Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Bioenergy Applications in Thailand

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Department of Alternative Energy Development and Efficiency (DEDE)

Ministry of Energy, THAILAND

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand Integrated Energy Blueprint

The National Energy Policy Council (NEPC)'s resolution on August 15th, 2014

Integration | Harmonized Time Frame | Better Balanced Focus

Security Economy Ecology

กระทรวงพลังงาน
MINISTRY OF ENERGY

PDP EEP AEDP GAS OIL

TIEB
THAILAND INTEGRATED ENERGY BLUEPRINT

PDP — POWER DEVELOPMENT PLAN
แผนพัฒนากำลังผลิตไฟฟ้าของประเทศไทย*

EEP — ENERGY EFFICIENCY PLAN
แผนอนุรักษ์พลังงาน*

AEDP — ALTERNATIVE ENERGY DEVELOPMENT PLAN
แผนพัฒนาพลังงานทดแทนและพลังงานทางเลือก

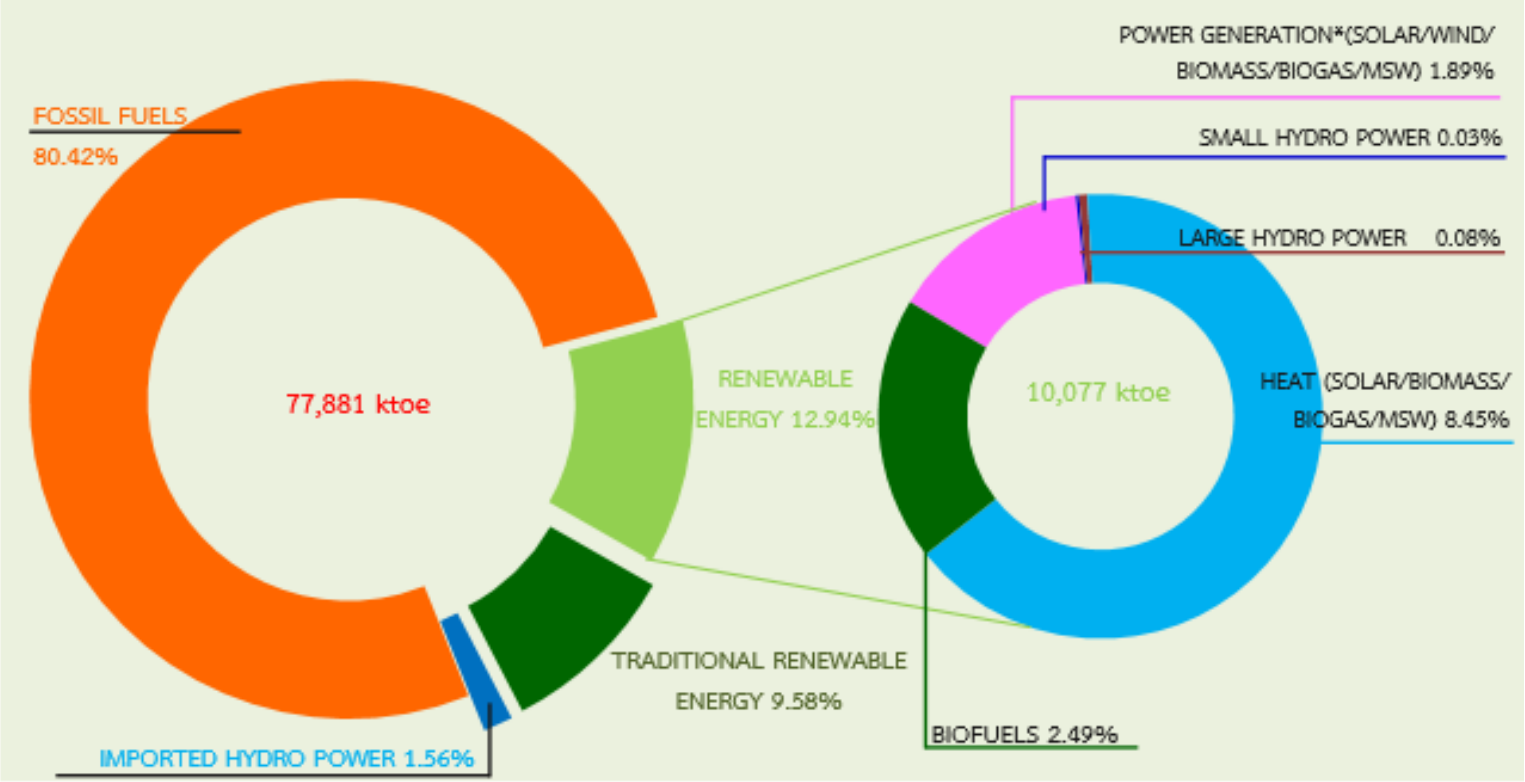
GAS — GAS PLAN
แผนบริหารจัดการก๊าซธรรมชาติ

OIL — OIL PLAN
แผนบริหารจัดการน้ำมันเชื้อเพลิง

Thailand Final Energy Consumption 2015

Final Energy Consumption

Alternative Energy Consumption



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Performance of RE in 2015

Alternative Energy	Target 2036				Performance 2015			
	MW	Million litres/day	Gwh	ktoe	MW	Million litres/day	Gwh	ktoe
Electricity [1/]	19,684.40		65,581.98	5,588.24	7,962.79		18,259.9	1,556
Solar	6,000		8,409.60	716.58	1,419.58		2,378.0	202.7
Wind	3,002		4733.55	403.35	233.90		328.8	28.0
Small Hydro Power [2/]	376		1,350.44	115.07	172.12		291.4	24.8
Biomass	5,570		34,155.24	2,910.37	2,726.60		12,961.0	1,104.4
Biogas [3/]	1,280		8,325.50	709.42	372.51		1,080.8	92.1
MSW [4/]	550		3,372.59	287.38	131.68		520.3	44.3
Large Hydro Power [5/]	2,906.40		5,235.00	446.07	2,906.40		699.5	59.7
Heat				25,088				6,579
Solar				1,200				5.7
Biomass				22,100				5,990
Biogas				1,283				495
MSW				495				88
Alternative Heat [6/]				10				
Biofuels				8,712.43		6.90		1,942
Ethanol		11.30		2,103.50		3.50		879
Biodiesel		14.00		4,404.82		3.40		1,063
Pyrolysis Oil		0.53		170.87				
Compressed Bio-methane Gas		4,800		2,023.24				
Alternative Fuels [7/]				10				
Alternative Energy Consumption				39,389				10,077
Final Energy Consumption				131,000				77,881
Percentage of Alternative Energy Consumption (%)				30				12.94

Sources : EGAT, MEA, PEA, ERC, DEDE, and DOEB

Notes :
1/ Including off grid power generation.
2/ Including hydro power plants ≤ 12 MW & hydro power plant using the water downstream.
3/ Including waste water / waste dumping and energy crops.
4/ Including municipal solid waste and industrial waste.
5/ The existing installed capacity.
6/ Including geothermal and oil from used tires.
7/ Including bio-oil and hydrogen.

Feed-in Tariff (FiT) for VSPP in 2015

Installed Capacity (MW)	FiT (THB/kWh)			Supporting Period (years)	FiT Premium (THB/kWh)	
	FiT_F	(1) $FiT_{V,2560}$	FiT		Biobased Fuel (for the first 8 yrs)	special Southern zones(2) (for project lifetime)
Waste-to-Energy						
≤ 1 MW	3.13	3.21	6.34	20	0.70	0.50
> 1-3 MW	2.61	3.21	5.82	20	0.70	0.50
> 3 MW	2.39	2.69	5.08	20	0.70	0.50
Landfill organic waste	5.60	-	5.60	10	-	0.50
Biomass						
≤ 1 MW	3.13	2.21	5.34	20	0.50	0.50
> 1-3 MW	2.61	2.21	4.82	20	0.40	0.50
> 3 MW	2.39	1.85	4.24	20	0.30	0.50
Biogas from wastewater/manure	3.76	-	3.76	20	0.50	0.50
Biogas from energy crops	2.79	2.55	5.34	20	0.50	0.50
Small hydro						
≤ 200 kW	4.90	-	4.90	20	-	0.50
Wind	6.06	-	6.06	20	-	0.50

(1) FiT_V is subjected to be adjusted by core inflation

(2) Includes 3 Southern provinces (Yala, Pattani, Narathiwas) and 4 districts in Songkhla province

Alternative Energy Development Plan (AEDP) 2015-2036

Commitment to the development of a low-carbon society

Facilitator: *Private-led investment*

Strategy: Alternative Energy Development Plan 2015-2036

Facilitator: *Government funded on R&D*

Goal: *Target 30%* renewables in Total Energy Consumption by 2036

Bio-Energy

Biomass	Biogas	MSW + Industrial Waste
5,570 MW	1,280 MW	550 MW
22,100 ktoe	1,283 ktoe	495 ktoe

6,720 MW Power | 23,878 Ktoe Heat

Bio-Fuel

Ethanol	Biodiesel	Pyrolysis Oil
11.3 ML/Day	14 ML/Day	0.53 ML/Day

CBG	Alt. Fuels*
4,800 t/Day	10 ktoe

Solar

6,000 MW

1,200 Ktoe

Wind

3,002 MW

9,002 MW Power | 1,200 Ktoe Heat

Hydro

Large Hydro 2,906.40 MW	Small Hydro 376 MW

3,282.40 MW

New-Energy

Geothermal, Used Tire Oil, etc.

10 ktoe

* Alternative fuels = Bio-oil, Hydrogen

Main Activities

Electricity

- Area-based RE power generation target must be related to RE potential (RE Grid Capacity)
- Develop and support for power generation from unutilized fuel (e.g. agricultural waste, industrial waste, fast growing crop)
- Support competitive bidding for power purchasing system

Heat

- Promote and support RDF transformation for municipal waste management
- Promote and support biomass-derived fuel (e.g. biomass pellet, bio-coal)
- Support biogas generation from waste water or solid waste
- Promote heat utilization in building by building code establishing

Biofuel

- Promote utilization of B10, B20 in both transportation and industrial sector
- Promote gasohol utilization
- Promote CBG utilization for vehicle and industry
- Promote biofuel production efficiency improvement

Biomass Plan

Promote the community scale biomass power generations by

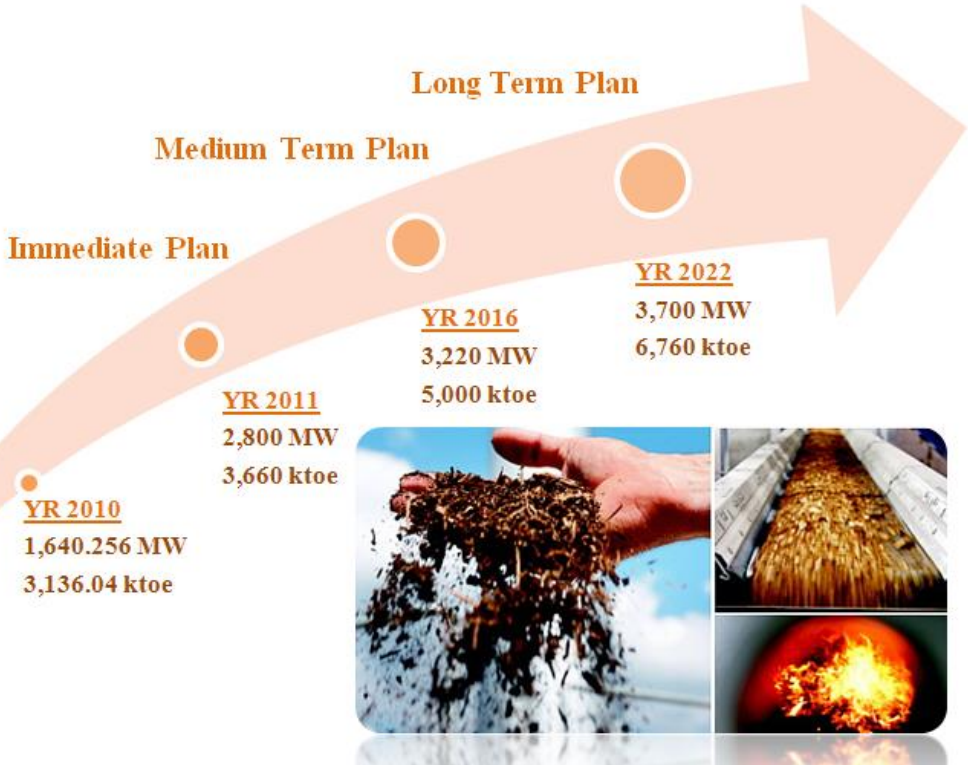
- establishing community enterprises to co-manage the operation and fuel supply;
- identifying suitable technologies, for example gasifiers, for community scale power generation; and
- formulating necessary incentives for promotion of their uses.

Promote biomass power development by

- providing new incentives to developers such as different rate Adder based on technology and size;
- expansion of national grid; and
- Creation of public participation.

Promote R&D on Biomass technologies, i.e

- plantation of fast growing plants;
- harvesting and collection;
- transportation and logistics such as pellets and briquetting.



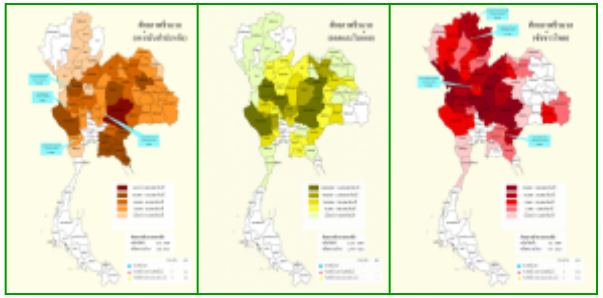
Biomass Plan and Next Step

Plan: - Promote the community scale biomass power generations
- Promote R&D on Biomass technologies
- Promote biomass power development

Next step:

Encourage biomass utilization

- substitute fossil fuel in local industry and in community
- increase the utilization of unused biomass
- improve the energy efficiency in agro industry

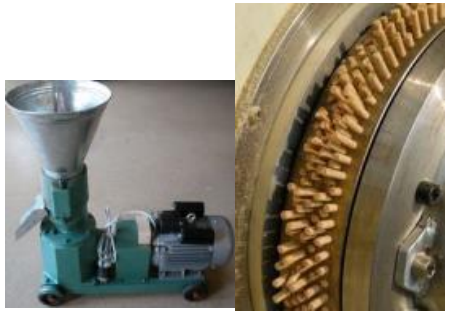


Promotion & Support

- update and provide biomass potential map
- develop biomass excellent center
- financial support and co-promote CDM activities
- develop the biomass collection and transportation system

R&D

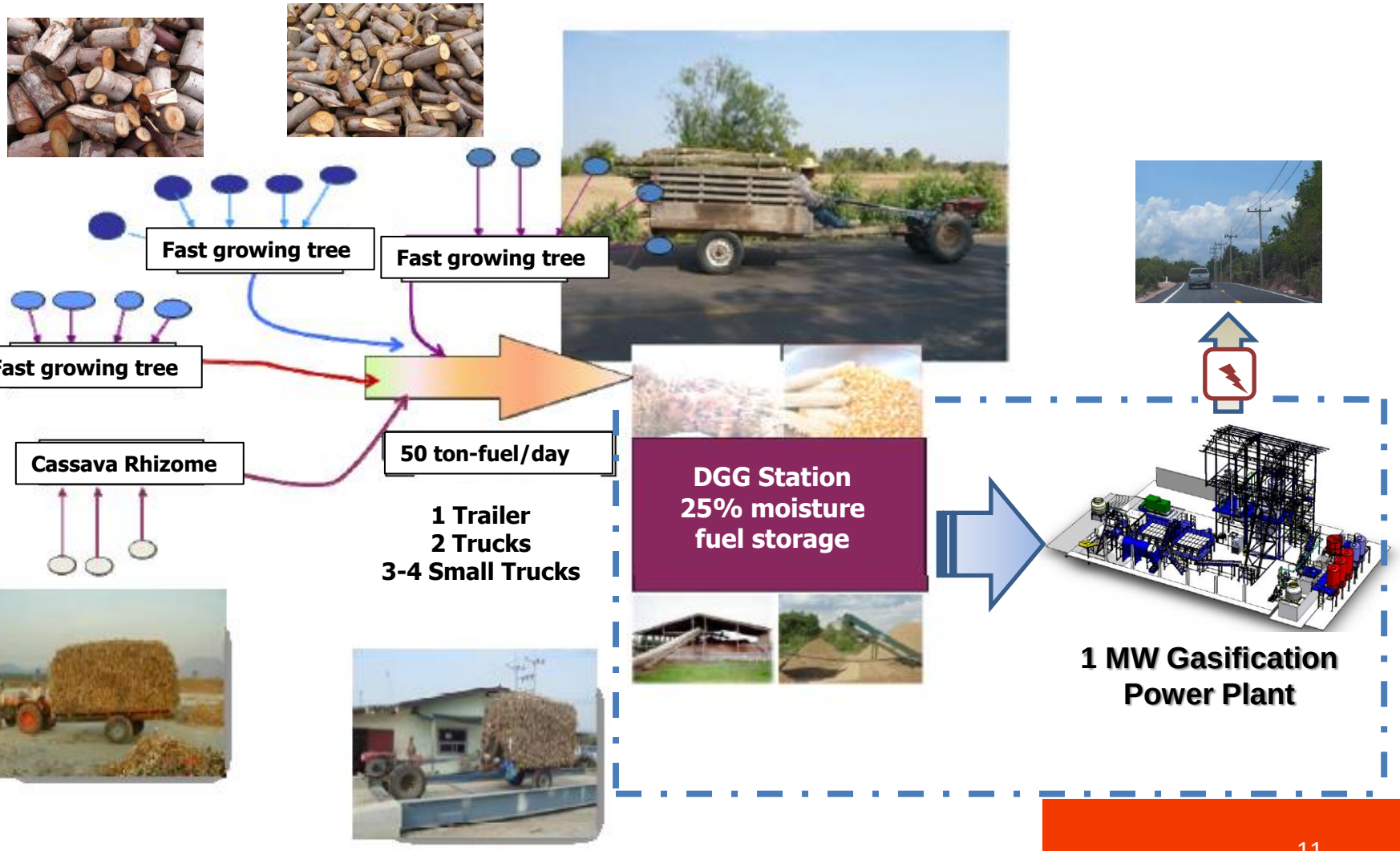
- encourage biomass transformation : pellet
- biomass to liquid technology
- high efficiency biomass technology



Promote and Support for Establishing of Distributed Green Generation (DGG) Project

Example of DGG management concept

Site: None Sanguan DDG Station: Nong Bua Lamphoo Province



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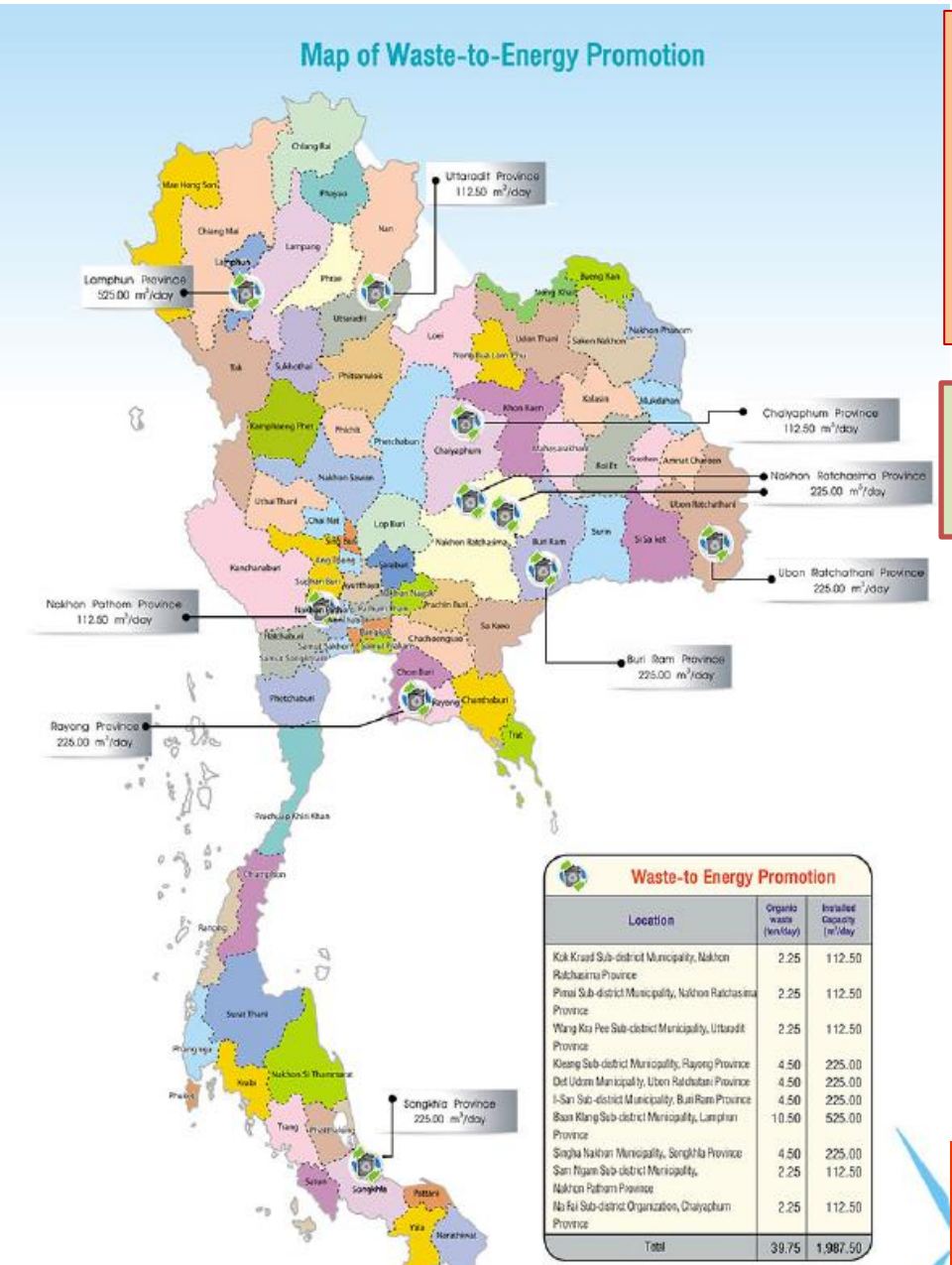
DEDE activities on Biomass project



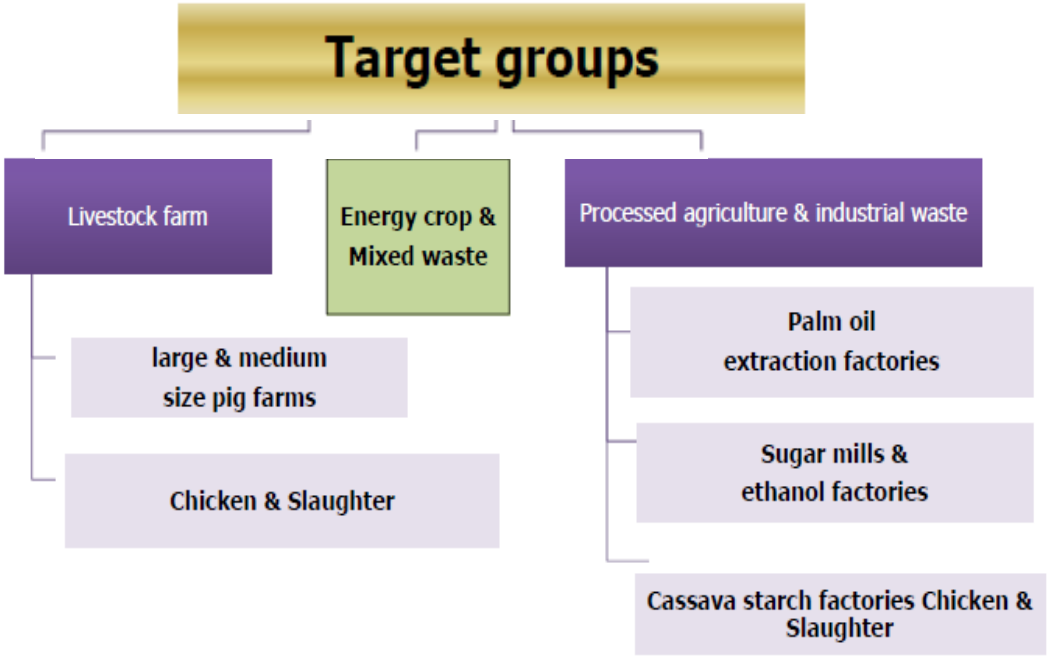
Waste-to Energy Promotion

Location	Organic waste (ton/day)	Installed Capacity (m³/day
Kok Kruad Sub-district Municipality, Nakhon Ratchasima Province	2.25	112.50
Pimai Sub-district Municipality, Nakhon Ratchasima Province	2.25	112.50
Wang Krai Pee Sub-district Municipality, Uttaradit Province	2.25	112.50
Kleang Sub-district Municipality, Rayong Province	4.50	225.00
Det Udom Municipality, Ubon Ratchatani Province	4.50	225.00
I-San Sub-district Municipality, Buri Ram Province	4.50	225.00
Ban Klang Sub-district Municipality, Lamphun Province	10.50	525.00
Singha Nakhon Municipality, Songkhla Province	4.50	225.00
Sam Ngam Sub-district Municipality, Nakhon Pathom Province	2.25	112.50
Na Rai Sub-district Organization, Chaiyaphum Province	2.25	112.50
Total	39.75	1,987.50

- Conduct on study and develop of the method for exploring the biomass potential by focusing on the potential of biomass in each area including stakeholders participation (entrepreneurs, land owners, farmers, local people), in order to ensure the sustainability of using biomass as a key resource for renewable energy

- Demonstrate on using biomass pellet for small boilers in industrial sector in stead of using fossil fuel (Fuel oil, coal)

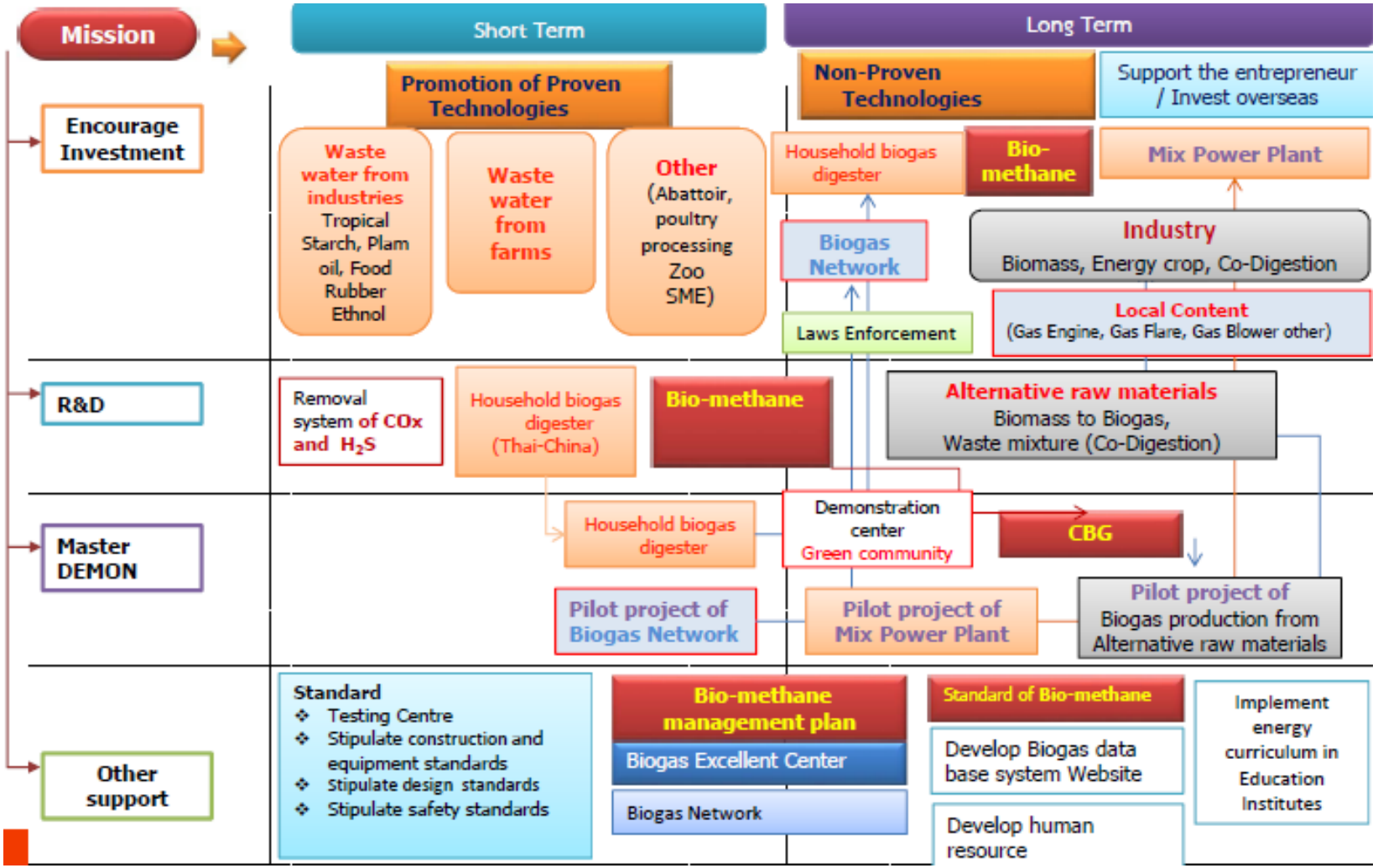
Biogas



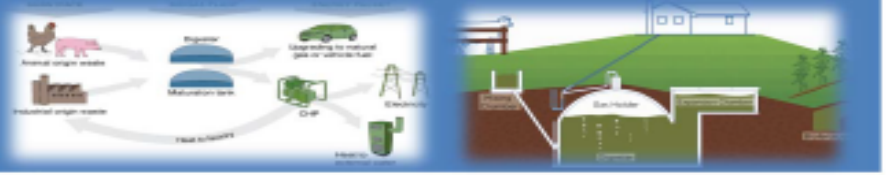
Currently Development Progress for Biogas		
Item	Target in 2036	Performance (Jan-December 2015)
Electricity (MW)	1,280	372.5
Heat (ktoe)	1,283	495
CBG (ton/day)	4,800	-



Biogas Development



Biogas Development

Development Guidelines on biogas	
1. Promoting community to collaborate in broaden production and consumption of renewable energy	❖ Household level, especially Rural community ❖ Biogas network
2. Adjusting incentive measures for investment from private sector appropriated with the situation	❖ Biogas for Compress Bio-Methane Gas(CBG) production
3. Amending laws and regulations which do not benefit to renewable energy development	❖ Biogas safety Standard
4. Public Relations and building up comprehensive knowledge of people	❖ Conduct public relations via media to disseminate knowledge and news **"Biogas Safety Campaign"**
5. Promoting research work as mechanism in development of integrated renewable energy industry	❖ Mixed wastes (Co-Digestion) ❖ CBG for transportation

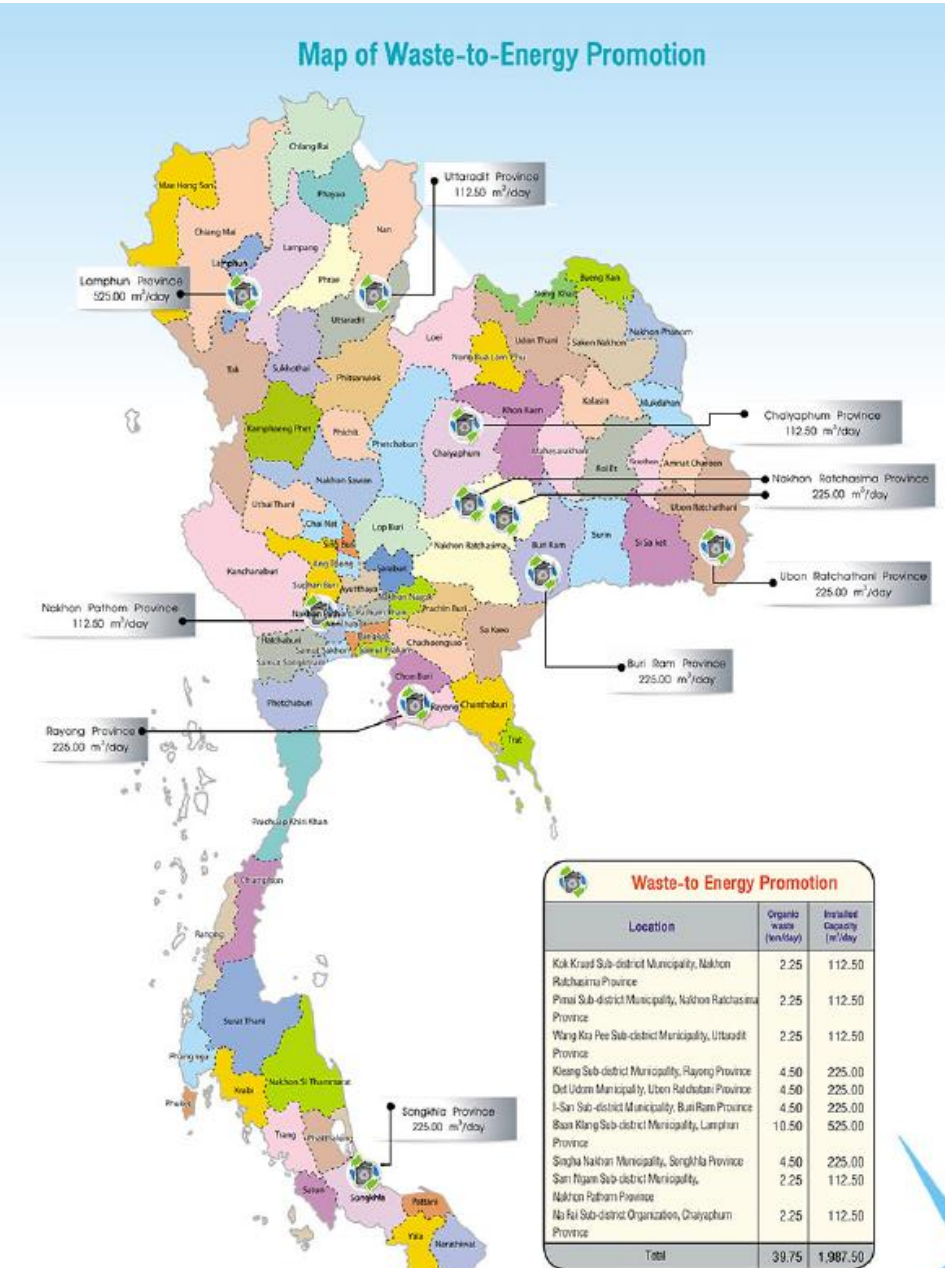
Biogas

Target groups

- Livestock farm
  - large & medium size pig farms
  - Chicken & Slaughter
- Energy crop & Mixed waste
- Processed agriculture & industrial waste
  - Palm oil extraction factories
  - Sugar mills & ethanol factories
  - Cassava starch factories Chicken & Slaughter



Waste to Energy



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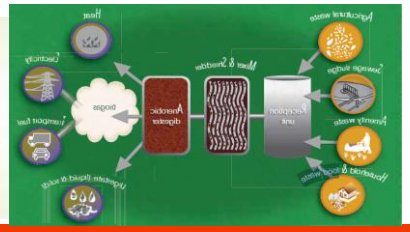
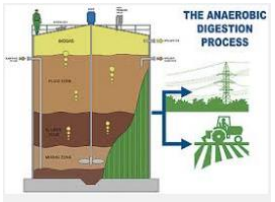
Total	39.75	1,987.50

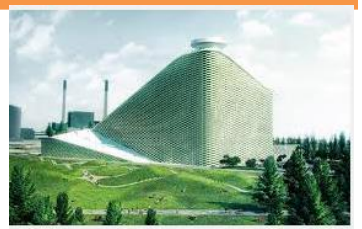
DEDE has been promoted on organic waste to energy in form heat and electricity

- Conduct on data compilation of waste amount and waste management
- Study on various technologies of waste to energy suitable for local waste quantity
- Develop small biogas digester prototype of for (capacity 40 kg/day, biogas production 2.5 m^3/day). The project was installed in school in Bangkok and suburbs and further use national wide.
- Develop municipal organic waste to biogas system for a replacement of LPG for using in household and slaughter house
- Develop prototype two stage biogas system (acid fermentation tank and biogas digester) from fresh market waste with the capacity 2 ton/day , biogas production 100 m^3/day)

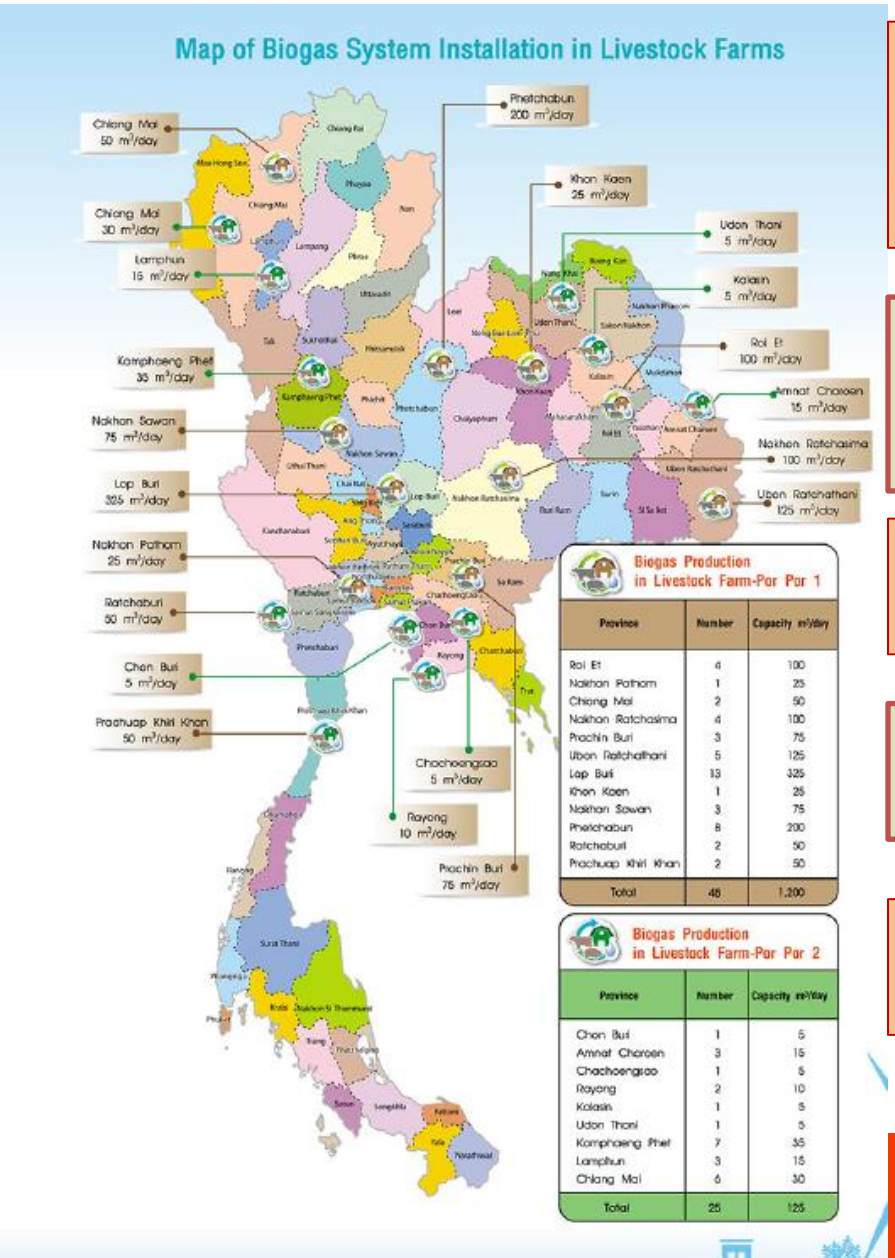
Waste to Energy Development Barriers

Lack of waste separation. Low rate of waste utilization. Household hazardous waste mixed in with general waste.
Local authorities lack household hazardous waste collection and transport system
Protests by communities.
Limitation of grid connection due to inadequate capacity of transmission lines;
Lack of support from financial institutions;
License delay and long process for getting power purchase concession;
Obstruction by laws or regulations; Changes in government policy.

DEDE Activities : Biogas production applies for heat and electricity by promoting



Biogas Production in Livestock Farm-Por Por 1

Province	Number	Capacity m³/day
Roi Et	4	100
Nakhon Pathom	1	25
Chiang Mai	2	50
Nakhon Ratchasima	4	100
Prachin Buri	3	75
Ubon Ratchathani	5	125
Lop Buri	13	325
Khon Kaen	1	25
Nakhon Sawan	3	75
Phetchabun	8	200
Ratchaburi	2	50
Prachuap Khiri Khan	2	50
Total	48	1,200

Biogas Production in Livestock Farm-Por Por 2

Province	Number	Capacity m³/day
Chon Buri	1	5
Amnat Charoen	3	15
Chachoengsao	1	5
Rayong	2	10
Kalasin	1	5
Udon Thani	1	5
Kamphaeng Phet	7	35
Lamphun	3	15
Chiang Mai	6	30
Total	25	125

- Biogas from waste water of agro-process industries: Tapioca starch, liquor and beer, food, palm (steam process mill), paper, rubber, and ethanol
- Biogas production from waste water from animal dunk livestock farms by ready made system
- Compressed bio methane gas (CBG) from pig manure for using as vehicle fuel
- Installation of 8 m^3 of Biogas production systems to replace LPG for cooking
- Co-digestion with Completely Stirred Tank Reactor (CSTR) type in 3 Zoos

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AEDP 2015 Targets - Biofuel

Fuel

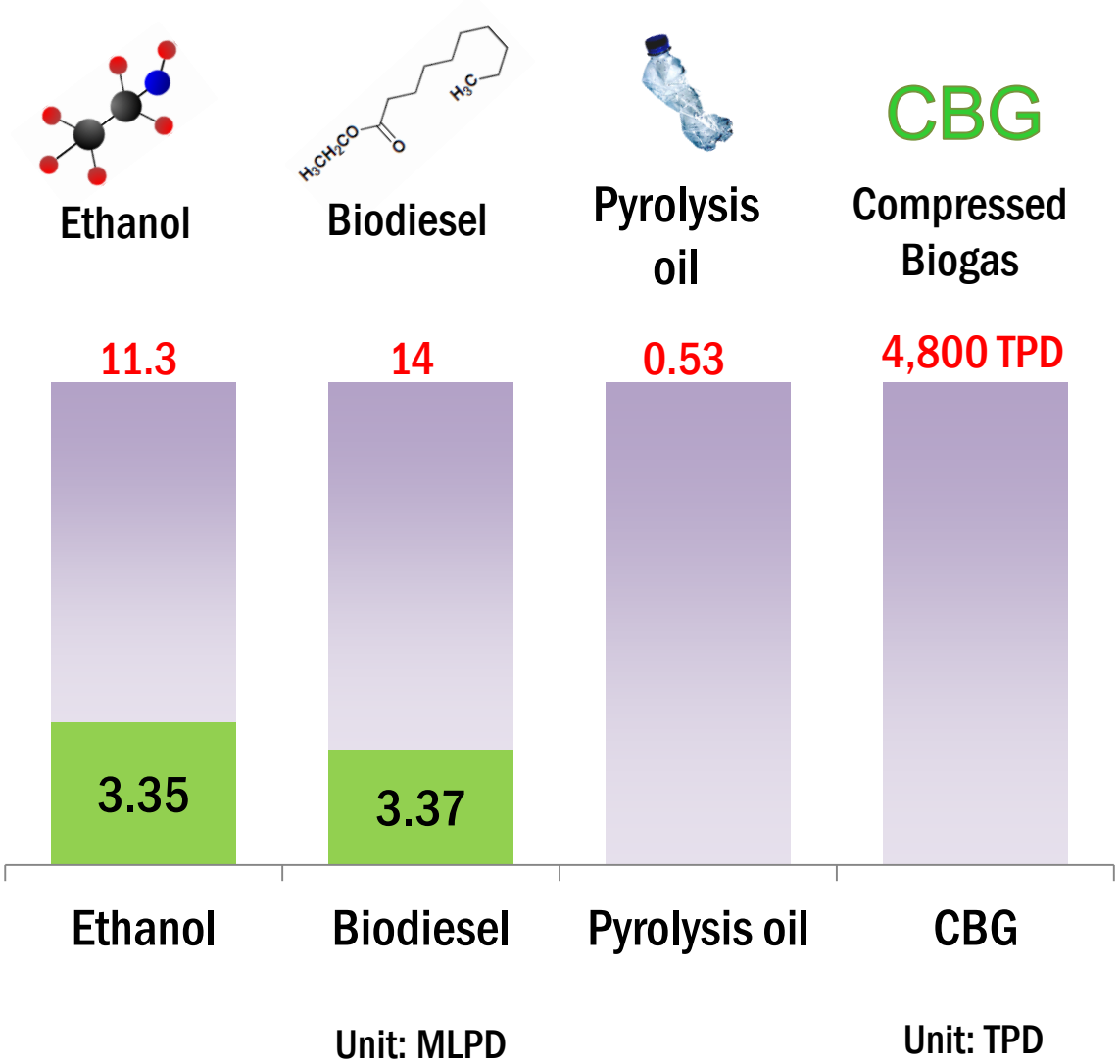
2036 RE Biofuel targets

8,712 ktoe*

(25.04% of fuel demand)

2015 biofuel generated

1,942 ktoe



Remark : * ktoe equivalent of biofuel

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Thailand 2015 Ethanol Feedstock

Area: 9.59 M Rai
Yield: 11.08 T/Rai/Yr
Output: 105.96 MT
Molasses: 4.607 MT

Sugarcane

Area: 8.96M Rai
Yield: 3.6 T/Rai/Yr
Output: 32.36 MT

Cassava

3.16 MT Molasses

0.91 MT Sugarcane Juice

2.17 MT Cassava

69 ML

759 ML

346 ML

Ethanol

1174 ML
(3.21 ML/day)

1 Hectare = 6.25 Rai

Sources – Office of Agricultural economics
Department of Alternative Energy and Efficiency

Department of Alternative Energy Development and Efficiency
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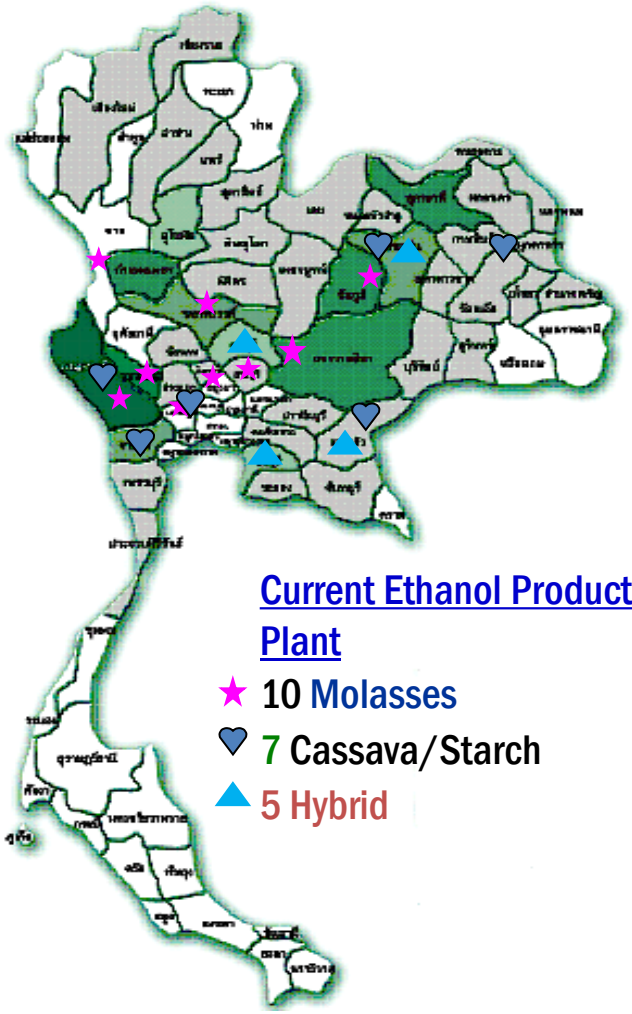
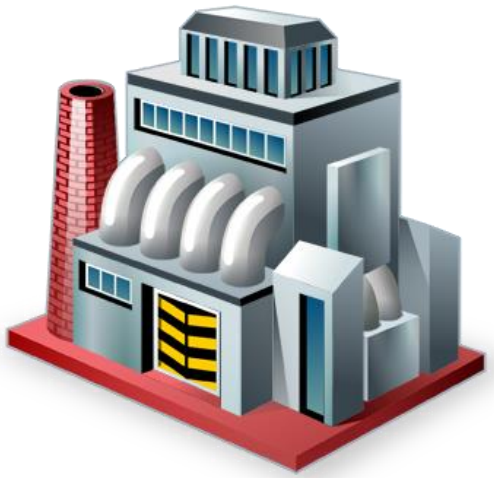
Ethanol Production Capacity



Feedstock	No. of plants	Capacity (ML/day)
Molasses	10	2.26
Cassava	7	1.455
Molasses and Cassava	5	1.25
TOTAL	22	4.965



Source –Department of Alternative Energy and Efficiency

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Fuel and car compatibility

ULG
(Unleaded gasoline)
Pure gasoline

All cars

E10
90% gasoline
10% ethanol
E10 (91) & E10 (95)

Most cars manufactured since 1995

แก๊สโซฮอล์ E20
80% gasoline
20% ethanol

Most cars manufactured since 2008

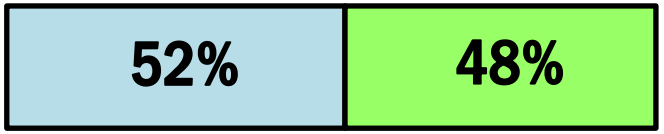
E85
15% gasoline
85% ethanol

Flex-fuel Vehicles (FFV)

Sources – Department of Energy business

4.52 million cars

20.3 million motorcycles



Sources – Department of Land Transportation

- FFV cars in Thailand are produced by Toyota, Honda, Mitsubishi, Chevrolet, Volvo, Mazda
- 2 models of FFV motorcycles are recently produced by Yamaha.

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Ethanol Policies

Promoting Ethanol Consumption

Ethanol Consumption Promoting Policies

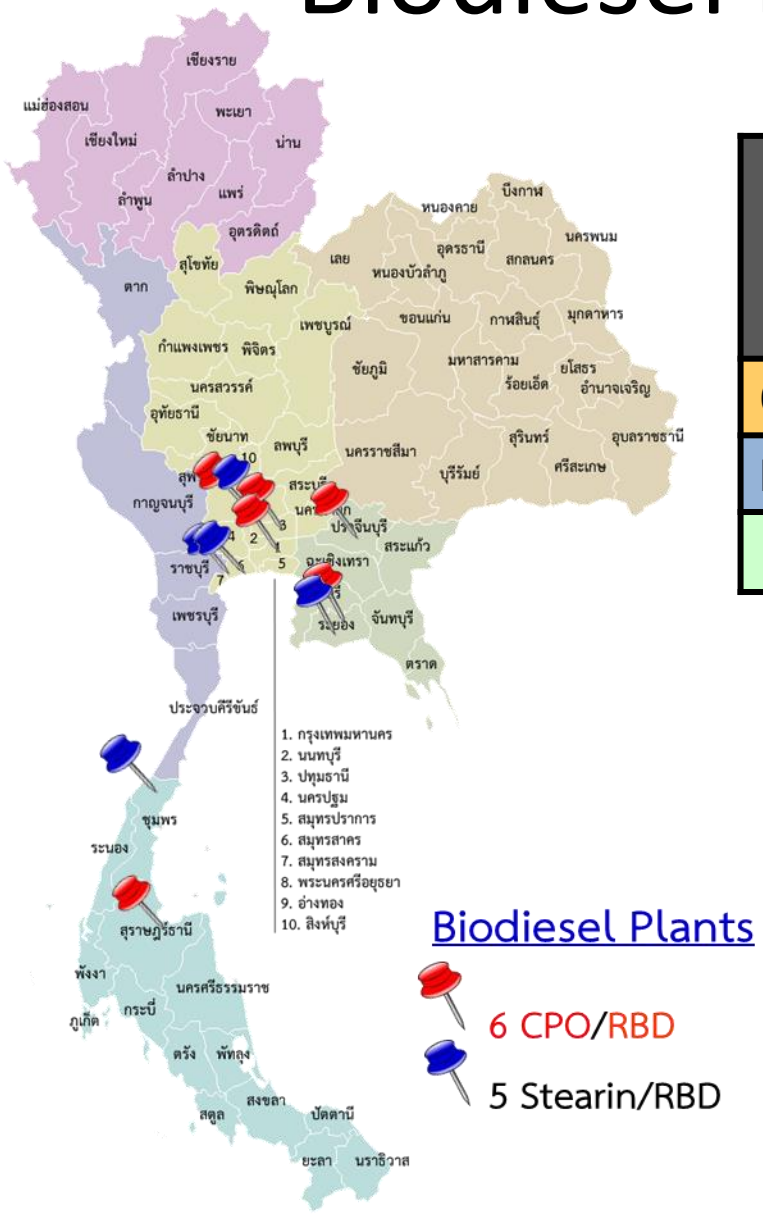
1. Increase gasohol demand through marketing mechanisms
   (Price incentive/Gasohol service coverage/PR)
2. Increase share of gasohol vehicles
   (Increase E20/E85 compatible car)

Promoting Sustainable Ethanol Production

Ethanol Production Promoting Policies

1. Promote more sustainable and more efficient ethanol feedstock plantation/production
2. Increase ethanol production efficiency
   (Reduce production cost + logistic cost)

Biodiesel Production Plant



Feedstock	Registered capacity	
	No. of factories	Capacity (ML/day)
CPO/RBDPO/Palm Stearin	6	3.5
Palm Stearin	5	1.4
Total	11	4.9

Department of Energy Business , August 2015

Source –Department of Alternative Energy and Efficiency

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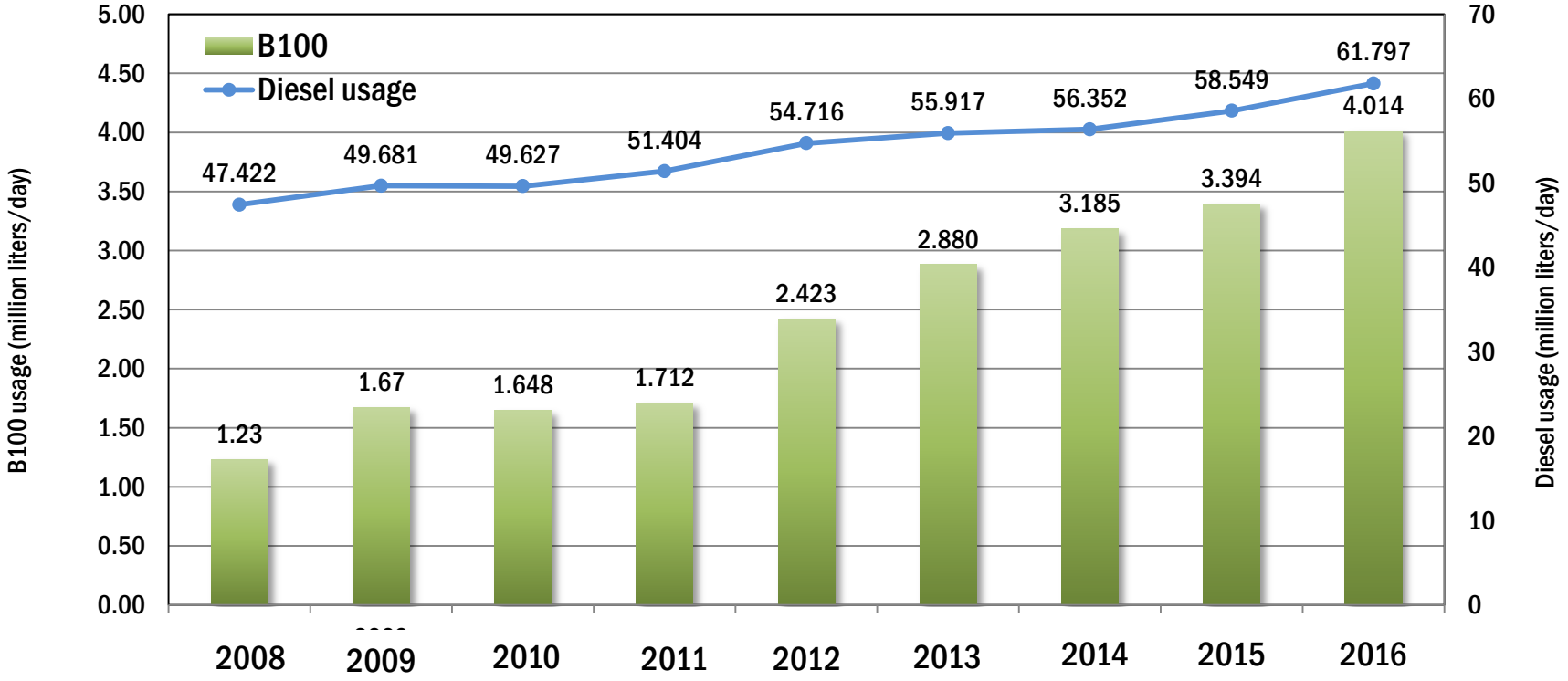
Biodiesel Usage

Thailand mandated 7% biodiesel (B7) blend for every liter of diesel sold since Jan 2014



- Thailand mandated B5 since Jan 2012 and B7 since Jan 2014
- Blending percentage can be adjusted in accordance with palm oil supply abundance

Sources – Department of Energy business

Department of Alternative Energy Development and Efficiency
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Related Polices

2016 Phase2 Thailand excise tax scheme for B10 diesel eco-car
Excise tax rate at 12% starting from 1st Jan 2016

2018 Completion of double-track railway infrastructure

Option B10 — B10 — B20

2016 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 2026 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 2036

B10 Promotion

- Develop diesel-substitution fuel (both traditional and advanced) in terms of both feasibility and economically
- Develop higher %biodiesel compatible vehicles

- Promote B10 as an optional alternative fuel (Price incentive/Service coverage/Quality control)
- Tax incentives for vehicles that use high % biofuel (2026)
- Mandate B10 (2026)

- Promote B10 usage in transport and industrial sectors
- Promote B100 usage in agricultural machineries

B20 Promotion

- Develop and improve new feedstock
- Promote production of advanced biofuel that can be commercially blended in higher percentage

- Promote consumption of higher-blend biodiesel as an optional alternative (Service coverage/Quality Control)
- Excise Tax incentives for vehicles that use high % biofuel

- Promote consumption of biofuel-blended fuel in both transport and industrial sectors

Thank you for Your attention