

Alternative Energy Development Plan: AEDP 2012-2021

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Abstract

Fossil fuels is the major energy source to drive economic growth in the world but the most risk for future security and the major cause of green house gas emission. Thailand falls in the same situation when the economic relies heavily on imported fossil-fuels. From the statistic information source last year illustrates that Thailand's crude oil imported value in 2011 was as high as 927 billion Baht. This definitely results in losing the huge amount of money and environmental impact of the country. Therefore, Thailand needs effective mechanism to fight against this crisis. The government of Thailand, therefore, has currently assigned the Ministry of Energy to set up the 10 Year Alternative Energy and Development Plan-AEDP (2011-2021) aiming to create the framework and direction for increasing alternative energy consumption by 25% in 2021. This is based on the forecast that the future energy demand in 2021 at 99,838 ktoe while the existing demand is 71,728 ktoe. The AEDP plan - for a resource efficient, greener economy with more opportune investment - aims for promoting the use of alternative energy to reduce imported fossil-fuels, strengthening energy security, promoting alternative energy consumption at the community levels under the green community concept, supporting domestic manufacturing of alternative energy technology for domestic requirement, and last but not least, research and development for the country's competitiveness in the world market. In achieving the AEDP, **strategies** have been set out such as, community participation in the production and consumption, more attractive incentives for private investment in alternative energy, rules and laws amendment, infrastructural improvement, creation of public awareness and educational campaign, and research and development support. The AEDP expects benefits from saving 574,000 million Baht on Thailand's bill for oil import with the private investment value of 442,000 million Baht. The emission reduction commitment will be reduced to 76 million tons/year with additional income for 23,000 million baht.

Keywords: *alternative energy development plan, renewable energy, policy mechanism*

1. Introduction

Thailand relies heavily on imported energy. In 2011, crude oil was imported as high as 85%, and the total imported value was about 1,125 billion Baht. This situation plus the impact of climate change and environment resulting from greenhouse gas emission is the critical issue that everywhere in the world, including Thailand, pays great attention and set measures for solving it out. Among effective mechanism to tackle with this issue, alternative energy seems to be the best ways out for us to develop and promote towards a final end of green house gas reduction and paving the ways for Thailand to become a low carbon society and the world renowned showcase as the country of alternative energy consumer and developer.

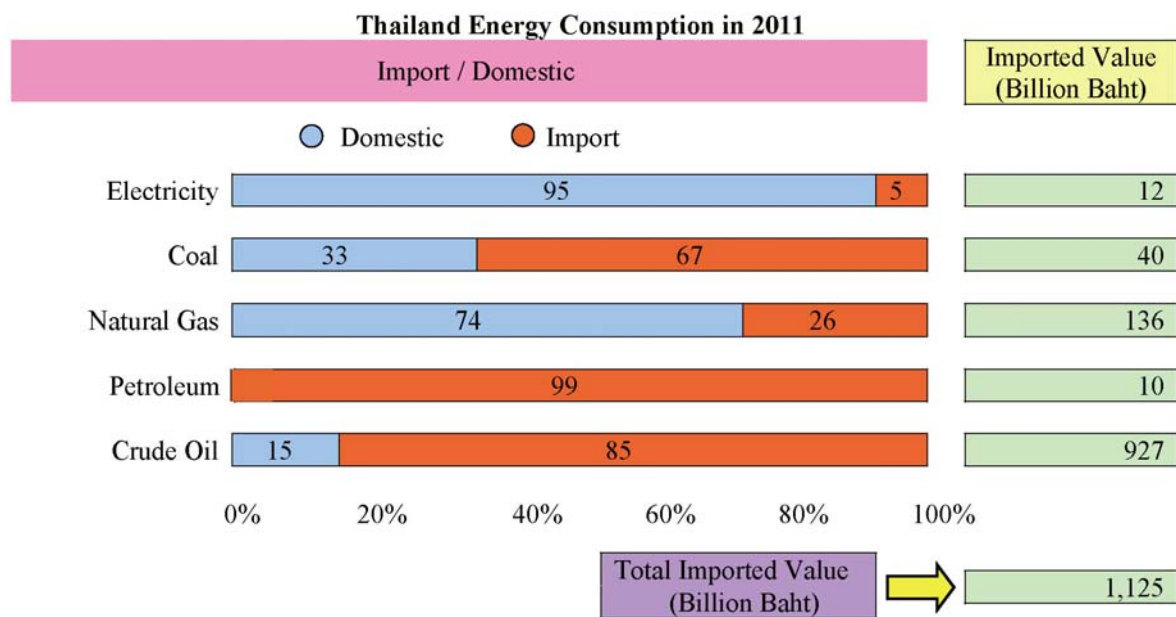


Fig. 1 Thailand Energy Consumption in 2011

In terms of alternative energy sources, Thailand is rich in agricultural products that can be yielded for energy purposes such as biomass, biogas, biodiesel, ethanol, and the by-products from processed food industry. Geographically situated in the equator, Thailand also has great potential in solar with average radiation of 18.2 MJ/m²/day; and in some areas with wind speed potential. Thus, these can make Thailand the best potential on alternative energy development and create opportunity to strengthen energy security in the future.

The Government of Thailand has currently assigned the Ministry of Energy to set up the 10 Year Alternative Energy Development Plan (AEDP) aiming to create the framework and direction for increasing alternative energy consumption by 25% in 2021.

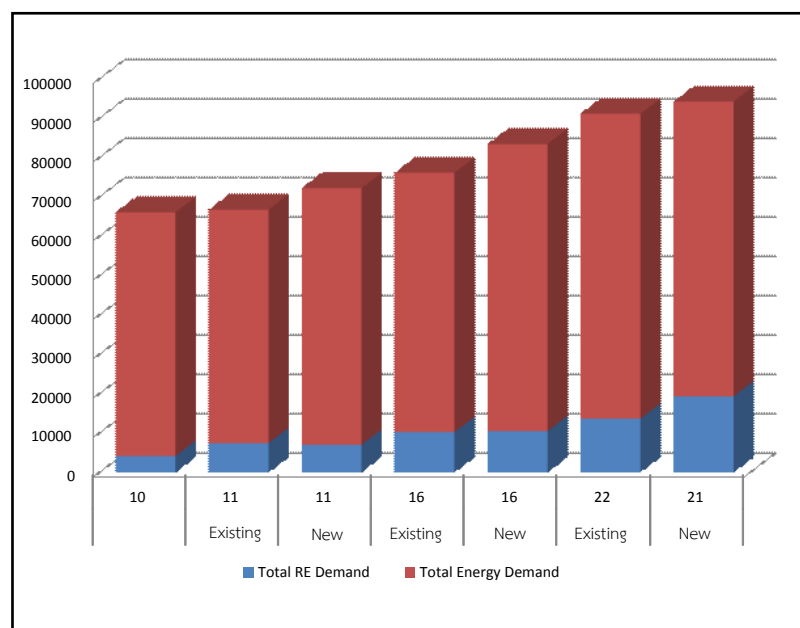


Fig. 2 AEDP of 25% targeting within 2021

It is forecasted that the future energy demand in 2021 will be accounted for 99,838 ktoe while the existing demand is 71,728 ktoe. The energy consumption from the Power Development Plan (2010-2030) together with AEDP (2022-2021) is expected to increase from 7,413 ktoe in 2012 to 25,000 ktoe in 2021 or 25% of the total energy consumption.

2. Key contents

2.1 Objectives:

- 1) To sustainably develop alternative energy as one of the main energy for fossil fuels substitution and oil import replacement (AEDP excludes CNG from the monitoring table in transport sector)
- 2) To strengthen the national energy security
- 3) To create the community-based alternative energy facility in the form of “zero-waste integrated complex”
- 4) To support the alternative energy technology production in the country
- 5) To research, develop, and promote alternative energy technologies for the country’s competitiveness

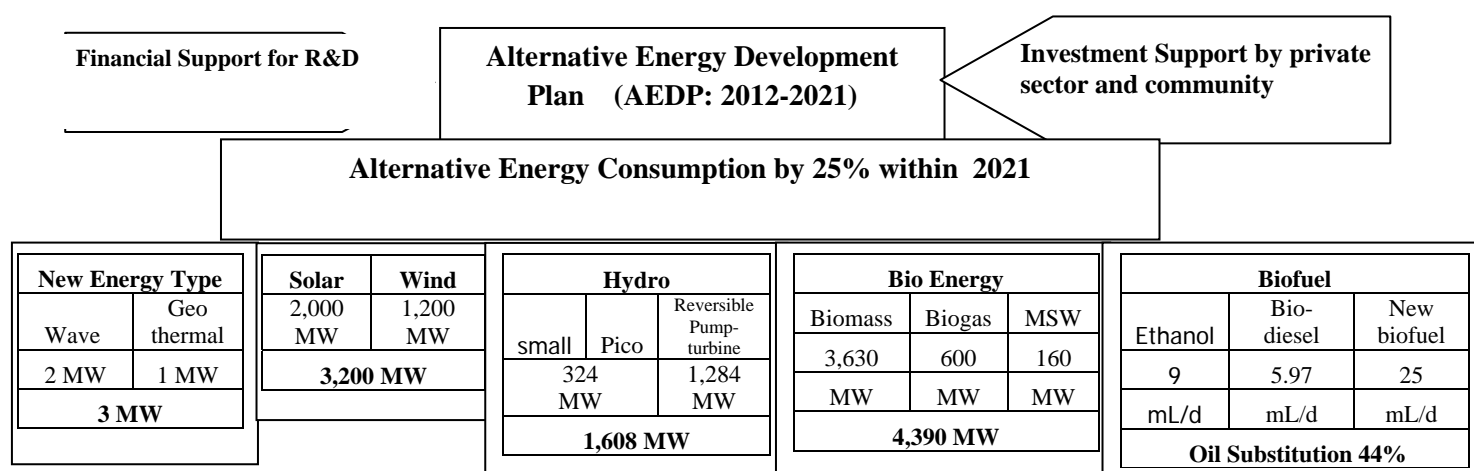


Fig. 3 Development towards Low Carbon Society

2.2 Strategies

In order to promote AEDP, the following 6 key components are set as strategies:

1. Promoting community participation in alternative energy development and consumption across the country
2. Improving incentive measures to foster private investment
3. Amending laws and regulations unfavorable to alternative energy development
4. Improving essential infrastructure such as transmission and distribution system as well as smart grid
5. Promoting public relations and knowledge enhancement
6. Promoting research activities as the entire development tool for alternative energy industry

3. Driving towards technologies

3.1 Electricity Generation

3.1.1 Solar: The AEDP target of solar power generation at the year end in 2021 is 2,000 MW while the existing generating capacity is 75.48 MW. Therefore, solar development and promotion under AEDP strategies are set as follows:

1. Promoting small solar system for the community and household levels including solar PV rooftop in order to achieve the generating capacity of 1,000 MW in 2021. Apart from households and communities levels, the government also promotes solar energy application in official building and industrial rooftops, housing and condominium projects, and government buildings,
2. Improving financial measures to foster private investment such as, the adder system to become Feed In Tariff (FiT),
3. Amending laws and regulations unfavorable to alternative energy development for example, amending and improving the Industrial Act 1992 (B.E. 2535),
4. Improving essential infrastructure such as transmission and distribution system as well as smart grid. In this strategy, EGAT, PEA and MEA have prepared for extending and accelerating transmission system to serve the increasing supply of alternative energy, and smart grid system development,
5. Promoting public relations and knowledge enhancement of using different types of solar PV system among people or related sectors,
6. Promoting research activities as the entire development tool for alternative energy industry i.e. in downstream solar cell production industry such as Silicon Wafer.

3.1.2 Wind: The target of 1,200 MW for wind to generate electricity is set to achieve AEDP in 2021 while the existing generating capacity is 7.28 MW. The wind development is therefore has been implemented through the AEDP strategies as follows:

1. Promoting wind turbine co-generation in remote areas and islands inaccessible to electricity, and wind turbine for agricultural purpose especially water pumping wind turbine and Thai windmill.
2. Facilitating private sectors to manage remote land use in installing wind turbine
3. Amending and improving laws/regulations as well as some procedures unfavorable to alternative energy development such as; the procedures of the Ministry of Natural Resources and Environment with regard to land exploitation for wind farm, a permission for private sectors to develop energy projects by allowing them to utilize some sensitive areas which have no more forestry conditions or face difficulty to be rehabilitated, including the amendment of Industrial Act 1992 (B.E. 2535).
4. Facilitating wind development by providing the roadmap of transmission system and storage i.e. pump storage in high wind potential area in the Northeastern part of Thailand.
5. The promotion of wind user/producer network.
6. Speeding up the production industry relating to the component parts of electricity storage and hybrid wind generation and developing wind turbines suitably applied for wind velocity in the country.

3.1.3 Hydropower: The hydropower target under AEDP to be achieved by 2021 is 1,608 MW while the existing generating capacity is 86.39 MW. (excluding the 500 MW of EGAT Pumped Storage Power Plant at Lam Takong 1-2). The development is as follows:

1. Promoting community-based hydro power generation in areas where there are no grid-connected and electricity, and community-based hydro power plant where local administration agencies or community owners can be self-participated or owned, operated and maintained in the future.
2. Improving laws and regulations unfavorable to the AEDP by finding solutions to solve problems/obstacles arisen from small hydropower project development in the sensitive areas such as watershed area level 1-B, national parks, or wildlife conservation areas etc.
3. Providing hydropower facilities by assigning DEDE and EGAT to develop projects on the small hydro power at irrigation dams and the small hydropower generator system with the generating capacity from 200 – 6,000 kW. Besides, EGAT has also been assigned to develop the new Pumped Storage System Projects in 2 areas in the North East; Lam Takong Pumped Storage Projects

(3-4) with the installed capacity of 500 MW, and Chulabhorn Pumped Storage Power Plant Project with the installed capacity of 784 MW.

4. Disseminating useful information on hydro power projects.
5. Research and development on the micro hydro turbine generator with minimum head.

3.1.4 Waste-to-Energy: The AEDP target in 2021 is 160 MW while the existing generating capacity is now 13.45 MW.

Waste-to-energy under AEDP is undertaken as follows:

1. Promoting and supporting Waste-to-Energy in the Small and Medium Local Administrations and in small communities such as schools, temples etc.
2. Speeding up the amendment/improvement of Private Participation in State Undertaking Act 1992 (B.E. 2535) to allow private sectors to jointly invest with the Local Administrations on producing all types of waste-to-energy especially plastic waste-to-fuel and the RDF that is to be managed for co-generation use in the industries.
3. Creating participation of the targeted areas in installing waste-to-energy production system, and knowledge campaign to educate the youth on waste management with an in-depth energy and environment knowledge at the community level.
4. Research and study on RDF management, incinerator and small scale RDF production system of not more than 50 tons/day in order to be able to produce in the country and the development on standard and equipment relating to plastic waste-to-fuel production.

3.1.5 Biomass: The Biomass target set under AEDP is 3,630 MW while the existing generating capacity is 1,751.86 MW. The development includes the following strategies:

1. Promoting the installation of Distributed-Green-Generation (DGG) to be owned, managed by energy enterprise groups and communities; and fast-growing plantation in the empty/unexploited lands to be processed and distributed to DGG for power generation extension.
2. Support financial incentives such as ADDER adjustment to be FIT and special Renewable Energy Incentives for community based DGG projects. This also includes financial support for the biomass power plant to increase its efficiency by changing low pressure boiler to higher one.
3. Facilitating biomass development by assigning PEA and EGAT to expand the transmission system and distribution to go hand in hand with biomass power plant development, especially in high potential areas like in the South of the country.
4. Creating participation in the targeted areas where biomass production system can be installed and making knowledge campaign to educate the youth on biomass management as well as biomass networking.
5. Research and development on biomass pallet in terms of production, consumption and standards, in order to serve the future hub of biomass fuels. Besides, Gasifier, Gas Engine technology, and downstream industries for the purpose of domestic production capability and Biomass-to-Liquid technology are also included in the research list.

3.1.6 Biogas: The Biogas is targeted to be 600 MW in the year 2021 while the current generating capacity is 138 MW. The activities under AEDP strategies of Biogas are:

1. Promoting biogas production for the benefit of household use in small rural areas and developing biomass network in the community for their own management when electricity generated from biogas is over supplied in the community.
2. Improving Incentive measures for private investment by promoting CBG consumption and production in transport sector through appropriate pricing mechanism that reflects the real cost of production.
3. Studying laws and regulations on the Biogas System Security Standard.
4. Disseminating knowledge and information and biogas safety campaign and uses through various types of media.

5. Developing Co-Digestion for biogas production particularly on using water hyacinth and cornstalk to be fermented with animal waste including the development of CBG use to increase efficiency in transport sector.

3.2 New Alternative Energy for Power Generation

A study was made by Department of Alternative Energy Development and Efficiency (DEDE) to study new alternative sources of energy that are viable for power generation. They are expected to have potential to further develop for the commercial purpose. To be cited here are:

3.2.1 Geo-thermal: The AEDP set the target of geo-thermal at 1 MW while the existing generating capacity is 350 kW.

1. The development however faces with some impediments due to insufficient heat of geothermal and lack of community understanding process geothermal production and uncertainty of imported technology.

2. However, in order to achieve the target of geo-thermal, some measures have been taken us such as, development of Thailand geothermal potential map, an assessment on feasible geothermal development in terms of economic value, community, environment and health impact through appropriate types of technologies, and a test bed on suitable technologies for low heat geothermal.

3.2.2 Tidal and Current Energy: The target set under AEDP is 2 MW. while the generating capacity is none.

Major impediments towards tidal energy are: lack of the information and assessment of tidal energy use. Therefore, DEDE set the guidelines and directions of tidal and current energy by, studying tidal energy sources and technology models in Thailand which is expected to be potentially located at Sarasin bridge in Phuket, Samui-Pa Ngan Island vicinity and Taen Island, and also seeking for potential for a pilot project assessment and preparation.

3.2.3 Hydrogen and Energy Storage System

Hydrogen and Energy Storage System have also been faced with impediments such as lack of recognition of essential research and development planning and implementation in the country, reliance of imported technology, and continuous financial support and incentive measures to develop and utilize hydrogen in the power sector and the energy storage system.

3.3 Alternative Energy in Transport Sector (petroleum substitution)

3.3.1 Ethanol (for gasoline replacement)

The ethanol target under AEDP is 9 mL/day while the existing generating capacity accounts for 1.3 mL/day. To succeed the target, two areas are focused:

1. Supply side

1.1 The acceleration of cassava and sugar cane production at the average amount of 5 and 15 tons/rai/year respectively within 2021 as indicated in the table below;

| Raw Materials | Lan (MRAI) | Productivity/ton/rai | Output (mton/yr.) |
|---------------|------------|----------------------|-------------------|
| cassava | 7 | 5 | 35 |
| sugar cane | 7 | 15 | 105 |

1.2 The promotion of other alternative energy crops for commercial purposes such as sweet sorghum etc.

Nowadays, Thailand possess 10 ethanol plants and there will be 5 more in 2012. With the continuous and strong support by the Thai Government, Thailand would develop towards the Centre for Ethanol in ASEAN.

2. Demand side

- 2.1 The policy to cancel gasoline 91 within October 2012
- 2.2 Pricing management for E20 and gasohol 95 by making the former 3 Baht/litre cheaper and more market margin than the latter but not less than 50 Satang/litre to bring more attractive incentives for the expansion of E20 stations
- 2.3 Financial support will be provided for research and testing to accelerate the ethanol use by providing the conversion guidelines/kid for old vehicles and motorcycle modification into E85 use or ED95 use of diesel engine.
- 2.4 Continuous public relations and campaign to create better understanding on gasohol E10, E20, E85
- 2.5 The support of E-85 and ECO vehicle manufacturers by reducing excise tax at the rate of 50,000 and 30,000 Baht/vehicle respectively
- 2.6 Seeking support from government agencies to consider E85 car purchasing
- 2.7 The modification of rules, regulations and laws to support a free ethanol market in the future i.e. the cancellation of the Liqueur Act enforcement on the prohibition of ethanol production for fuels, and the improvement of the Excise Act to help ethanol export and prepare for the new technology such as Multi Dispenser etc.

3.3.2 Biodiesel (Diesel substitution): The target of biodiesel under AEDP is 5.97 ML/day, while the existing combined capacity is 1.62 ML/day. The key activities will be developed as follows:

1. Supply side

Taking into account the impact on food crops plantation, the promotion of palm plantation in suitable areas will be developed by; promoting the 5.5 Million Rais of palm plantation land with the combined yield of 5.3 Million Rais within 2021 and the raw palm oil capacity of not less than 3.05 Mton/rai/year. Meanwhile, the yielded target will be reached not less than 3.2 ton/rai/year and 18% of oil content.

2. Demand side

Key strategies have been outlined on the demand side through; the management of biodiesel mixed portion to be in line with palm oil production volume in the country, the pilot project of B10 and B20 utilization in truck fleets or fishery boats, and the development of the standard of FAME model to be able to contain 7% biodiesel mixed portion (B7).

3. Fine-tuning management has been designed for the management concept to promote biodiesel such as; plantation, extraction, edible oil production, biodiesel production and run-on industries, import, export and R&D with the aim to reduce cost and create value-added for the country's maximum profit

3.3.3 New fuels for future diesel substitution: The target at the year end of AEDP is 25.0 ML/day, and the development is as follows:

1. At present, ethanol has been planned for use in the country as efficient gasoline substitution. However, this seems not to be the same as in the case of the replacement of diesel with biodiesel due to some impediments, especially in the insufficiency of raw materials for its production. Therefore, the research and development on new fuels to replace biodiesel are crucial, leading to the set up of 7 new directions which comprise; the development of two energy crops (Jatophra and Algae), three types of blended ethanol to substitute biodiesel (FAEE, ED95 and Diesohol), and two types of petroleum processing technologies (BHD and BTL). These have been manipulated under the action plan (2013-2016) through the integrated cooperation between the Ministry of Energy and the Ministry of Science and Technology. The details are as follows;

- Jatropha: The development of jatropha plantation, species, life-cycle equipment and the test-bed on long term engine operation
- Algae (river and sea algae): The improvement of species and the development for commercial purpose
- FAEE : The experiment on use of EAEF in vehicles and seeking for the standard of quality testing
- ED95: The development of additives and old engine technology modification
- Diesohol: Ethanol proportion testing for suitable blended diesel which already had 3-5% of biodiesel combination, and the engine testing with diesohol
- BHD: The engine testing with BHD and the standard of quality testing
- BTL: Pilot scale production and work testing

2. The result to be extended for commercial purposes (long term for 2017-2021) will be prepared for the next action plan when the research results are acceptable and will be extended to all refineries in Thailand.

New Fuels Development Plan for Future Diesel Substitution

| Development Plan | Indicator | Phase 1 | Phase 2 | | | | | | | | | | | | |
|--|---|--|---------------------------------|--|--|--|----|----|----|----|---|---|----|----|--|
| 1. Research 1.1 ED95 1.2 Diesohol 1.3 FAEE 1.4 BHD 1.5 River and Sea Algae 1.6 Jatropha 1.7 BTL | - The research result on the future new fuels has been envisaged enough for the policy decision and is ready for the pilot project and commercial development respectively. | | | | | | | | | | | | | | |
| 2. Pilot Project and Fleet Test | - The emergence of the Pilot Project at the Fleet Test Level - The decision to select the most suitable new fuels. | <div>14-16</div> <div>-Piloting ED95 or Diesohol or FAEE</div> <div>15 – 17</div> <div>-Piloting Algae, Jatropha+BHD</div> <div>15 - 17</div> <div>-Piloting the BioJet(BHD)</div> | | | | | | | | | | | | | |
| 3. The Commercial Development | - The emergence of commercial-based factories with the generating capacity of 2 ml/day in 2018 - The increasing capacity to 25 ml/day in 2021 | <table border="1"> <tr> <th colspan="4">Capacity for commercial purpose</th></tr> <tr> <td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr> <td>2</td><td>6</td><td>15</td><td>25</td></tr> </table> | Capacity for commercial purpose | | | | 18 | 19 | 20 | 21 | 2 | 6 | 15 | 25 | |
| Capacity for commercial purpose | | | | | | | | | | | | | | | |
| 18 | 19 | 20 | 21 | | | | | | | | | | | | |
| 2 | 6 | 15 | 25 | | | | | | | | | | | | |

3.4 Renewable Heat

Renewable heat on biomass, waste, biogas and solar was promoted with Incentive Measures to replace heat from fossil fuels in the industrial sectors such as cooking gas, fuel oils, LPG and coal etc. which can be summarized as follows:

1. Solar

A 100 ktoe of solar heating capacity is set under AEDP while the existing combined generating capacity is 1.98 ktoe. To achieve the target, key activities are planned to; promote the installation of solar heating/cooling, probably to be firstly started as the pilot project in the

government building; develop the low cost solar heating system at the residential level and solar drying system in SME and community enterprises (OTOP), as well as improve mandatory mechanism, such as building energy code for large building, to install the solar heating/cooling system

2. Biogas

The AEDP target for biogas in 2021 is 1,000 ktoe while the existing combined generating capacity is 379 ktoe. The development includes , among other, the implementation of the compressed biogas projects, aiming to accelerate the use of natural gas in the transport sector up to 5% target

3. Biomass

The AEDP target for biomass is 8,200 ktoe while the existing combined generating capacity is 3,286 ktoe. This will be promoted through biomass pellet production and the comprehensive use of heat co-generation (electricity and heat) or biomass co-generation.

4. AEDP target value for 25% in 2021

Table 1: Target Value of Alternative Energy Consumption under AEDP

| Type | Unit | Original Target | New target | |
|---|---------------|------------------------------|-----------------|---------------|
| Electricity | | KTOE | KTOE | Million units |
| 1. Wind | | 89 | 134 | 1,283 |
| 2. Solar | | 56 | 224 | 2,484 |
| 3. Hydro | | 85 | 756 | 5,604 |
| 4. Biomass | | 1,933 | 1,896 | 14,008 |
| 5. Biogas | | 54 | 270 | 1,050 |
| 6. MSW | | 72 | 72 | 518 |
| 7. New Energy | | 1 (Hydrogen) | 0.86 | 10 |
| Total | | 2,290 | 3,352.86 | 24,956 |
| Power substitution portion | % | 6% | 10.1% | |
| Heat | | | | |
| 1. Solar | KTOE | 38 | 100 | |
| 2. Biomass | KTOE | 6,760 | 8,200 | |
| 3. Biogas | KTOE | 600 | 1,000 | |
| 3.1 Biogas | | | 797 | |
| 3.2 CBG (5% of NGV) | | | 203 | |
| 4. MSW | KTOE | 35 | 35 | |
| Total | KTOE | 7,433 | 9,335 | |
| Biofuels | | | | |
| 1. Ethanol | mL/day | 9.0 | 9.0 | |
| 2. Biodiesel | mL/day | 4.5 | 5.97 | |
| 3. New Fuels for diesel substitution | mL/day | - | 25.0 | |
| Total | mL/day | 13.5 | 39.97 | |
| Fuels substitution portion | | 14% | 44% | |
| Alternative energy consumption per final energy consumption of the country | | 12% (not include NGV) | 25% | |

Table 2: The Target of Installed Generating Capacity from Alternative Energy

| Type | The installed capacity target in 2021 | The storage installed capacity in 2021 |
|---------------|---------------------------------------|--|
| | GW-hr | MW |
| 1. Wind | 1,283 | 1,200 |
| 2. Solar | 2,484 | 2,000 |
| 3. Hydro | 5,604 | 1,608 |
| | | <div> <ul style="list-style-type: none"> ● EGAT Pump storage 1,284MW ● Small-Hydro 324 MW </div> |
| 4. Biomass | 14,008 | 3,630 |
| 5. Biogas | 1,050 | 600 |
| 6. MSW | 518 | 160 |
| 7. New Energy | 10 | 3 |
| | | <div> <ul style="list-style-type: none"> ● Geothermal 1 MW ● Tidal or Current 2 MW </div> |
| Total | 24,956 | 9,201 |

5. Expected Benefits from AEDP

| | 15 Year REDP | AEDP -25% in 10 Years |
|---|---|--|
| <u>Energy Sector</u> <ul style="list-style-type: none"> • % of fossil substitution • Electricity (MW) from the alternative energy • Heat (ktoe) • Biofuels (mL/day) • % of fossil fuels replacement | 12% (20% including NGV) 5,604 MW 7,433 13.5 14% | 25% (excluding NGV) 9,201 MW 9,335 39.97 44% |
| <u>Economic Sector</u> <ul style="list-style-type: none"> • Oil import reduction • Investment promotion in private sector | 460,000 mBaht/year 382,240 mBaht/year | 574,000 mBaht 442,000 mBaht |
| <u>Environmental Sector</u> <ul style="list-style-type: none"> • CO₂ reduction • Carbon credit selling income | 42 mton/year in 2565 14,000 mBaht/year | 76 mton/year in 2021 23,000 mBaht |
| <u>Innovation and Technological Development Sector</u> <ul style="list-style-type: none"> • Research planning | None | Clear action plan (12-16) |

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