategy of the organization. (2) Analyze the situation in the future at least 5 years or more to determine the mission, vision and objectives of the organization through question "how to verify the results in concrete form." (3) Plan the operations to reach goals according to the strategy and resource allocation correctly. (4) Collect various information for administration and follow up on the performance of each period. Besides, the Benefits from using the BSC support as: (1) Helps to improve the organization's performance. (2) Makes the entire organization focused on organization's strategy by requiring officers throughout the organization helps to implement strategies into practice. The SWOT analysis is used as a tool for identifying the factors that the company have to consider while formulating a strategy to achieve the goal of the company (Rangkuti, 2009; Mujtaba and Jamal 2018). The analysis can be used by the company to analyses their strength and opportunities and maximizing it to their benefit and advantage while on the other hand, minimizing the weakness and threat of the company. According to Gitosudarmo (2001). The SWOT analysis can also be used to evaluate the degree of strength on the internal factors of the company like Strength and Opportunities. Furthermore, the external factor can also be analyzed so that the company can reduce their weakness and establish comparative advantage for their business. It supports for realizing the 4 aspects to specify a business sense scrubbed an outstanding in the real market as follows: (1) Strengths (S): shows the area of the organization's forms. It mentions as our strengths or advantages; (2) Weakness (W): performs our weaknesses or disadvantages; (3) Opportunities (O): presents opportunities that can be implemented; (4) Threats (T): mirrors risk, limitations or obstacles that affect the organization's operations. The SWOT analysis framework determines issues, analyzes and evaluates weaknesses, strengths, correctness and obstacles to make the analysis more accurate. Framework of SWOT analysis depends on the nature of the organization with a great variety in many styles (Boonyatisathan, 1990; Tummajarriyawat, 2018). In the sense of "Formation of Model and Strategic Plans for Developing" in term of eco-friendly renewable energy, Thummajariyawat (2018) has said that the statistical data and SWOT analysis expressed as the tools showing to Thai government in the long-term of sustainable cluster management. Cost-Effectiveness Analysis (CEA) is used in a process of business to consult in the factor opportunity cost into equation with the use of the NPV tool net present value (NPV); it is also a form of decision-making criteria for project investment (Ouyang, 2009; Arrow, 2000; Muñoz, 2017). It emphasizes on the

maximizing the average of products and make the opportunity cost between cost and benefits receiving.

Some research measure other achievements of the bank in Sweden shown that the importance of other successes is to use the BSC measuring system (Hussian, 2005). Furthermore, the index balance success measure helps to develop in a better direction for organization said by Kaplan and Norton (1992). Zhang and Li (2009) used BSC Tools in China to help increase the value of performance management assessment system. SWOT performs the strength of institution matching with resource for earning the opportunity and the weakness can motivate firm to gauge the outside company's threats supported by Kamb et al. (1995); Thompson and Strickland (2001); Phadermrod et al., (2016). The new choice of energy lacking solution is being found "biofuel." It can be replaced into the community light as known "Waste to Energy."

The people are now looking for the hope via using the wastes starting to use in the machine. One possible uses to turn the waste being the usable product is making the biofuel. Biofuel is a fuel derived from biomass as energy from plants and animals based on photosynthesis and chemicals or elements of living organisms or various organic substances including agricultural production and wood. Ethanol is a biofuel form that has clear liquid, colorless, flammable properties with sensitivity and high octane. The ethanol obtained from the fermentation to be distilled at atmospheric pressure. Under appropriate reaction conditions to change fat or change the structure of oil from triglyceride to alkyl esters which is similar as diesel oil called "Biodiesel or B10." This option one is "clean" to people and environment in the same time used. Replacing the oil used with biofuels is increasing the desirable of waste oil production and reducing the "greenhouse gas pollutant emissions." Community's demand for biofuels can raise household income and preserve the land, water, and community resources for the next generation. In recent years, the biofuels need to support competing economically with used oil creating deadweight losses in the community.

Measuring the value of economic projects considers as an important indicator of investment decisions It can demonstrate generally measured through 3 indicators: (1) NPV – It is the calculation of the difference in the present value of the revenue that is expected to be received each year throughout the life of the project and the present value of the expenses paid out; (2) Benefit – Cost Ratio (B/C Ratio) - It is finding the numerical value between the present value of revenue throughout the project life divided by the current value of the cost throughout the project life. The benefits will be suited when B/C ratio is greater than 1 (Vitliemov, et al., 2019) and (3) Internal Rate of Return (IRR) – It is reflecting the return on investment at the point of capital by comparing with the interest rate or financial cost or the cost of the project that is more or less than the interest rate or financial cost (Hardacer, et al., 2004; Lee, et al., 1980; Warren, 1982; Illes, 2002; Ross, et al., 2005). Tangjitprom and Romprasert (2019) have mentioned that "Renewable Energy" for community is mirroring the society's choice and worth for continuing as community project investment supported. Mele (2019) has shown that renewable energy consumption and aggregate income run a "unidirectional causal flow" because it corresponds to the theory and hypothesis of economic growth.

3. RESEARCH METHODOLOGY

The framework of research is shown as follows: Starting from exploring the environment and well-being of the community including problems and needs of villagers and the elderly. Then, bringing the information to analyze and plan the project responding to the needs within the community area. Using the "Balanced Score Card Technique" to adjust the strategy operating including analyze current situation by brainstorming and classify the impact of external factors on the project via SWOT Analysis. The economic CEA is used to adjust time value for expense items and project benefits with using NPV tool in a form of decision-making criteria for project investment. Paper studies the cost of producing biodiesel from used oil via outstanding local agriculture community near Bangkok. It has outcome over than 50 L/week but not over than 150. One year is used for collecting the data. Risk management is important in every project designed, even if the risk is still not exhausted. But it can be controlled and prevented the project management problems from occurring at a severe level. The project management must involve risks in terms of cost, time, and planned operations. Since the project has many sizes and risks, there is still a relationship with the project size as well. These methods are used for identify the project analysis and for solving the risk of fuel lacking in sense of cost analysis.

4. RESEARCH RESULTS

Main energy or base energy is an energy that can meet the needs of electricity continuously for 24 h supporting the economic, social and competitive development of the country. This type of power plant such as thermal power that uses fuel supplied continuously in large quantities and the price is not high, such as natural gas, fuel oil, coal or nuclear (Haseeb, et al., 2019).

The other one is renewable energy and alternative energy such as wind, solar, garbage and biomass are clean energy and can never extinct. Although the development of wind and solar energy will have a higher cost than the main energy which will affect the electricity cost more or less. But it is reflected that Thailand is progressing and serious in supporting energy that is friendly to the world. Furthermore, it helps by reducing the carbon dioxide in electricity production. However, it is both the production cost and the limitations on potential in different types of energy sources be another important problem that must be considered together. Learning the limitations in each type of energy, including primary energy and renewable energy will help to determine the proportion space and volume appropriately. Comparing to the body of our people that needs main food and vitamin supplements for growth and strength as well as various types of energy that must be balanced together so that it will benefit the nation in the long run. The important property of biodiesel that the community mentions be biodegradable according to the biological process. When community uses vegetable oil after finished cooking, the remained oil often throwing into the drain. It is causing water

pollution and harmful to community's health because it has been clinically proven that repeatedly using fried oil to cause the cancer. The solution that community seeks for this problem is to collect used oil and come up with the easily chemical processes to produce its as "Esther" with similar properties to diesel. So, the community can use its instead of diesel oil called biodiesel which it can help community to reduce the amount of waste, reduce the pollution and also produce the other biodiesel used for agricultural machine (Muzurura, 2018; Ali and Haseeb, 2019). Community biodiesel should be a collaboration of government and community with the goal of transferring knowledge about biodiesel production technology because the raw materials used in the production of biodiesel can be obtained from the local sources such as oil, jatropha oil, used vegetable oil and from various oil crops to be used as fuel for agricultural machinery immediately. Moreover, it can help to reduce household expenditure in the local area. Biodiesel produced when mixed with diesel at a ratio of 5:95, it can be used with all high-speed diesel engines of all brands, lower cost than diesel, and without damaging the environment. Now a day, the Government promote for community biodiesel such as provide the training, knowledge and production techniques. Because the government wants to select some potential communities established a prototype community and learning center of the community in the near future. An example - Nong Jok community, Lumpukchee district - with a large amount of fried oil is used in Nong Jok province.

To determine the cost, paper uses the data from the community members in the cultivation of 50 L of used oil prices by purchasing the resources having the initial cost of equipment as shown in Table 1.

Table 1 shows the investment expenses of community for starting the project on purchasing the resources having the initial cost of equipment. The community has to do the 1st time of investment on biodiesel project for comparing with the cost in the 2nd time because the some variable cost for the 2nd has changed because of reusing in some input factors. Comparing on Table 2 is to determine the cost in the cultivation of 5 L of used oil prices by using the resources available in the community or materials remaining in the household. Thus, it can reduce the cost of equipment as shown in Table 2.

Next, to determine the benefit of 50 L in 264 days as shown in Table 3 is identified the community benefits earning from biodiesel project. So, the community can use Tables 1-3 to supporting on making decision via cost-benefits analysis designed.

Tables 2 and 3 show that in 1 year (case of using only 50 L of used oil to produce biodiesel), the community can earn income as 5,654.80 – 1,181 = 4,473.80 or around 4,474 Baht/year. If the community uses more than 50 L such as 1,500 L of used oil to produce the biodiesel, it will earn around 134,220 Baht/year. It will be worth enough. However, to check with the worth of long-term investment, paper uses NPV for calculating as follows:

$$NPV = -C0 + \sum \frac{B - C}{((1+r)^n)} \quad (1)$$

Table 1: Variable cost of producing biodiesel in community for 1st time (C_0)

Details	Credit (Baht)
Used oil price (buying from near community) 50 L (1 L=12 baht) per day	600
Microbial fermentation 1 spoon (5 baht/L)	250
Bucket 1 piece	120
Wage price per person	200
Electric price (1 baht/L)	50
Thermometer	120
Pure diesel 3 L (1 L=27 baht)	81
Another price such as buying alcohol (5 baht/L)	250
Total cost	1,671

Table 2: Variable cost of producing biodiesel in community for 2nd time (C_1)

Details	Credit (Baht)
Used oil price (buying from near community) 50 L (1 L=12 baht) per day	600
Microbial fermentation 1 spoon (Community supports)	0
Buck 1 piece	0
Wage price per person	200
Electric price (1 baht/L)	50
Thermometer	0
Pure diesel 3 L (1 L=27 baht)	81
Another price such as buying alcohol (5 baht/L)	250
Total cost	1,181

Where
C0 refers initial cost
B refers benefit
C refers cost
r refers to interest rate be announced from Bank of Thailand at 7.15%
n refers number of years.

Therefore,

$$NPV = -Co + \sum \frac{B - C}{(1+r)^n} + \sum \frac{B - C}{(1+r)^n} + \sum \frac{B - C}{(1+r)^n}$$

$$NPV = -1,671 + \sum \frac{4,474}{(1+1.75)^1} + \sum \frac{4,474}{(1+1.75)^2} + \sum \frac{B - C}{(1+1.75)^3}$$

NPV = 785

The NPV calculation is used to determine the present value of the future expected cash flows from the investment. In this project, by subtracting the 785 Baht cost of the investment, the net benefit of the investment can then is determined.

Furthermore, the paper also provides the case when he IRR of an investment is discount rate generating an NPV of zero which would make the financial decision maker indifferent to accept or reject the investment.

Table 3: Benefits of producing biodiesel in community

Benefits	Output/year	Price/L	Total
Number of biodiesel 0.8 L/day (from used oil 50 L) in 1 year=264 days	211 L	25	5,275
Glycerol	21.1 L	18	379.80
Total benefits			5,654.80

A biodiesel price is cheaper than diesel 2 Baht/L

The decision criteria for IRR are as follows:

- When IRR exceeds the required return, accept the investment
- When required return exceeds IRR, reject the investment.

IRR and NPV as decision criteria always present the same conclusion for conventional independent-investment decisions. However, when an investment is not conventional, IRR may not exist. Also, IRR cannot rank multiple mutually-exclusive investments. Then, biodiesel project is attempting to evaluate a particular project with the following cash flow projection as shown in Tables 4 and 5.

The project costs 1,181 Baht today and the required return on investments of this type is 8%. Calculate both NPV and IRR and determine whether or not you should undertake the project. Using the excel file calculating as shown below:

NPV 19,291 = NPV(8%,C32:C39)-80000

The NPV calculation is used to determine the present value of the future expected cash flows from the investment (this is the measured market value of the investment). By subtracting the 1,671 cost of the investment, the net benefit (or loss) of the investment can then be determined.

Particular attention should be paid to the value arguments in the NPV function. The values that the NPV function considers begin in period 1. Therefore, cash flows that occur before then period 1 must be considered separately.

The resulting NPV of the project is positive, indicating that the project should be accepted since it increases shareholder wealth.

IRR 273.71% = IRR(C49:C57)

Unlike the value arguments in the NPV function, the value arguments in the IRR function begin immediately. As a result, we can add in the original cost of the project, which occurs in period zero.

The selection criterion for IRR is "accept a project as long as its IRR exceeds the required return." Since this project's IRR of 273.71% exceeds the required return of 8%, the project should again be accepted.

It can interpret the number of NPV equal 19,291 Baht, this can be said that the value of the net benefit that occurs in the future when the deduction is reduced to the present. It means that an investment from the use of capital or interest rate is at 8%, then the project will receive profit in the amount of 19,291 Baht. In other words, the NPV value is greater than zero or positive causing be worth enough for investing. Particular attention should be paid to the value arguments in the NPV function. The value that the NPV function

Table 4: Cash flow projection started from year 1 for biodiesel project

Year	Cash flow
1	4,474
2	4,832
3	4,861
4	5,250
5	5,670

Table 5: Cash flow projection started from year 0 for biodiesel project

Year	Cash flow
0	−1,671
1	4,474
2	4,832
3	4,861
4	5,250
5	5,670

considers begin in period 1. Therefore, cash flows that occur before then period 1 must be considered separately. The resulting NPV of the biodiesel project is positive, indicate that the biodiesel project should be accepted since it increases community wealth. Furthermore, unlike the value arguments in the NPV function, the value arguments in the IRR function begin immediately.

As a result, paper adds in the original cost of the biodiesel project, which occurs in period zero. The selection criteria for IRR is "accept a biodiesel project as long as its IRR exceeds the required return." Since the biodiesel project's IRR of 273.71% exceeds the required return of 8%, the biodiesel project should again be accepted. Payback period analysis of the biodiesel project expresses a tool to evaluate the possibility of uncomplicated investment and quick assessment suitable for investment funds showing the 1st year is payback as shown in Table 6.

Besides, the cost – benefit analysis on social benefit of biodiesel project in community has to be realized in Table 7.

Table 7 shows that the project will benefit most to community members followed by the elderly. From received score 5 points out of full score 6 points shows that the project will be able to generate social benefits at a highest level.

Lastly, the risk analysis is mentioned in Tables 8 and 9.

5. CONCLUSION AND POLICY IMPLICATIONS

The results of the study show that the community gathered in the form of members to facilitate the integration of used remained oil

Table 6: Payback analysis for biodiesel project

Payback analysis						
Undiscounted payback analysis						
		Projected				
		Year 1	Year 2	Year 3	Year 4	Year 5
Undiscounted net cash flow	−1671	4474	4832	4861	5250	5670
Cumulative net cash flow		2803	7635	12,496	17,746	23,416
Positive cash flow?		True	True	True	True	True
Undiscounted payback period	1	First year positive				
Partial year payback period	0.37	Actual number of years				
Partial year payback period (one cell)	0.37	Using arrays and index				
Discounted payback period analysis		Discount rate	10.00%			
		Projected				
		Year 1	Year 2	Year 3	Year 4	Year 5
Undiscounted net cash flow	−1671	4067	3993	3652	3586	3521
Cumulative net cash flow		2396	6390	10,042	13,628	17,148
Positive cash flow?		False	True	True	True	True
Undiscounted payback period	1	First year positive				
Partial year payback period	0.41	Actual number of years				
Partial year payback period (one cell)	0.41	Using arrays and index				

Table 7: Social benefits of biodiesel in community

Key persons	Highest (+3)	Moderest (+2)	Lowest (+1)	Lowest (−1)	Moderest (−2)	Highest (−1)	Total scores
Community members	3						3
Elders		2					2
Total							5

Table 8: Considering potential risk occurring

Issues to consider	Explanation	Potential risks
Community and Environment	Risks caused by the project have an impact on the way of life, community, society, environment, ecology and natural disasters that may occur	Risks associated with buying the remained oil from other neighbors (D)
Process	Risk in terms of operational processes such as technical problems and technological obsolescence that may happen including factors arising from those who work/project operators such as lack of knowledge and shortages of labor in the area	Risks in the lack of in-depth knowledge about biodiesel producing or communication problems via technology between project organizers and the elderly participating in the project
Policy and Law	Risks in terms of compliance with rules, regulations, state laws and government policies that may change in the future or the policy is announced not be used in practice	Policy risk, controlling prices, seeing the base (E)
Participants	Risks caused by service recipients such as changing needs	The risk that the group of participants in the community will not be interested and do not want to join the project (A)
Economic	Various factors that may affect the operating costs or economic changes that may affect the project	Price risk of production factors which will affect the cost of the project can be changed (C)

which it is important as the raw materials. Members have an average cost of left vegetable oil equal to 600 Baht and have the labor cost of production equal to 200 Baht. Furthermore, there is an average cost of other production costs equal to 331 Baht. When comparing production costs and benefits obtain from analyzing through various values, finds that this project is suitable for communities in the production of biodiesel as a fuel oil used and the average cost of production is quite low comparing to a high profit left for community. In addition, the risk aspects reveal that the government should support the budget for production equipment and send the experts for educating the community. Because in the long term the community will be able to produce the cheap biodiesel by itself causing the reduced in agricultural production costs and energy imports from abroad including reducing daily expenses which increase the proportion of income more than ever before.

Up to this point, paper shares the idea for the alternative energy that means energy be used to replace fuel oil and natural gas.

Table 9: Guidelines for reducing and mitigating risks

Grade	Guidelines for reducing and mitigating risks
A	Actions to reduce the possibility and severity of risks need to be hurry and think immediately as soon as the project starts or before the project starts
B	Actions to reduce the possibility and severity of risks will set up and start the operation once the project has started
C	Actions to reduce the possibility and severity of risks should be set up and take action if there is sufficient budget and support
D	To acknowledge, but does not require any action except for the risk level will intensify over time
E	To acknowledge, but does not require any action except for the risk level will intensify over time

It can be divided by the source into 2 types: (1) nonrenewable energy such as coal, natural gas, nuclear, rock, oil and sand, oil, etc. (2) renewable energy such as solar, wind, biomass, water and hydrogen. The renewable energy is the clean energy with no environmental impact. Everyone can realize that it is a source of energy available in the local community. The renewable energy is developed step by step till produced and used as suitable for the way of community people. Various vegetable oils such as rape seed (a lot of oil crops in Europe and America), sunflower, sesame, cotton, peanut, soybean, castor, black soap, coconut, palm and oil after cooking from restaurants and fast-food restaurants such as McDonald's, Burger King and Kentucky Fried Chicken coming through the chemical process as follows: to be methyl ester ethyl ester or butyl ester, also known as "biodiesel" which can be used as fuel instead of petroleum diesel in various mixtures without affecting the various systems with diesel engines even if used for short and or long periods. The used of biodiesel as fuel will not have an impact on the environment because it can be degraded by biological processes and less air pollution than diesel fuel. Biodiesel helps the nation solve the energy crisis. Because biodiesel has similar properties comparable to diesel oil and can be produced from oil plants in Thailand, thereby reducing the import of oil from foreign countries. In addition, biodiesel also helps creating energy security for the country in various area such as agriculture, industry and environment.

The results of the analysis on social benefits illustrates how much biodiesel project has benefited society. It can explain that the biodiesel project has been benefit to the most villagers, farmers and housewives followed by the elderly. From the total score of 5 points from the full score of 6 points in cost-benefit analysis shows that the project is able to generate social benefits at a highest level. Besides, the outcomes of risk analysis identify risks according to the yield process showing an outstanding in four areas: (1) Academic: It can apply the basic of economic analysis and financial analysis to change the result of the common concept of society. (2) Policy: It uses as a tool helping the makers to make an easily decision in the same time the social welfare is increased, looking at the use of available resources in the community for maximum efficiency including creates the tight of using local resource. (3) Economic and Commercial: It is an important part of the investment decision and the value of the biodiesel project that occurs in the community. (4) Social and community aspects: It used as a reflection of social choices in the community. Moreover, the Ministry of Energy and Provincial Office has used as a guideline for drafting a development plan for other communities leading to the selection of community that is ready to be established as the next model community. As well as the village headmen and villagers in the community, they have seen the pictures, opinions and criticisms of the outcomes to conduct the biodiesel project for benefits spreading around people in the community.

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