Thailand Bioenergy Technology Status Report 2013

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- Biomass Potential
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- Thermochemical Conversion Technologies
- Liquid Biofuel Production Technologies
- Biogas Technologies

The working group for Bioenergy Science Technology and Innovation Policy for Thailand in the context of AEC

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Forward

Energy supply security and reduction of greenhouse gas emission are important issues in the ASEAN region where bioenergy is realized as one of the highest potential renewable energies. Thailand is considered as one of leading countries in the region in bioenergy production and its supporting policies.

Towards the opening of AEC, regional cooperation is important to help develop and improve ASEAN as a whole. The Joint Graduate School of Energy and Environment (JGSEE) and National Science Technology and Innovation Policy Office (STI), as the working group for Bioenergy Science Technology and Innovation Policy for Thailand in the context of AEC" or "ASEAN Biomass STI", has recently updated the status of Thailand bioenergy technologies and disseminated in this report.

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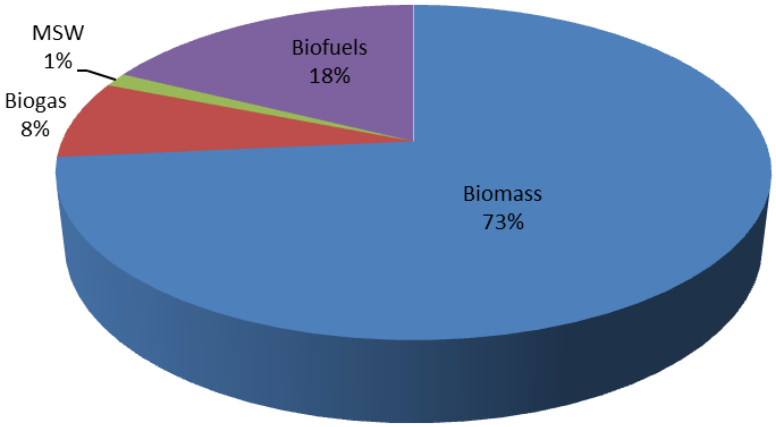
Bioenergy Development Plan

Bioenergy Consumption 2012



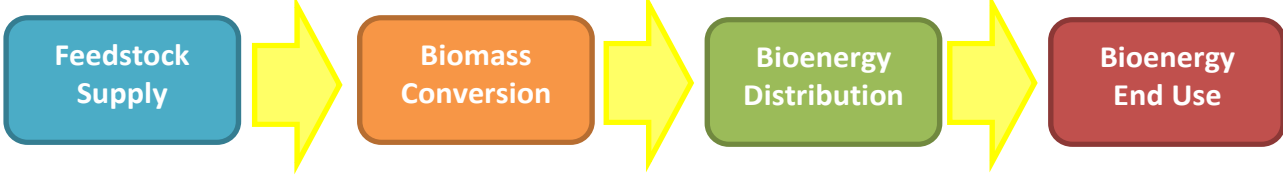
Electricity	**2,196.1**	**MW**
Biomass	1,960.0	
Biogas	193.4	
MSW	42.7	
Heat	**4,882.0**	**ktoe**
Biomass	4,346.0	
Biogas	458.0	
MSW	78.0	
Biofuels	**4.1**	**ml/d**
Ethanol	1.4	
Biodiesel	2.7	

Source: Energy in Thailand: Facts &Figures 2012 (DEDE)

Bioenergy Consumption by 2021 (AEDP : 2012-2021)

Heat			Electricity			Biofuels		
Biomass	Biogas	MSW	Biomass	Biogas	MSW	Ethanol	Biodiesel	New Energy Replacing
8,200 ktoe	1,000 ktoe	35 ktoe	3,630 MW	600 MW	160 MW	9 million litres/day	5.97 million litres/day	25 million litres/day
9,235 ktoe			4,390 MW			44% Replacing Oil		

Source: www.dede.go.th



Biomass-to-Energy Supply Chain

Biomass Potential

In 2012, the biomass potential in Thailand represented 16,812.88 ktoe, in which 9,231.82 ktoe were from utilization as solid biomass fuel (agricultural residues), 6,560.82 ktoe from biogas production, and 1,020.24 ktoe from biofuel production.

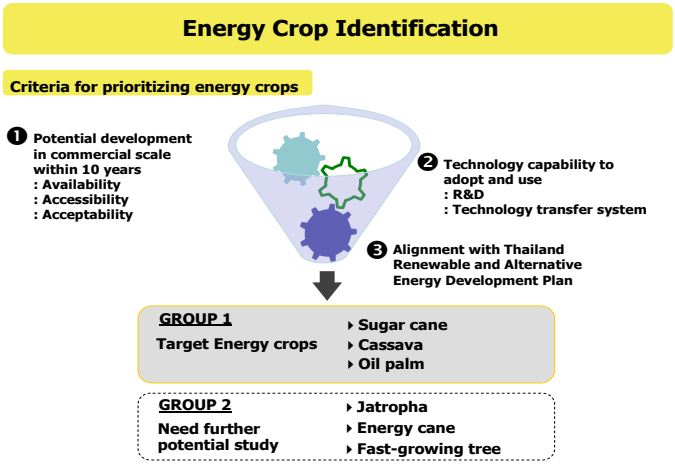
Thailand biomass potential in 2012

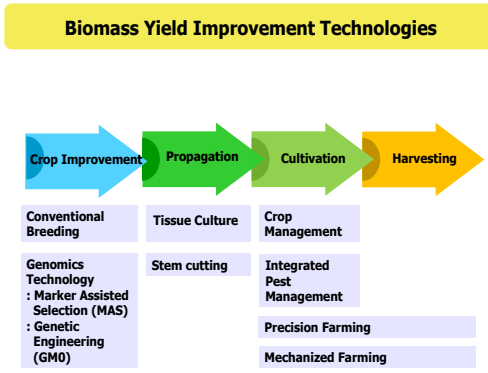
Type of Bioenergy	Physical Unit	Quantity for biomass feedstock production	Energy Potential (ktoe)
Agricultural residues	**Million tons/year**	**24.15**	**9,231.82**
Field based residues	Million tons/year	17.23	6,570.54
Process based residues	Million tons/year	5.77	2,196.70
Agro-based residues	Million tons/year	1.15	464.57
Biogas	**Million m^3/year**	**11,749.02**	**6,560.82**
Animal manure	Million m^3/year	733.68	364.72
Municipal solid waste	Million m^3/year	582.25	268.77
Industrial wastewater	Million m^3/year	10,433.09	5,927.33
Biofuels	**Million litres/year**	**1,525.70**	**1,020.24**
Bio-ethanol	Million litres/year	642.40	323.52
Bio-diesel	Million litres/ year	883.30	696.72
Total			**16,812.88**

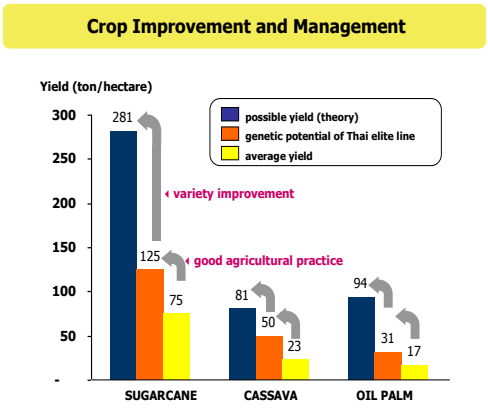
*EFB = Empty Fruit Bunch

Biomass Yield Improvement Technologies

In Thailand, major energy crops are cassava, sugarcane, and oil palm. Currently the demand for these crops for biomass energy is increasing. Therefore, Thailand aims to increase the productivity and quality with optimum efficiency of resource utilization. Nowadays, productivity can be improved via variety improvement and agricultural management. Normally, yield can be around two times of the average yield when better agricultural management such as integrated pest control, precision farming, and also mechanized farming system is applied. However, the productivity can be lifted to 3-4 times when technologies for variety improvement (e.g., marker assisted selection (MAS) and genetic engineering (GE)) are applied with good agricultural practice. Sikhio model and MitrPhol are good examples.







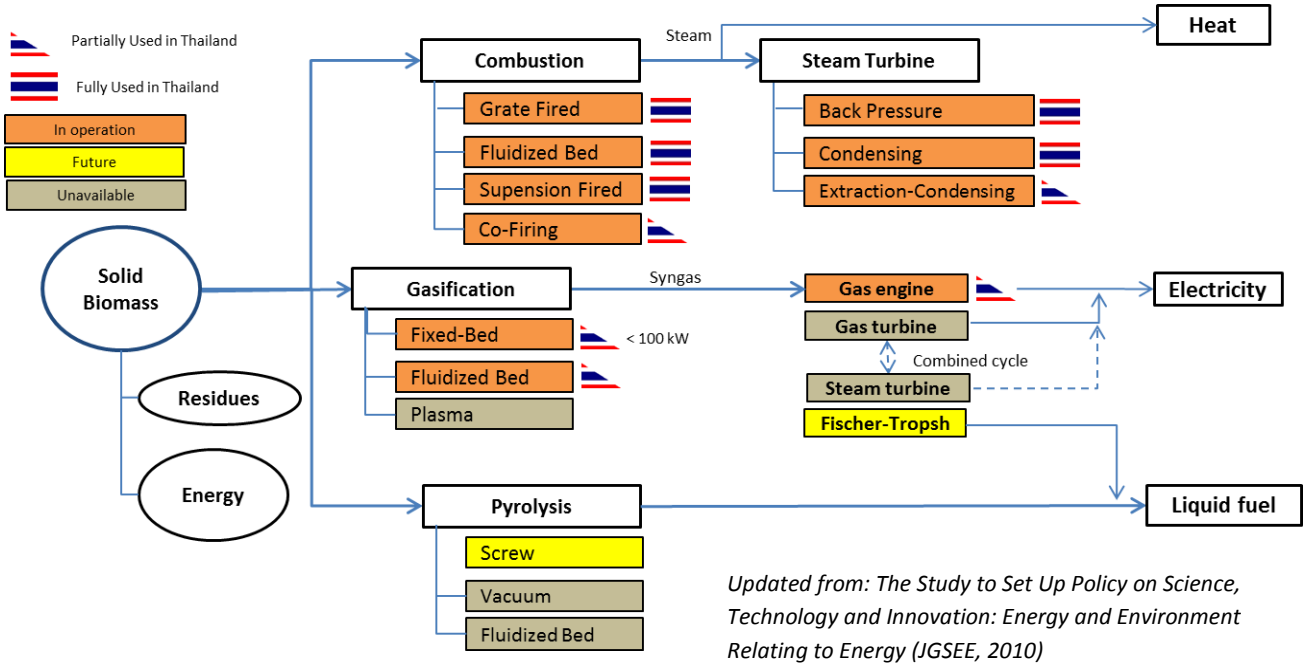
Sikhio model, Nakhon Ratchasima, demonstates the use of good agricultural practice (such as drip irrigation system and customized fertilizer) to increase the productivity of cassava to about 30-40 ton/hec

Source: http://oan.cdmediaguide.co.th/mitrphol/onweb/Eng-about-RD-08.htm

Thermochemical Conversion Technologies

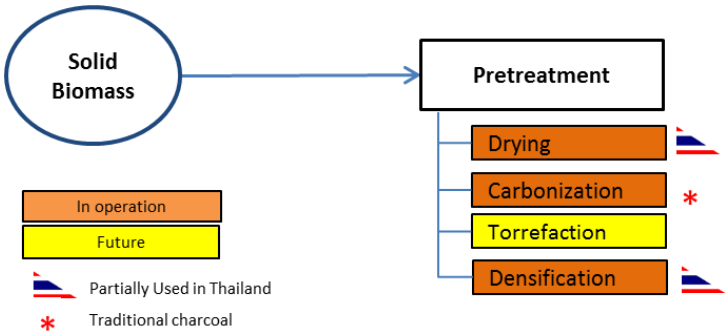
Thermochemical conversion is one of processes that transform biomass into energy. Major thermochemical conversion technologies include combustion, gasification and pyrolysis. In Thailand, biomass is used as fuel for heat and electricity production mainly via combustion boiler and steam turbine. Gasification is applied only for small-scale power generation systems (i.e. less than 1 MWe) or for industrial heat application, while pyrolysis is still in the laboratory scale study. Biomass pretreatment prior to energy conversion processes including size reduction, moisture reduction and fuel densification is carried out to improve transportation and energy conversion efficiency, but still not widely implemented due to the high cost.

Status of Thermochemical Conversion Technologies in Thailand



Updated from: The Study to Set Up Policy on Science, Technology and Innovation: Energy and Environment Relating to Energy (JGSEE, 2010)

Status of Pretreatment Technologies in Thailand






Thermochemical Conversion Technologies

The number of gasifier installations is increasing in Thailand. The majority is fixed bed downdraft type which mostly has a small capacity range of a few hundreds kWe or less than 1 MWth.

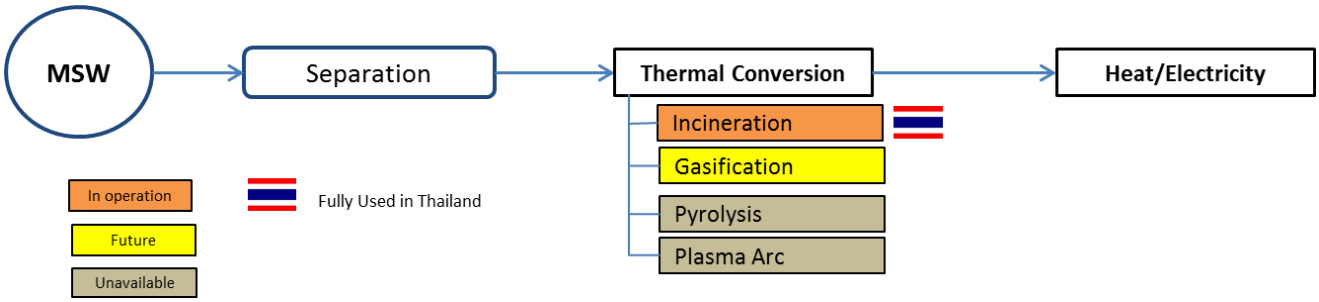



Fluidized bed type is adopted for a larger capacity ranging from a few hundreds kWe to 1 MWe or industrial heat application.




In Thailand, municipal solid waste (MSW) is disposed mainly by landfill. There is only one large scale MSW power plant with an installed capacity of 14 MWe located in Phuket province, which uses the combustion technology.

Status of MSW Technologies in Thailand



Updated from: The Study to Set Up Policy on Science, Technology and Innovation : Energy and Environment Relating to Energy (JGSEE, 2010)

MSW Incinerator at Phuket (Power plant)

Technology: Moving grate stoker combustion (imported from Japan)

MSW feed capacity: 700 tons/day

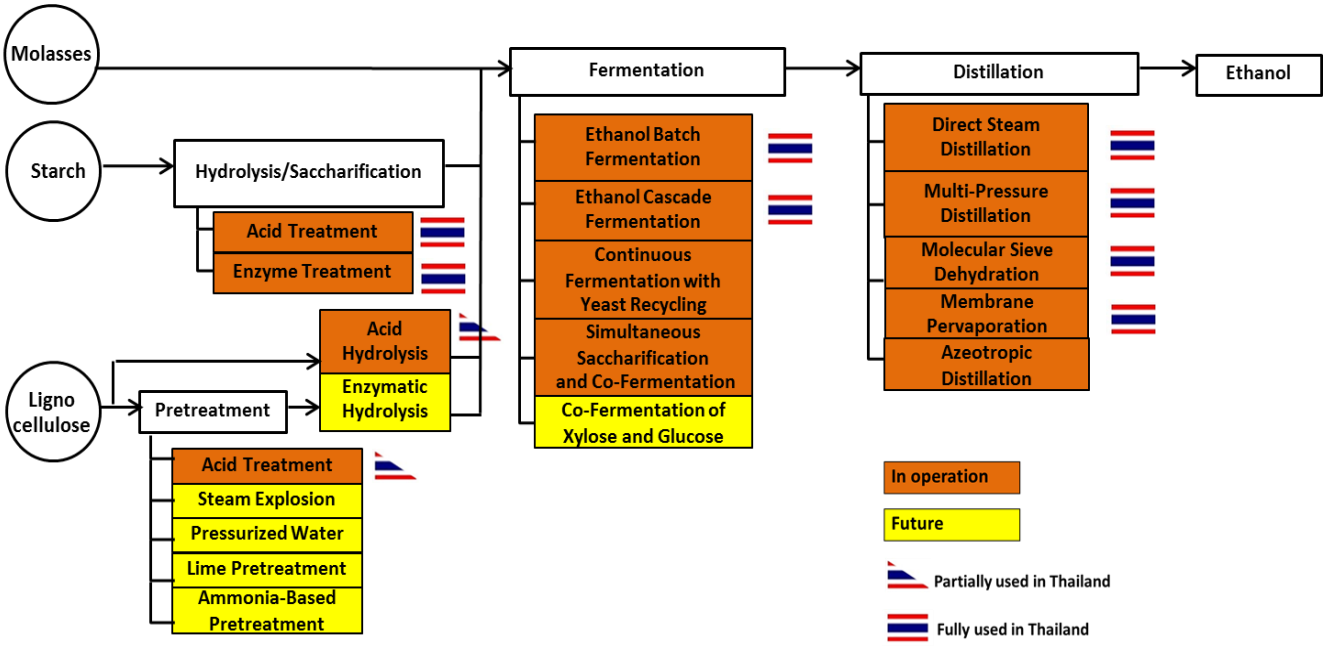
Power generation installed capacity: 14 MW (sold to the utility grid)

Liquid Biofuel Production Technologies

The current commercialized liquid biofuels in Thailand are ethanol and biodiesel. Majority of ethanol production is produced by the fermentation of molasses, a by-product of sugar manufacture, while biodiesel is manufactured from the transesterification of palm oil.

The governmental plan on 10% ethanol blended with gasoline, so called gasohol E10, is currently applied, as well as promotion of E20 and E85. On the contrary, the use of biodiesel for diesel substitution still faces a lot of restrictions, especially the insufficient feedstock in Thailand to produce biodiesel; therefore, the use of alternative feedstock (i.e. palm fatty acid) for biodiesel production has been widely developing. Biodiesel production from algae is also under development but still at early stage.

Status of Ethanol Production Technologies in Thailand

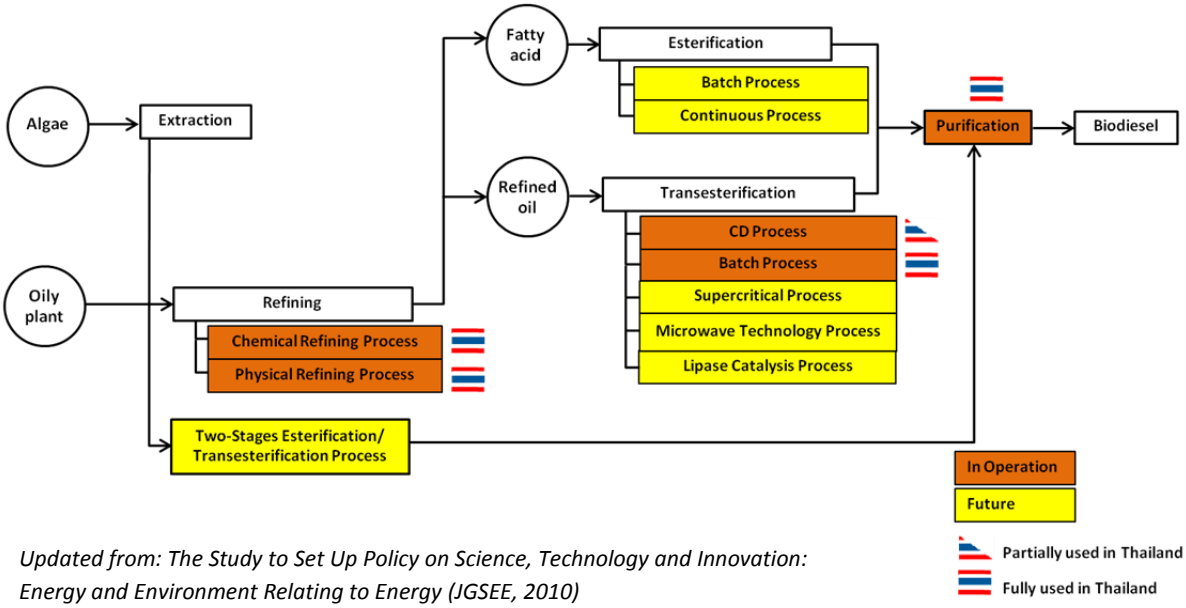


Updated from: The Study to Set Up Policy on Science, Technology and Innovation : Energy and Environment Relating to Energy (JGSEE, 2010)

Ubon Bio Ethanol Company Limited (UBE)
Type: Ethanol plant
Capacity: 400,000 litres/day
Raw Material: Fresh tapioca and tapioca chips

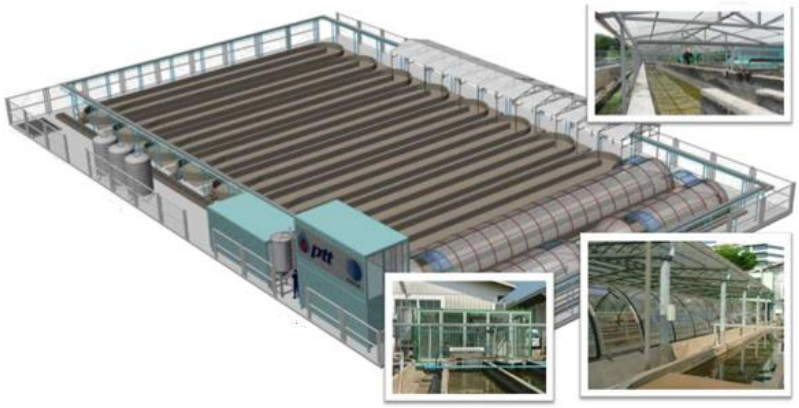
Liquid Biofuel Production Technologies

Status of Biodiesel Production Technologies in Thailand



Updated from: The Study to Set Up Policy on Science, Technology and Innovation: Energy and Environment Relating to Energy (JGSEE, 2010)

Pure Biodiesel Company Limited (PBC)
Type: Biodiesel plant
Capacity: 300,000 litres/day
Raw Material: Palm stearin, RBDPO and CPO



PTT THINKALGAE Pilot Plant

- PTT: 100,000L working volume with CO_2 directly from PTT Gas Separation Plant
- Continuous Production
- Cultivation closed + open ponds
- Biodiesel Units (TISTR in-house) or PTT Research & Technology Institute Hydroprocessing Units

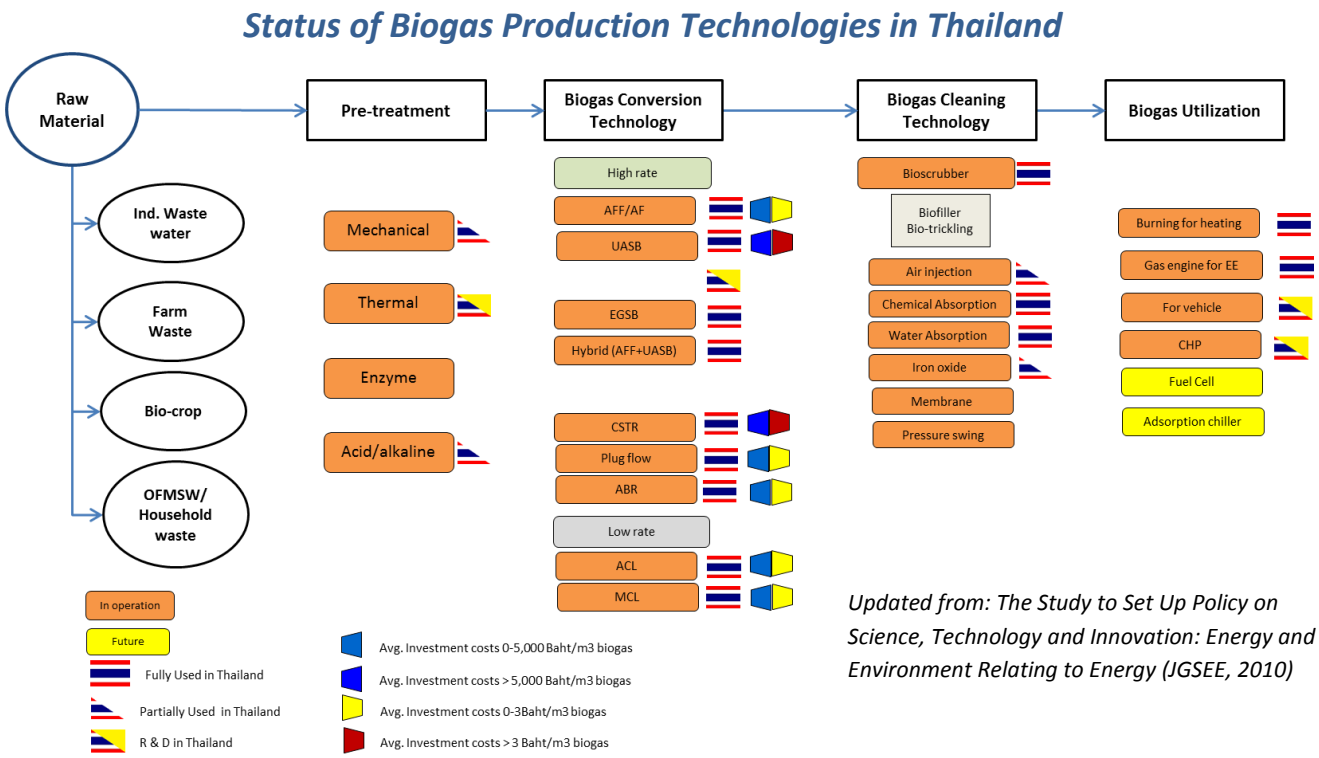
Source: http://cecar.unu.edu/renewable-energy/microalgae-biofuel-research-kangvansaichool-ptt-research.pdf

Biogas Technologies

Thailand has utilized biogas technologies for waste treatment and energy production since 1960s. During the first period of the development, the use of biogas was limited mainly for the disposal of animal manure and the production of energy for cooking. Biogas technology has been expanding from animal farms to agricultural and food industry for wastewater treatment since the 1990s with the strong support from the government in terms of tariff and non-tariff incentives. There exists more than 1,000 biogas plants throughout Thailand.

Biogas Technologies

Four major types of biomass - industrial wastewaters, farm wastes, bio-crop, and MSW - are classified as potential feedstocks for biogas production.



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Examples of Industrial Scale Biogas Plants in Thailand