

**An overview of Thailand's conventional and renewable
energy generation and an analysis on Thai solar energy policy
with a comparison to the German renewable energy
legislation**

By

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Abbreviations

AEDP - Alternative Energy Development Plan

EPPO- Energy Policy and Planning office

EE - Energy Efficiency Plan

EGAT - Electricity Generating Authority of Thailand

MOE -Ministry of Energy

MEA- Metropolitan Electricity Authority

NPGR -Net Peak Generation Requirement

PEA- Provincial Electricity Authority

PPA- Power Purchase Agreement

PDP - Power Development Plan

RE - Renewable energy

SPP- small power producer

TSPD- Transmission system planning department

VSPP- Very Small Power Producer

Definitions

Adder

Adding additional premium prices on top of normal prices that power producers under the VSPP and SPP scheme. They will receive the special price once they start selling electricity to power utilities.

SPP

Allowing small private companies to become a small power producer supplies and electricity to the grid by using non-conventional energy (natural gas, crude oil, nuclear, waste energy), such as renewable energies. Generating capacity should be more than MW and not exceeding 90MW.

VSPP

Very small power producer supplies electricity to the grid by using renewable energy sources and feed stock, such as MSW, biomass and agricultural waste with the capacity not exceeding 10MW.

IPP

Independent power producer are power plants that are invested and operated by private companies. These kind of power plants are usually large scale Natural gas and coal power plants.

Off-Grid domestic PV system

PV systems installed to provide power mainly for house hold or village and is not connected to the grid.

Off-Grid Non-domestic PV

PV systems that is for industrial purpose. Industries such as agricultural water pumping, remote communications, telecommunication relays, safety devices that are not connected to the grid.

Grid connected distributed PV system

PV systems that is integrated into consumer's private, public and commercial buildings to provide power to the grid or a grid connected consumer. In this report it is used to describe the solar roof top program.

Grid connected Centralized PV system

Basically referring to a solar farm. The main function is to supply bulk power to the grid, through large scale ground mounted system.

Base load

A base load power source are power plants that is responsible for generating electricity to meet the minimum demand. The minimum demand is referred to as the base "load requirement" it is the minimum level of demand on the power supply system over a period of 24 hours.

In the case of Thailand the base load is comprised of Natural gas and Coal power plants.

Energy security

The Thai government's definition of "Energy Security" is to diversify the source of energy, in order to provide sustainable and secure supply of electricity. It does not consider importing of fossil fuels from foreign countries to be categorized as a possible risk to national energy security. For example in the case of coal, it is a based load fuel and therefore it is a necessity and must be imported. Renewable energy is not considered reliable and is only promoted to offset a portion of fossil fuel percentage and lower the release of CO₂ (EPPO, Summary of Thailand Power Development Plan 2012-2030 (PDP 2010: Revision 3), 2012).

Conventional power plants

Any power plant that burns fossil fuel to generate electricity. Feed stock for conventional power plants will be natural gas, oil and coal.

Renewable energy

The Thai government's definition of "Renewable Energy" is any type of energy that can be supplied by nature and replenish in a short period of time after being depleted (EPPO, n.d).

Those sources are solar energy, wind energy, hydro power, geothermal, biomass, tidal energy and biogas.

It is worth mentioning that in Thailand the word "renewable energy" is used differently in different government agencies, but the meaning is the same. For example EPPO uses the term renewable energy (EPPO, n.d), while DEDE on the other hand uses the term "Alternative Energy" (DEDE, n.d).

Additionally, there is also a similar term that that the Thai government has coined and is referred to as “Traditional renewable energy “. This must not be confused with “Renewable Energy”. The definition of Traditional renewable energy is basically fuel types, such as fire wood, paddy husk and agricultural waste that will be converted into charcoal and use to generate heat (DEDE, n.d).

Abstract

RE generation is booming around the world and is starting become a norm. According to the Renewables global status report, in 2014 the global RE accounts for 28% of total generating capacity, of which it could potentially cover up to 22% of the global electricity demand (REN21, 2015).

In the case of Thailand the country also wants to increase RE generation and have plans to increase RE consumption by 20% by 2036 (GIZ, 2015). To achieve this goal the government has introduce policies and incentives to attract investors to invest in RE technologies, such as the adder/FIT program, BOI incentives and the ESCO consultant.

This research will explain about the structure of Thailand's energy sector and the different types of RE policies and incentives that were introduced by the government. Thailand was selected for this research was because it was one of the first country in ASEAN that has introduce the FIT and it is also actively promoting RE investment in the country. The author is also from Thailand and has many contacts in the country, which data collection would be easier to compile if the field research was conducted in his home country.

An analysis of RE policies and its effect on the market will be made to determine if the policy has succeeded or not. Furthermore, an emphasis will be made especially on solar PVs policies to explain deeply on how the policy works for that type of RE instead of briefly explaining each type of RE. The reason for choosing solar energy over other type of RE sources was because Thailand has a high solar energy

potential with the daily average solar radiation of 18.2 MJ/m² per day (The Solar Club, 2011)

This level is higher than in Germany, who is a leader in RE generation and only has 12.4MJ/m² of solar radiation per day (Energy, 2015). Another reason was that many foreign investors are interested in the Thai solar energy market, due to good FIT tariff rates and incentives. This research would be beneficial to investors because it contains useful information about energy generation and different type of policies and incentives that are supporting them.

Germany is known for their success in promoting RE, through the famous EEG policy. By looking at best practices from a country who has successfully increased the share of RE in only a few years would help Thailand leap frog and avoid all the problems that might occur if they designed the policy themselves. Apart from searching for effective policies to adopt ,by analysing Germany's past experience it is also possible to prevent potential problems that might occur during implementation period because they have already experienced that problem before us.

Research Questions

The below are the main questions that need to be answered in this report.

1. What are the solar regulations in Thailand and how have they developed over the past years?
2. Did the RE and solar policies have any impact on the market?
3. Were the RE and solar policies effective?
4. What were the RE regulations that made RE development in Germany successful?
5. Could some Thai regulation be improved by adopting successful German regulations?

Knowing about the Thai solar and RE development plan will help explain about what kind of support the government is giving and how are they being implemented. Furthermore, analysing the annual statistics of solar generation and amount of private investment into solar projects will determined the effectiveness and quality of the policies

Thailand is not a politically stable country and the policies will change according to the government that is in office and if the opposition party is elected there will be a high chance that the policies will change to fit their ideas. This means that when there is a change in the government there will some modifications in the policy, therefore the PDP and the AEDP will tend to be updated every time a government changes.

Analysing the different policies from different government will help us understand more about what kind of approach and attitudes from each governments has regarding about solar energy and RE. Cross checking the data from related ministries will help

ensure that the data is accurate and reliable. The data could also be used to check the effects of the policies on solar development in Thailand. By analysing the data from the annual reports about renewable energy development, some questions could be answered, such as if the policies that the government had introduced were successful or not. One of the possible indicators could be, that if it is reported that the solar capacity has increased annually according to plan, it could mean that the policy has an impact on the solar generation, but on the other hand, if there is no change or there are signs that there is a decline in the overall generation of solar, it would mean that the policy might be failing or is not effective.

Research Methodology

Source of data will be acquired from various sources, Ranging from one on one interviews to accessing reliable governmental data base that is related to energy and RE development in Thailand and Germany. Information that is needed will be about governmental policies, regulations, statistics, and any latest update from the government about solar policies and RE development.

The type of statistics that will be important for the research will be about the short- long term targets of solar energy that the government wants to achieve and what the plans to help achieve them are. Looking into the supportive measures such as the FIT will help understand more about how much support the government is giving to the private sector and also to confirm if it is making a difference. Information about the percentage of solar energy in the current market and its development progress will allow the author to assess the current solar market trend and how it might develop in the future.

Other source of information that would be valuable to this research would be research papers about policy development for both Thai and German sources, for the purpose of literature review and to know about different types of opinion regarding about policy development in the 2 countries.

Scope of Research

Thailand has 3 main energy regulation frame work.

- Power development Plan
- Alternative Energy Development Plan
- Energy Efficiency Development Plan

In this report the main focus will be on policy on electricity generation from solar energy, therefore the report on Energy Efficiency Development Plan will be excluded.

The research will be based exclusively on the Thailand's energy situation and emphasising on the solar policies.

Technologies for Electricity generation from solar energy will only refer to solar PVs and therefore the topic of solar thermal will be excluded from this report.

An analysis of the Government's energy policy will cover policies for overall national energy policy, solar energy generation from both grid connected centralized PVs and grid connected distributed PVs systems. Successful policies in this report means that because of the policies the percentage of installed capacity have increased and investment will continue to increase in the coming year. For an unsuccessful policies are policies that failed to live up to their purpose and have to be terminated. There is also a third type of policy performance, it is in the middle of successful and unsuccessful. This is when the policy has made a difference, but it encountered many problems during implementation period and needs to be improved.

Policy areas to compare with the Germans will be only be relating to their RE regulations and laws. A brief explanation on past RE developments and a general explanation on their current energy situation will also be written, in order to verify if there are any similar patterns in RE developments between current Thailand and Germany's past. Policies that will be looked into include the EEG and their national energy policy.

Thailand's new Power development plan and the Alternative Renewable energy Plan is currently being revised and has not been release to the public. Hence, the focus will be on the previous civilian government's PDP, which is the 2012-2030 power development plan (PDP 2010 revision 3). However some reference will still be made to the new PDP 2015-2036 introduced by the military government. The source of information will be from documents received from the internet and government officials.

For the AEDP most of the data will be from the AEDP 2008-2022 instead of the AEDP 2012-2021, because there are more information available on the AEDP 2008 than the AEDP 2012. Also a similar case to the PDP 2015-2036 some references will be made on the AEDP 2012-2021 and updated AEDP 2015-2036. Since AEDP 2015 is still being revise coincidentally at the time when this research was written, the latest information available at that time will be from the Q4 2014 and any update about the resolutions that is going to be introduced beyond this period of time will not be included.

Desk Research

Desk research will revolve around acquiring statistical data, annual reports, and policies from governmental websites and data bases. All types of research papers that are related Thailand's solar development and RE policies, details about German RE development and policies will be sought out for the purpose of literature review.

Below are governmental data bases that will be accessed.

- **Department of Alternative Energy Development and efficiency**
http://www4.dede.go.th/dede/index.php?option=com_content&view=article&id=1841%3A2010-09-22-07-02-07&catid=128&lang=th
- **Energy Policy and Planning Office**
<http://www.eppo.go.th/info/index.html>
- **Board of Investment Thailand**
<http://www.boi.go.th/index.php?page=incentive>
- **German Federal Ministry for Economic Affairs and Energy**
<http://www.bmwi.de/EN/Topics/Energy/renewable-energy.html>
- **GIZ Thailand**
<http://www.thai-german-cooperation.info/index.html>

Field Research

Field research will be done in a form of one on one interviews with representatives from government agencies related to Energy production and RE development

Below are the government agencies that will be interviewed. All of the representatives requested that the author cite their department instead of their personal names.

- Department of Alternative Energy Development and efficiency
- EGAT, Transmission System Planning Department
- Thailand Board of Investment
- German Agency for International Cooperation (GIZ)

Department of Alternative Energy Development and Efficiency

The DEDE is responsible for Regulating and Promotion of Renewable energy in Thailand. It also provides consultancy to industries and other private sector on how to comply with the regulations from the Energy Policy and Planning Office.

The interviewee is a representative from the Bureau of Solar Energy Department, DEDE (DEDE D. o., 2015).

Main questions for the DEDE will be as follows

- Development progress of the new government policy “PDP 2015-2036 and the AEDP 2015-2036”.
 - The updated PDP and AEDP has already been finalized, however it has not been printed into the official report and will take a couple of months until it is release publicly.
- According to the updated AEDP 2015 the target for the solar roof top program nationwide is 200MW. Why is there a cap on the amount of solar PVs that could be installed? And why is there a deadline for the application for the solar roof top program? Is the grid full?

The reason for the cap on the amount of PVs was to test the market and to experiment what kind of respond would the public have on the policy. Another reason was that the government is trying to encourage the public to use the “net –metering” system and discourage people from just selling all their electric to the grid, which the fees will be passed on to the public and would be a burden. RE is not operating in the same way as conventional do, which the current grid and transmission lines are designed to suit conventional. Therefore, the utility operators are not familiar with integrating the PV systems into the grid and wanted to test the effects of what might

happen if PVs are introduced and have decided to start small and will increase the cap in the future.

The official insisted that the grid is not full and that the grid still have available space for RE, but also stated that more investment would be needed on the grid and transmission lines to accommodate RE to the grid.

- If Thailand wants to promote renewable energy like in Germany, why don't they have "grid priority"?
 - Thailand is trying to keep up with the increasing demand of electricity. RE is not stable and must be accompanied by conventional generators. The base load of Thailand is comprised of natural gas and coal, therefore it is impossible to lower the output of conventional power plants without jeopardizing energy security.
- The energy policies in Thailand, both the AEDP and the PDP have been changing every time a new government takes office. Is this politically related?

Yes it is related to politics and the policy will change with the government, but the targets of RE tends to increase and not decrease when a new government changes office.

- Should there be any laws designed especially to prevent future governments from changing the policies?
 - It will be better if the government could have the same long term plan to work with and adhere to it. It would make it easier for related agencies to work with the policies, because it is not changing frequently. However, it is not the government's priority to introduce such regulations, because they are more concerned with the base load and diversifying the fuel types to generate electricity. RE expansion would come later after having a sustainable base load.

- Why does Thailand have more solar farms than solar roof tops?
 - It is due to the market mechanism that the private sector chooses to invest more in solar farms and also because of favourable prices in the support fees.

It is also important to know that if there is a difference in the policies and management style between the current military government and the past civilian government.

Thailand Board of Investment (BOI)

The purpose of the Board of Investment is to provide information and advice for both local and foreign companies that have an interest in doing business in Thailand. If the company is registered with the BOI they could receive incentives and special benefit, if their business is in line with the BOI conditions.

The interviewee is a representative of the BOI Thailand and questions that will be ask will be listed as follows.

- What are the incentives and benefits that solar companies will get if they invest in solar energy in Thailand?

Foreign companies that want to invest in RE sector in Thailand would have special rights and supported with incentives. The Thai government is trying to promote RE energy development in Thailand and that is the reason why there are many incentives available this year.

For solar energy investment, foreign companies would be not be subjected to the 49% foreign and 51% Thai rule if they want to register their company. The foreign company would could have 100% ownership and would also have the ability to buy land.

However in a case where the company selling out their business the land rights must be sold back to Thai buyers. Foreigner workers, such as engineers that the company plans to send to Thailand would also get income tax exemptions for a certain period of time as well. Tax exception on imported machinery and equipment that is necessary will also be provided. (Thailand, 2015).

- Are there any benefits for companies that want to build a solar manufacturing plant in Thailand?
 - The same incentives for establishing foreign company would also be applied to manufacturing companies. Basically they have the same incentives.

EGAT, Transmission System Planning Department (TSPD)

The TSPD is part of EGAT and is responsible for planning and expansion of grid and transmission lines. The interviewee is a representative of that department and the questions asked is listed as follows (EGAT T. S., 2015).

- The government is building more power plants, both renewable and conventional. Will the grid be able to cope with the expansion?
 - Yes the grid can handle the expansion and there are plans to expand the transmission lines and build more grids to cope with the increasing power demand. But, there are also challenges because RE does not operate the same way as conventional power plants. RE Investors would have to consult with the grid department to confirm if there are any grid available in the area they want to construct a solar farm.
- Why does Thailand not have a Grid priority?
 - Thailand cannot lower the output of natural gas and coal power plants because they are the base load. This will jeopardize our energy security. Furthermore, the cost per unit of electricity from conventional sources are still cheaper than that of RE sources.
 - This is a similar response from the DEDE representative regarding about the reason why the Thai government did not have a grid priority. It would seem that the government does not consider RE as a long term investment that would lower their cost through savings.

- Why is there a cap on the amount of solar energy from the solar roof top program that could enter the grid?
 - It is not because the grid is full. The cap was set to test the market if the private sector is interested in the scheme or not. Another reason was that they are currently trying to find the best policies and method to ensure that the new scheme will not put too much burden on the public. Introducing net metering should be the answer.

This response is similar to the DEDE.

- How would Thailand's grid and transmission lines develop into in the future? It is said in the AEDP 2012-2021 that smart grids would play an important role in expanding the shares of RE.
 - Not only that smart grids will play an important role in the future of Thai electricity generation, but other systems will also be installed to help boost effectiveness for both electricity distribution and RE development. Systems, such the integration of weather forecast and storage devices. All of grid technologies will be linked and will be operated together.
- In the past did the other government agencies that came up with the national RE generation targets, have consulted the TSPD about grid availability before coming up with the targets.
 - Past governments did not consult with the grid developers about grid readiness and have led to problems with RE projects that have to be cancelled because there is no grid available in that area or that it is not ready to accept RE.

However, the government have started to consult with the TSPD and things are getting better.

- Why are the information relating to the grid not available to the public?
 - All transmission and distribution system is owned by the government. When the government wants to expand the grid they will contract private companies to manage the project. The

companies would have to go through a competitive bidding process, which they will receive the data about the grid at that time.

Therefore, to prevent unfair advantage the government does not publicize much information on the internet.

German Agency for International Cooperation (GIZ)

The GIZ is a Thai and German cooperation that has been partners for over 55 years. The GIZ has given assistance in all fields of technical cooperation ranging from agricultural to renewable energies. Interviewing the representative would give the author another opinion from a foreign entity about Thailand's RE policies, especially about solar policies.

Sadly this option is not available because the German staff that was stationed in Thailand is currently in Germany and is not available for interview, therefore in this report there will be no data from the GIZ Thailand office, but will have information from their official website in Germany.

Data from government data bases

EPPO

EPPO's main role is to formulate national energy related policies relating to both petroleum and renewables. They will receive orders from the government and try to create policies for other agencies. Policies relating to RE will be created and then sent to the DEDE to be enforce and promote.

Data that could be extracted from EPPO's website will include statistical data on the target of renewables, PDP report and electricity generation by fuel types.

Cross checking energy statistics from EPPO and the DEDP will be attempt to confirm the authenticity of the numbers from both agencies.

DEDE

The DEDE data base will provide information about the AEDP reports. Annual renewable energy statistics is also available to compare the developments of solar development in Thailand and compare it with the PDP targets from EPPO.

BOI

The BOI also have data about solar investment incentives available for companies. A summary of Thailand's solar market and its potential is available. However, the BOI website is not user friendly and it is hard to navigate. It is recommend that anybody who wants to know about what kind incentives is available, should visit the BOI representative directly and ask for information.

Electricity generation in Thailand

The source of electricity in Thailand is generated from 5 types of power plants.

1. EGAT (Electricity Generation Authority of Thailand)
2. Independent Power Producer (IPP)
3. Power purchase from foreign countries
4. Small Power Producer (SSP)
5. Very Small Power Producer (VSPP)

EGAT is an entity that is owned by both the public and private sector. The system (Fig 1) is called the Enhanced Single Buyer (ESB), where most of the electricity generated by power plants around Thailand, whether it is owned by public or private will be bought exclusively by EGAT. EGAT also own a number of power plants and generate electricity and send power through their own transmission lines which spans around the country. Electricity generation in Thailand comprises of both public and private ownership, but apart from the power plants the rest of the utilities are owned by the state. In other words the state has nearly full control of electricity transmission and a number of power plants in Thailand (EGAT, 2013)

The distribution process is maintained by 2 main state owned entities, the Metropolitan Electricity Authority (MEA) and the Provincial Electric Authority (PEA). MEA is responsible for distribution around the metropolitan areas, which includes Bangkok, Samut Prakan and Nonthaburi area, while the rest of the Thailand is managed by the PEA.

Figure 1 shows how electricity is generated in Thailand, though the value chain.

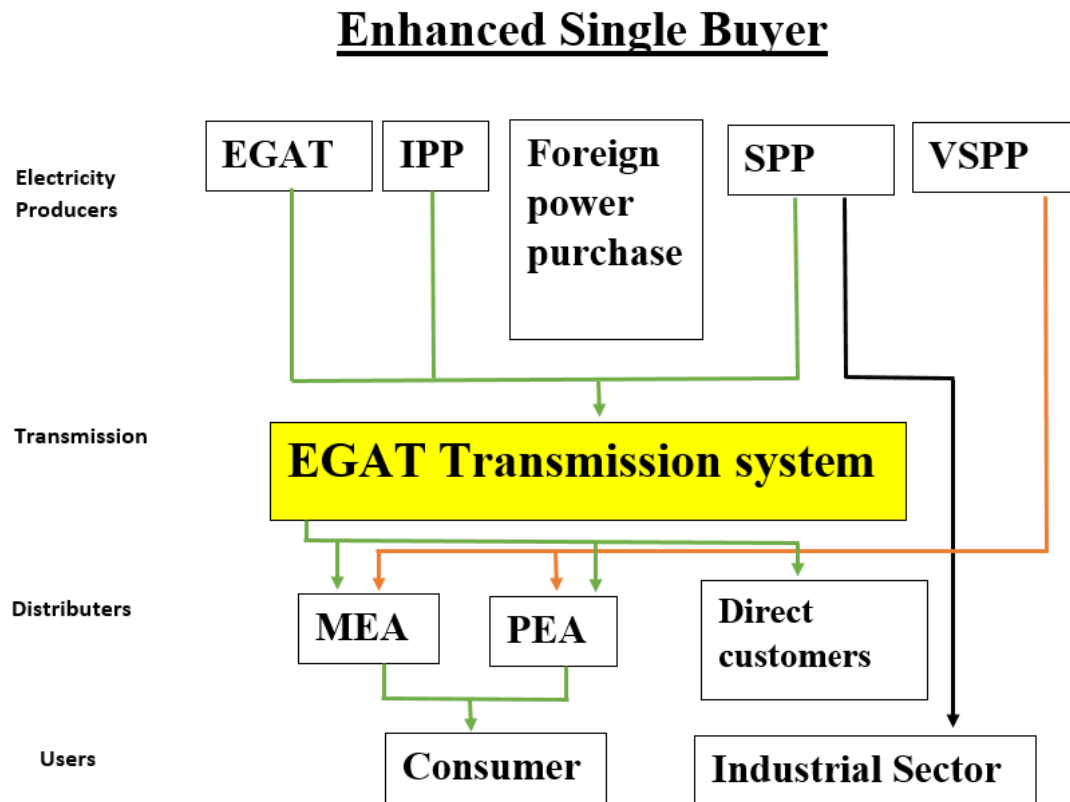


Figure 1: Electricity Generation in Thailand

Source: EGAT

Energy Consumption

Thailand's total population has reached 67 million people as of 2015 and it is also ranked as the 2nd largest economy in South-East Asia behind Indonesia. With any developing country the expanding economy and increasing population will come with a higher demand for energy. In Thailand's case the energy consumption could be separated into 5 sectors (Fig 2). The largest demand for energy is the industrial sector, which accounts for nearly half of the energy demand (44%), and also followed by the residential households (23%), commercial buildings (18%), Small and Medium Size Enterprise (11%) and the last 4% is for public utilities.

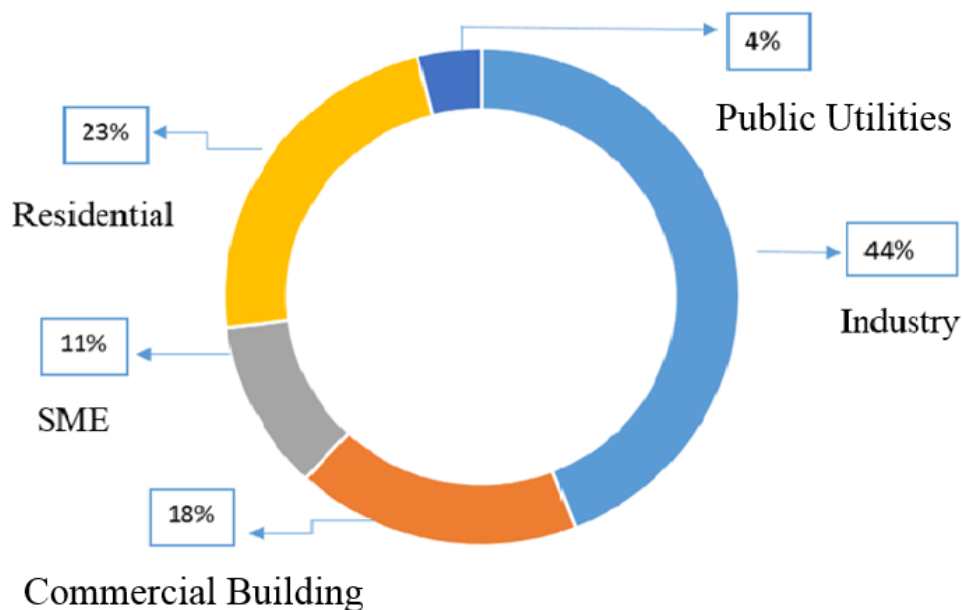


Figure 2: Energy Consumption by sector

Source: EGAT

Out of all the five sectors, the industry, commercial buildings and residential has a high demand for energy and if combined the total energy demand from those sectors would account for 85% of the total energy demand in Thailand.

This could be one of the reasons why the Thai government would want to encourage people to participate in the solar roof top program, which is aimed at self-consumption rather than selling electricity to the grid.

Electricity demand in each region

The regions in Thailand could be separated into 4 parts, Southern, Central, Northern and North eastern. In each region electricity demand and peak hours will be different from one another (Fig 3). According to a document from TSPD of EGAT , the region with the highest energy demand is the central region , which accounts for 71% of the energy demand in the country (EGAT T. S., 2015). Thailand has a centralized develop approach , meaning that most develop plans are usually focused on large urban cities like the capital city of Bangkok (Planning, 2002) , of which the city alone uses 30% of the energy demand. This nearly equals to the total amount of energy usage of the southern, North eastern and northern regions combined. For the central region the reason for high energy demand is that most of the factories and other heavy industries are located in that region , while in other locations such as the North eastern and southern part are mainly engaging in agricultural and tourism.

Figure 3 shows how energy consumption is different in each reagoins across Thailand.

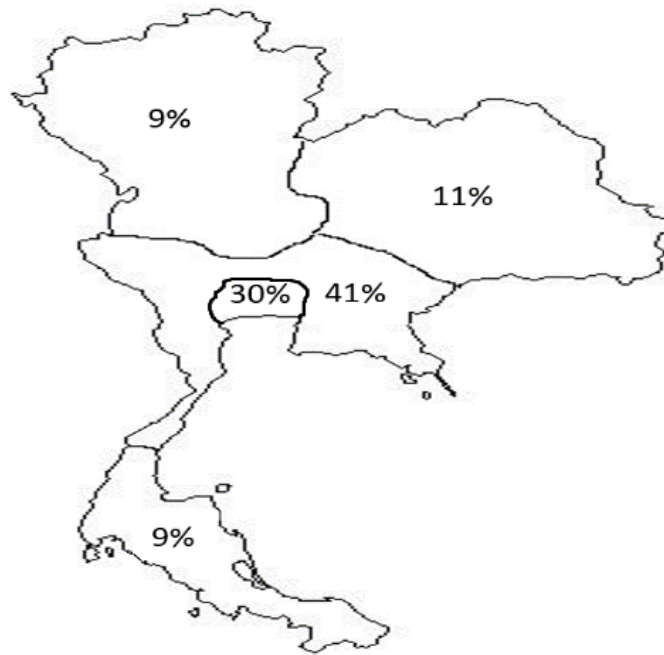


Figure 3: Energy consumption in each region

Source: EGAT

Net Peak Generation Requirement

Net peak demand has always been a concern for the Thai government, because if there is an increase in the peak it would mean that they would have to revise the reserve margin. EGAT has stated that the level of energy reserve must be at least 15% and in the case of the western part of Thailand, if natural gas supply is not available the reserve will be 20% (EPPO, 2012). With this in mind the government has decided to build more power plants to ensure that the energy reserve is not lower than 15%.

In 2015 electricity usage has once again reach a new record of the Net Peak Generation Requirement (NPGR) ,which has increased to 27,139 MW (EGAT, 2015) from the previous peak generation of 26,942 in 2014 (EPPO, 2014). In Figure 4 shows how the NPGR has risen over the period of 8 years and it is expected to increase again next year.

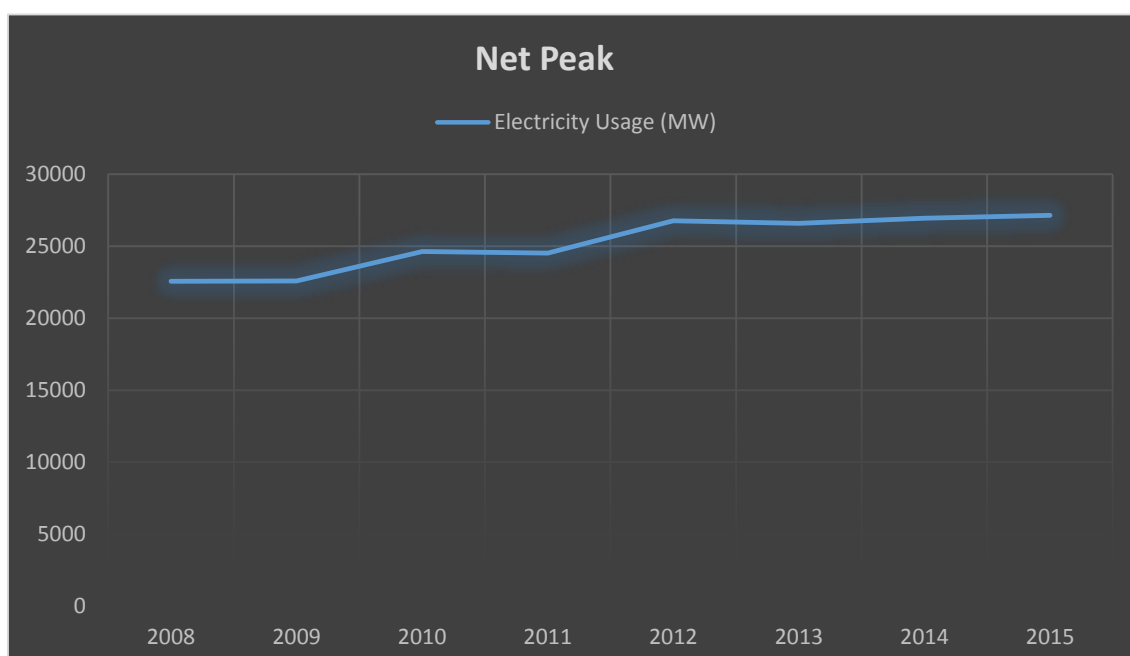


Figure 4: Net Peak Generation Requirement

Source: EPPO

Over forecast of energy demand

Even though the government has justified the construction of new power plants with energy demand forecast and referring to the increasing NPGR, some critics argue that the government has over forecast the national energy demand, which has led to over investment and economic inefficiencies. The increase in the investment of building more power plants will have to be financed by tax payer's money, which it would be collected in a form of electricity bills (Foundation H. B., 2013).

The article also argues that the reason why the percentage of RE remains low was, because the Thai government did not fully support RE development and therefore creates a reliance on centralized generation. The RE goals was not integrated into the policy planning and is treated as equals to conventional sources (Foundation H. B., 2013).

Peak demand

The peak and time of peak demand in each region is correlated with the development and what kind of activities are done in the region. Each region has different time of peak hours and the amount of peak demand. The central region and the Bangkok metropolitan sector peak demand in 2014 was at 19, 323 MW and the time of peak hour was at 2 pm, while comparing with the rest of the remaining regions in the country the average peak time is around 7:30 pm to 8:30 pm. The period and total peak demand in the other regions are also different and lower than the central region. For example, southern peak was at 2,683 MW in 7th May, North-Eastern part was at 3,468 MW in 4th June and lastly the Northern part accounts for 2,727MW in 4th June (EGAT T. S., 2015)

A possible explanation why the central region is different from the other 3 regions was that the industries and office are centralized around the central region and the working hours is during the day time. The rest of the country is either in the service sector or engaging in agricultural activities. The peak time is at that time because it is the time that the people finished their jobs and come back to their homes.

Knowing about the peak demand would help renewable and conventional energy policy makers understand more about the characteristics of energy demand in each region and effectively plan strategies effectively. For instance one possible scenario that policy makers could consider is the incorporation of renewable energy to help offset peak demand in Thailand. The central region have the potential to utilized solar photovoltaic (PV) to offset the peak demand, because their peak hour is at 2 pm, which is when the solar radiation is at its peak. In an article compiled by the Heinrich Böll Foundation called “Energy Transition the German Energiewende”, also mention how even though the cost of solar PV is high, it could offset a conventional generator. Germany is a great example because they have installed solar PVs to a point where the installed peak hour is no longer a concern and have offset 1/3 of the peak demand. (Morris & Pehnt, 2012).

For Thailand it is difficult to compare to Germany, the peak demand period in Thailand is different in the Southern, North eastern and the North. Only the central region and the Bangkok Metropolitan areas have the same peak hour as Germany, which is around mid-day.

The rest of the regions have their peak demand in the evening and when there is no solar radiation available. If storage devices are available solar energy can be stored

and use at night time to help offset peak demand, but due to the budget constraints in rural areas in Thailand the purchase of storage devices could be considered too expensive for some investors.

Fuel types and electricity generation in Thailand

According to the DEDE Thailand uses a wide varieties of fuel types to generate electricity (Fig 5). A large portion of the energy mixt is from fossil fuels (Natural gas and Coal/lignite), which if combined fossils will contribute 76% to the total electricity generation in Thailand. Coal and lignite are mostly imported from foreign countries, with the exception of natural gas, which is from both domestic reserves and purchased from Myanmar. For RE the share is increasing, but still contributes only a small percentage (11%) if compared to fossils. Other source of energy includes large hydro (9%) power and PPAs (5%) from neighbouring countries (Myanmar and Laos), which they have agreed to sell electricity from their dams. (DEDE, n.d, pp. 1,4).

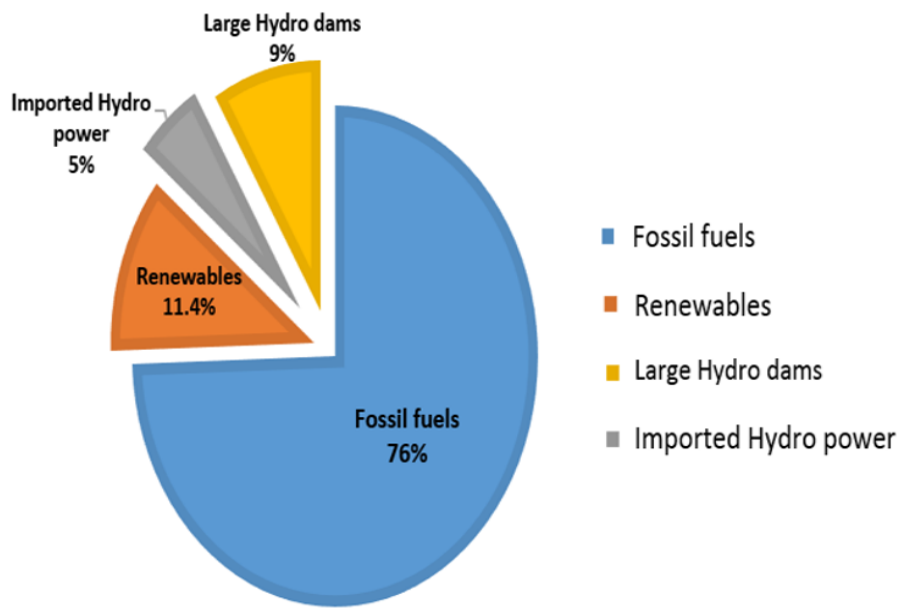


Figure 5: Energy mixt in Thailand in 2014

Source: DEDE

Renewable Energy generation in Thailand

As seen in the energy mixt RE accounts for 11.4% of the total energy production. RE sources in Thailand could be categorized into 6 types as seen in figure 6.

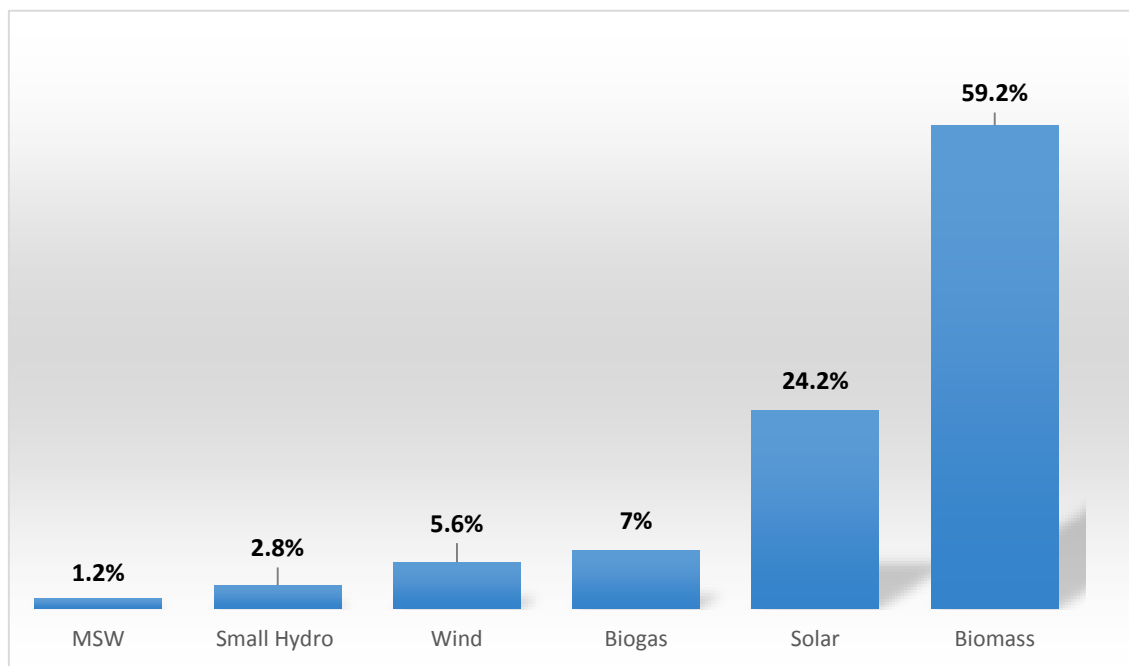


Figure 6: Renewable Energy Power Generation in 2014/Q1

Source: DEDE

Biomass has the highest share in the RE sector which accounted for more than half of the generation capacity and then followed by solar energy. The reason why biogas has a large share was due to extensive governmental support and in recent years have been designing policies to help encourage the private sector to invest in Biomass usage (GIZ, n.d, p. 1). It is logical for the government to support biomass usage as a preferred RE source, because Thailand is an agricultural country and from those activities will produce large amount of agricultural waste that could be used as a secondary resource. However, there are some speculations that it was a populist policy

and was meant to impress the farmers because they are the main voters. According to the “Biomass Database Potential in Thailand” report by DEDE main types of agricultural waste that could be used as RE source would be rice husk, palm shell coconut shell. Most of them are used in a co-incineration to generate electricity. (DEDE, 2012, para.1).

Other sources of RE, such as municipal solid waste (MSW), wind, Biogas and small hydro have a low output for several reasons. In the case of MSW most of the waste was improperly disposed or sent to open dumpsites across the country (Cherdsatirkul, 2012) and was not used in the waste in a waste to energy plant.

Wind energy in Thailand is also being encouraged, but the obstacles, such as low wind speed and over complicated paper work has deterred potential investors (DEDE, 2008).

Biogas generation was encouraged, because it has the potential to transform agricultural waste from the food processing industry into energy, but due to poor coordination between government agencies, it does not encourage the public and private sectors to cooperate with each other (S. Prasertsan,B. Sajjakulnukit, 2005).

Small hydro power systems in Thailand has the total capacity ranging from 0.2-6MW. Nearly all of the large dam project sites are exploited already, therefore the government is encouraging small scale hydro power in rural areas. The major complications for developing small scale hydro was that the potential sites are located in national parks , getting permits and conducting Environmental Impact Analysis (EIA) will take a long time to complete (DEDE, 2008).

In the coming years there is also a possibility that the percentage of generation from some RE sources might change. Since the military government has taken control of the country, they have decided to suspend policies and projects from the previous civilian government (Prime Minister Yingluck Shinawatra). Those policies were known as the “first generation of RE scheme”, which was designed to increase the percentage of RE sources of biomass, biogas, solar, small hydro and wind. However, the current military government has decided that their government will emphasis on solar and waste to energy from MSW (GIZ, n.d).This change will be referred to as the “second generation of RE scheme” , which there is a chance that this could lead to an increase in the percentage of Solar and waste to energy development projects

Energy regulatory frame work

Power Development Plan (PDP)

To ensure constant and sustainable supply of electricity to the country, the government has created a road map called the “Power Development Plan” (PDP). The PDP is a long term energy plan that comprises of targets and strategies that the government plans to implement in the future. The Thai government has realized that the country is dependent on natural gas and have to lower its usage in the country. Therefore to achieve this goal the government has decided to diversify the fuel source used for generating electricity, by increasing RE, foreign PPAs and coal imports.

The features of the PDP will include all the information about Thailand’s Energy situation in that period of time in a form of forecasting on the current status and future development of energy sources, both conventional and renewable. Information regarding about the amount of decommissioning power plants and new power plants are also given to justify the future investment in construction of new power plants. The policy and goals chapter in the report is the part that should be analysed carefully, because in that section, it explains about energy targets the government has set and national policies to achieve those goals.

The PDP had mentioned that the plan will be in line with the AEDP and will take RE development into the national energy development plans. This would ensure that RE will develop together with conventional sources and not be left out. However, even though in the PDP strategy states that it will in cooperate RE and have made plans to increase generating capacity, it does not mean that Thailand will be following the footsteps of Germany. Thailand is only focusing on energy diversity to secure energy

security and RE energy is part of the diversification of fuels. There is no priority for RE development and it is treated on the same level as conventional sources.

In terms of grid development in the PDP 2012-2030 (PDP 2010: revision 3) the plan did not even mention anything about the grid in the development plan (EPPO, 2012). It might be a problem in the near future, because if the government does not develop the grid and transmission lines together with the expansion of power plants the grid will be full. Investors that want to invest in any types of power plants will have a problem because the grid does not have any space left to add in more electricity and no transmission lines to transfer power to consumers.

[PDP 2015-2036](#)

The report provided by the GIZ called “RE policies in Thailand” contains information about the recent updates on Thailand’s energy policy.

The recently updated PDP 2015-2036 is built on 3 main principles. The first principle is “Energy Security”, it is defined as having a secure power supply for the nation and increase availability of transmission and distribution systems” in-order to keep up with the increasing energy demand. This should be considered as a good news because the government have mentioned about the importance of grid development as part of energy security. However, the main goal is to diversify fuel types and lower dependency on natural gas and increase generating capacity from biomass, coal, foreign PPAs and even nuclear power is considered (GIZ, 2015, “PDP 2015-2036).

According to an interview with a representative from the DEDE, which have mentioned that the government has considered this principle to be the most important (DEDE, 2015).

The second principle is “Economy” it is to adjust the electricity price and ensure that it reflects the real cost of production. Energy efficiency will be promoted to help lower the need to construct new power plants and also reduce energy imports. Lastly, the final principle is “Ecology”, which is to reduce the negative impacts on the environment from energy generation. The aim will be to reduce CO₂ per unit of electricity generation, through promotion of RE and energy efficiency (GIZ, n.d).

From the 3 principles of the new PDP, even though it was mentioned that RE sources are meant to substitute fossil fuels, it seems that in the eyes of the Thai government RE was used because it has lower environmental impact than conventional sources and that is why, it was categorized in into the “Ecology” section. Hence, to put it in simpler terms the government supported RE because it good for the environment.

RE could be a solution to energy security. In some countries RE are considered as a source of energy that provides security to the country, because RE sources are renewable, while fossil fuels on the other hand can be depleted. For example in the case of solar power it uses energy from the sun and does not require any feed stock, which if compared to coal power plants that require tons of coal in put per day to generate electricity. Installing solar PVs would also eliminate the need to import fossil fuels from exporting countries and would eventually lead to energy security and also cost savings, because RE does not adhere to the fluctuating global fuel price.

Interestingly, apart from ecological and security advantages, RE could also be economically favourable. Using solar energy as an example once again, as mentioned before solar PVs have the ability to lower cost through long term savings of energy imports. In Germany it was said the RE sector in 2006 has generated up to 230,000 jobs and is expected to increase to 500,000 in 2020. RE development in Germany has also led to the introduction of the “made in Germany brand” that has help increase in the entire value-added chain for RE industries (BMU, 2007, pp. 14-15).

PDP 2015-2036: Targets

To achieve the goal of energy diversification all targets below must be reached by the end of 2036 (GIZ, 2015, “PDP 2015-2036”).

- Percentage of natural gas must be lowered from 64% to 30-40%
- Renewable energy targets must reach 15-20%
- Increase power generation from coal and lignite , with carbon capture technology and storage technology and present it as “clean coal”
- Foreign Hydro power purchase will be increased from 7% to 15-20%
- Nuclear power is also considered and will account for 0-5% of electricity generation

It is worth mentioning that after comparing the PDP 2012-2030 and the PDP 2015-2030, the RE generation target has been reduced from 25% (EPPO, 2012, p. 3) to 15-20% (GIZ, n.d, “PDP 2015-2036”).

Alternative Energy Development plan (AEDP)

The AEDP is similar to the PDP, but it is design especially for RE development. In the AEDP (DEDE, 2008) apart from information that should be included in the report, such as the RE energy development targets and strategies, the AEDP will contain information on short to medium term goals and targets for all types of RE in Thailand (Biogas, Small hydro, Solar power, wind, Biomass, Geothermal and even hydrogen). Detail explanation on the potentials and obstacle of each RE source are also provided to help understand about which type of RE sources have potential in Thailand. Expected outcome of benefits are also forecast to show how significant RE could benefit the country and people. Furthermore, to encourage the private sector to invest in RE technologies, various promotional mechanisms are introduce, such as the BOI investment incentives that provides many tax reductions, DEDE support that can provide consultation to people who is interested and also have soft loans for financing projects. Lastly the most important mechanism is the FIT, which was the main component that has encouraged the private sector to invest in RE technologies.

ADEP action plan

There are five strategies and principles that the DEDE had decided to follow. Some of the principles are similar to that of the PDP. Objective in the AEDP 2008 that the DEDE hope to accomplish includes (DEDE, 2008, p. 2). (The objectives in the AEDP 2008 and AEDP 2012 are the same)

1. Develop RE and encourage it to become a main energy source and be able to substitute imported oil in the future.
2. To strengthen national energy security
3. To support domestic renewable energy technology industries
4. Promote utilization of RE and encourage the formation of the “Green community”
5. Promote research of Thai-based renewable energy technologies in order to compete with the world market

One of the short comings of the AEDP is that it does not provide any information on how to achieve those targets and also does not have any mechanisms to measure their progress.

Comparing the objectives in the AEDP to the updated PDP (PDP 2015-2036), the principles of energy security are in line with each other, but there are also differences where in AEDP mention the objectives of developing RE to replace fossil fuels and conventional power plants (p.2). This section is in contradiction with the new PDP, which have plans to increase energy generated from coal and also introduce nuclear power (GIZ, n.d, ”PDP 2015-2036”).

The targets of RE development in the AEDP 2008 will be separated into 3 phases and the time frame will range from short to long term. The difference between each phase will be the type of project and schemes the government plan to achieve in a

certain period of time. For example finding technologies to incorporate into RE projects will be in the immediate phase, while activities relating to R&D and promotional campaigns will be in the medium to long term.

Table 1 explains about the 3 phases of AEDP 2008 targets that the government plans to achieve at the end of 2022.

Table 1:2008 AEDP short – long term targets

Source: DEDE

Immediate term (2008-2011)	Medium term (2012-2016)	Long term (2017-2022)
Support utilization reliable of existing RE technologies , such as solar , Biofuels, Biomass for power generation in potential areas	Promote local industry and support RE R&D on prototypes for both local and economic benefits	Further promote RE technologies and green community concept
financial and non-financial incentives, such as soft loans and tax exemptions	Increase rural energy production and develop green communities	Promote Thailand the so called Biofuel hub of ASEAN
-	Promote use of advance Biogas technology	-

The government that was in office during the implementation of the AEDP 2008 at that time has supported the usage of all types of potential RE sources, but as seen in table 1 they are emphasising more on promoting biogas and biomass than other RE sources.

Comparison of AEDP plans on solar targets from AEDP 2008-2022 to AEDP 2015-2036

Thailand has a total of 3 AEDP plans. The first RE plan was dubbed as the AEDP 2008-2022. In this plan the solar target was 500MW (DEDE, 2008, p. 14). The scope of the solar target was vague and the government did not elaborate on the category of the solar energy, for example they did not say how many MW out of the total target will be allocated to solar farms or solar roof tops and just labelled it solar energy.

Comparing the AEDP to the revised AEDP 2012-2021 (NEPC resolution, 2013) it has significant changes in the solar targets. The total generating target has changed from 500MW to 3000MW by 2021 (Tongsopit, 2014, “AEDP 2012-2021”). In this plan the type of solar projects is clarified and the specific quotas were set for how many MW will be allocated for different types of solar projects. According to a document received from a representative of the DEDE, there are 3 types of solar projects that the government has introduced. Those are solar farm (2000MW), solar roof top (200MW) and solar community (800MW) (DEDE, 2015, p. 13). The 200MW solar roof top will be split into 2 types, residential and commercial/factory. Both types will get a quota of 100MW each. The solar community project was meant to create a local value added chain and act as a new source of income for rural communities, however there were set backs and it was mention in a report by Chrometzka from GIZ, which states that the solar community project was never implemented, due to concerns about how the project will be financed and transparency issues (GIZ, n.d, Solar Community Into Gov and Agricultural).

As expected in the latest AEDP 2015-2036 the targets and goals will be modified and is different from the previous plan. Referring once again to the statics from the document given by the representative (DEDE, 2015). The total solar target have been increased to 3861MW. The 3 main categories of solar project have also been modified. The target for solar roof top have increased to 261MW from 200MW (pp.16-17) .The additional 61MW was not going to be distribute between the 2 types of solar roof tops, but was granted solely granted to the residential type. As for the solar community project the government has decided to keep this project and renamed it to “Solar PV for government and Agricultural Cooperative”. The focus of the scheme will be on solar farms with maximum output of 5MW per project and a total target of 800MW. This will be a public and private partnership between the government and agricultural cooperatives. Consultation from the ESCO Company have also been made available for the potential projects (p.18). Lastly, for the targets of solar farms the government has decided to add an additional 800MW (p.19) and will add up to 2800MW.

Table 2 shows the changes of targets and names of the 3 AEDPs from 2008 to 2015

Table 2: Change in targets of solar energy in the AEDP over time

Source: DEDE

AEDP 2008-2022	AEDP 2012-2021	AEDP 2015-2036
Solar target 500MW	Solar Farm 2000MW	Solar Farm 2800MW
-	Solar Roof top 200MW	Solar Roof top 261MW
-	Solar Community 800MW	Solar PV for government and Agricultural Cooperative 800MW
Total: 500MW	Total: 3,000MW	Total: 3,861MW

Comparing PDP 2012-2030 (PDP 2010: revision 3) and AEDP 2012-2021 solar energy target

A comparison of the PDP 2012-2030 (PDP 2010: revision 3) and the AEDP 2012-2021 solar target was made to confirm if information from both reports are in line with each other.

In AEDP (Sutabutr, 2012) the target for solar power generation was 2000MW by 2021(p.3). However, in PDP (EPPO, 2012) mention that the total planned solar target is 3,800MW by 2030. It also mentioned that to achieve the planned target, there will be 2 phases of development. The first phase will be from 2012-2021 and by the end of 2021 the solar generating capacity will reach 1806.4 MW. Phase 2 will start from 2022-2030 and will add an additional 1,995.7MW of solar power to the grid and will have a grand total capacity of 3,800 MW (p.15).

After looking into the first phase of solar development in the PDP, the numbers are quite different from one another. The target for solar is 1,806MW by 2021, which this is different from the 2000MW by 2021 in AEDP. Furthermore, there is a question about what will happen after 2021, because the AEDP will expire on that year, while the PDP will last until 2030. From PDP report it also mention that there are plans for development of RE, even after 2021 and by 2030 the total RE generation capacity should reach 29%, if it went according to plan (p.15).

A possible explanation to this could be lack of coordination between the organizations or the development plans were not as integrated as they claimed to be, since both development plans were independently written by 2 different agencies. Tongsopit and Greacen (Tongsopit & Greacen, 2013) have also mentioned in their

paper called “An assessment of Thailand’s Feed in tariff program” that the development plans were separately drafted and could hamper RE development. This proved that the development plans were not as integrated as they claimed to be (Tongsopit & Greacen, 2013, “Conclusion And Recommendation”, para.4).

Military takeover and revision of PDP and AEDP

After the coup d’état in 2014 on the 22nd of May (BBC, 2014) , which has led to a military takeover of the civilian government. The military apart from vowing to stabilize the political tensions in the country, have also made plans to reform Thailand in many areas including the energy sector.

They have decided to revise all energy related development plans, which includes the AEDP, PDP and the EE and then simultaneous draft them all at the same time. This could have been intentional or coincidental. But according to a source from the DEDE, the representative have confirmed that the new government intentionally revised all types of power development plans, in order make all the related ministries to jointly develop the new plans together at the same time (DEDE, 2015).

Solar development in Thailand

It was reported by the DEDE in the “Thailand PV status report 2012-2013” (DEDE, n.d) that solar development in Thailand has begun as early as the 1980s. During that period the purpose of solar PVs was to provide power for mobile medical clinics and telecommunication equipment. During that period solar policies was aimed at rural people and used as compensation for the lack of grid connectivity. After 2 decades at the beginning of the 1990s the government introduced another policy. This time it was to install PVs to power water pumping units and install charging stations in rural areas, free of charge. However, the result of the project was not what the government had expected. After couple of years the pumps and batteries broke down and it was said that the reason was due to the owners lacking knowledge on how to maintain the equipment. Another attempt was made once again in 2000 and this time it was called “Solar Home Systems”. 203,000 stand-alone PVs systems were distributed to rural villagers across the country. Sadly the result of the project were the same as the previous one, which in just a couple of years the PVs broke down and were left unused.

However, it is worth mentioning that not all projects were a failure in the 2000s and there was a project that actually succeeded. The purpose of the project was to provide PV modules to schools that were not connected to the grid in rural areas. It was considered a success because those PVs that were installed, is still being use today. Lessons learnt from those projects were that, if things that were provide for free and does not fit the actual needs of the person receiving it, the outcome would most likely be a failure (p.9). Governmental policy makers should keep in mind that if they give

people something they do not need or want, they would not see its value and will not make any effort to sustain it.

The real change to the solar sector happened in 2006, when the Adder program was introduced. Data from the “Thailand PV status report 2012-2013” pointed out that this was the first mechanism that was responsible for the switch from off-grid to on-grid connection and most of the PVs that are installed after that period were in a form of ground mounted solar systems (DEDE, n.d, p. 10). It could be seen that after 2010 (Figure 7), the amount of PVs connected to the grid have skyrocketed and doubling the amount of installed PVs. In a separate report Tongsojit and Greacen added that because of attractive adder price and efficient application was the reason for the increase in number of investors applying for the adder.

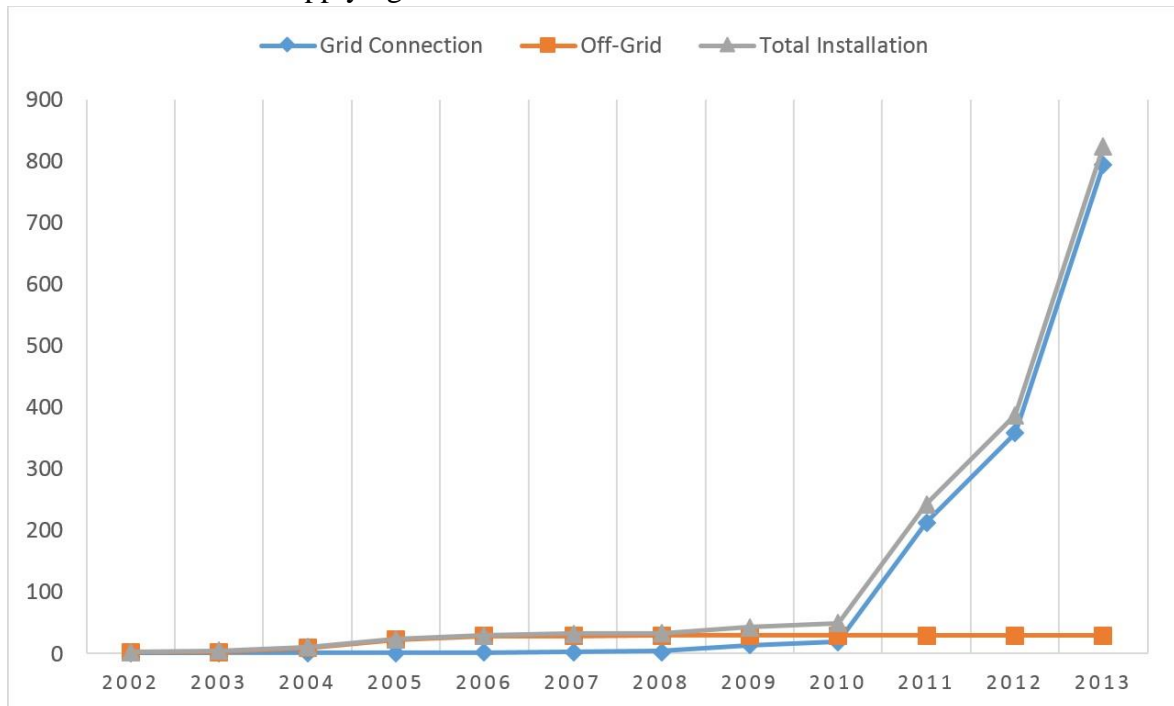


Figure 7: Development of solar installations in Thailand

Source: Thailand PV status Report 2012-2013

RE support incentives

If any true RE revolution was to take place there are aspects that are essential to foster the transition from conventional to RE consumption. The government must be motivated and create a good environment for private investors to take part in national RE development. More importantly, any policy that is going to be introduced should operate through a market based system in order to ensure the continuity of the policy by having good financing sources. The government could achieve this by introducing both financial and non-financial supportive measures. Supportive measure, such as the FIT is known to be widely used around the world, but there are also other types of supportive measures that countries could choose from, such as the Quota model, Tendering system and Net-metering.

In the case of Thailand they have decided to introduce the FIT and have other beneficial incentives, such as the BOI incentives, ESCO Company and support from the DEDE.

Support from DEDE

Apart from promoting RE in Thailand, the DEDE also provide other services that could be beneficial to investors. This include the one stop service, where the idea is to have everything that is related to solar energy investment located at one place. It also serves as a data base for anyone who is interested in RE, for example if an investor is interested in investing in solar technologies , the DEDE could provide them with information about maps on solar intensity, development progress and information about the technology (DEDE, 2015, p. 6).

Thailand's Adder program

The technology specific tariff or the Adder was first introduced in 2006 and was the first form of FIT in Thailand. The adder is a “premium price tariff”, which adds an additional price on top of normal prices that generators would receive. The program is available for VSPPs and SPP generators. The rates will depend on the type of RE technology, size of plant and will not have a degression rate. To finance the scheme all the cost will be passed on to the consumers (Tongsopit, 2014).

When the adder program was first introduced the biogas and biomass projects were heavily supported and funded by the government (GIZ, n.d, p. 1), however the most attractive RE source in the adder scheme (Table 3) was for solar projects. Solar energy projects had the highest support rate of 6.50฿, while comparing to biogas which is only 0.50฿ to 0.30฿ per kW. There were also additional extra top up price for the 3 provinces near the southern border with Malaysia. Which, the reason for the extra fee was due to security risk from the separatist movement in the area.

Table 3: Adder rate 2010

Source: EPPO

Type of RE	Capacity	Support rate ฿/kW	3 southern province and 4 districts in Songkla ฿/kW	Duration of support (years)
Biomass	1MW or less	0.50฿		7
	More than 1 MW	0.30฿	+1฿	
Biogas	1MW of less	0.50฿		7
	More than 1MW	0.30฿	+1฿	
Waste (MSW and industrial <ul style="list-style-type: none"> • Digester /Landfill • Thermal process 		2.50฿		7
	-	3.50฿	+1฿	
Wind	50MW or less	4.50฿	+1.5฿	10
	More than 50MW	3.50฿		
Small Hydro	50kW-200kW	0.80฿		7
	Less than 50kW	1.50฿	+1฿	
Solar	-	6.50฿	+1.5฿	10

Development of the Adder program

Tongsopit and Greacen interestingly explains about the developments of the adder and how it has affected the Thai market in a paper called “An Assessment of Thailand’s feed In Tariff Program” (Tongsopit & Greacen, 2013). Described the amount of solar applications sold in 2008 as a “solar gold rush”, it was a period when the demand for adder permits was high and companies were scrambling to get as many permit as much as possible. As a result from this phenomenon the amount of predicted generating capacity from the applications has surpassed the 2000MW (The Evolution of Thailand’s Adder Program, para. 6)

At that time it seems that the adder was a success, but not until 2009 when the MOE started to realized that a large portion of the PPAs were actually bought by small companies that does not have any interest in constructing solar power plants and just wanted to purchase as many PPAs as much as possible and then resell it to other companies at a higher price. This was alarming because the amount of energy from the PPAs have reached 2GW and went over the target of 500MW. The MOE was concerned, since all the cost will be passed on to the consumers and that if all the permits were approved it would be too much of a burden for the consumers. The reason why this activity was thriving was, because during that period of time applying for a PPA permit was a simple process and there were also no cap on the amount of applications that could be issued to the investors (para. 6,7).

To solve this problem the MOE have decided to create a committee to ensure that the investors are complying with all the regulations and amend existing ones. They have also lowered the adder price for solar energy and ordered the utilities to ensure that

all applicants have met the necessary regulations before allowing them to connect to the grid (para.8). Bid bonding was introduced to prevent companies with the intention of reselling permits. The idea of Bid bonding is to make interested companies pay a deposited money of 6\$ per kW to ensure that they are not going to terminate the contract after they received the permits (para.5). The changes and stricter regulation have not only made a big impact on the solar market in general, but also to entire RE sector. As a result there were fewer applicants applying and the rates of applicants applying has slowed down considerably compared to the period before policies were changed (para.12).

The change adder has closed some loop holes in the policy and had successful solve some problems. However, it has also create new ones as well. The committee was criticized for the lack of transparency. The committee is operating in a centralized management style and decision making will be held by the committee with no public participation. All types of RE projects will also have to be reviewed exclusively by the committee and there were no guidelines to help decide which RE projects should be approved first (para.10, 11).

The adder had a promising start at the beginning of the program, it manages to attract investors with attractive prices and even have assurance that the contract once signed will not be terminated. However, problems arose during the implementation period and the policy have encountered many obstacles that has restricted the program from reaching its full potential. Support for the program was not constant and kept on changing, there were no existing laws to prevent new governments from modify the regulations after they took office and support is going on and off. Lessons to be learned

for the new FIT should be to strengthen the regulations and prevent loop holes from occurring at the planning phase and should not wait until implementation. The number of accepted applicants for the new FIT must be carefully monitored and should not repeat the same mistakes as the adder and lastly, transparency should be improved to increase investor confidence and clear any doubts about the scheme.

FIT program

Feed in tariffs is one of the mechanisms that are used in many countries to encourage the production of RE generation. The purpose of the FIT is to subsidize RE generators and help them compete with conventional generators by getting in a PPA agreement with the utilities. RE generators will be paid a fix tariff for renewable electricity that is sent into the grid. The price of the tariff will vary and depend on the circumstances. For example the fees paid will depend factors, such as year installed, type of RE technologies and the size of the plant. The FIT is not a subsidy program and therefore, the cost of the tariff that utilities will pay to the RE generators will be passed on to the consumers into their electricity bill (BMU, 2007, pp. 5,6,24).

Even though, the FIT has the potential to encourage many investors to invest in RE, policy makers should be cautious about cost of the FIT. If the government had issued too many permits it could lead to increase in the cost and put too much presser on the consumer. The economic effects of an increase in energy tariff will have different effects in different countries. Developing countries are more sensitive towards changes in the electricity tariffs, compared to their developed counter parts.

Transforming from adder to FIT

The transition from the adder to FIT program started during the implementation of the AEDP 2012-2021, but the period when the adder will be completely replaced by the FIT will be in the AEDP 2015-2036. The FIT will move from a premium price to a fixed price that will be constant over the duration of the PPA, of which it will represent the real cost of production and be reviewed according to the market mechanisms.

GIZ has reported that for projects which was caught in the middle of transition from adder to FIT during the AEDP 2012, will still have rights to the adder program and investors that have already finalized the contract with the government will have this right. The government have also decided to increase the quota for the solar farms as a second chance for applicants that failed to get the PPAs during the first round of concession, but only 576MW quota will be available and the terms will also be different. Investors in the extension period will not have adder support, but will instead have the FIT support at the rate of 5.66 € (GIZ, n.d, “Private Investor Solar Farm Revived”).

The focus of the military government have also changed and is currently supporting technologies of waste to energy, Biomass and Biogas technologies. Wind and solar on the other hand will be focused in the next stages of development (GIZ, 2015, “AEDP 2015-2036”). In the new FIT the method of selection of projects is different from that of the adder. Instead of the first come first serve system, investors are required to go through a bidding process and projects that is the most competitive will be selected. This will screen out any companies with the intention of just acquiring

permits and reselling it. With this method companies would have to show the project's feasibility study before applying for the PPA.

Thailand FIT

The new FIT for VSPP can be separated into 3 types of FIT.

$$\text{FIT} = \text{FIT (F)} + \text{FIT (V)} + \text{FIT Premium}$$

The FIT (F) is a fixed based payment that RE generators will receive for the entire agreed duration. For the FIT (V) price will vary according to as fuel type for the feed stock, inflation rate and feed stock. Technologies that is in this category are usually biogas, biomass and waste to energy. The last option is the FIT premium, which to be able to have this option investors must fall into two project types. The first type is a support of for any projects that utilizes renewable fuels for a duration of eight years. Projects that is suitable will include, biomass, biogas and waste to energy. The second option is for projects located in the three southern province of Thailand, which will receive full support for the entire duration of the project. The support of the three southern province fees have also been increase from adder program, it is better because in the adder program it will only add an extra fee to the RE project, but the duration of support time as other provinces. This is not attractive enough for investors to take the security risk in that region. For the new FIT government is trying to increase the attractiveness by providing of the three southern provinces by giving full support for the entire duration of the project (GIZ, 2015, "Renewable Energy Support").

Solar FIT

The main difference between the solar adder and the FIT was that in the FIT scheme the duration and the target quota has increased. The rates have also been adjusted and Clarification about the type of solar projects were made. The government have diversified from only having solar farms and expand to have additional solar projects, such as the roof tops and Solar PV for Government and Agricultural cooperatives. The price have also been adjusted to adapt to the current year (Table 4).

Table 4: Solar Energy support mechanism - Adder and FIT

Source: DEDE

Year of AEDP	Type of supporting measures	Support Rate Thai Baht (฿)	Duration of support (Years)
AEDP 2008-2022	Adder	8.00฿	10
	Adder	6.50฿	10
AEDP 2012-2021	<ul style="list-style-type: none"> Solar Farm Adder 	8.00/6.50 ฿	10
	<ul style="list-style-type: none"> FIT PV roof top (2013) -Residential (0-10kWp) -Small Enterprise (10-250kWp) -Medium to Large Enterprise/ factory (250-1,000 kWp) 	6.96฿ 6.55฿ 6.16฿	25
	<ul style="list-style-type: none"> FIT Community Solar 	N.A	N.A
	<ul style="list-style-type: none"> Solar Farm FIT 	5.66฿	
AEDP 2015-2036	<ul style="list-style-type: none"> Solar Roof Top (2014) -Residential (0-10KWp) -Commercial / factory (10-250 kWp) (250-1,000 kWp) 	6.85฿ 6.40฿ 6.01฿	25
	<ul style="list-style-type: none"> Solar PV Government and Agricultural cooperatives 	5.66฿	

Public uncertainty in the solar roof top program

The rates for solar FIT is considered attractive, but for the solar roof top program there are doubts on whether the government is fully supporting the scheme because the investors are wondering on why is there a quota and deadline for applying for the permits. Since, the Thai government does not normally publicize their information that often, it is not a surprise that the public does not know about recent updates or what the government is doing. In a conference called “Joining hands for sustainable energy” that was hosted in Bangkok. The topic was about RE development in Thailand. When the topic on the new FIT for solar roof top was raised, nobody knew the reasons on why the government have place a cap and a deadline for solar roof tops (Joining hands for sustainable energy, 2015).

The government in most cases will only give out basic information regarding about price and the duration on the FIT and will not explain to the public on how they came to his decision. Even on the governmental website there is only a summarized explanation from the meetings about solar roof top, which the best hope at finding information is to go directly to the DEDE and ask for information. With the lack of information from the government the public are left with the only option of assuming and guessing, which it could lead to confusion and misunderstanding about the policies.

To clarify about the cap on the solar roof top scheme, questions were asked directly to representative from the DEDE’s solar energy department (DEDE D. o., 2015) and EGAT’s, TSPD (EGAT T. S., 2015). Comparing the answers from both department will determine if the information is credible or not.

After interviewing both governmental agencies the response was similar. Both agencies insisted that the grid is not full and have space to accommodate RE, but also said that the grid needs to be expanded and modernized.

The main reason for the quota on solar roof tops was to test the market and check the popularity of the scheme. Another reason was that there is only a few regulations on solar roof top and this project will be a testing phase, which mistakes and complications that occurred during the implementation period will be analysed and improved. This could be referred back to the section about the adder program. They have had problems in the past when the government does not have a cap on the number of MW and risk over charging the consumers.

When ask about the possibility of removing the cap on the amount of MWs for solar roof top the representative from the DEDE said that the department is discussing about the issue at the moment and is currently researching on the effects and the possibility of a removing the cap.

BOI incentive

The government of Thailand wants to increase solar energy businesses in the country and has instructed the BOI of Thailand to introduced incentive to make solar energy business attractive to both foreign and local companies to invest in business related to solar power. There are two types of solar business that the BOI is currently supporting. The first type is categorized as the service and public utilities, meaning that any power plants using RE sources to produce electricity or steam will receive the benefits. The second type is manufacturing of solar PVs for the electronics and electrical appliances industry. If a foreign company decides to invest in solar cell manufacturing they will get the same benefits with companies that will build solar power plants, but the difference will be that the manufactures would have to get an approval from the BOI board (BOI, 2015).

Incentives for solar energy business

- 8 years corporate income tax exemptions (excluding land cost and working capital)
- Exception of import duty of machinery
- 1 year exception of import duty for raw materials or essential materials that is needed for manufacturing export products (year of exception could be extended , which will depend on the board)
- Foreign employees that the company has relocate to Thailand will get income tax exception for a period of time
- Rights to own 100% of the company
- The rights to purchase land for the project

For foreign companies investing in solar energy businesses in Thailand will receive special benefits that other types of industries will not have. For example one of the most

important features is the 100% ownership rights of the company. In Thailand there is a law that prevents foreign companies in certain industries to have share not more than 49% and must not have less than 51 % of Thai shareholders. An example of such industry would be the agricultural business. Since Thailand has a large number of agricultural business, foreign companies are required by law to have only half of the shares to prevent them from having full control of the company. Furthermore, most foreign companies are not allowed to purchase land and must rent land from Thai land lords, however there are exceptions for some “special” industry that is allowed to purchase land.

The Thai government does not prevent foreign companies from investing in local business, but they will not encourage it and would even make it unattractive for investors. It is a different case for the industries that the government wanted to expand, of which they will give many incentives and support to draw in as many investors as possible.

ESCO Company

It is a non-profit organization that is specialized in energy management. It was established by the government in the early 2000 to encourage efficient management of all types of energy and also provide consultation to the government when they are developing new energy policies. For a sustainable development of RE market it is important to keep in mind that it is not a government policy that is the only important factor, but at the same time it must also have the right supportive measures that could propel the development and sustain it.

The main purpose of the ESCO Company is to consult and act as a knowledge centre to give advice and encourage the development of RE technology to potential investors that is interested in investing in the Thai market. Services from ESCO Company that would be beneficial to investors could be separated into 2 types. The first type is consultancy about project development, which technical information about RE technology will be provided and also a feasibility study service will be available. The second type of consultancy is about financial consulting. If the investor does not have any capital to invest in the project, the ESCO Company could seek out the source of funding for them and provide them with the necessary financing. In another scenario where the investors have the capital to invest but does not have any knowledge about RE projects, the ESCO Company could find potential projects and introduce them to the investor (DEDE, 2012).

ESCO fund

Even though the main business activity for ESCO is to provide consultancy to investors, it also has a secondary support mechanism called the ESCO fund.

The ESCO fund was introduced by the DEDE in 2008 and was financed through the “Energy conservation promotion fund” with the budget of 500 million Thai baht with aim of funding energy efficient and RE projects. The project is separated into 2 phases and potential projects would have to pass a screening from a committee that was formed by the Energy for environment foundation and the Energy Conservation Foundation of Thailand (Foundation E. f., n.d.).

Once the project proposal is passed, subsidies will help cover a portion of the cost for the companies. The subsidy could be used to for other purpose depending on the project , which will include equipment leasing, credit guarantee, equity investment, technical assistance, ESCO venturing and carbon crediting.

However, at the end of phase 2 most of the projects that were approved were mostly energy efficiency projects. RE projects that were approved was dominated by biogas projects and only 1 solar project was approved (Sirikoon, 2012).

German case study

Energy turn around

The energy mixt in Germany is comprised out of mainly conventional sources that has contributed up to 80% of the total energy production. The other 20% is from renewable sources (Fig 8). Like any other country Germany is highly dependent on fossil imports. However, this situation will change in the future because the federal government has decided to switch from conventional production to RE production and with an ambitious goal of producing 80% of electricity from renewables by the year 2050. This ground breaking decision is known as the “Energy Transition” (Energiewende).

To achieve this goal the German federal government has introduce many legislations and incentives to help boost power generation from the RE sources. Important laws such as the EEG and the FIT have made a large impact over the past years and will continue to play an important role in the German national energy development in the future. Introducing new regulations will not be enough to ensure success in the energy reform. Monitoring process and continuous improvement is also needed to ensure that the policy is living up to its expectations. Grid development will also a major challenge for the Germany government and is therefore seen as a priority (BMU, 2007).

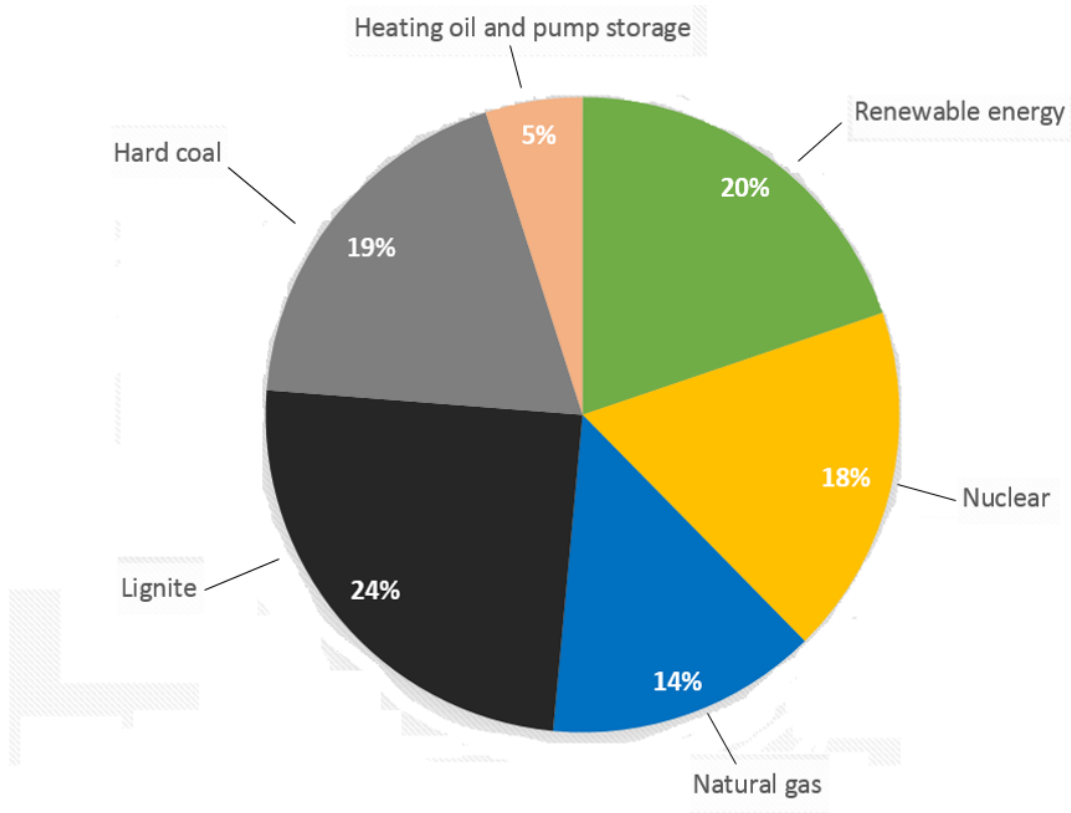


Figure 8: German Energy mixt in 2011

Source: Federal ministry of economics and technology

RE production

Renewable sources (Fig 9) in Germany is comprised out of Solar, hydro, wind and Biogenic household wastes. Wind energy is the most widely used source of RE, which accounts for 8% out of the 20% total RE in Germany and was promoted in the first phase of the RE development during the electricity feed in act. Biomass is the 2nd most popular (5%), while solar and hydro only account for 3 % each and the last one is 1% from biogenic household waste.

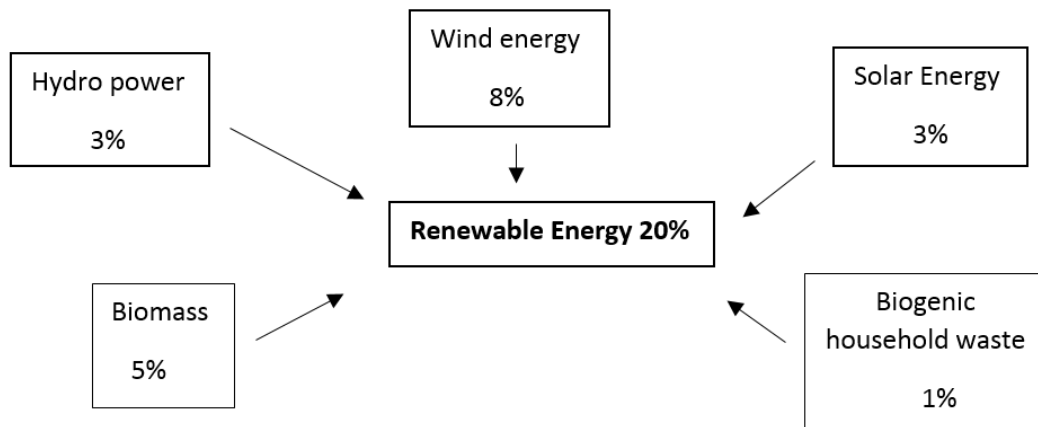


Figure 9: RE in Germany

Source: Federal Ministry of Economics and Technology

Summary of German policies

According to the International Renewable Agency “IRENA” the topic renewable energy alternatives in Germany started during the oil crisis, which stressed the importance of energy security from energy imports. However there were not any significant change at that time, because they ended up talking about utilizing coal and nuclear power as a baseload. But later on at the same period of time in 1979 a tariff for RE generation was introduced to create a market for RE and to stimulate growth. The regulation implies that the distribution utilities purchase locally produce RE at a price that is equivalent to the avoided cost, meaning that RE generators will receive compensation for the higher production cost. However, the pitfall was that the estimate for the avoided cost was considerably low and has resulted in a low price base and did not make a significant impact on the market. It was business as usual and the German energy sector was dominated by large power generators using fossil based fuel sources, mainly from coal and nuclear. The trend started to change around 1986 during the nuclear disaster at Chernobyl. After the accident there was a negative impact on the public opinion on nuclear technology and the government was asked to change the energy policies to pave way for more alternative sources such as RE (IRENA, n.d).

The first RE policy

The major change in energy policies happened in 1991 when the Electricity Feed in Act was introduced. It was a policy that was aimed at regulating RE and guarantees that RE generators will have access to the grid. The introduction of the first official FIT for RE was a game changer for RE generators and especially for wind energy, which the government has given the highest tariff rate of 90% above average electricity price. Then in 1997 it was incorporated into the reform plans of the energy sector and by the time the reform plans were being conducted the Electricity Feed Act was considered as a success and it has placed Germany as the 2nd largest producers of wind energy (IRENA, n.d).

EEG

The key stone of the current German RE policy called the “Renewable Energy Source Act” or in short the EEG, was introduced in the early 2000s and was amended in 2004. The EEG was the successor of the electricity feed in act and was credited for Germany’s success in increasing RE generation (BMU, 2007).

Even though the Electricity Feed in Act was considered a success in creating a market for RE, policy makers have decided that the policy must be improved ,in order to adapt to the change that was about to come. The reasons that led to the change was due to rapid growth of RE output that even exceeded the 5% cap that was set to support its development. Also to lower the burden of the cost for the support incentive and improve investor confidence, it was decided that the cost for the compensation for RE generators should be shared on a national scale through the equalization scheme rather than on a regional scale. Furthermore, the government is committed in the energy

transition and plan to switch from fossil based generation to a renewable based generation. To achieve this there has to be an improvement in the planning phase and also must be in compliance with the EU directives. With this in mind the policy makers have decided to introduce the EEG (BMU, 2000)

According to EEG hand book “EEG- the Renewable Energy Source Act” (BMU, 2007) The EEG’s aim is to further expand the market of for RE generation by amending previous legislation and introducing additional ones. The significant of the EEG is that it has made it mandatory for utilities to prioritize RE access to the grid. This referred to as “Grid Priority” which means that at times when the grid is running near the full capacity, conventional generators must lower their output to make way for RE electricity. Grid operators are also instructed to synchronized grid development with RE expansion (p.5). The cap on RE generation is also removed and RE generators will receive a fixed tariff through the FIT scheme. The FIT in Germany does not use tax payer’s money and is not a subsidy. The cost for the support will be distributed and charged in the electricity bill to the end user. Another important aspect of the EEG was that it is required by law that the rights of investors will be upheld and a case where the policy has changed in the future, their rights regarding fees paid, grid priority and the duration of support time will be protected (p.6).

Renewable technologies in the past decade have undergone major technological advancements. The cost per unit to manufacture has been decreasing and is still continuing to decrease, due to increase in manufacturing efficiency and mass production. To ensure continuous improvement, there need to be a mechanism that could put pressure on the industries and encourage them to become innovative. That

mechanism is called the “Degression Rate”. The definition of this mechanism is that it is an annual reduction of supportive price given to RE generators. The rate of degression will depend on the year of installation and the type of technology. For example in the case of PVs, the support for a solar power plant was 49.21 euro cent per kWh in 2007 for twenty years, however if the same power plant was in a different year for instance in 2008 the price would be different at 46.75 euro cent per kWh. With this mechanism in place industries must constantly develop innovative solutions to be competitive to reduce the cost of installation of the PVs to same level as the demand (p.7).

Difference between Thai and German FIT

The FIT incentive in Germany has been a role model policy to develop RE generation in many countries, including Thailand.

Most of the main components of the FIT in Germany is similar to that of Thailand’s. However there are notable difference. In Germany the FIT grants a fix tariff to all type of RE plants and operators will receive support for a period of twenty years (excluding small hydro power), while in Thailand they have a wider range of support time and conditions. For example solar projects will have twenty five years of support time and other RE sources will have twenty years (except landfill that has ten years). The German FIT also have no cap on the amount of RE generation and is running in line with the market, while Thailand has a minimum target and has a cap. Furthermore, Thailand does not have a degression rate, which companies that is producing electricity to the grid gets large amount of profits when they are in operation. Tongsofit have also argued that the reason why the degression rate could not be place in Thailand was due to

red tape. There are also no limit or cap on the amount RE that could be sent to the grid in the German FIT, while in Thailand the grid has limited space and could only accommodate a limited amount of RE.

The focus of the RE type is also different between the 2 countries. Before it was wind energy in Germany, while in Thailand it was Biomass. However the focus has changed and now in the revised EEG and the AEDP 2015. Germany has switched to solar, geothermal and biomass. Thailand has changed to Biomass, Biogas and waste to energy. Lastly, Thailand does not have clear laws to protect investor's interest. In Germany it is in their basic rights that investors will be protected in any changes to the policies in the future. Changes such as the duration of support and grid priority will be upheld.

Difference for the solar FIT was that in Germany they have introduced a policy called "Location Specific Fee". It was introduced during the 2004 amending of the EEG and its aim is to encouraging people to install PVs on buildings or as a building component. If PVs are installed on buildings they will get an extra five euro cent extra. Degradation will also be different. PVs that are installed on buildings will receive lower rate of degradation of 5%, which compare to open space PVs it is 6.5% per year (BMU, 2007, p. 8).

This is an interesting policy because installing on top of buildings will use the space efficiently and lower the space needed to install the PVs in open spaces. It could be introduced to Thailand, but the problem will be the cost passed on to consumers. If too many people are interested the electrical fee will rise and will be a burden on the public. A possible scenario could be that this could be a pilot project and the

government could have a cap on the number of houses that is allowed to participate. It would be a similar path to the current FIT where they are testing the consumer's response.

Solar rates Germany

Solar PVs in Germany has contributed only 3% to energy production. As mentioned earlier in the previous section, solar rates in Germany could be separated into 2 parts. Those are the power plants that are integrated into buildings /sound proof walls and PV power plants that is built in open spaces (BMU, 2007, p. 8).

Table 5: German solar FIT

Source: EEG

		Year				
Type of solar installation	Capacity	2004	2005	2006	2007	
Plant installed on buildings	• Less than 30kWp	57.40	54.53	51.80	49.21	Payment Euro cent /kWh
	• 30kWp - 100kWp	54.60	51.87	49.28	46.82	
	• More than 100kWp	54.00	51.30	48.74	46.30	
Building surface bonus	-	5	5	5	5	
Plants not installed on buildings (normal FIT)	-	47.70	43.42	40.60	37.96	

Grid development and RE production

The grid development and RE development has to be developed together at the same time. RE production is a decentralised system that is distributed around the country, it is a different approach from the conventional sources that is usually construct near large cities. The grid developers would have to change the way they design the grid because the old strategy were not designed to accommodate RE production. This will be a hard task to accomplish because RE generation does not depend on the demand of the consumers, but rather on the condition in the area. In the case of solar energy it will rely on the intensity of the sunlight and will be harder to predict.

The grid of the future will have to adapt to these changes by assuring that when demand of RE is low, the grid must be able to transport it to another location. This would mean that the grid operators would need to construct high power lines to be able to transport the energy. Furthermore, operators must take into account that in the future there will be more RE generation. This means that the grid must be able to handle “bidirectional traffic” from the VSPPs.

Most countries have over looked the importance of the grid and have realized later that they would need to expand the grid. In both the German national energy policy and EEG has stated clearly about the priority of developing the grid together with RE. The energy development plans are also transparent and explains in detail on what are the objectives and details on how to achieve it (Technology, 2015).

In Thailand it is a different story. The grid in Thailand is designed for conventional electricity generation and is trying to adapt to the increase in RE production. According to the department for transmission system planning at EGAT, the

representative have reported that the Thai government have only recently consult about the status of the grid and in the PDP have only mentioned a small section about the need to expand the grid , without giving any details. The representative also argued that the reason why they could not share the information to the public was that because unlike Germany where the grid operators and the utilities are privately owned, the Thai grid and utilities are government owned and any expansion of the grid would be contract to private companies, of which they would have to go through a bidding process. The information regarding about the grid will be given in the bidding stage and thus not shared with the public (EGAT T. S., 2015).

Importance of having generating 2 systems

The advantage of RE technologies are that unlike its conventional counterpart they do not need to worry about the fluctuating prices of the energy market and some do not even need to have a feed stock to generate electricity. However, the problem with RE sources of solar, hydro and wind is that it could not be controlled and match with public energy demand. In order to ensure grid stability there will still be a need for conventional power plants to become a backup generator (BMU, 2000).

In both the German and Thai energy development plan have both realised this and has stated that conventional sources will still be part of the energy mix. For Germany they used the term flexible conventional power plants , while in Thailand according to the government their main goal is to diversify the energy source and came up with the so called “ clean coal technologies”, which will serve as a the base load and ensure reliable generations.

Monitoring

Creating many policies and targets is important, but at the same time it is also important to be able to measure the progress and impacts, in order to verify if the policy is working or not and whether it needs to be revised to better suit the situation.

In the German energy policy it is required that every 3 years there should be report on the progress of the policy and it will be written by a panel of energy experts. This reporting routine will determine how the policy could be improved by analysing the obstacles. This approach would be beneficial to Thailand if they could create a monitoring process like in Germany. Many policies are being created by the Thai government, but there is no monitoring process to confirm if the policy is effective or not (BMU, 2000).

Recommendation

The policies and incentives such as the , the FIT, BIO incentives ESCO and DEDE consultations have made a positive impact on RE expansion and was accredited for the increasing RE generation in Thailand. However, incentives alone will not be enough to ensure sustainable development of RE as a whole.

Below are improvement that Thai government should consider improving

- Transparency
- Better coordination between government agencies
- Integration of all energy development plans
- Grid prioritization
- monitoring

Solving these issues would help boost investor confidence, ensure continuous improvement of the policy and sustainably develop RE in Thailand.

Solar energy in Thailand only accounts for 24% of the totally share of RE, but it is increasing rapidly because of the adder and FIT program. However, expansion of all types RE cannot expand at the rate that the investors are investing in, due to limited grid availability.

German policies and best practice that Thai government should consider adopting should be as follows.

Monitoring of policies

Monitor procedures should be create in Thailand, since previous governments have introduced many policies but does not have any methods to confirm if it is a success or if it should be improved. For the sake of transparency the monitoring

committee should be a 3rd party, should be comprised out of energy experts and publish their findings on the internet for the public to read.

Integration of development plans

The AEDP and the PDP have both mentioned that they were written to be in line with each other, however the reports were separately written by 2 different government agencies. Integrating the plans together would ensure that the plans in the AEDP is going to be as part of the national development goals and not just plans to expand RE. In Germany the development of RE is integrated into the national development plan and all related policies are justified with detailed explanation on why it was introduced.

Prioritizing grid expansion

Grid development should be included in the national energy development agenda. The current situation of the Thai grid is that it could only accommodate a limited amount of RE. If there is no additional investment on the grid in the future, Thailand will have a problem increasing the generation capacity of RE because the grid will be full. Limited information given to the public about the details of the grid has created uncertainty and confusion for potential investors. The bidding process of the grid prevents any information on the grid to be distributed publicly. If the data could be published online it would make it easier for companies that are interested in RE generation to conduct feasibility studies.

Transparent reporting

The top down approach from the Thai government has limited public knowledge of government activities. Having a transparent reporting will increase public and investor trust in the government. Future developments of Thai energy plans should be design to have full details on policy developments and make the format easy to understand for public review. This approach will also allow the general public to give feedback and suggestion about the policies. The government is currently only consulting with energy experts through conferences and meetings between departments, but the general public does not have any say in the development of the policy.

Law to protect interest of investors

If Thailand plans to succeed in developing RE that is in line with market, they must ensure that the interest of investors are protected. There need to be a law that will ensure that the government could guarantee that the contract and agreement will be fulfilled, even if there is a change in the policy. Accomplishing this will increase investor confidence and could attract more investors to invest in RE.

RE energy law

There need to be law that is designed especially for Thailand, which the EEG from Germany would be great example to look at. The energy regulations in Thailand will change every time a new government takes office. To make the situation worst Thailand's is also not a politically stable country. This has resulted in frequent changes in the government and every new government that took office will have their own version of development goals. Therefore, there should be a law that will ensure that any new government that will take office will have to follow through the long term plans and not change it.

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