

The 15 Year Ethanol Development Plan: 2008-2022

Ethanol

1. Mission

To promote ethanol producing and consuming at least 9 ml a day by 2022 for decreasing the oil dependency, increasing the value and building up the stability of agro products through creating the sustainable marketing, making a campaign to educate and building up the substantial confidence to consumers. Promote the integrated ethanol industry which is environmental friendly, including a development on logistic system for cost reduction, R&D for new energy crops for the country and people.

2. Introduction

Ethanol is a kind of alcohol derived from plant fermentation to convert starch from plant to sugar then converting sugar to alcohol, after purifying it to 95 percent alcohol by distillation it is called **ethanol**. Ethanol for blending with oil to fill in engine has its purity from 99.5 % by volume which is capably used as fuel. In Thailand, ethanol is used to blend with gasoline for fuel use or so-called as **gasohol**.

Gasohol production in Thailand was originated by Royal initiative of our King Bhumibol in 1985. Gasohol production for alternative energy use was initiated in a study of royal project by producing ethanol from sugarcane. After that the public and private started alerting to co-develop and test with the engines. Even it was not widespread used until the world oil price increased sharply in 2003, the government has turned to seriously push up producing and consuming of gasohol. The target is set for ethanol promotion at 2.4 ml/day to substitute MTBE in gasoline 95 and to replace oil content in gasoline 91 by 2011.

Reducing the levy of Oil Fund to lower the retailed price of gasohol 95 than of gasoline 95 by 1.50 baht/l, complementing with several promotion measures by the government, the people turn to increase using of gasohol. In December 2005, gasohol use was at a high proportion by 17.4 percent of total gasoline selling. Government has improved such the measures to keep promoting the gasohol production and consumption, e.g. ethanol pricing formulation, confidence-building measure, including a pricing measure. Up to November 2008, consuming of ethanol in Thailand would be in form of gasohol 95, gasohol 91, E20 and E85 at 11 ml/day or as 1.11 ml/day of ethanol.

To push up the 15 Year Ethanol Development Plan to achieve the target , it is extremely essential to develop the co-operation among stakeholders and the supply chain from raw material sources for ethanol production to ethanol marketing as shown in **Figure 1**

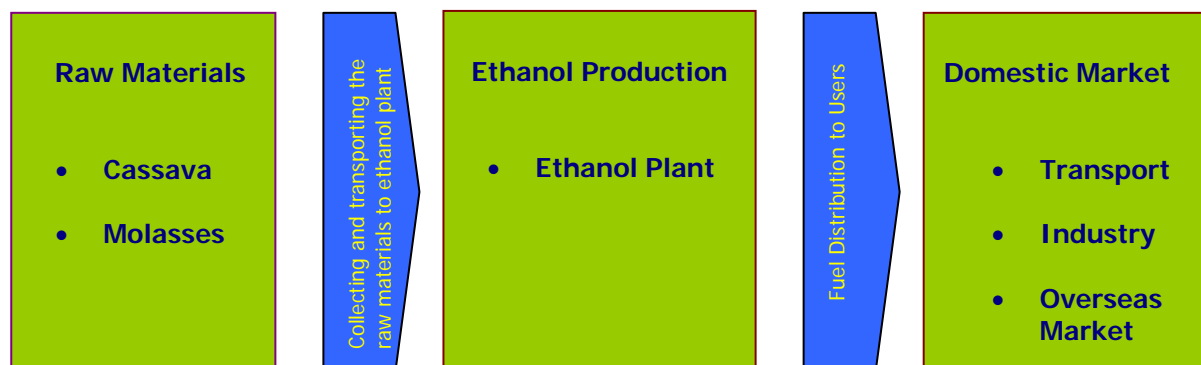


Figure 1 Ethanol Supply Chain

In the following chapter, current situation of ethanol be described by its supply chain to analyse the problems and obstacles facing at each chain, including a significant trend to develop the ethanol that will lead to implementation of the 15 Year Ethanol Development Plan, indicators and achievement level of the plan, covering to the success level for monitoring and evaluating the plan success at each step.

3. Current Ethanol Situation

3.1 Raw Materials for Ethanol Production

Since Thailand is an agricultural country, thus various kinds of energy plants can be taken as feedstocks or raw materials to produce ethanol, e.g. sugarcane, cassava, corn, sweet sorghum, etc. However, when considering the economic cost effectiveness, the main raw materials in present ethanol industry are molasses and cassava.

(1) Molasses, a by-product from sugar refining process. By crushing a ton of sugarcane would derive 45 kg of molasses or 4.5 percent of sugarcane feeding into the process.

OCSB, *the Office of Cane and Sugar Board*, had expected the demand and supply of sugarcane and molasses as shown in Table 1 illustrating the sugarcane yields and demand on sugarcane to produce sugar for domestic consumption and exporting. From 2009 onwards the excess sugarcane will be capably taken as raw materials to produce ethanol. Moreover, the Table presents molasses yield and demand on molasses for liquor production, animal feed, monosodium glutamate and exporting, the rest is taken to produce ethanol. In 2009, the excess molasses for ethanol production yielded at 1.27 ml/day.

Table 1: Demand and Supply of Molasses in 2008-2011

Unit: mt/yr

Item	2008	2009	2010	2011
Cane Crushing Season	07/08	08/09	09/10	10/11
Targeted sugarcane ^{1/}	73.30	80.00	87.00	95.00
Yield /rai (t/rai/yr) ^{1/}	11.81	13.00	14.00	15.00
Planting area (m.rai) ^{1/}	6.20	6.20	6.20	6.20
Sugarcane for producing sugar for domestic consumption ^{1/}	18.00	20.00	20.00	20.00
Sugarcane for producing sugar to export ^{1/}	55.20	42.00	37.00	32.00
Sugarcane for ethanol production ^{1/}	0.00	18.00	30.00	43.00
Molasses	3.30	3.76	4.09	4.47
Liquor Factory *	1.00	1.00	1.00	1.00
Animal feed/ Monosodium glutamate *	0.36	0.40	0.40	0.40
Export **	0.50	0.50	0.50	0.50
The rest for producing ethanol	1.44	1.89	2.19	2.57
Accounted to ethanol derived from molasses (ml/d)	0.99	1.27	1.50	1.76
Plant capacity of ethanol derived from molasses (ml/d)	1.60	1.60	1.60	1.60

Source: 1/ the National Agenda, OCSB June 30th, 2008

* OCSB data in 2007-2009, as for 2010-2011 were the preliminary data

** Export of Molasses in 2006-2007 data collected by the Customs Department

It is found from the data of the Customs Department that in October 2008, an export of molasses was at total of 51,745 t accounted to an average of 3,007 baht/t and total molasses import was at 2,223 t or averaged as 17,166 baht/t.

(2) Cassava is grown mainly in Nakhon Ratchasima, Kamphengphet, SaKaew, Chaiyapoom, Chachoengsao. The Agricultural Economic Office had estimated the cassava yield in 2009 at 29.60 mt which will be processed to cassava chips, pellets and starch for local consumption and export. The rest as excessive products are used to produce the ethanol for 1.25 mt and capable producing of ethanol at 0.58

ml/day and as for the year 2010-2011 see in Table 2, illustrating the demand and supply of cassava in 2008-2011.

Table 2: Demand and Supply of Cassava in 2008-2011

Unit: mt/Yr

Item	2008	2009	2010	2011
Cassava yields	25.56	29.60	31.45	33.30
Planting area (m.rai)	7.397	7.400	7.400	7.400
Yield/rai (t/rai/Yr)	3.456	4.00	4.250	4.500
- Domestic demand	7.77	8.19	8.42	8.69
Cassava chip/strip, pellets	2.31	2.52	2.63	2.73
Starch	5.46	5.67	5.80	5.96
- Exporting demand	15.96	20.16	21.42	22.05
Pellets	4.20	3.36	3.36	3.15
Cassava chip/strip	2.10	6.72	7.35	7.77
Starch	9.66	10.08	10.71	11.13
The rest of cassava for producing ethanol	1.83	1.25	1.61	2.56
Accounted to ethanol derived from cassava (ml/d)	0.85	0.58	0.75	1.19
Production capacity of ethanol derived from cassava (ml/d)	0.62	1.97	2.17	2.17
Total of ethanol derived from molasses + cassava (ml/d)	1.84	1.86	2.25	2.95

Note: Data source is from Department of Agricultural Economics, updated on 12th June 2008

Production capacity of ethanol plant excluded the factories of IEC and FahKwanThip due to unclear reports..

Prices of mingled fresh cassava and cassava chip/strip will fluctuate for the year round. An average in November 2008 was at 1.28 and 4.35 baht/kg respectively.

Besides such the energy plants, the overseas have R&D in taking grass, wood residue, agricultural wastes, seaweed/algae and carbohydrate from biomass to produce the biofuels in various forms as shown in Figure 2. Thus in this Development Plan, it covers R&D for additional options of raw materials or feedstock for ethanol production by considering such that feedstock potential in Thailand.

Fuel Type	Raw Material	Advantages	Development Stage
Ethanol derived from Cereals/sugar	corn/sorghum/ sugarcane	* producing fuel at high octane value for blending with gasoline * producing from raw material sources which are renewable and widely available	Commercial and wide use
Biodiesel	Vegetable oil, Crop fat and Animal fat	* Reducing the pollution * Increasing the lubricate for biodiesel	Widely commercial use
Green diesel and Green gasoline	Vegetable oil and crop fat blended with crude oil	* Be the great feedstock/ raw material for refinery * Be the fuel with low sulphur mixtures	Experiment using commercially in Europe and Brazil
Ethanol derived from Cellulose	grass, wood waste and agricultural wastes	* Producing the ethanol with high octane number value for blending with gasoline	the USA aims to demonstrate using commercially in 2012
Buthanol	Corn/sorghum/wheat/ sugarcane	* Be an alternative energy with high heating value, hard evaporation and non-absorbing the water	BP and Dupont planed to initiate using the buthanol in 2007

Fuel Type	Raw Material	Advantages	Development Stage
Oil derived from Pyrolysis process	Biomass types of solid shells	* Be feedstock/raw material in fuel oil refinery and in aromatic and phenol industries	Using commercially for energy and chemicals industries
Fuel derived from synthesis gas	Various forms of biomass and fossil fuels	* Capably blending biomass with fossil fuel for using as raw material * capably producing the high quality diesel and gasoline	Demonstrate producing of fuel from synthesis gas derived from large fossil fuel resources
Diesel/Jet fuel derived from algae	Micro algae from nursery	* High yielding per area * Capably capturing of CO ₂ and recovering it	Demonstrate the model or its prototype in a decade of 1990
Hydrocarbon compound from biomass	Carbohydrate from biomass	* Capably producing of synthesis diesel, synthesis gasoline and other petroleum products	Be at the stage of laboratory

Figure 4: Biofuel Production from Various Types of Raw Materials and Technologies

(Source: www.nrel.gov)

3.2 Collecting and Transporting Raw Materials for Ethanol Production

Types of raw materials collecting by ethanol plants are in two main methods classified by raw materials used, i.e. (1) Molasses and (2) Cassava.

(1) **In case of using molasses** since molasses are by-product of sugarcane processing industry, thus molasses can be directly collected from sugar mill/refinery. However, most of ethanol plants using molasses as feedstock will be a factory extended from sugar mill and thus need no additional infrastructure in collecting and transporting the molasses. But the factory with no molasses possession by itself will need to transport mainly by trucks.

(2) **In case of using cassava** most of factories producing ethanol from cassava will provide the purchasing fields in front of factories. Besides, directly purchasing from farmers, there are medium merchants who also establish the fields/grounds, to purchase cassava, located near the planting areas for re-selling to the factories.

3.3 Ethanol Production

Presently, there are 11 plants producing ethanol from molasses with a total capacity of 1,575 ml/d and one plant is producing ethanol from cassava at a capacity of 0.13 ml/d as shown in **Table 3**. It is found from data of the 9 ethanol plants that in November 2008, a total ethanol production was at 24.07 ml or averaged at 0.80 ml/d with an inventory of 6.64 ml as ethanol stock.

Table 3: List of Ethanol Plants and Production in November 2008

Ethanol Plants		Capacity (l/d)		Data of 1-30 November 2008 (ml)		
		Installed	Actual (average)	Actual	Data	Stock *
				Production	Distribution	
1	Pondwilai Inter	25,000	—	—	—	—
2	Thai Agro Energy	150,000	140,617	4.22	4.16	
3	Thai Alcohol	200,000	200,583	6.02	7.26	1.79
4	KhonKhen Alcohol	150,000	123,894	3.72	2.83	1.84
5	Thai Nguan Ethanol	130,000	45,036	1.35	1.40	1.43
6	Petro Green (Chaiyapoom)	200,000	13,333	0.40	0.00	0.54
7	Thai Sugar Ethanol	100,000	83,874	2.52	3.65	0.60
8	KI Ethanol	100,000	87,451	2.62	2.68	0.03
9	Petro Green (Kanlasint)	200,000	83,000	2.49	2.08	0.23
10	Ekarath Patana	200,000	—	—	—	—
11	Thai RungRoeng Energy	120,000	24,684	0.74	1.84	0.18
Total Capacity		1,575,000	802,472	24.07	25.91	6.64
Average per day (ml/d)				0.80	0.86	

Note: * Deducted a Deadstock

- 1) Pondwilai producing the acetic acid instead
- 2) Thai Sugar Ethanol shut down its production since 23-30 November 2008
- 3) Petro Green (Kanlasint) shut down its production since 1-17 November 2008
- 4) Petro Green (PoohKiew) shut down its production since 1-26 November 2008

Generally, ethanol production process will be fermentation utilising bacteria and the preferred technologies are Alfa Laval, Katzen, Maguin, Praj and Shandong (as shown in Table 4.)

Table 4: Thailand Ethanol Production by Technologies

Technology	Process Predominant		Application
	Molasses	Cassava	
AIFA LAVAL	* Continuous Fermentation -- Single Fermentor * a Multi-Pressure, Two Distillation Columns	* Batch Fermentation --SSF * a Multi-Pressure, Multi Distillation Columns	* Thai Alcohol Plc
KATZEN	* Fed-Batch Fermentation – SSF * a Multi-Pressure, Multi Distillation Columns	* Fermentation -- SSF * a Multi-Pressure, Two Distillation Columns	* Ratchaburi Ethanol
MAGUIN	* Cascade Fermentor—Continuous * Two Distillation Columns	* Cascade Fermentor--Continuous * Two Distillation Columns	* Thai Agro Energy * Petro Green
PRAJ	* Continuous Fermentation * a Multi-Pressure, Two Distillation Columns	* Continuous Fermentation -- SSF * a Multi-Pressure, Two Distillation Columns	* KhonKaen Alcohol * Thai Sugar Ethanol * KI Ethanol
SHANDONG	* Cascade Fermentor—Continuous * a Multi-Pressure, Two Distillation Columns	* Continuous Fermentation * a Multi-Pressure, Two Distillation Columns	* ThaiNguan Ethanol

3.4 Market and Energy Distribution to Users

Since the supply of ethanol, used for fuelling in Thailand, at some period would be higher than the demand therefore, the present ethanol markets are both domestic and oversea markets

(1) **Ethanol domestic market**, ethanol will be distributed to consumers through oil trading companies. Ethanol will be transported by lorries from ethanol plants/factories to the nearest oil warehouse for blending with gasoline at various proportions. Up to the present, there are 4 products, i.e. 95 gasohol, 91 gasohol, E20 and E85 for distribution to the public through the petrol stations. At the end of November 2008, the petrol stations selling ethanol be total at 4,178 stations of the 12 oil trading companies as shown in Table 5.

Table 5 Gasohol Service Stations *(as in November 2008)*

No	Company	91 Gasohol	95 Gasohol	91 and 95 Gasohol	E20 and 95 Gasohol	E20 and 91,95 Gasohol	E20, E85, and 91,95 Gasohol	Total by Company
1	PTT	-	375	669	2	95	2	1,143
2	BangChak	126	84	544	-	88	1	843
3	Shell	2	295	306	-	-	-	603
4	PTT, Executive	-	48	98	-	-	-	146
5	ESSO	-	223	327	-	-	-	550
6	Chevron	5	183	235	-	-	-	423
7	Thai Oil	-	2	-	-	-	-	2
8	Siam Saha Services	-	141	-	-	-	-	141
9	Southern	-	142	-	-	-	-	142
10	IRPC	-	1	-	-	-	-	1
11	Petronas	-	43	74	-	-	-	117
12	Rayong Purifier	-	67	-	-	-	-	67
	Total Stations	133	1,604	2,253	2	183	3	4,178

Source: DOE (*the Department of Energy Business*), November 2008.

The domestic price of ethanol will be based on import price, i.e. CIF pricing of ethanol in Brazilian Commodity Exchange Sao Paulo of Brazil, by taking a change in Thailand ethanol price in comparison to Brazilian Market (BMF) and Chicago Market (CBOT). This ethanol pricing formulation will be taken to calculate the levy to the Oil Fund. This is to make the retailed prices of gasohol products lower than of gasoline in order to encourage the people to increase using the gasohol.

Thai government has promoted using ethanol to substitute the gasoline by replacing of gasoline in various proportions, from 10 percent to 85 percent. Therefore, important factors to specify the market scale of ethanol in the country are: (1) gasoline demand and (2) automobile technology.

(1) **Gasoline Demand:** in August 2007, EPPO conducted an estimation on gasoline demand for the year 2021 at 32.18 ml/d with an average growth rate of 3.2 percent from the year 2007.

(2) **Automobile Technology:** at this part we will discuss on the automobile technology at the present and at the future trend to support the gasoline blended with ethanol at the following proportions:

Fuel Type	Automobile Technology
E10	Most of cars with injection system, making from the year 1995, are capably fuelled by E10 gasohol.
E20	Development on cars for capable fuelling by E20 needed a modification for systems related. Such the essential systems are: fuel injection system, fuel injection and improving materials used in fuel system and engine for capable using ethanol at a higher blending rate. As for the public sector provides the promotion measures though a tax privilege for E20 cars since January 2008 (by an advanced notification), the car makers thus have developed the car models to be fuelled by E20. Presently, more than 80 percent of modern car models in the market are capably fuelled by E20.
E85	To develop the car for capable using ethanol blended from 0 – 85 percent, it needs the engine improvement and all related systems, including the new testing of all functions. This would count as the car technology development to a higher level and that needs to take a preparation time sufficiently to develop the car at each model. Currently, the manufacture and distribution of E85 cars in Thailand are of VOLVO C30 and VOLVO S80.

(2) Ethanol overseas market

In April 2007, exporting of ethanol as fuel was first made by KhonKaen Alcohol for 0.35 ml of ethanol exported to the Philippines. Up to the present, total exporting of ethanol are at 45.07 ml to several countries, e.g. the Philippines, Singapore, Australia, Taiwan and European countries. **Figure 5** illustrates the shares of ethanol export by countries.

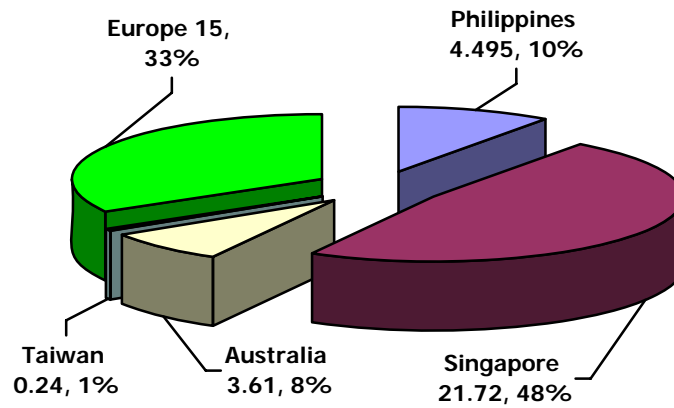


Figure 5 Ethanol Export by Countries

3.5 Supply Chain Stakeholders

Stakeholders throughout the ethanol supply chain are explained as in Table 6.

Table 6 Supply Chain Stakeholders

Supply Chain	Stakeholders
Sources of ethanol feedstock	<ul style="list-style-type: none"> • Farmers who grow energy crops • Medium merchants • Factory for primary processing of energy crops • Ministry of Agriculture and Co-operatives • Ministry of Commerce
Ethanol production	<ul style="list-style-type: none"> • Ethanol industry • Producers/Distributors of ethanol production technology • Ministry of Industry • Ministry of Science and Technology • Energy Ministry
Market and distribution of energy to users	<ul style="list-style-type: none"> • Oil trading company • Oil refinery • Oil service station • Automobile Industry • Energy Ministry • Excise Department • Customs Department • Industrial factory • the public (people)

3.6 Current Promotion Measures

Besides the tax privilege for investment through BOI, revolving fund project, CDM project for renewable energy, the other promotion measures are such as:

- Ethanol Standard Requirement
- Liberlisation of Ethanol Production -- by Ministry of Finance issuing the Notification Re: Administrative Method of Distillated Liquor--Type of SamTub (Ethanol) for Fuelling, B.E. 2550 (2007)
- Requirement on the Levy Rate to Oil Fund for 95 Gasohol, 91 Gasohol, E20 and E85 for lowering such those retailed prices than of 95 gasoline and 91 gasoline.
- Ethanol pricing formulation by referring to Brazilian market.

4. Problems and Barriers in Ethanol Development

In this part we will discuss only on problems and barriers occur at each of supply chain by dividing into 3 large issues, i.e. (1) Technical Problems, (2) Economic Problems and (3) Problems of Policy and Regulations as summarised in Table 7.

Table 7 Problems and Barriers in Ethanol Development

Type	Problems and Barriers
Technical	<ul style="list-style-type: none">• Insufficient feedstock to produce ethanol, if we would promote using at 9 ml/d in 2022• Planting area for energy crops are restrictive• Lack of expertise personnel
Economical	<ul style="list-style-type: none">• Oil pricing fluctuation• Unstable feedstock, which may be glut and scarce• Sometime, ethanol cost may be higher than of fossil fuel
Policy and Regulations	<ul style="list-style-type: none">• Farmers, entrepreneurs, investors have no confidence in policy

5. Substance Solutions for Ethanol Development

The substance solutions for ethanol development to overcome the problems and barriers as stated in Table 4 are presented in Table 8.

Table 8 Substance Solutions for Ethanol Development

Problems - Barriers	Substance Solutions for Ethanol Development
<u>Technical</u>	
<ul style="list-style-type: none"> • Insufficient feedstock to produce ethanol, if we would promote using at 9 ml/d in 2022 • Planting area for energy crops are restrictive 	<ul style="list-style-type: none"> • Research and develop for increasing the yields of cassava and sugarcane • Research, develop and promote producing ethanol from other alternative energy crops
<ul style="list-style-type: none"> • Lack of confidence on using gasohol products, esp. E85 	<ul style="list-style-type: none"> • Conduct the public relations to educate and build up confidence to consumers • Issue the Standard Requirement on E85 Oil and E85 Service Stations • Conduct the Testing of E85 use
<ul style="list-style-type: none"> • Lack of expertise personnel 	<ul style="list-style-type: none"> • Promote the transfer/exchange of knowledge between the public sector and the private sector
<u>Economical</u>	
<ul style="list-style-type: none"> • Oil pricing fluctuation 	<ul style="list-style-type: none"> • Promote producing the ethanol • Promote using gasohol for its all products by implementing the measures on tax and pricing
<ul style="list-style-type: none"> • Unstable feedstock, which may be glut or scarcity 	<ul style="list-style-type: none"> • Administrate to build up the stability of ethanol industry from the up stream to the down stream • Promote using the FFV • Increase the size of ethanol market by supporting the ethanol export and promote using ethanol as feedstock in industrial sector
<ul style="list-style-type: none"> • Sometime, ethanol cost may be higher than of fossil fuel 	<ul style="list-style-type: none"> • Promote the upstream and downstream industries of ethanol • Develop to get an effective ethanol transport system • Research and develop to build up the value added to wastes derived from ethanol production, e.g. the waste water yeast, etc.
<u>Policy and Regulations</u>	
<ul style="list-style-type: none"> • Farmers, entrepreneurs, investors have no confidence in policy 	<ul style="list-style-type: none"> • Clearly determine the demand and supply of ethanol in Thailand • Disseminate the information with correctness, clear and up to date

6. The 15 Year Ethanol Development Plan

The substance solutions for ethanol development in 5. that leads to the 15 year ethanol development plan as follows.

Table 9 the 15 Year Ethanol Development Plan (2008-2022)

Development Plan	Short Term (2008-2011)	Middle Term (2012-2016)	Long Term (2017-2022)
1. Feedstock/Raw Materials	* Research and develop for increasing the yields of cassava and sugarcane		
	* Research and develop for producing ethanol from other alternative crops		
2. Ethanol Industry	* Promote ethanol producing from molasses and cassava		
		* Promote ethanol producing from sugarcane /other alternative crops with economic cost-effectiveness	
	* Promote the Upstream and Downstream Industries of ethanol; e.g Acetic acid, Ethyl acetate, etc.		
	* Research and develop creating a value added to waste from ethanol production		
		* Develop an ethanol transport system for more efficiency	
3. Marketing/Consumption Promotion	* Promote using all types of gasohol by incentive measures on pricing /tax measure		
	* Promote using the FFV		
	* Conduct public relations to educate people for building up confidence to consumers		
	* Set the Standard Requirements on the E85 oil and service stations / Testing for E85 use		
	* Support ethanol export and promote using ethanol as raw materials in industry		
4. Integrated Ethanol Management	* Manage for creating the stability of ethanol industry from its upstream to downstream industries		
	* Collect and disseminate the data with correctness, clear and up to date		
5. Personnel Development	* Develop the government personnel for having special expertise		
	* Promote transferring/exchanging the knowledge base between the public and the private sectors		

7. Indicators of the Plan Achievement and Its Level

To capably follow the progress of the plan, we would determine the level of plan achievement at each period as shown in Table 10. However, such the indicators and achievement level would need to review and adjust for consistency with its circumstance at the time.

Table 10: Indicators and Achievement Level of the 15 Year Ethanol Development Plan

Development Plan	Indicator	Achievement Level														
		Short Term				Medium Term					Long Term					
		08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Target of promote producing the ethanol (ml/d)		1.24	1.34	2.11	2.96	6.2					9.0					
1 Feedstock / Raw Material																
* Research, develop and promote growing cassava and sugarcane with high yielding	* Cassava yield per rai increasing not less than (t/yr)	Average cassava yielding per rai not less than 4.5 t/yr														
	* Sugarcane yield per rai increasing not less than (t/yr)	Average sugarcane yielding per rai not less than 15 t/yr														
* Research and develop producing ethanol from other alternative energy crops	* A number of results from research/study (projects)	Results of research, study and demonstration on producing ethanol from other alternative energy crop at least 1 project														
2 Ethanol Industry																
* Promote producing ethanol from sugarcane/ other alternative energy crops	* Progressive level of promoting an ethanol produced from other alternative crops					Commercially producing ethanol from other alternative crops at least 1 project										
* Promote the successive industries of ethanol (upstream/ downstream industries of ethanol)	* Progressive level of promoting the successive industries of ethanol	At least one factory increasing as a successive industry of ethanol				At least one factory increasing as a successive industry of ethanol					At least one factory increasing as a successive industry of ethanol					
* Research and develop the building up value added for waste from ethanol production	* A number of project on demonstration of building up value added for waste from ethanol production	At least one project on demonstration of building up value added for waste from ethanol production														
* Develop the ethanol transport system for higher efficiency	* Develop the ethanol transport system for higher efficiency					Getting the optimised method to develop the ethanol transport system for higher efficiency										
3 Ethanol Consumption																
* Promote using all of gasohol products by implementing incentive measure on pricing / tax measure	* Determine the incentive measures	Prices of all gasohol products lower than of benzene and E85 price lower than gasohol 95 at not less than 30%				Price of E85 is lower than of gasohol 95 at not less than 30%					Prices of all gasohol products lower than of benzene and E85 price lower than gasohol 95 at not less than 30%					
* Promote using cars type of FFV	* Determine the incentive measure	Reduce tax for FFV														
	* A number of FFV	not lower than 2,000 cars				not lower than 390,000 cars					not lower than 1,070,000 cars					
* Conduct the public relations to create the confidence to consumers	* A number of PR media both on TV and radio (times/yr)	At least 100 times/yr														
4 Integrated Administration and Management of Ethanol																
* Admin to create stability of ethanol industry since its upstream to downstream	* Progress of implementation	Setting the implementation framework to administrate the ethanol industry				Ethanol produced be enough for domestic demand					Prices of ethanol and feedstock be at optimum level					
* Collect and disseminate the data that correct, clear and up to date	* A number of reports disseminated	Conduct the annual report at lease one time/yr														
5 Human Resource Development																
* Promote knowledge tranfer and exchange between the public and the private	* A number of times holding the workshop for knowledge exchange	At least one time a year														
* Develop human resources of the public sector for having specific expertise	* A number of human resources (persons)	At least 40 persons				Develop human resources of the the public sector for having specific expertise					A number of human resources (persons)					