

(Translation)

## Summary of the 15-Year Alternative Energy Development Plan

### Direction and Vision of Thailand's Alternative Energy Development

#### 1. Important Factors of Development of Thailand's Alternative Energy

Energy is an important factor in driving national economy. As a result, Thailand cannot avoid creating energy security along with sustainable economic development. In creating Thailand's energy security, development of alternative energy is a very important approach. Important factors for development of Thailand's energy are the following:

##### (a) Need to find sufficient energy sources to meet the country's demand

According to the assumption of the growth of demand for final energy of the country during 2009-2011 is 2% and during 2012-2022 is 3%. Accordingly the volume of use of final energy of the country in 2011 is 70,300 thousand tons of crude oil equivalent, in 2016 81,500 thousand tons of crude oil equivalent and in 2022 97,300 thousand tons of crude oil equivalent. However, study shows that production of energy from energy sources in the country between 2009-2022 will not significantly change from the present level. Therefore there is a need to develop alternative energy sources in the country to meet the increasing demand for energy.

**(b) Richness of local alternative energy sources** Study of local alternative energy potential shows that Thailand has a high potential of alternative energy because Thailand is an agricultural country and has a great volume of agricultural produce. At the same time Thailand has agricultural produce-processing industry, which facilitates production of biomass energy, biogas, including biodiesel and ethanol. Thailand also has natural energy potential, such as solar energy with average intensity of sunlight radiation of approximately 18.2 megajoule/square meter/day.

**(c) Energy security** Thailand is a country that depends on importation of energy in a high volume. From 1988 to 2008, importation of commercial primary energy was averagely 60.8% of commercial primary energy demand, and the proportion of importation of oil was 80% of total import volume. The proportion of energy importation has increased because the volume of local energy production cannot increase to meet the demand. Therefore if alternative energy is not seriously developed, Thailand will have to import more energy to the level of 70%. This situation will substantially affect the country's energy and economic stability.

**(d) Need to reduce global warming** The study of projection of world energy of the International Energy Agency shows that the present release of greenhouse gas by the energy sector will cause an increase in the earth's temperature by an average of 6

degrees Celsius in the long run. The world therefore needs to promptly take action to reduce the volume of greenhouse gas release. To respond to international demand and to avoid possible trade protectionism in the future and for the nation's sustainable development, Thailand needs to adopt clear measures and approach to cope with global warming. The development and promotion of alternative energy is an approach to reduce the volume of greenhouse gas, which is a major cause of global warming.

## **2. Future Direction of Alternative Energy**

Considering all factors described above, oil will still be the world's and Thailand's major energy source in the next 15-20 years. However the volume of oil found, production cost and oil price will still highly fluctuate. Oil price crisis at the beginning of 2008 prompted countries to be alert about the fact that the source of oil and fossil fuel is limited. The awareness of global warming has prompted the world to pay attention to energies that release low volume of carbon dioxide. Global warming problem will play an important role in setting energy direction and policy of countries around the world, including Thailand. In addition to focusing on development of alternative energy as Thailand's main energy, for energy security and to deal with global warming, Thailand must give high priority to the promotion of alternative energy with high economic potential, research and development of technology to enable the maximum utilization of alternative energy sources available for the best interest of the nation and people in the long term, as well as gaining knowledge on alternative energy for development of local industry so as to manufacture more equipment and devices for production of alternative energy.

## **3. The Vision of the 15-Year Alternative Energy Development Plan**

To develop into **“the country's main energy, to reduce dependence on oil import, to create energy security for the country at the price acceptable to people, and reduce impacts on the environment and communities, and to reduce the volume of release of greenhouse gas, which is a major cause of global warming.”**

### **15-Year Alternative Energy Development Plan**

#### **1. Objectives**

In line with the direction of future alternative energy and to realize the vision of the 15-year alternative energy development plan, the following objectives are formulated:

- To make Thailand use alternative energy as its main energy in place of imported oil;
- To strengthen the security of supplying energy to the country;
- To promote the use of energy for an integrated green community;
- To support local industry of alternative energy technology production;

- To research, develop and promote the high-efficiency technology for alternative energy.

## 2. 15-Year Alternative Energy Development Plan

The 15-year alternative energy development plan is divided into 3 phases: (1) short term, 2008-2011, (2) medium term, 2012-2016, and (3) long term, 2017-2022, with the following guideline and target of development of alternative energy:

(1) **Short term (2008-2011)** Focusing on promoting proven technologies of alternative energy with high potential, such as biofuels, power and heat generation by biomass and biogas, by implementing full financial support measures. **The target of alternative energy development is 10,961 ktoe, representing 15.6% of the total energy used (Table 1).**

(2) **Medium term (2012-2016)** Promoting the alternative energy technology industry and supporting the development of new prototypes of alternative energy technology for higher economical cost-effectiveness. This includes promoting the new technology of biofuel production and development of Green City prototype that leads to building up the strength of alternative energy production at community level. **The target of alternative energy production is 15,579 ktoe, representing 19.1% of the total energy used (Table 1).**

(3) **Long term (2017-2022)** Promoting new alternative energy technology that is economical cost-effective, including extension of Green City and community's energy, and promoting Thailand to become the hub of biofuel export and alternative energy technology export in ASEAN region. **The target of alternative energy development is 19,799 ktoe, representing 20.3% of the total energy used (Table 1).**

**Table 1 Target of 15-Year Alternative Energy Development**

Energy Type	Potential	Existing	Year 2008-2011		Year 2012-2016		Year 2017-2022	
	MW		MW	MW	ktoe	MW	ktoe	MW
<b>Electricity</b>								
Solar energy	50,000	32	55	6	95	11	500	56
Wind energy	1,600	1	115	13	375	42	800	89
Hydropower	700	56	165	43	281	73	324	85
Biomass	4,400	1,610	2,800	1,463	3,220	1,682	3,700	1,933
Biogas	190	46	60	27	90	40	120	54
MSW	400	5	78	35	130	58	160	72
Hydrogen			0	0	0	0	3.5	1
<b>Total</b>		<b>1,750</b>	<b>3,273</b>	<b>1,587</b>	<b>4,191</b>	<b>1,907</b>	<b>5,608</b>	<b>2,290</b>
<b>Thermal (Heat) Energy</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>	<b>ktoe</b>
Solar energy	154	1	5		17.5		38	
Biomass	7,400	2,781	3,660		5,000		6,760	
Biogas	600	224	470		540		600	
MSW		1	15		24		35	

<b>Total</b>		<b>3,007</b>		<b>4,150</b>		<b>5,582</b>		<b>7,433</b>
<b>Biofuels</b>	<b>ml/day</b>	<b>ml/day</b>	<b>ml/day</b>	ktoe	<b>ml/day</b>	ktoe	<b>ml/day</b>	ktoe
Ethanol	3.00	<b>1.24</b>	<b>3.00</b>	805	<b>6.20</b>	1,686	<b>9.00</b>	2,447
Biodiesel	4.20	<b>1.56</b>	<b>3.00</b>	950	<b>3.64</b>	1,145	<b>4.50</b>	1,415
Hydrogen			<b>0</b>	0	<b>0</b>	0	0.1m.kg	124
<b>Total</b>			<b>6.00</b>	1,755	<b>9.84</b>	2,831	<b>13.50</b>	3,986
Total energy demand (ktoe)		66,248		70,300		81,500		97,300
Total renewable energy demand		4,237		7,492		10,319		13,709
<b>Proportion of renewable energy use</b>		<b>6.4%</b>		<b>10.6%</b>		<b>12.7%</b>		<b>14.1%</b>
NGV (mmscf)		108.1	393.0	3,469	596	5,260	690	6,090
Total alternative energy demand (ktoe)				10,961		15,579		19,799
<b>Proportion of alternative energy use</b>				<b>15.6%</b>		<b>19.1%</b>		<b>20.3%</b>

### **Pushing the Plan forward into Action**

Pushing the 15-year alternative energy development plan into action needs to place importance on participation by all sectors concerned so that the action can go to the same direction efficiently, effectively and concretely, by translating the plan into action along with revisions of laws, rules and regulations and gaining knowledge to support the implementation and systematical monitoring and evaluation. The approach is as follows:

#### **1. Promotion of Production and Use of Alternative Energy**

By adopting appropriate incentive measures to facilitate development of alternative energy that is fair to people of all sectors as follows:

- Adopting financial measures, particularly adopting and reviewing the measures of added price of purchase of power from alternative energy that is appropriate to the changing economic situation and technology;
- Adopting tax and investment measures as an incentive for operators, to promote investment and risk prevention through the ESCO Fund;
- Creating confidence in alternative energy industry for financial institutions;
- Pushing alternative energy projects forward to a clean development mechanism (CDM);
- Involving sectors concerned to revise laws and regulations that are complicated or obstacle to the development of the country's alternative energy;
- Promoting local alternative energy technology production industry to reduce cost and increase local production proportion;

- Setting acceptable alternative energy technology standard;
- Disseminating technical knowledge and examples of successful alternative energy projects to reduce risks in investment in alternative energy at the initial stage;
- Compiling and publicizing the accurate and precise alternative energy situation.

**2. Promotion of Energy Research and Development** By allocating budget and involving all sectors concerned to continuously study, research, develop and demonstrate from upstream to downstream, focusing on commercial justification of the study and research, to create concrete results that cover the following issues:

- Survey of potential energy sources;
- Research and development to increase energy plant production;
- Research and development of alternative energy technology with high efficiency that is consistent with the characteristics of local alternative energy sources;
- Study of management of each type of alternative energy at both macro and micro scales;
- Educating local people and creating a learning society under the Sufficiency Economy principle.

### **3. Raising Awareness and Publicizing**

- Campaigning among people and sectors concerned so that they are aware of the importance of alternative energy on the country's energy security, economy and society, and to participate in the development of alternative energy;
- Publicizing among people of all sectors so that they are aware of the policy and measure of promotion of alternative energy of various types and can gain access to alternative energy broadly and fairly;
- Establishing an alternative energy network as a mechanism for exchanging knowledge;
- Holding workshop seminars to train alternative energy personnel;

- Providing courses on alternative energy from the basic education, to instill alternative energy consciousness among Thai youths, who will be important forces in the development of the country.

### **Factors of Success of the Plan**

In order to achieve the objectives of the plan, the factors of success are as follows:

- 1. Setting alternative energy as a national agenda.**
- 2. The state has a policy to continuously promote alternative energy, particularly financial incentives, such as** the measure of added price of purchase of power from alternative energy, ESCO Fund, to promote investment and prevent risks, particularly for small and very small industries, measure of financing to reduce initial burden of investment in new forms of alternative energy technology including low interest rate for loans for investment in production of new alternative energies, BOI promotion for investment in alternative energy, and investment in industry of technology related to alternative energy, compensation for the retail price of diesel and benzene with biofuel content to be lower than the retail price of regular diesel and benzene.
- 3. Construction by the state of infrastructure to support expansion of alternative energy,** such as expansion of transmission system, biofuel reserve depot.
- 4. Revision of laws and regulations related to alternative energy,** for example joint venture act, town planning act, rules and regulations of management of import-export of crude palm oil, rules and regulations of joint export of ethanol by several ethanol producers, environmental act requiring an environmental impact study for a hydropower project with an obligation to build a dam/reservoir with investment of more than 200 million baht.
- 5. All agencies concerned must be allocated budget for research, development, demonstration, promotion, campaigning, dissemination and publicizing of alternative energy within the scope of implementation of the plan.**
- 6. Access to alternative energy sources such as wind energy and hydro energy sources and supply of raw materials.**
- 7. Designation of alternative energy technology standard.**

### **Expected Results**

- 1. Economic Aspect**
  - Reducing energy importation by more than 460,000 million baht per year in 2022;

- Promoting investment in the private sector by more than 382,240 million baht;
- Creating jobs in related industries by more than 40,000 people, resulting in money circulation in the country's economy;
- Generating income from sale and purchase of carbon by more than 14,000 million baht per year;
- Reducing the state's investment in constructing fossil fuel power plants by more than 3,800 megawatts, which involves an investment of not less than 100,000 million baht;
- Generating revenue back into the country, by developing the country to become the hub for exportation of ethanol and alternative energy technology, e.g. solar cells with high efficiency, gasification technology and biogas production in ASEAN region.

## 2. Social Aspect

- Reducing impacts from urban migration of labor, by creating jobs in rural areas, for example fast-growing tree planting promotion projects for use as fuel in an integrated green community power plant;
- Farmers will continuously and securely earn income from sale of more agricultural produce;
- Upgrading the quality of life of people in the country to gain access to energy equally and broadly.

## 3. Environmental Aspect

- To develop into a low carbon society and to help reduce global warming.

### Scope of Budget under the 15-Year Alternative Energy Development Plan

In implementing the 15-year alternative energy development plan, there will be investment by private and public sectors and state enterprises in a total of more than 488,257 million baht, comprising private investment of 382,240 million baht, public investment of 52,968 million baht and state enterprise investment of 53,049 million baht, which may be summarized as follows:

(1) Investment by the Private Sector						
Investment value (in	Short term			Medium term (2012-2016)	Long term (2017-2022)	Total (3 phases)
	2009	2010	2011			

million baht)						
	32,470	41,910	59,785	102,726	145,349	
Total (1)	134,165			102,726	145,349	382,240
(2) Investment by the Public Sector						
	2,269	2,964	4,111	27,124	16,500	
Total (2)	9,343			27,124	16,500	52,968
(3) Investment by State Enterprises						
	8,752	1,962	1,827	15,460	25,048	
Total (3)	12,541			15,460	25,048	53,049
Grand total	156,049			145,310	186,897	488,257

CHANDLER and THONG-EK

## **1. Summary of the 15-Year Alternative Energy Development Plan**

### **1.1 Introduction**

Thailand has to acquire energy, particularly imported oil, as high as an average of 45%. Thailand also has to import part of natural gas, coal and electricity from neighboring countries. The proportion of dependence of energy from the outside is higher than 55%. This causes the country to lose foreign currencies and substantially affects its energy security. Energy price, particularly oil price, increases all the time and the price significantly fluctuates due to continuous decline of world's oil reserves, conflict in the region that is the world's main source of energy, and increasing speculation. The oil price in the world market has fluctuated and broken record to more than US\$ 147 per barrel, which has affected the world economy and Thailand's economic development. With the instability of energy price, particularly oil price, management of the macro-economy of a country with high proportion of dependence on energy from outside like Thailand will be difficult, which will affect the country's economic situation continuously and severely.

Thailand is an agricultural country, and has agricultural produce including agricultural produce surplus with high potential to become alternative energy, e.g. sugar cane, cassava, oil palm, rice, corn, by transforming sugar cane residue, palm filaments and shells, paddy husk and corn cob into fuel for electricity and thermal energy generating for use in industrial production. Molasses and cassava are used to produce ethanol; palm oil and styrene are used to produce biodiesel. It is therefore a strategy of the Ministry of Energy to develop alternative energy from these energy plants so that it will become an alternative market for Thai agricultural produce. This will help absorb agricultural produce and help stabilize agricultural produce price and the public sector will need not allocate budget to guarantee the prices of the said agricultural produce. In addition, the technology of alternative energy from energy plants has been developed continuously and can cover or almost cover economic cost if slightly supported by the government.

In addition, Thailand has natural energies that are renewable energies such as small hydropower, wind energy and solar energy that can produce alternative energy. However due to potential and technological limitations, this needs special support by the government.

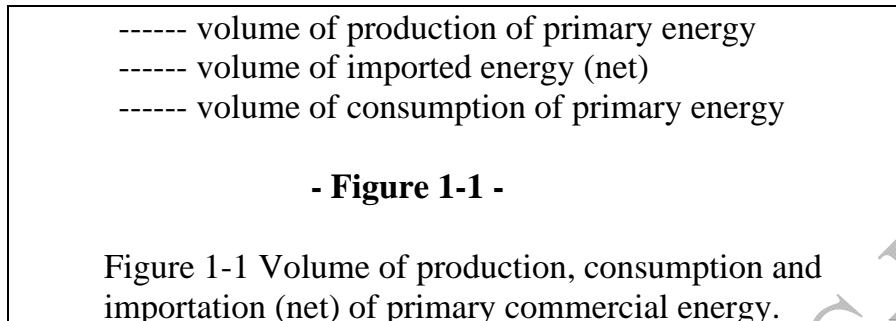
Consequently, the Ministry of Energy has undertaken to implement the government's policy to prepare the 15-year alternative energy long-term plan to set the direction and framework for the country's development of alternative energy.

### **1.2 Present Energy Situation<sup>1</sup>**

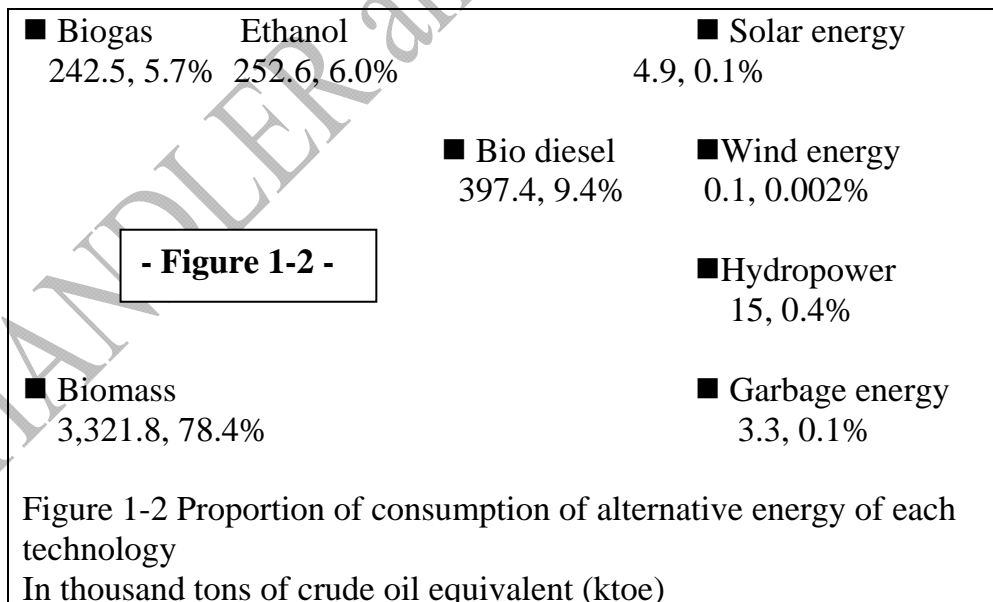
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<sup>1</sup> Energy statistic in 2008 is a preliminary estimate.

In 2008 Thailand consumed primary commercial energy in a total of 81,958 thousand tons of crude oil equivalent (ktoe), with an average increase rate of 11% from 1988 to 2008 (Figure 1-1), while the imported energy was a total of 48,655 thousand tons of crude oil equivalent, representing 59% of the total volume of energy consumption, valued a total of 1.24 trillion baht.



The increased oil price and continuous decline of world's oil reserve as well as the government's serious promotion of alternative energy have caused the increasing use of alternative energy in the country. In 2008 the consumption of alternative energy was a total of 4,237 thousand tons of crude oil equivalent, representing 6.4% of the volume of final consumption of energy, an increase by 29.5% from the year 2007. Alternative energies that are widely used are biomass both in the form of electricity and thermal of 3,322 thousand tons of crude oil equivalent. The next are biogas both in the form of electricity and thermal, biodiesel and ethanol respectively (Figure 1-2).



The increase in the proportion of consumption of alternative energy to 6.4% of the volume of final consumption of energy or 4,237 thousand tons of crude oil equivalent has enabled Thailand to reduce importation of energy by a value of approximately

99,500 million baht<sup>2</sup>, and has helped reduce the release of greenhouse gas by 13 million tons of carbon dioxide equivalent. The significant expansion of use of alternative energy is a result of the government's policy and measures of serious promotion of alternative energy, namely:

(a) **Rule and regulation/policy promotion measures**, i.e. regulations on purchase of power from small power producers and very small power producers (SPP and VSPP), setting of the standard of biofuel including biodiesel and ethanol.

(b) **Financial incentive measures**, i.e. designation of added purchase price for electricity from renewable energy (adder), providing low-interest loans through a working capital project, financial support to reduce initial investment burden, establishment of the fund for joint investment and promotion of investment in energy conservation and alternative energy projects (ESCO Fund), encouragement of the private sector to develop clean development mechanism (CDM) projects, adoption of tax measures to reduce initial investment burden, e.g. BOI privileges and allocation of budget to state organizations to develop projects that are difficult for a private party to develop due to involvement of application for approval from several government agencies.

(c) **Research, development and demonstration promotion measures** The government has provided budget for education and research, development and demonstration plan, and has implemented policy measures to encourage the use of renewable energy in order to achieve the objective of solving the country's energy problem, including budget for research and technical development and demonstration to agencies, educational institutions and organizations with several research projects that provide commercially justified return and that can be developed to achieve concrete results.

(d) **Measures on campaign and dissemination of knowledge on alternative energy** The government has provided budget for campaign and dissemination of knowledge on alternative energy to raise awareness in all sectors about the importance of alternative energy, and to build confidence for investors to invest in alternative energy business and to urge people to use alternative energy continuously and broadly.

### **1.3 Direction and Vision of Thailand's Alternative Energy Development**

#### **1.3.1 Important Factors of Development of Thailand's Alternative Energy**

Energy is an important factor in driving national economy. As a result, Thailand cannot avoid creating energy security along with sustainable economic development. In creating Thailand's energy security, development of alternative energy is a very important approach. Important factors for development of Thailand's energy are the

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<sup>2</sup> Assessed at the average crude oil price in 2008 at US\$ 94.45 per barrel with the exchange rate of 34 baht per US\$.

need to find sufficient energy sources to meet the country's demand, richness of local alternative energy sources, energy security and the need to reduce global warming, with the following details:

**(a) Need to find sufficient energy sources to meet the country's demand**

According to the assumption of the growth of the country's demand for final energy during 2009-2011 is 2% and during 2012-2022 is 3%. Accordingly, the volume of use of final energy of the country in 2011 is 70,300 thousand tons of crude oil equivalent, in 2016 81,500 thousand tons of crude oil equivalent and in 2022 97,300 thousand tons of crude oil equivalent. However, study shows that production of energy from energy sources in the country between 2009-2022 will not significantly change from the present level. Therefore there is a need to develop alternative energy sources in the country to meet the increasing demand for energy.

**(b) Richness of local alternative energy sources** Study and survey of local alternative energy potential shows that Thailand has a high potential of alternative energy because Thailand is an agricultural country and has a great volume of agricultural produce. At the same time Thailand has agricultural produce-processing industry, which facilitates production of biomass energy, biogas, including biodiesel and ethanol. Thailand also has natural energy potential, such as solar energy with average intensity of sunlight radiation of approximately 18.2 megajoule/square meter/day or 5.05 kilowatt-hour/square meter/day. The potential of alternative energy of various types may be classified as follows (Table 1-1):

**Table 1-1 Potential of Alternative Energy in Thailand**

Type of Energy	Potential of Electricity Generating (megawatt)	Potential of Thermal Energy Production (ktoe)	Potential of Biofuel Production (million litres/day)
<b>Natural energy group</b>			
Solar energy	50,000	154	-
Wind energy	1,600	-	-
Hydropower	700	-	-
<b>Bioenergy group</b>			
Biomass	4,400	7,400	-
Biogas	190	600	-
MSW	400	78	-
<b>Biofuel group</b>			
Ethanol	-	-	3.0
Biodiesel	-	-	4.2

**(c) Energy security** Thailand is a country that depends on importation of energy in a high volume. From 1988 to 2008, importation of commercial primary energy was averagely 60.8% of commercial primary energy demand, and the proportion of importation of oil was 80% of total import volume. During 1988-1989, the proportion

of value of importation of energy was 2-4% of the GDP, and this proportion increased to 7% in 2000, to 11% in 2005, and to 13% in quarters 1 and 2 of 2008 (Figure 1-3). The proportion of energy importation has increased because the volume of local energy production cannot increase to meet the demand. Therefore if alternative energy is not seriously developed, Thailand will have to import more energy to the level of 70%. This situation will substantially affect the country's energy and economic stability.

**(d) Need to reduce global warming** The study of projection of world energy of the International Energy Agency shows that the present release of greenhouse gas by the energy sector will cause an increase in the earth's temperature by an average of 6 degrees Celsius in the long run. The world therefore needs to promptly take action to reduce the volume of greenhouse gas release. Numerous countries around the world are bound by the UN convention on climate change. At the same time the United States has seriously paid attention to reduction of the volume of release of greenhouse gas. To respond to international demand and to avoid possible trade protectionism in the future and for the nation's sustainable development, Thailand needs to adopt clear measures and approach to cope with global warming. The development and promotion of alternative energy is an approach to reduce the volume of greenhouse gas, which is a major cause of global warming.

### **1.3.2 Future Direction of Alternative Energy**

Considering all factors described above, oil will still be the world's and Thailand's major energy source in the next 15-20 years. However the volume of oil found, production cost and oil price will still highly fluctuate. Oil price crisis at the beginning of 2008 prompted countries to be alert about the fact that the source of oil and fossil fuel is limited. The awareness of global warming has prompted the world to pay attention to energies that release low volume of carbon dioxide. Global warming problem will play an important role in setting energy direction and policy of countries around the world, including Thailand. In addition to focusing on development of alternative energy as Thailand's main energy, for energy security and to deal with global warming, Thailand must give high priority to the promotion of alternative energy with high economic potential, and research and development of technology to enable the maximum utilization of alternative energy sources available for the best interest of the nation and people in the long term, as well as gaining knowledge on alternative energy for development of local industry so as to manufacture more equipment and devices for production of alternative energy.

### **1.3.3 The Vision of the 15-Year Alternative Energy Development Plan**

To develop into **“the country's main energy, to reduce dependence on oil import, to create energy security for the country at the price acceptable to people, and reduce impacts on the environment and communities, and to reduce the volume of release of greenhouse gas, which is a major cause of global warming.”**

## 1.4 15-Year Alternative Energy Development Plan

### 1.4.1 Objectives

In line with the direction of future alternative energy and to realize the vision of the 15-year alternative energy development plan, the following objectives are formulated:

- To make Thailand use alternative energy as its main energy in place of imported oil;
- To strengthen the security of supplying energy to the country;
- To promote the use of energy for an integrated green community;
- To support local industry of alternative energy technology production;
- To research, develop and promote the high-efficiency technology for alternative energy.

### 1.4.2 Targets

In order to achieve the abovesaid objectives, the targets of the 15-year alternative energy development plan are as follows:

- **Target of making Thailand use alternative energy as its main energy in place of imported oil** The use of alternative energy is targeted to at least 20.3% of the final energy within the year 2022 and the alternative energy can meet energy demand of the country's all economic sectors broadly and fairly at an appropriate price.
- **Target of strengthening the security of supplying energy to the country** The country will be able to be more self reliant on energy and to strengthen the stability of the country's energy and economy.
- **Target of promoting the use of energy for an integrated green community** A community will be able to develop local alternative energy sources to produce energy in line with local demand, self reliance on alternative energy will be promoted according to the Sufficient Economy approach, and the country will adjust itself into a low carbon society.
- **Target of supporting local industry of alternative energy technology production** Local industry of alternative energy technology production will be created, with local content, to reduce the cost of alternative energy production.
- **Target of researching, developing and promoting the high-efficiency technology for alternative energy** To increase the efficiency of the existing alternative energy technology to achieve maximum efficiency, to reduce dependence on technology from abroad, and to develop new alternative energy technology that can use alternative energy sources to achieve maximum benefit.

### 1.4.3 15-Year Alternative Energy Development Plan

The 15-year alternative energy development plan is divided into 3 phases: (1) short term, 2008-2011, (2) medium term, 2012-2016, and (3) long term, 2017-2022, with the following guideline and target of development of alternative energy:

**(1) Short term (2008-2011)** Focusing on promoting proven technologies of alternative energy with high potential, such as biofuels, power and heat generation by biomass and biogas, by implementing full financial support measures. **The target of alternative energy development is 10,961 ktoe, representing 15.6% of total energy used (Table 1-2).**

**Table 1-2 Short-Term Target of Alternative Energy Development (2008-2011)**

Type of Energy	Electricity		Thermal (ktoe)	Biofuel and NGV		Total (ktoe)
	MW	ktoe			ktoe	
Solar energy	55	6	5	-	-	11
Wind energy	115	13	-	-	-	13
Hydropower	165	43	-	-	-	43
Biomass	2,800	1,463	3,660	-	-	5,123
Biogas	60	27	470	-	-	497
MSW	78	35	15	-	-	50
Ethanol (million litres/day)	-	-	-	3.0	805	805
Biodiesel (million litres/day)	-	-	-	3.0	950	950
NGV (million cubic feet/day)	-	-	-	393.0	3,469	3,469
<b>Total</b>	<b>3,273</b>	<b>1,587</b>	<b>4,150</b>	<b>-</b>	<b>5,224</b>	<b>10,961</b>

**(2) Medium term (2012-2016)** Promoting the alternative energy technology industry and supporting the development of new prototypes of alternative energy technology for higher economical cost-effectiveness. This includes promoting the new technology of biofuel production and development of Green City prototype that leads to building up the strength of alternative energy production at community level. **The target of alternative energy production is 15,579 ktoe, representing 19.1% of the total energy used (Table 1-3).**

**Table 1-3 Medium-Term Target of Alternative Energy Development (2012-2016)**

Type of Energy	Electricity		Thermal (ktoe)	Biofuel and NGV		Total (ktoe)
	MW	ktoe			ktoe	
Solar energy	95	11	17.5	-	-	28.5
Wind energy	375	42	-	-	-	42
Hydropower	281	73	-	-	-	73
Biomass	3,220	1,682	5,000	-	-	6,682

Biogas	90	40	540	-	-	580
MSW	130	58	24	-	-	82
Ethanol (million litres/day)	-	-	-	6.2	1,686	1,686
Biodiesel (million litres/day)	-	-	-	3.6	1,145	1,145
NGV (million cubic feet/day)	-	-	-	596	5,260	5,260
<b>Total</b>	<b>4,191</b>	<b>1,907</b>	<b>5,582</b>		<b>8,091</b>	<b>15,579</b>

(3) **Long term (2017-2022)** Promoting new alternative energy technology that is economical cost-effective, including extension of Green City and community's energy, and promoting Thailand to become the hub of biofuel export and alternative energy technology export in ASEAN region. **The target of alternative energy development is 19,799 ktoe, representing 20.3% of the total energy used (Table 1-4).**

**Table 1-4 Long-Term Target of Alternative Energy Development (2017-2022)**

Type of Energy	Electricity		Thermal (ktoe)	Biofuel and NGV		Total (ktoe)
	MW	ktoe			ktoe	
Solar energy	500	56	38	-	-	94
Wind energy	800	89	-	-	-	89
Hydropower	324	85	-	-	-	85
Biomass	3,700	1,933	6,760	-	-	8,693
Biogas	120	54	600	-	-	654
MSW	160	72	35	-	-	107
Hydrogen	3.5	1	-	0.1 m.kg.	124	125
Ethanol (million litres/day)	-	-	-	9.00	2,447	2,447
Biodiesel (million litres/day)	-	-	-	4.50	1,415	1,415
NGV (million cubic feet/day)	-	-	-	690	6,090	6,090
<b>Total</b>	<b>5,608</b>	<b>2,290</b>	<b>7,433</b>		<b>10,076</b>	<b>19,799</b>

### **1.5 Pushing the Plan forward into Action**

Pushing the 15-year alternative energy development plan into action needs to place importance on participation by all sectors concerned so that the action can go to the same direction efficiently, effectively and concretely, by translating the plan into action along with revisions of laws, rules and regulations and gaining knowledge to support the implementation and systematically monitoring and evaluation. The approach is as follows:

**1.5.1 Promotion of Production and Use of Alternative Energy** By adopting appropriate incentive measures to facilitate development of alternative energy that is fair to people of all sectors as follows:

- Adopting financial measures, particularly adopting and reviewing the measures of added price of purchase of power from alternative energy that is appropriate to the changing economic situation and technology;
- Adopting tax and investment measures as an incentive for operators, to promote investment and risk prevention through the ESCO Fund;
- Creating confidence in alternative energy industry for financial institutions;
- Pushing alternative energy projects forward to a clean development mechanism (CDM);
- Involving sectors concerned to revise laws and regulations that are complicated or obstacle to the development of the country's alternative energy;
- Promoting local alternative energy technology production industry to reduce cost and increase local production proportion;
- Setting acceptable alternative energy technology standard;
- Disseminating technical knowledge and examples of successful alternative energy projects to reduce risks in investment in alternative energy at the initial stage;
- Compiling and publicizing the accurate and precise alternative energy situation.

**1.5.2 Promotion of Energy Research and Development** By allocating budget and involving all sectors concerned to continuously study, research, develop and demonstrate from upstream to downstream, focusing on commercial justification of the study and research, to create concrete results that cover the following issues:

- Survey of potential energy sources;
- Research and development to increase energy plant production;
- Research and development of alternative energy technology with high efficiency that is consistent with the characteristics of local alternative energy sources;
- Study of management of each type of alternative energy at both macro and micro scales;

- Educating local people and creating a learning society under the Sufficiency Economy principle.

### **1.5.3 Raising Awareness and Publicizing**

- Campaigning among people and sectors concerned so that they are aware of the importance of alternative energy on the country's energy security, economy and society, and to participate in the development of alternative energy;
- Publicizing among people of all sectors so that they are aware of the policy and measure of promotion of alternative energy of various types and can gain access to alternative energy broadly and fairly;
- Establishing an alternative energy network as a mechanism for exchanging knowledge;
- Holding workshop seminars to train alternative energy personnel;
- Providing courses on alternative energy from the basic education, to instill alternative energy consciousness among Thai youths, who will be important forces in the development of the country.

<h2><b>1.6 Factors of Success of the Plan</b></h2>
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In order to achieve the objectives of the plan, the factors of success are as follows:

### **1.6.1 Setting alternative energy as a national agenda.**

**1.6.2 The state has a policy to continuously promote alternative energy,** particularly financial incentive measures, including

- Adoption of the measure of added price of purchase of power from renewable energy until 2011, by reviewing the rate so that it is appropriate to the technology and economic situation.
- Adoption of ESCO Fund measure to promote investment and guarantee risks, particularly for small and very small industries.
- Adoption of measure of financing to reduce initial burden of investment in new forms of alternative energy technology, including low interest rate for loans for investment in production of new alternative technologies.

- Adoption of BOI investment promotion measure for investment in alternative energy and investment in industry of production of technology related to alternative energy.
- Compensation for the retail price of diesel and benzene with biofuel content, to be lower than the retail price of regular diesel and benzene.

**1.6.3 Construction by the state of infrastructure to support expansion of alternative energy,** such as expansion of transmission system, biofuel reserve depot.

**1.6.4 Revision of laws and regulations related to alternative energy,** for example joint venture act, town planning act, rules and regulations of management of import-export of crude palm oil, rules and regulations of joint export of ethanol by several ethanol producers, environmental act requiring an environmental impact study for a hydropower project with an obligation to build a dam/reservoir with investment of more than 200 million baht.

**1.6.5 All agencies concerned must be allocated budget for research, development, demonstration, promotion, campaigning, dissemination and publicizing of alternative energy within the scope of implementation of the plan.**

**1.6.6 Access to alternative energy sources such as wind energy and hydro energy sources and supply of raw materials.**

<b>1.7 Expected Results</b>
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**1.7.1 Economic Aspect**

- Reducing energy importation by more than 460,000 million baht per year in 2022;
- Promoting investment in the private sector by more than 382,240 million baht;
- Creating jobs in related industries by more than 40,000 people, resulting in money circulation in the country's economy;
- Generating income from sale and purchase of carbon by more than 14,000 million baht per year;
- Reducing the state's investment in constructing fossil fuel power plants by more than 3,800 megawatt;
- Generating revenue back into the country, by developing the country to become the hub for exportation of ethanol and alternative energy technology, e.g. solar cells with high efficiency, gasification technology and biogas production in ASEAN region.

### **1.7.2 Social Aspect**

- Reducing impacts from urban migration of labor, by creating jobs in rural areas, for example fast-growing tree planting promotion projects for use as fuel in an integrated green community power plant;
- Farmers will continuously and securely earn income from sale of more agricultural produce;
- Upgrading the quality of life of people in the country to gain access to energy equally and broadly.

### **1.7.3 Environmental Aspect**

- To develop into a low carbon society and to help reduce global warming.

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