CHAPTER IV

THAILAND'S BIOENERGY POLICIES AND PROSPECTS

Thailand has fully commercialised biofuels in under five years.

Samai Jai-In, Energy Expert, Royal Thai Navy, November 2009

Economic shocks are a constant feature of the global econmy. The next five years of economic recovery will require constant adaptation to mitigate the impact of the shocks on the vulnerable.

Ammar Siamwalla, Scholar, Thailand Development Research Institute, 2009

This chapter examines the Thailand's policies concerning trade, environment and sustainable development through a case study of bioenergy – the first objective of the research. It delves into the related institutional, policy and regulatory framework for bioenergy development in Thailand since the 1990s.[25] Following an introduction and overview of the energy scenario in Thailand in the *first* section, the broader national framework related to bioenergy is described in the *second* section. The *third* section outlines the current policy framework in which the bioenergy sector is developing. In order to situate the prospects for bioenergy trade, section *four* charts the course of the expanding trade and development ties in the Mekong region. How will development in Thailand and the Mekong region be affected by increased regional trade and investment in bioenergy? It concludes with an analysis of the opportunities and challenges in bioenergy development in Thailand and the Mekong region in section *five*. This chapter, thus, contains the policy and regulatory state of play of bioenergy in Thailand. It forms the basis for the anlaysis of the case narratives in Chapter V and the scenario development in Chapter VI.

4.1 Bioenergy in Thailand: facts and figures

Thailand has signalled a new era in energy development with its recent renewable energy strategies. The Government has set an ambitious target of meeting 8% of energy needs

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from renewable sources by 2011. Thailand is a net importer of fossil fuels. In 2009, less than one percent of Thailand's energy matrix was from renewable energy sources. Despite the impacts of the financial crisis on export-led growth, Thailand's demand for energy will continue to grow. There is greater importance being placed on developing the agroindustrial sector as an engine for economic growth. At the same time, there is a rising awareness of the need to mitigate the environmental impacts of energy use.

As the world's largest exporter of tapioca and rice, and second largest sugar exporter, Thailand has significant capacity to produce agricultural feedstocks for biofuels. A primary motive to do so is to reduce the rising costs of meeting the domestic energy demand. Thailand's energy elasticity in relation to gross domestic product (GDP) has been rising since the early 1980s to a relatively high level of 1.4 to 1. This means that for each percentage increase in GDP, there is a resulting increase of 1.4% in energy consumption. Given that the majority of energy is consumed in the transport (37%) sector, the aim of Thailand's 15-year *Alternative Energy Development Plan*, adopted in May 2009, is for biofuels to contribute 14% of total transport fuel demand by 2030 (DEDE 2009).

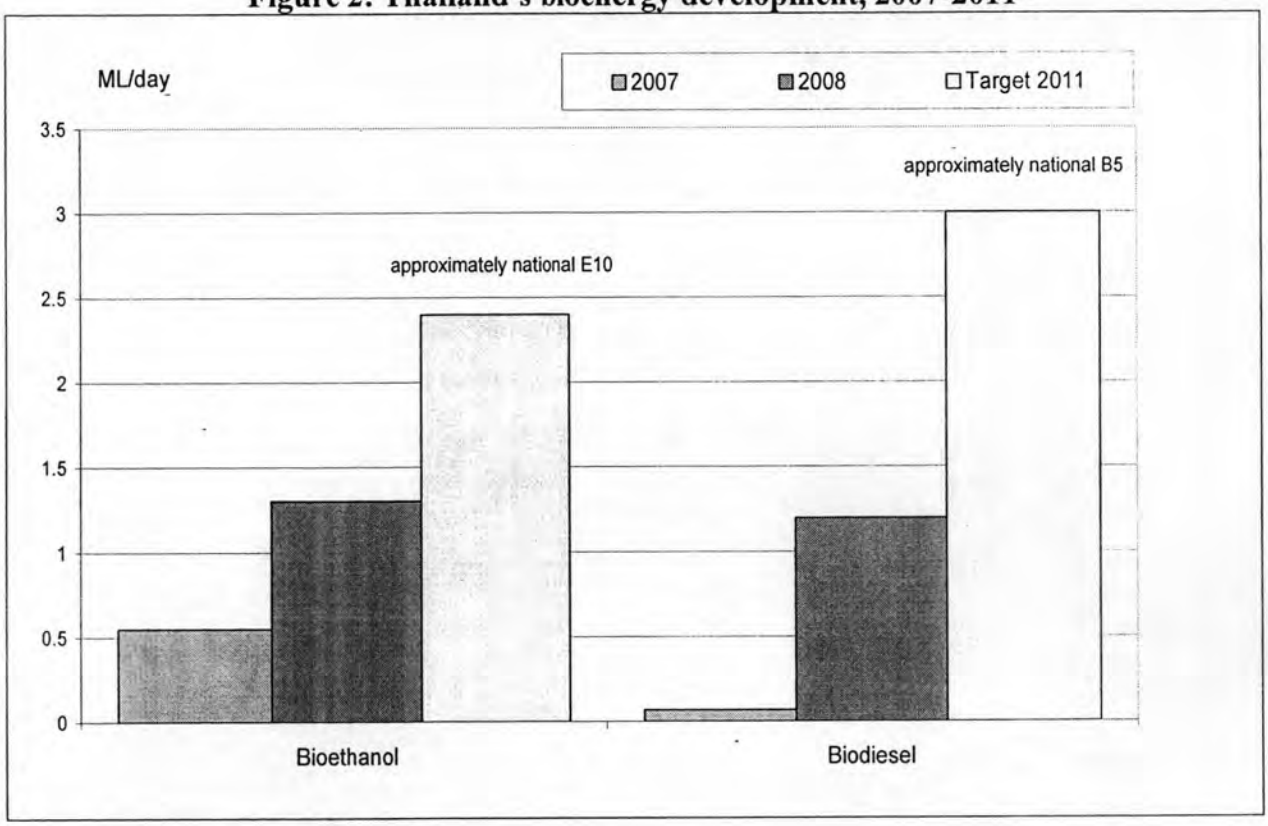
Thailand's biofuels sector is more advanced than in other countries in Asia for several reasons. First, Thailand is heavily dependent on imports of petroleum to stimulate its export-led growth. Over the past decade, Thailand spent approximately 10% of its annual GDP on oil imports. Already in the 1980s, Thailand began investing in research and development to decrease oil dependence by converting its abundant agricultural biomass into biofuels. Second, in light of the volatile world price of oil, biofuels offer a means to diversify fuel sources, thereby increasing energy security. Third, developing the biofuels sector represents an opportunity to diversify and add value to the agricultural sector, thereby stimulating rural development.

Based on this combination of diverse policy objectives, Thailand's Cabinet approved a strategic plan for gasohol in 2003 and one for biodiesel in 2005, as well as created a *National Biofuels Committee* to coordinate efforts. Thailand's longer-term ambitious target, approved in March 2009, is to supply 20% of national energy consumption with renewable energy by 2022, compared with 8% in 2008.

Main sources of agroenergy

Thailand produces two types of biofuels – ethanol (from sugarcane juice cassava) and biodiesel (from palm oil). There is also an increasing amount of electricity generated in Thailand from agricultural waste and biomass residues and bagasse. The development of the biofuels sector, thus, has the potential to promote energy security by tackling oil dependence, revitalize and add value to rural economies and reduce greenhouse gas emissions. To this end, Thailand has commercialised both ethanol and biodiesel in the national fuel market as of 2008.

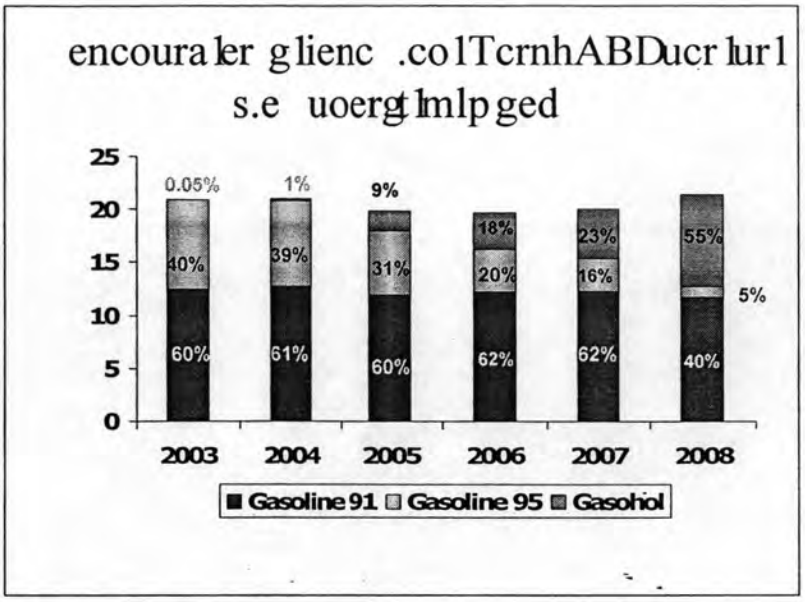
Figure 2: Thailand's bioenergy development, 2007-2011



Source: Samai 2009

As illustrated in the figure below, with the targets in place for gasohol, consumption of ethanol has increased from 0.05% in 2003 to 5% in 2008. This increase in consumption illustrates the current commitment to provide incentives to enable the national targets to be met based on the reference scenario outlined above. The incentives provided to the ethanol producers in the form of licenses and price support led to an increase in supply beyond the current domestic consumption.

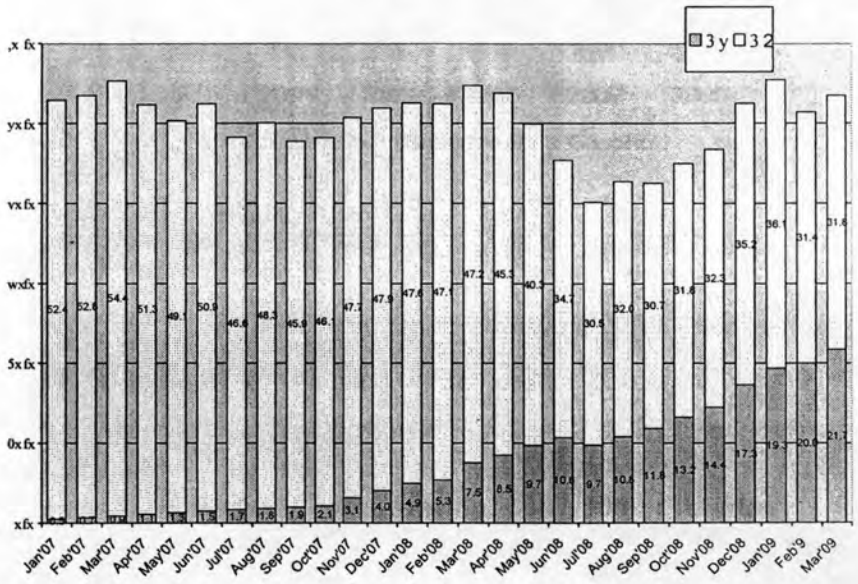
Figure 3: Gasoline and gasohol consumption in Thailand, 2003-2008 (ML /day)



Source: Samai (2009)

With the blending of B2 mandatory since February 2008, as illustrated in the figure below, consumption of biodiesel blended with crude palm oil (CPO) has increased significantly from January 2007 to March 2009.

Figure 4: Biodiesel consumption, 2007-2009 (ML/day)



Source: Samai 2009

Thailand has a long history with research on bioenergy, initiated by the King's Royal projects in Chitralada Gardens in 1985. Starting in 2003, Thailand has developed comprehensive strategies for ethanol and biodiesel. As the world's largest exporter of tapioca

and rice, and second largest sugar exporter, Thailand has significant capacity to produce agricultural feedstocks for biofuels.

National policy framework

Thailand has put in place a supportive legislative and institutional framework for bioenergy development. Thailand has commercialised ethanol and biodiesel The Gasohol and Biodiesel Strategic Plans establish phased-in development of targets and blending requirements. A National Biofuels Committee was established to coordinate policymaking. In 2005, Thailand approved its first ***National Energy Strategy*** focusing on energy conservation and alternative energy development. Highlighting the need to develop renewable energy, the ***Energy Industry Act,*** adopted in December 2007, established the mandate for the Ministry of Energy to develop biofuels standards, which were finalised for biodiesel and gasohol in 2008.

In March 2009, a revised 15-year ***Renewable Energy Development Plan (2008-2022)*** was approved by the Cabinet. This plan envisages increasing the proportion of alternative energy to 20.4% of national energy consumption by 2022. The biofuels sector is a key element of this strategy. A ***National Committee on Biofuels Development and Promotion*** was established in 2005 to facilitate domestic coordination. The ***Biodiesel Strategic Plan*** is promoting the expansion of palm oil plantations by 2010. Since February 2008, a 2% blend of biodiesel (B2) is mandatory nationwide, with B5 targets in place for 2011. To meet the targets, the palm oil sector is struggling to increase production for biodiesel. The Government is also providing incentives to increase palm oil and Jatropha cultivation for biodiesel. It is promoting community-based biodiesel production to increase energy self sufficiency at the local level. Community-based biodiesel production and use is being fostered in over 470 communities around the country.

The ***Gasohol Strategic Plan*** is working towards substituting ethanol in gasoline by 2011. Investment is focusing on doubling cassava and sugarcane yields by 2021 to build a viable ethanol sector. At present, nearly 90% of ethanol production is from sugarcane molasses. Thailand's Board of Investment is providing incentives to invest in alternative energy projects. In 2007, the Board approved 89 projects worth 72 billion baht (US$2 billion), doubling investment in alternative fuel project from 2006.

Whilst there are significant opportunities to adding value to agricultural production through developing bioenergy crops, several constraints have been identified. Although increased use of bioenergy may address immediate energy needs, it may have unintentional implications for sustainable development. It may lead to increased food prices and encourage farmers to expand agriculture in environmentally unsustainable areas, putting pressure on land, water, forests and biodiversity.

A ***National Committee on Food Security*** was created in 2008 to discuss concerns about the impact of the promotion of biofuels on food crops. Debate has centered on avoiding competition between food and fuel crops through the establishment of plantation areas for biofuels in degraded and less-fertile lands.

While comprehensive legislation is in place for palm oil used in the production of biodiesel and sugarcane and cassava for ethanol, there is a need to strengthen regulations concerning land use and land tenure. This will better ensure that the socio-environmental consequences of the forecast expansion of plantations for energy crops contribute to sustainable development. Deforestation has occurred at an alarming rate over the past half century in Thailand in large part due to lack of sufficient enforcement of land use and forest management regulations. Notwithstanding the recently passed ***Community Forest Bill (2007)***, which allows for the participation of local communities in the decisionmaking process, civil society organisations have called for increased transparency and participatory approaches in the design, implementation and monitoring of Thailand's forestry laws.

The development of bioenergy relates to the legal and policy framework for the energy, agricultural and forestry sectors, as well as to legal requirements to undertake environmental impact assessments in the ***Enhancement and Conservation of National Environmental Quality Act (1992)***. Despite increasing attention to sustainable management of the country's natural resources, including in the Government's ***Tenth National Economic and Social Development Plan (2007-2011)***, the state of the environment in Thailand has been significantly impacted by over forty years of economic growth. Moreover, it is widely recognised that there has been a lack of sufficient implementation and enforcement of environmental laws and regulations. Several environmental threats are critical: deforestation and encroachment on protected areas. As a direct result, Thailand's legal framework would benefit from greater clarity, as well as better enforcement, implementation and monitoring. To

this end, the King of Thailand's philosophy of ***Sufficiency Economy*** provides the overarching stimulus to move towards sustainable development in the Thai context. Based on building resilience and self sufficiency, this concept has been put into practice at the Royal Chitralada demonstration agricultural projects. As a conceptual basis for development, *Sufficiency Economy* emphasises a balanced approach to modernisation in a globalised world in order to build local resiliency to external shocks to the economy.

Thailand is actively participating in regional energy initiatives to facilitate the development of bioenergy in the Greater Mekong Subregion, the Association of Southeast Asian Nations and the Asia-Pacific Economic Cooperation forum. These efforts are focused on building low-carbon economies in the region through developing more efficient infrastructure and facilitating trade and investment. Regional work to establish guidelines for biofuel standards has yet to address sustainability criteria.

There are political and economic challenges to Thailand's visions to emerge as a regional hub for renewable energy. Thailand has undergone considerable political turmoil over the past three years. In the wake of the coup d'état political developments in September 2006, the 1997 Constitution was abrogated and replaced by an Interim Constitution on 1 October 2006, with provision for the appointment of a Prime Minister, a legislature, and a 100-member Constitutional Drafting Assembly for a Permanent Constitution. Following the referendum that approved the new Constitution in August 2007, National Assembly elections on 23 December 2007 resulted in the election of the People's Power Party (PPP) with Samak Sundaravej confirmed as the Prime Minister in January 2008. A new Cabinet was formed in February 2008 and, after the impeachment of Samak, again in September 2008, under PPP-led Somchai Wongsawat. Following Somchai's resignation in December 2008, Democratic Party leader, Abhisit Vejjajiva was elected by the Parliament to be Thailand's fourth Prime Minister in the span of two years. These changes in government have slowed the political momentum driving national coordination to implement bioenergy plans, laws and regulations.

The global economic financial crisis is also impacting Thailand's growth and stability, with consequences for bioenergy development. The Government announced several measures in 2008 to mitigate the impacts of volatile fuel and food prices, including price pledging programs to guarantee farmers' incomes. Two economic stimulus packages worth 1.566 trillion baht (US$44 billion) (12% of GDP) are being implemented through tax reductions,

direct transfers the poor and public works. To enhance agricultural competitiveness, 230 billion baht (US$6.5 billion) will be spent over the next three years. This investment will be targeted at improving irrigation systems, crop seeds, agricultural standards and productivity.

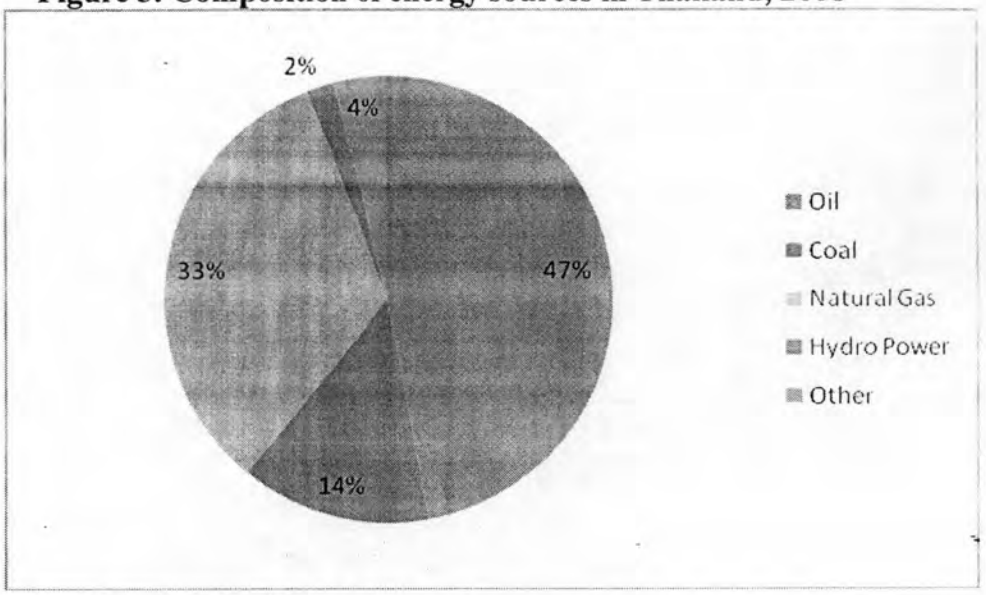
Climate change has added a sense of urgency to the debate in Thailand, stimulating bioenergy development through the Clean Development Mechanism (CDM) of the Kyoto Protocol. In 2006, the Cabinet created the institutional basis for national action on climate change. A ***National Commission on Climate Change Policy*** is tasked with coordinating national policies. The ***Thailand Greenhouse Gas Management Organisation*** – the country's designated national authority for the CDM, has approved nearly 70 projects. Nevertheless, public awareness of the economic and environmental impacts resulting from climate change remains low.

Whilst the direction of bioenergy policy has been established through national targets, Thailand is still in the process of finalizing the institutional and legal framework for bioenergy. This is in large part due to the destabilizing political process over the past few years. To this precarious situation has been added the consequences of the unfolding economic crisis on Thailand's export-led growth. Nevertheless, progress has been achieved towards making the legal and institutional framework more effective and transparent to facilitate investment in bioenergy. The focus is shifting from first generation to second generation biofuels based on non-food feedstocks, such as cellulosic materials, oil nuts and algae.

Overview of the energy scenario

Thailand's demand for energy has increased significantly over the past decades. Despite efforts over the past few years to shift to alternative energy sources, the country remains dependent on imports to fuel its growing manufacturing-based economy. Thailand's expenditure on petroleum imports decreased from 15.4% of Gross Domestic Product (GDP) in 2004 to 10% in 2008. This situation represents the combined effects of the contracting global economy, prospects of decreasing demands for Thailand's exports and a vigorous government policy to stimulate renewable energy sources. Thailand's annual growth in primary energy consumption between 1999 and 2004 was more than double the world average of 2.9% (World Bank 2008). The figure below outlines the composition of energy sources in Thailand in 2008 (DEDE 2009).

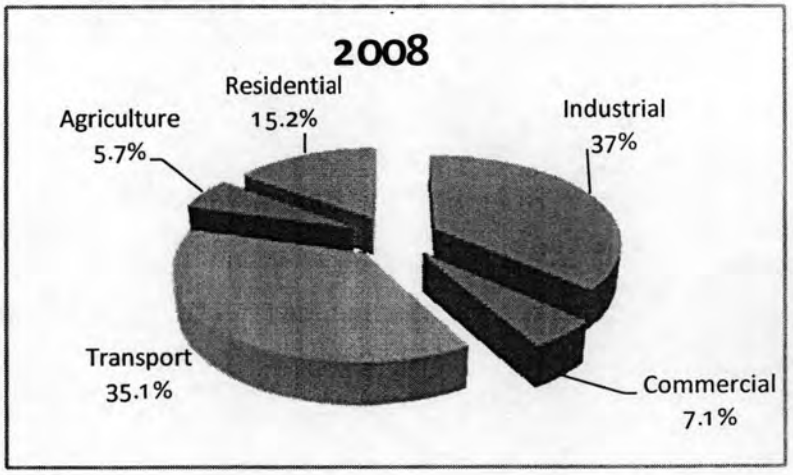
Figure 5: Composition of energy sources in Thailand, 2008



Source: Ministry of Energy (2009).

Energy use in Thailand in 2008 was primarily consumed in industry (37%) and transportation (35.1%), with more modest use in the residential (15.2%), commercial (7.1%) and agricultural sectors (5.7%). The figure below provides the shares of final energy consumption by economic sector in 2008 (DEDE 2009). Since 2005, biodiesel and ethanol fuel development is intended to contribute to the fuel mix in the transport and agriculture sectors, with biogas feeding into electricity and processed heat generation.

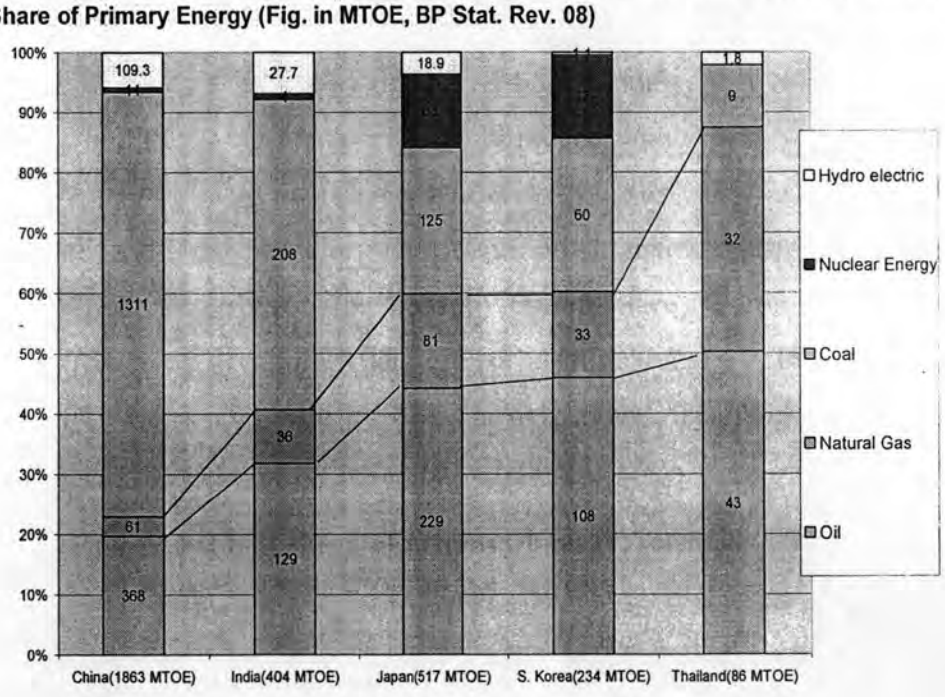
Figure 6: Final energy consumption by sector 2008



Source: Ministry of Energy (DEDE 2009).

Thailand's long term goal is to gain independence from fossil fuels. In this scenario, the projection is to increase the contribution of ethanol to 10% of gasoline by 2012, with the possibility of attaining 50% with flex-fuel vehicles using E85 by 2020. The goal is to achieve 5% of high speed biodiesel by 2012, with the possibility of reaching 50% with second generation biodiesel by 2020. Natural gas is forecast to contribute 20% to transportation fuels by 2015 (interview with Samai 10 November 2009). Moreover, Samai Jai-In explains that Thailand aims to become a "knowledge-based bio-economy, in which bioenergy will be a central part." This policy course is set to be achieved with ASEAN Economic Community integration by 2015. It will include regional energy grids, such as the ASEAN gas grid, electricity grid and transportation and common logistics platforms. Alongside these developments, experts agree on the need to put in place "a common strategic regional investment in resources, technology and industrial infrastructure" (Interview with Samai 10 November 2009). Compared with its ASEAN neighbours, Thailand has a high reliance on imports of fossil fuels, as outlined in the figure below.

Figure 7: Comparison of share of primary energy, selected Asian countries, 2008



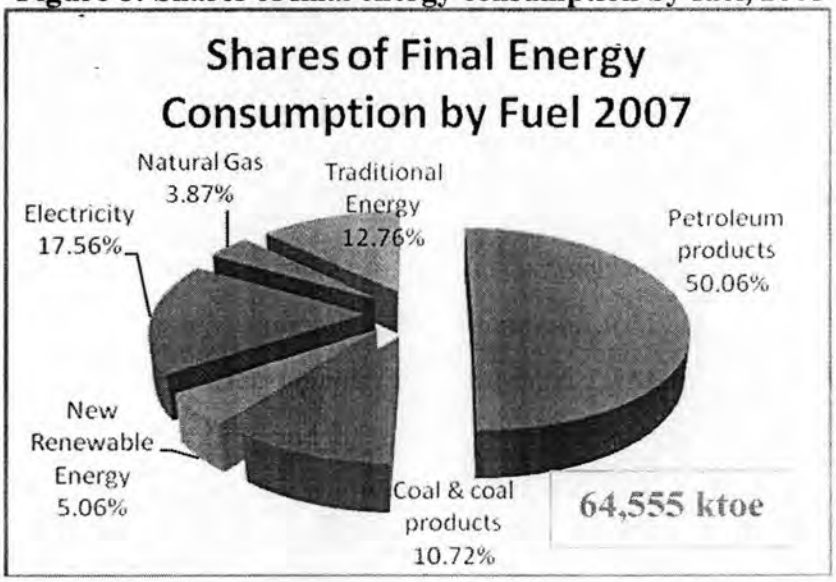
Source: Samai 2009

Thailand announced several measures in 2008 and 2009 to mitigate the impacts of fluctuating fuel and food prices. Two economic stimulus packages worth 1.566 trillion Baht

(US$44 billion) (12% of GDP) are being implemented through tax reductions, direct transfers the poor and public works. To enhance agricultural competitiveness, 230 billion Baht (US$6.5 billion) will be spent over the next three years. This investment will be targeted at improving irrigation systems, improving crop seeds, agricultural standards and productivity.

Over the past five years, the Government has actively promoted energy conservation and increased the share of renewable energy consumption to 5% in 2007. The goal in the ***National Alternative Energy Development Plan*** adopted in March 2009 is to increase the share of renewable to 8% by 2011 and 20% by 2020. The share of final energy consumption by fuel in 2008 is set out in the figure below.

Figure 8: Shares of final energy consumption by fuel, 2008



Source: Ministry of Energy, 2009

Future prospects

Thailand has strengthened the legal and policy framework promoting bioenergy production and use, primarily in the transport sector. The Government has put in place tax incentives for ethanol and biodiesel producers, as well as for the automotive sector. The mandatory B2 biodiesel production guarantees and prices have created a favourable condition for growth. Ethanol faces a different set of challenges. While gasohol consumption is expected to increase with greater public acceptance of gasohol compatible vehicles, many ethanol plants have been forced to suspend operations due to surplus supply and rising input costs. While possible, exporting surplus ethanol production requires case-by-case approval by

the Ministry of Commerce. Thailand exported around 70 million liters of ethanol in 2008, with a total value of 225 million baht (US$6.4 million) (DEDE 2009).

A major factor in the push to increase production of biofuels is to contribute to domestic consumption, as a substitute for imported petroleum. However, there is a growing expectation that Thailand may emerge as a regional exporter of biofuels within Asia. To this end, as described at the end of this chapter, Thailand is actively engaged in developing a supportive regional framework for bioenergy. Whether Thailand emerges as a regional hub for renewable energy will depend on the consistency and clarity of its bioenergy strategies, as well as global commodity markets. Generally, commodity producers benefitted from higher food and fuel prices in 2007-2008. However, following high volatility in 2008, commodity prices, especially for food and fuel, are expected to decline in 2009 in response to slowing demand as the global financial crisis deepens. This situation may hamper Thailand's efforts to manage its emerging bioenergy sector. Moreover, while biofuels represent an opportunities to add value to the agricultural sector, there are also serious concerns over the future of food security in the region.

In terms of national development objectives, the ***Tenth National Economic and Social Development Plan for 2007-2011*** establishes the guiding concept of the ***Sufficiency Economy*** in order to build economic resilience to external shocks, while ensuring growth with stability. This concept provides an overarching incentive to develop alternative energy sources to lessen dependence on petroleum imports and enhance energy security, as well as to promote energy sufficiency at the local community level.

The future prospects for the bioenergy sector will have a significant impact on Thailand's agricultural sector. Thailand's competitiveness in agriculture is based on cheap labour and an abundance of land resources. These two factors, a report for the Office of the Cane and Sugar Board notes, are no longer strengths (TDRI 2000).

The agricultural sector serves to underpin food sufficiency, poverty reduction, employment creation, and increasingly, feedstock inputs into the rapidly expanding bioenergy sector. The contribution of the agricultural sector to GDP (11.4%) and to exports (15%) has decreased significantly since the mid-1980s. Nevertheless, the contribution of agriculture to employment remains high, accounting for 40% in 2008 (World Bank 2008).

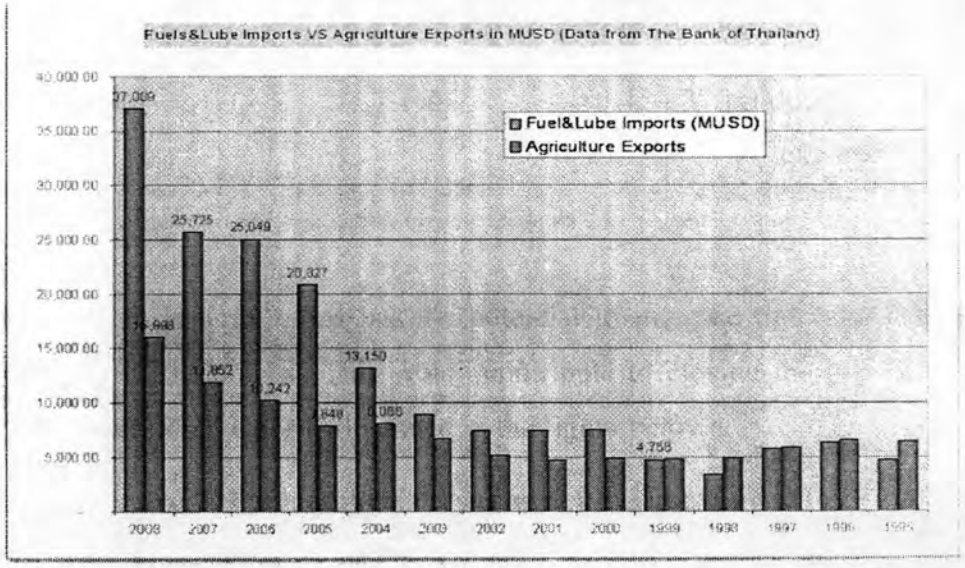
Table 13: Thailand's major agricultural products and world ranking, 2008

Crop	Million tonnes	Hectares	World ranking
Rice	30.2	11.00	1st exporter
Rubber	3.02	1.76	1st producer & exporter
Sugarcane	64.4	1.01	2nd exporter 14 exports 75% of production
Cassava	27.0	1.17	1st exporter 14 exports 80% of production
Oil palm	6.6	0.42	3rd producer 14 exports are negligible

Source: BOI 2009

Demand for energy crops has the potential to increase the value added in this key sector of Thailand's economy. This would contribute to closing the gap between costly oil imports and agricultural exports illustrated in the figure below.

Figure 9: Fuel imports versus agricultural exports, 1995-2008
Million Baht per annum



Source: Samai 2009

As illustrated in the figure above, since the turn of the century, Thailand's annual expenditure on fuel imports has been rising exponentially relative to agricultural exports.

Whilst there are opportunities to adding value to agricultural production through developing energy crops, several challenges are identified in the literature (Bundit 2009).

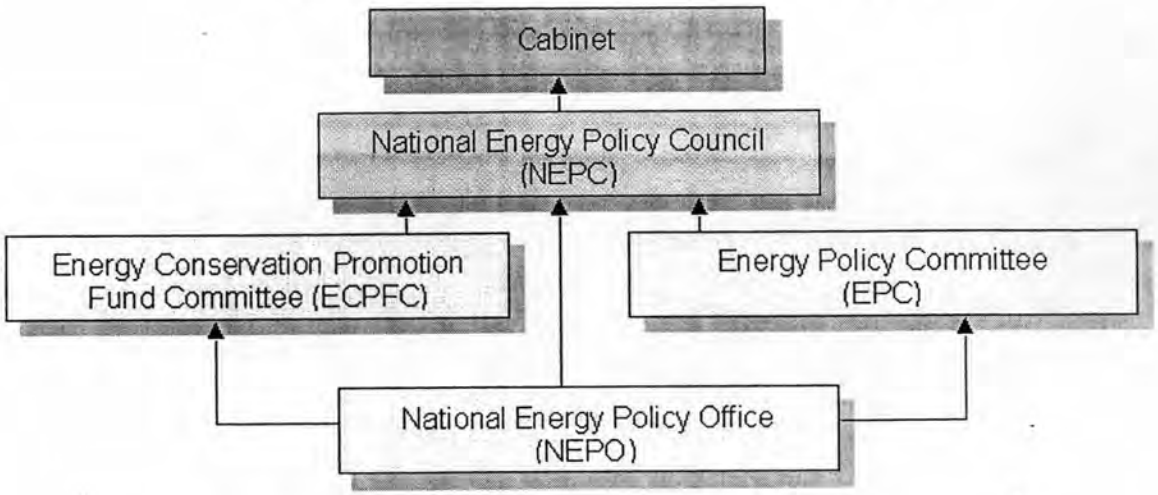
Finding a balance between energy security, energy efficiency and sustainable resource management to develop the biofuels sector in a sustainable manner presents several challenges. It will require technological and productivity innovation alongside sustainable resource management. Moreover, building a viable biofuels sector requires sustained political will to ensure effective implementation and enforcement of policy mandates and regulations.

4.2 Thailand's national legislation and international obligations

This section outlines the legal framework relevant to bioenergy in Thailand, including related to the Clean Development Mechanism of the Kyoto Protocol. A list of the legal instruments and key environmental and socio-economic laws and regulations is contained in **Appendix J**.

The energy sector in Thailand is administered by the Ministry of Energy, which was established in 2002 pursuant to the ***Restructuring of Government Organisation Act (2002)***. The energy sector is guided by the ***National Energy Policy Council***, established under the ***National Energy Policy Council Act (1992)***, which is responsible for managing the energy sector in Thailand, including granting energy operating licenses and setting up energy pricing regulations. Council members include ministers from all related ministries, including from defence, energy, finance, foreign affairs, agriculture, transport, commerce, science and technology, industry and the National Economic and Social Development Board. The Government agencies under the National Energy Policy Council are shown in the figure below.

Figure 10: National Energy Policy Council, 1992



Source: EPPO (2009)

The National Energy Policy Council administers the ***Energy Conservation Promotion Fund (ECON Fund)*** to support renewable energy research. This fund was established under the ***Energy Conservation Promotion Act (1992)***. The main objective of this Fund is to provide financial support to designated factories and buildings involved in energy conservation programs, including renewable energy projects. The Energy Conservation Promotion Act defines "Renewable Energy" to include energy obtained from sources such as: wood, firewood, paddy husk, bagasse, biomass, hydropower, solar power, geothermal power, wind power, waves and tides.

Energy laws and regulations

The legal framework governing the energy sector was solidified with the enactment of the ***Energy Industry Act*** on 10 December 2007. The objectives of this Act include to:

- Promote an adequate and secure supply of energy.
- Promote the use of renewable energy that has less adverse impact on the environment.

The Energy Industry Act mandates the Government to establish the fundamental policy guidelines for the energy industry as follows (Section 8):

- Procure energy to adequately meet the demand, with good quality, security as well as reasonable and fair prices, **emphasizing full exploitation and development of renewable energy** and indigenous energy resources for the purpose of sustainable

development of the country in social, economic and environmental aspects, including **reducing dependency on imported energy**.

- Promote the **participation of the local communities and the general public** in the management and monitoring of energy-related operations.

The Energy Industry Act gives the ***Energy Regulatory Board*** the authority to issue licenses for energy industry operation and determine the criteria, procedures and conditions for energy industry operation (Section 51), including those related to:

- efficiency of energy and resource utilization
- requirements for the use of renewable energy
- environmental standards

To promote the use of renewable energy and technologies in the electricity sector, a ***Power Development Fund*** was established in Section 93 of the Energy Industry Act.

In March 2006 the Supreme Administrative Court cancelled two royal decrees that had privatized the Electricity Generating Authority of Thailand (EGAT). While this represents a significant change for the power sector, the impact on bioenergy is difficult to ascertain. The biggest impact is that a flawed privatization process would have privatized the EGAT monopoly before establishing an independent regulatory authority. New attempts at privatization will likely be preceded by the establishment of a regulator, which should lessen the risk that EGAT's monopoly control of the transmission system.

The broad strokes of Thailand's ***Energy Policy and Development Plan (2007-2021)***, approved by the Cabinet in June 2007, are to restructure energy industry management, ensure security of energy supply and promote energy conservation and efficiency. The plan prioritizes the promotion of alternative renewable energy. In the longer term, the objective is to foster competition in the energy industry.

For the first time, the Plan incorporates controversial plans to build four **nuclear power plants** each of 1,000 megawatts by 2021.

The Plan also address energy conservation measures in the transport sector. With respect to renewable and alternative energy, the Plan has the objective to:

- Support the purchase of power generated from renewable energy (i.e., agricultural residues, industrial and municipal waste, biogas, wind and solar energy), including from Very Small Power Producers.
- Establish a public organisation to carry out the promotion of renewable energy use (currently under consideration).
- Support research and development on alternative energy that is sustainable, efficient and compatible with the principle of Sufficiency Economy.
- Disseminate information about alternative fuels to the public.
- Promote private sector initiatives and public participation in energy policymaking.

The Government has put in place the following measures to meet the targets outlined in the Energy Policy and Development Plan:

- Established a Renewable Portfolio Standard regulating that new power plants must have 5% of their generation capacity generated from renewable energy (i.e., solar, wind, biogas).
- Put in place incentive measures encouraging the purchase of power generated by renewable energy, for example through the provision of tax credits and privileges, and subsidies in the form of 'adders' for small power producers from the Energy Conservation Promotion Fund.
- Promoted special investment privileges through the Board of Investment, including favourable tax and duty exemptions and loans, and land ownership rights for foreign investors.

In order to make progress towards greater energy efficiency, Thailand's ***Energy Conservation Plan (1995-2011)*** covering industry, transport, and equipment and appliance standards. **Table 14** provides the old and new targets set out in this Plan.

One of the results of this review related to bioenergy was the establishment of ***Energy Conservation Targets***. These new targets stipulate in a Cabinet Resolution that the production of ethanol and biodiesel should reach 2.4 million liters and 3 million liters per day respectively by 2011. As of March 2009, the production of ethanol and biodiesel reached 1 million and 1.39 million liters respectively per day (DEDE 2009).

Table 14: Thailand's five-year Energy Conservation Plan (2007-2011)

Energy Conservation Plan	New Targets		Old Targets	
	Ktoe	percentage	Ktoe	percentage
1. Increase efficiency	10,354	12.7	7,694	9.1
Industry	3,411	4.2	3,832	4.6
Transportation	6,270	7.7	3,290	3.9
Energy management	673	0.8	571	0.7
2. Alternative Energy	7,530	9.2	10,226	12.1
Natural Gas Vehicle			3,264	3.9
Renewable energy	7,539	9.2	6,962	8.3

Source: Ministry of Energy (2008)

Thailand is promoting renewable energy course, such as wind, solar, biogas and biomass. Pursuant to Cabinet Resolution in 2005, the Ministry of Energy has mandated that 5% of electricity generated by new conventional power plants comes from renewable sources by 2011. The 8% target corresponds to a total capacity of 2,200 megawatts (MW). This means that an additional 1,340 MW needs to be installed by 2011. To meet the 1,340 MW target, the Ministry of Energy has instituted several different mechanisms, including an ***obligatory quota system*** - referred to as the **Renewable Portfolio Standard**.

A key to the success in stimulating electricity from renewable energy is the 'adder' - a feed-in tariff that will provide premium rates for renewable energy and additional sums for electricity generated from renewable energy sources beyond the standard rate per unit (kilowatt hour). Current feed-in tariff levels for small power producers in 2009 are outlined in the table below (DEDE 2009). The Ministry of Energy is revising the feed-in tariffs to ensure economic viability of these emerging sources of renewable energy.

Table 15: Subsidies for small power producers (May 2009)

Fuel type	Adder (Baht/(kWh)	Purchase capacity (MW)
Municipal solid waste	2.5 (fixed)	100
Wind	2.5 (fixed)	115
Solar	8 (fixed)	15
Other renewable energy	0.3 (bidding)	300
TOTAL		530

Source: DEDE (2009)

Environment and natural resource laws and regulations

Thailand has in place several key environmental laws and regulations of relevance to bioenergy.

- Enhancement and Conservation of National Environmental Quality Act (1992)
- Factory Act (1969, amended 1992)
- Public Health Act (1992)
- Hazardous Substances Act (1992)
- Forest Act (1941)
- Community Forest Bill (2007)
- Land Code (1954)
- Land Reform for Agriculture Act (1975)

The main environmental law in Thailand is the ***Enhancement and Conservation of Natural Environmental Quality Act (1992)***. This law is comprehensive and contains several progressive provisions designed to enhance environmental protection, including the following:

- Creation of a ***National Environment Board*** (Chapter I) to oversee coordination between ministries and guide conservation of national environmental quality (Section 13)
- Establishment of an ***Environmental Fund*** (Chapter II) funded by the Fuel Oil Fund (Section 22)
- Prescription of environmental quality standards (Section 32)
- Formulation of a National Environmental Management Plan (Chapter III, Part 2) to design environmental implementing policies (Section 35)
- Prescription of an **environmental impact assessment process** (Sections 46-51)
- Establishment of a multi-agency **Pollution Control Committee** to oversee pollution control matters (Sections 52-54)

- Regulation of air and noise (Sections 64-68); water (Section 69-77); and other pollution and hazardous waste (Sections 78-79)
- Duty to use central waste treatment facilities based on the "polluter pays" principle (Section 74).

The Act establishes general environmental principles which serve as the basis for all environment-related legislation and relevant national programs. In this way, the environmental principles in the Enhancement and Conservation of National Environmental Quality Act are reflected in laws and regulations concerning the energy, industrial and transport sectors. It stipulates that assistance will be provided for public education with respect to statutory environmental protection requirements and regulations.

Article 67 of the Thai Constitution stipulates that individuals and communities have the right to conserve, protect and to benefit from local natural resources and biodiversity. It prohibits any projects or activities which can cause serious negative impacts to the environment, natural resources and public health. The Constitution further states that if the authorities want to pursue a project with the potential to cause these negative impacts a comprehensive EIA must be conducted. This must include a public hearing process with the participation of independent environmental and public health organisations.

The **National Environment Board** has four key functions:

- To submit policies and plans for the enhancement and conservation of national environmental quality to the Cabinet.
- To prescribe environmental quality standards.
- To propose amendments or improvements to laws related to the enhancement and conservation of national environmental resources.
- To supervise the management and administration of the Environmental Fund.

The **Pollution Control Committee** is responsible:

- To submit policies and plans for the enhancement and conservation of national environmental quality to the Cabinet.
- To provide opinions and recommendations to the National Environment Board for amendments or improvements to environmental laws.
- To advise the Minister of Natural Resources and Environment on setting up effluent or emissions standards.
- To coordinate the efforts of government agencies, state enterprises, and the private sector in their actions to control, prevent, mitigate, or eradicate pollution.

The Act contains a detailed **environmental impact assessment** (EIA) process, which

incorporates public and expert participation in decisionmaking. The National Environment Board has mandated EIA reports be submitted to the Ministry of Natural Resources and the Environment for proposed projects if they involve:

- Dams or reservoirs, irrigation, commercial airports, hotels, or resorts
- Systems under the law related to expressways and railroad-based mass transportation
- Mining activities and industrial estates regulated by law
- Commercial ports
- Thermal energy-based electric power plants of 10 megawatts or higher
- Large industrial operations

Environmental impact assessments are used to evaluate possible environmental impacts and to establish the measures necessary to prevent, avoid, or mitigate any environmental damage that may occur during the development of large-scale projects. Large-scale CDM projects are required to conduct an EIA.

Pursuant to the National Environmental Quality Act (1992), the Ministry of Natural Resources and the Environment has outlined **industrial standards** related to bioenergy, including emission standards for biomass power plants before and after 1 October 2004; industrial wastewater effluent standards for biogas plants and post-treatment systems; and general wastewater effluent standards.

Wastewater is among the main environmental concerns related to the commercialization of bioenergy. ***The Factory Act (1969, amended 1992)*** controls the establishment and operation of factories concerning: (1) location; (2) standards on discharge of waste; (3) documentation to ensure compliance with standards and requirements; and (4) other health and safety requirements. The Factory Act authorizes the Minister of Industry to issue regulations to measure business facilities to treat wastewater.

In accordance with the ***Public Health Act (1992)***, the Pollution Control Department is involved in a wide range of waste disposal matters, from overseeing the process of waste transportation and disposal to establishing criteria aimed at controlling public health. The Pollution Control Department and the Office of Natural Resources and Environmental Policy and Planning oversee activities that may endanger public health, as well as regulate wastewater discharge and air emissions.

The Hazardous Substances Act (1992) covers chemicals, or other materials capable of endangering human health and safety, livestock, plants, property, or the environment. The

Ministry of Industry has the statutory power to classify hazardous substances. The Act also covers control, management and disposal of waste, pollution or other substances from production plants. Wastewater and air pollution treatment are established in accordance with Notifications of the Ministry of Industry on water discharge and air quality emissions.

Thailand has enacted several **forest policies** based on the following national plans and Acts. These laws are relevant with respect to the proposed expansion of energy crop plantations in Thailand.

- The ***Forest Act (1941)***, established by Cabinet Resolution on 3 December 1985, includes the basic principles for the long-term exploitation forests to benefit the State, with measures providing for environmental protection and promoting reforestation.
- The ***National Forestry Policy (1985)*** establishes targets for economic forests and protected forests. The target of maintaining 40% forested land was further divided into 25% for economic forests and 15% for conservation forests. Following the national ban on logging established in 1989, these targets were reversed to 25% for conservation forests and 15% for economic forests.
- The ***Tenth National Economic and Social Development Plan (2007–2011)*** ensures forests are maintained at not less than 33%, with not less than 18% for protected forests.
- The ***Community Forest Bill (2007)***, adopted by the National Legislative Assembly on 21 November 2007, grants legal rights to forest communities to preserve and manage their surrounding forest lands.

The ***Land Code (1954)*** and ***Land Reform for Agriculture Act (1975)*** are the main laws regulating land in Thailand. The Ministry of the Interior is responsible for land regulations. Under the Land Code, foreign individuals and companies are prohibited from owning land in Thailand. Companies incorporated in Thailand which are more than 50% Thai-owned are eligible to acquire land rights. As noted below, there are exceptions with respect to Board of Investment and Industrial Estate Authority of Thailand projects. Under those projects, special privileges are outlined. Foreigners may also be granted land rights pursuant to the ***Investment Promotion Act 1977***, whereby "a promoted person shall be permitted to own land required for the promoted business in such acreage as the Board may prescribe, even though it exceeds the limit prescribed under other laws" (Section 27).

Investment laws

Several investment laws are relevant to developing bioenergy in Thailand. Under the ***Investment Promotion Act (1977), Amendment No. 2 (1991) and Amendment No. 3 (2001),***

Thailand's Board of Investment (BOI) within the Ministry of Industry assists in the formulation and implementation of investment promotion policies. The Board of Investment determines foreign ownership for investment projects on a case-by-case basis. The BOI promotes projects based on the following types of incentives: (i) right to employ foreigners; (ii) right to own land; (iii) exemption or reduction in import duties on imported machinery; (iv) exemption from income tax for a period of between 3 to 8 years; and (v) exemption from paying income tax on dividends. A One-Stop Center is provided by the Board of Investment to help investors with administrative procedures and to obtain the necessary permits, licenses and approvals (BOI 2009).

Alternative and renewable energy was added to the Board of Investment list of industries targeted for a proactive marketing campaign, indicating the increasing importance of this sector (BOI 2006). In November 2008, the BOI initiated incentive measures to attract investment to the agroenergy sector, including an eight-year exemption of corporate income tax, a 50% reduction of corporate income tax for five more years, double deduction of transportation and utilities costs, and a 25% deduction from net profit for facility installation and construction costs on top of normal depreciation capital. While foreign direct investment in the agricultural sector is restricted for reasons of national security as noted above, one of the target sectors was energy saving and alternative energy related businesses, which includes fuel produced from agricultural products (BOI 2009).

The ***Industrial Estate Authority of Thailand Act (1979)*** establishes an Industrial Estate Authority as a state enterprise under the Ministry of Industry. This agency is tasked with developing Thailand's industrial development policy. It administers the 34 industrial estates and 17 export processing zones in Thailand. There are two categories of industrial estates established under the Act: *General Industrial Zones* – areas designated for industrial activities; and *Export Processing Zones* – areas designated for industrial or other activities either supporting exporting businesses or exporting directly.

The Industrial Estate Authority is responsible for issuing permits to industrial operators and granting special incentives and privileges, including the right to own land in the industrial estate area; to obtain work permits for foreign technicians and experts; and to remit foreign currency abroad. Industrial operators in Export Processing Zones are eligible for additional tax-based incentive and privileges, including:

- Exemption from special fees under the Investment Promotion Act, import duties, value added tax, and excise tax on machinery, equipment, including raw materials or any other items used in the manufacture of goods which are imported into the Export Processing Zone.
- Exemption from export duties, value added tax, and excise tax on products and byproducts derived from the production if they are exported.
- Exemption from or refund of taxes, if goods are taken into another export processing zone as if they have been exported (BOI 2008).

The ***Foreign Business Act (1999)*** restricts investment in 43 business sectors, including agriculture and forestry. In early 2007, the Ministry of Commerce proposed amendments to the Foreign Business Act to increase restrictions on foreign investments. These amendments have yet to be approved.

Multilateral trade obligations

The following section raises some issues concerning Thailand's bioenergy development in the context of the World Trade Organisation. Thailand became a Contracting Party to the General Agreement on Tariffs and Trade (GATT) in 1982 and a Member of the World Trade Organisation (WTO) in 1995. Thailand's membership in the GATT coincides with the rise in importance of its agricultural exports in the 1980s.

Agricultural trade liberalisation is a critical component of the Doha round of multilateral trade negotiations in the World Trade Organisation (WTO). First, commodity-exporting developing countries in particular would benefit from greater *market access* for agricultural products (energy crops) and biofuels. This would serve to increase revenues for research and development of sustainable production practices and technologies. Second, as a major agricultural exporter, Thailand would gain from *agricultural trade liberalisation* in the WTO Agreement on Agriculture to remove export subsidies in key developed countries, such as Japan, the EU and the US. As noted in a long-standing Brazilian proposal to the WTO (Brazil 1998), agricultural export subsidies in developed countries distort market access for trade in ethanol. Notwithstanding price support schemes for example for sugar, rice, cassava and palm oil, Thailand's agricultural sector is considered to be competitive on the world market in these agroenergy crops.

Third, trade trends will be affected by the definition of biofuels in the WTO as industrial, agricultural or environmental goods. The harmonised system of tariff classification used in the WTO classifies ethanol as an agricultural product with no distinction between its use for fuel or other purposes, whereas biodiesel is classified as an industrial product (Howse et. al. 2006).

Fourth, one way to address the social and environmental impacts of biofuels is to establish and enforce *sustainability criteria*. This is the path forward for biofuels charted by many governments, international organisations and non-governmental efforts to assess rising concerns. Most criteria to assess sectoral sustainability take into account the socio-environmental effects of *direct* biofuel production with respect to the land and production processes employed. However, as emphasised by reports by the Dutch Cramer Commission (2007) and the World Wide Fund for Nature (WWF) (Dehue et al 2007), the most serious sustainability issues are those related to the *indirect* impacts of large-scale biofuel production, mainly displacement of other agricultural activities and subsistence farming, as well as changes in land use from forests or grass to crops (Searchinger 2009). Criteria developed by the Roundtable for Sustainable Biofuels (2008) include life cycle greenhouse gas emissions, biodiversity, agricultural practices and social impacts.

Certification of the sustainability of biofuels represents at the same time a valuable marketing tool and a costly non tariff barrier to trade, especially for developing countries. A recent study on EU-ASEAN trade relations estimates that around 20-25% of EU biofuel consumption by 2020 will be derived from imports. Sustainability criteria agreed by the EU in March 2009 will determine market access for palm oil and ethanol imports (EU 2009). In this regard, Brazil, Malaysia and Indonesia are among the key biofuel exporters threatening to bring a complaint to the WTO on the basis of trade discrimination. Moreover, there is the issue of whether sustainability certification schemes would be legally compatible with the WTO Agreement. These instruments are applied to the production and processing methods of biofuels.

In summary, the sustainability of the entire chain of production of agro-fuels will affect bioenergy trade and have development implications, particularly for developing countries. Compliance with EU and Roundtable on Sustainable Biofuel guidelines may provide an incentive to address negative environmental impacts, but they may face a legal

challenge in the WTO. As with the evolution of eco-labelling and certification over the past two decades, sustainability criteria are deemed to be a *central* yet controversial aspect of the development of bioenergy.

A sense of déjà vu has taken over the WTO agricultural liberalisation agenda since its inclusion in the Uruguay Round negotiations. Notwithstanding an anticipated 2005 deadline, WTO members have yet to conclude the negotiations.

Multilateral environment obligations

Thailand is Party to the following multilateral environmental agreements relevant to bioenergy:

- United Nations Framework Convention on Climate Change (UNFCCC) (signed in June 1992, ratified on 28 December 1994 and entered into force on 28 March 1995)
- Kyoto Protocol (signed in February 1999, ratified on 28 August 2002 and entered into force on 16 February 2005)
- Convention on Biological Diversity (signed in June 1992, ratified on 31 October 2003 and entered into force on 29 January 2004)

Thailand has ratified both the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. In preparation for the Copenhagen meeting of the UNFCCC, Thailand announced it will cut greenhouse gas emission in the energy sector by up to 30% by 2020 (Wannarat 2009). As outlined by the Minister of Energy in Copenhagen, this is to be accomplished through a target to reduce the volume of emissions in each sector. At present, Thailand's greenhouse gases are as follows: energy sector 56%, transportation 26% and agriculture 18%. Therefore, the contribution of reducing emissions in the agricultural sector through conservation agricultural practices will have an important role to play, as described in the case narratives in Chapter V.

As a non-Appendix 1 country, Thailand has non-binding obligations under the Kyoto Protocol, such as submitting national communications. Thailand submitted an Initial National Communication on 13 November 2000 containing its greenhouse gas inventory as of 1994; greenhouse gas projections and identification of mitigation option; existing assessments on vulnerability and adaption and policies and measures as well as other issues related to financial resources, technology transfer and capacity building (MOSTE 2000).

On 15 August 2006, the Cabinet approved the creation of a ***National Commission on Climate Change Policy*** to be chaired by the Prime Minister and under the authority of the Office of Environmental Policy and Planning of the Ministry of Natural Resources and Environment. The coordinating role of such a body cannot be underestimated at this crucial juncture in developing a coherent legislative and policy framework for bioenergy.

Climate change has slowly emerged as a driver for development of bioenergy policies in Thailand. However, the introduction of a five year ***National Strategy on Climate Change*** in early 2008 has paved the way Thailand's active engagement, particularly through the Clean Development Mechanism (CDM) of the Kyoto Protocol (Walailak 2008a, Wanun 2008, IGES 2006).

The Climate Change Coordinating Unit within the Ministry of Natural Resources and Environment is responsible for providing collaboration and support to prevent and mitigate climate change impacts. Thailand is giving top priority to the implementation of CDM projects in the energy sector, including projects for the use of bioenergy, such as ethanol and biodiesel, biogas from farm and industrial wastewater and energy conversion from industrial waste (ONEP 2007).

Following Thailand's ratification of the Kyoto Protocol in 2002, the Government has implemented policies to promote energy conservation at the national level, including through allocating US$10 million in the current ***National Economic and Social Development Plan*** to increase environmental awareness and energy conservation in primary school curriculum.

The following labels are being devised to create incentives and raise awareness on energy efficiency and carbon footprint.

Figure 11: Energy efficiency labels, Thailand

Carbon reduction label

Carbon footprint label

Clean Development Mechanism

Thailand is an active host for projects developed for the Clean Development Mechanism (CDM) under the Kyoto Protocol. The newly created Thailand Greenhouse Gas Management Organisation (TGO) acts as the Designated National Authority and has adopted national guidelines for approving CDM projects (ONEP 2008). As of April 2009, the TGO has approved 60 CDM projects in Thailand (TGO 2009).

Previously, CDM projects received their final approval on a case-by-case basis from the Cabinet, which proved to be a lengthy process taking up to 60-70 days. The TGO provides a one-stop service for CDM applicants.[26] It also compiles greenhouse gas (GHG) inventories, information on GHG mitigation and promotes investment to reduce GHG emissions in coordination with the private and public sectors. The TGO is responsible for developing Thailand's CDM strategy, including comprehensive rules, regulations, national criteria, and procedures for CDM projects (ONEP 2007).

Thailand's CDM policy priority is currently based on the energy sector, including:

1.4 *Energy development* (projects to use bioenergy, such as ethanol, biodiesel and biogas from farm and industrial wastewater; conversion of industrial waste into energy; or for the use of renewable energy sources, such as solar, wind and small hydro-power systems)

2.4 *Energy efficiency* (e.g., projects to increase efficiency of combustion and steam generation, cooling systems or energy use in buildings)

3.4 *Environment* (projects to convert waste into energy or biofertilisers)

4.4 *Transport efficiency*

5.4 *Industrial processes* (projects that lead to reduced greenhouse gases)

To date, these objectives for the CDM do not encompass land use, land use change or forestry projects. The Ministry of Natural Resources and the Environment is studying the feasibility of including criteria for afforestation and reforestation in CDM projects (TGO 2009).

In Thailand, an environmental impact assessment is required for certain projects, including hydro (construction of dams or reservoirs), mining, power (thermal-electricity plants of over 10 megawatts), and large industrial refineries or factories (petrochemical operations). An initial environmental examination is required for projects with potentially

[26] See www.tgo.or.th.

limited environmental impacts. However, the Ministry of Energy can request the preparation of an environmental impact assessment.

Thailand's development of criteria and approval procedures for CDM projects is divided into two phases: Phase 1 focuses on the energy and industrial sector (now underway). In July 2005, Thailand's National Climate Change Committee approved draft procedures and criteria for projects in the energy and industrial sectors. Phase 2 focuses on establishing procedures and criteria for other sectors.

Use of alternative energy is an economic indicator for Thailand's ***Sustainable Development Criteria*** for CDM project evaluation. A point system or "scoring method" is used for evaluating each indicator or criterion. There are 24 indicators in four groups of sustainable development criteria. For the project to be considered as a CDM project and receive a Letter of Approval from Thailand, the project must have a positive score in each group of criteria and the total score must be positive (more than zero). Sustainable development criteria for CDM projects in Thailand are summarized in **Table 16**.

Table 16: Sustainable development criteria for CDM projects in Thailand

1. Natural Resource and Environment Indicators
1.1 Environment Indicators
• Reduction of greenhouse gases emission as specified the Kyoto Protocol • Reduction of air pollutant emission in compliance with air quality standards i.e. NOx HC PM10 SO_2 CO O_3 VOC's Dioxin • Noise and odour pollution (in compliance with government standards) • BOD Loading in wastewater (in compliance with government standards) • Waste management • Groundwater contamination and soil pollution (in compliance with government standards) • Reduction of hazardous waste
1.2 Natural Resource Indicators
• Water demand and efficiency of water usage • Soil, coastal and river bank erosion • Increase green areas under the project's initiative • Ecosystem diversity • Species diversity • Use/import of GMO and/or alien species to the project site
2. Social indicators
• People's participation (assessed by the level of participation being organised)

• Activities promoting social development, culture, and 'sufficiency economy' philosophy • Workers health and surrounding community health
3. Development and/or technology transfer indicators
• Technological development • Post Project Implementation Plan or Post Crediting Period Plan as outlined by the project • Capacity building
4. Economic indicators
4.1 Increasing income of stakeholders
• Increasing income of workers • Increasing income of other stakeholders, for example, increasing income of farmers through selling raw materials to the project
4.2 Energy
• Use of alternative energy • Energy efficiency • Increase in using local content

Source: TGO (2009).

There is significant potential to utilize the CDM to reduce GHG emissions in the energy sector in Thailand (Sitanon 2002). Over two-thirds of Thailand's total net GHG emissions are carbon dioxide (CO_2), mainly from the energy sector. Greenhouse gas emissions from the energy sector increased in relative and absolute terms from 1990 levels, indicating the opportunities for GHG mitigation. To date, approved CDM projects in Thailand have focused on second generation biomass to liquid (BTL) and biogas to generate electricity and heat. Under Business as Usual scenarios, energy sector greenhouse gas emissions are expected to double from 204 million tonnes per year in 2008 to 400-450 million tonnes by 2020. As outlined in Prime Minister Abhisit Vejjajiva's statement at Copenhagen, this estimate is based on projections for 3.5 to 5% GDP growth per year (November 2009).

4.3 Thailand's bioenergy policies

Thailand has a long history of research on biofuels initiated by the King's Royal projects in Chitralada Gardens in 1985. As the world's largest exporter of tapioca and rice, and second largest sugar exporter, Thailand has significant capacity to produce agricultural feedstocks for biofuels. Thailand's energy intensity in relation to gross domestic product

(GDP) has been rising since the early 1980s to a relatively high level of 1.4 to 1. This means that for each % increase in GDP, there is a resulting increase of 1.4% in energy consumption. The majority of energy is consumed in the industrial (37%) and transport (35.1%) sectors.

Thailand's biofuels sector is more advanced than in other countries in Asia for several reasons. First, Thailand is heavily dependent on imports of petroleum to stimulate its export-led growth. Over the past decade, Thailand spent approximately 10% of its annual GDP on oil imports. Already in the 1980s, Thailand began investing in research and development to decrease oil dependence by converting its abundant agricultural biomass into biofuels (JGSEE 2009).

Second, in light of the volatile world price of oil, biofuels offer a means to diversify fuel sources, thereby increasing energy security. Third, developing the biofuels sector represents an opportunity to add value to the agricultural sector and stimulate rural development. Fourth, biofuels may help to reduce greenhouse gas emissions, thereby contributing to addressing climate change. Based on this combination of diverse policy objectives, Thailand's Cabinet approved a strategic plan for gasohol in 2003 and one for biodiesel in 2005, as well as created a ***National Committee on Biofuels Development and Promotion*** to coordinate efforts. Thailand's longer-term ambitious target, approved in March 2009, is to replace 20% of national energy consumption with renewable energy by 2022, compared with 8% in 2008.

With its abundant agricultural resources, Thailand's objective is to increase energy security through developing alternative energy, particularly biofuels. After outlining Thailand's recently adopted ***Alternative Energy Development Plan***, the following section deals with policies for the main bioenergy sources: (1) ethanol; (2) biodiesel; and (3) biogas and biomass-to-liquid (BTL).

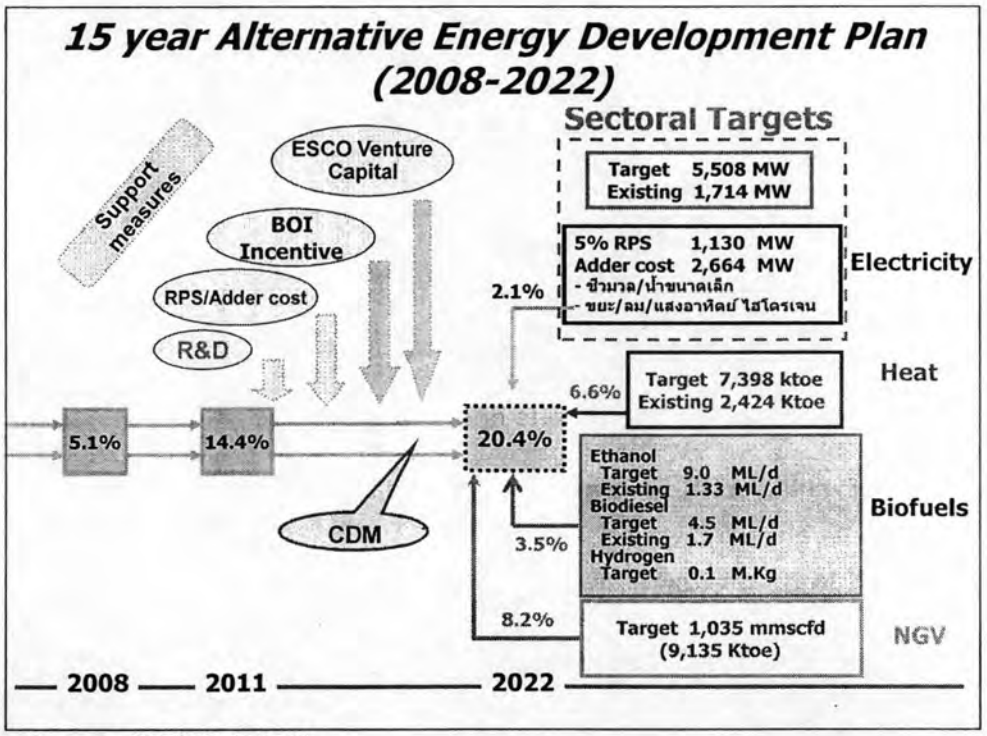
Alternative energy development: national mandates

In February 2009, Thailand adopted the ***Alternative Energy Development Plan (2008-2022).*** This ambitious strategy gives priority to production and use of alternative energy that is renewable, 'clean', and able to provide the country with greater energy security. The Ministry of Energy has a budget to develop renewable energy of 15.6 billion baht (US$45 million) over the next fifteen years.

The goal of the Alternative Energy Development Plan is "to increase the share of alternative energy mix to be 20% of the country's final energy demand by 2022." As set out in **Figure 10**, the Plan has the following general objectives:

- To increase the contribution of alternative energy in order to replace oil imports.
- To increase energy security.
- To promote integrated green energy utilization in communities.
- To enhance the development of alternative energy technology industries.
- To research, develop and encourage high efficiency alternative energy technologies.

Figure 12: Alternative Energy Development Plan (2008-2022)



Source: DEDE (2009)

The plan is developing ***hydropower***, which is estimated at 50 MW; ***solar power***, from which 32 MW of electricity was generated in 2008. The Ministry of Energy has been conducting researching into increasing solar and wind contribution to power generation in the country.

Thailand's targets for alternative energy to implement the 20.4% target set in the Alternative Energy Development Plan are contained in **Table 17.**

Table 17: Alternative Energy Development Plan targets by 2022

Department of Alternative Energy Development and Efficiency
Ministry of Energy

Renewable Energy targets by 2022

Energy type	Potential	Existing	Year 2008 - 2011		Year 2012 - 2016		Year 2017 - 2022	
Electricity	**MW**	**MW**	**MW**	ktoe	**MW**	ktoe	**MW**	ktoe
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	4.4001	**.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
Total		**1.750**	**3.273**	1.587	**4.191**	1.907	**5.608**	2.290
Thermal (Heat)	**ktoe**	**ktoe**		**ktoe**		**ktoe**		**ktoe**
Solar Energy	154	**1**		**5**		**17,5**		**38**
Biomass	7.4002	**.781**		**3.660**		**5.000**		**6.760**
Biogas	600	**224**		**470**		**540**		**600**
MSW		**1**		**15**		**24**		**35**
Total		**3.007**		**4.150**		**5.582**		**7.433**
Biofuel	**ml/day**	**ml/day**	**ml/day**	ktoe	**ml/day**	ktoe	**ml/day**	ktoe
Ethanol	3,00	**1,24**	**3,00**	805	**6,20**	1.686	**9,00**	2.447
Biodiesel	4,20	**1,56**	**3,00**	950	**3,64**	1.145	**4,50**	1.415
Hydrogen			**0**	0	**0**	0	0.1 m kg.	124
Total			**6,00**	1.755	**9,84**	2.831	**13,50**	3.986
Total Energy Demand (ktoe)		66.248		70.300		81.500		97.300
Total RE demand (ktoe)		4.237		7.492		10.319		13.709
Propotion of RE Used		**6,4%**		**10,6%**		**12,7%**		**14,1%**
NGV (mmscfd)		108,1	393,0	3.469	596	5.260	690	6.090
Total AE Demand(ktoe)				10.961		15.579		19.799
Propotion of AE Used				**15,6%**		**19,1%**		**20,3%**

Source: DEDE (2009)

Driven in large part by government incentives, Thailand's biofuel industry has experienced solid growth over the past few years. Liquid biofuels have been the most developed form of bioenergy in Thailand due to abundance of supply. Whilst most ethanol producers plan to supply to the domestic market to meet the Government's gasohol targets and to diversify the energy supply away from imported petroleum, there are emerging prospects for trade. In 2008, Thailand exported approximately 74 million liters of ethanol to a range of countries, including Australia, Japan, the Netherlands, the Philippines, Singapore and Taiwan (DEDE 2009). Exports are hampered by the need for case-by-case approval from the Ministry of Commerce pursuant to the ***Cane and Sugar Act (1984)***.

Following a Cabinet Resolution on 17 May 2005, Gasohol 95 was expected to replace conventional unleaded gasoline (ULG) in 2008. Unleaded Gasoline is sold at the pumps at a

price set at 1.5 Baht/liter (reduced in September 2009 from 4 Baht/liter) lower than regular gasoline. A new Gasohol 95 with a higher proportion of ethanol mix (20%) called ***E20*** was launched. There are also ambitious plans to develop palm oil for biodiesel. The National Energy Policy Council resolution of 2 April 2007, mandated that all diesel sold in Thailand contain at least 2% biodiesel (B2). As of 1 February 2008, B2 is the standard biodiesel mix sold nationwide (EPPO 2008).

Thailand also produces a large quantity of biofuel from ***biomass*** from the residues of the agricultural production process. In Thailand, ***biogas***, mainly derived from livestock manure, is used in cooking fuel and electricity generation. The Government's Energy Conservation Promotion Fund is supporting research on the feasibility of biogas generation from landfill and industrial wastewater.

As set out in **Table 18** below, the ***Alternative Energy Development Plan*** will be implemented in three phases:

Short term (2008-2011)

- Promoting proven technologies for alternative energy with high potential, such as biofuels and power and heat generation from biomass and biogas.

Medium term (2012-2016)

- Promoting alternative energy technology industry and supporting the development of new prototypes of alternative energy technologies for higher cost-effectiveness.
- Promoting new technologies for biofuel production and development of Green City prototypes that lead to strengthened local alternative energy production.

Long term (2017-2022)

- Promoting new technologies for alternative energy that are cost-effective, such as hydrogen energy, extending Green City and local energy.
- Supporting Thailand to become the hub of biofuel imports and alternative energy technologies in the ASEAN region.

Table 18: Alternative energy promotion measures (2008-2022)

Phase 1: 2008-2011	Phase 2: 2012-2016	Phase 3: 2017-2022
- conduct research on second generation technologies, e.g., on biodiesel and ethanol produced from seaweed, Jatropha, cellulose, hydrogenation, biomass-to-liquid - extend oil palm cultivation areas to increase the agro-production of energy crops - undertake hydrogen research and development - accelerate the extension of E20/E85 in petrol stations and the development of the auto industry for E85 - promote value added from biofuel by-products - establish investment incentives under the Board of Investment	- promote second generation technologies for biofuel production, e.g., biomass-to-liquid, hydrogenation - develop other cost-effective energy crops - demonstrate hydrogen production and use - build public confidence in the use of biofuels - develop Thailand as a biofuel hub and exporting center	- promote second generation technologies for biofuel production, e.g., biomass-to-liquid, hydrogenation - increase yield per rai of energy crops - promote and extend the results of hydrogen use - promote the production of ethanol from cellulose - promote the downstream biofuel industry - implement tax measures to stimulate the biofuels industry

Source: DEDE (2009).

A ***National Committee on Biofuels Development and Promotion*** was set up by Cabinet Resolution on 8 April 2005. This Committee is the focal point for matters relating to biofuel policymaking, monitoring and promotion. It is mandated to determine national policy and the management and development plans for biofuel production, promotion and use. The National Biofuels Committee inherits the duties and authority previously held by the National Ethanol Committee (established in 2001), which include the granting of licenses for the construction of ethanol plants and for the distribution of ethanol.

Ethanol production and use

Thailand's gasohol production program began in 1985 when the present reigning monarch, His Majesty King Bhumiphol Adulyadej initiated a gasohol development project at Chitralada Gardens in the wake of the first oil crisis in the 1970s. The King's projects

supported research into the production of ethanol from sugarcane for energy use also to promote the concept of *Sufficiency Economy*.

Thailand is the world's largest exporter of tapioca (cassava) and second largest exporter of sugar: the two main crops used in ethanol production. While cassava is considered to be a promising future feedstock for the ethanol industry, molasses from sugarcane is the current feedstock. The table below provides Thailand's existing and planned ethanol capacity as of November 2009.

Table 19: Ethanol production capacity, 2009

Potential capacity (from molasses, sugarcane, starch, cellulose)	2.58 Million litres/day
Existing capacity	1 Million litres/day

Source: DEDE (2009).

The Government vehicle fleet is mandated to use gasohol. Targets were set to distribute Gasohol 95 nation-wide and abolish unleaded gasoline by January 2007 as defined in a Cabinet Resolution on 17 May 2005. This target has been postponed indefinitely. As of November 2009, over 4,179 service stations nation-wide sell gasohol (DEDE 2009).

Other measures were put into place by the National Energy Policy Council to further the production and use of gasohol throughout Thailand. On 4 September 2006 a Council Resolution approved the liberalisation of ethanol production plants and distribution of ethanol in order to accelerate the production, promotion and distribution of ethanol nation-wide. Due to this Resolution, ethanol producers no longer require a license to manufacture their product, only a permit from the Ministry of Industry pursuant to the Factory Act (1992).

A ***Gasohol Strategic Plan*** was proposed by the Ministry of Energy and adopted by Cabinet Resolution on 9 December 2003. A Joint Working Group comprised of the Ministries of Energy, Industry, and Agriculture and Cooperatives was also created to determine measures to promote the construction of ethanol production plants and to develop plans for raw materials (feedstock) management. **Table 20** sets out the number and production capacity of the licensed ethanol plants in Thailand as of May 2009.

Table 20: Thailand's ethanol production capacity, 2009 (Million Liters)

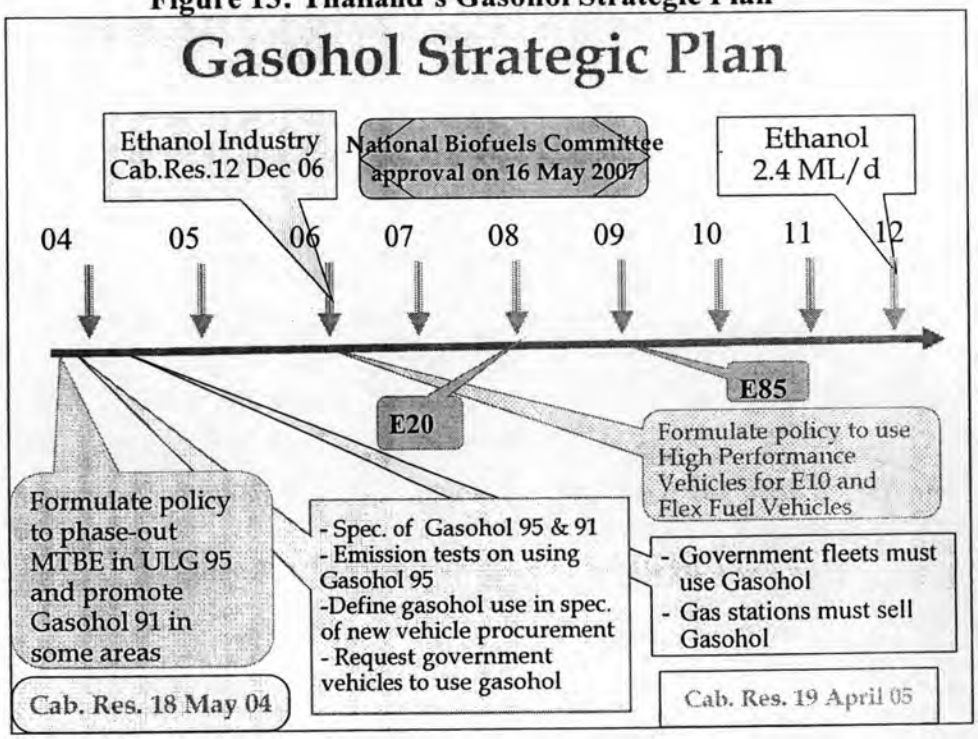
Status of plant	Sugarcane molasses		Cassava		Sugarcane and cassava		Total	
	Plants	Capacity	Plants	Capacity	Plants	Capacity	Plants	Capacity
Operating	10	1.445	1	0.13	1	0.15	17	1.725
Under construction	1	0.15	8	2.04	0	0	9	2.19
Licensed	16	2.89	24	8.39	8	1.22	48	12.50

Source: compiled by the author with information from interviews at DEDE (May 2009).

The ***Gasohol Strategic Plan***, approved by the National Biofuels Committee on 16 May 2007, consists of the following key elements (Figure below):

- Increase ethanol production to 2.4 million liters/day by 2011 and 9 million liters/day by 2022.
- Phase-out methyl tertiary-butyl ether (MTBE) in unleaded gasoline.
- Develop specifications for Gasohol 95 (91 octane gasoline mixed with 10% ethanol).
- Enforce the Cabinet Resolution to ensure that Gasohol 95 and 91 are available nation-wide.
- By 2012, all petrol consumed will be Gasohol 95 by law.
- Research and development into vehicle performance as well as monitor gasohol emissions.

Figure 13: Thailand's Gasohol Strategic Plan



Source: DEDE (2009)

Since 1979, the Ministry of Agriculture and Cooperatives has supported research to improve processing of sugarcane to alcohol and, subsequently, to enhance cassava policy research (EPPO 2009; Pitisant 2007). The ***Strategic Cassava Plan (2002-2006)*** focused on ensuring sufficient supply for industrial use without expanding cultivated areas. Thailand is investing in research to double increase cassava yield from 23 to 50 metric tonnes per hectare by 2020, and sugarcane yield from 56 to 106 metric tonnes per hectare by 2021. The Ethanol-Biodiesel Club of Thailand (2001) estimates that there is a significant potential to increase domestic capacity of tapioca for export. **Table 22** sets out recent National Energy Policy Council and Cabinet resolutions related to ethanol.

Table 21: Recent national resolutions related to ethanol

Date & approving body	Summary of resolution
26 April 2002	Devises methods of promoting ethanol use as fuel.
12 September 2002 (National Energy Policy Council)	Resolves that 0.036 baht/liter from gasohol sales goes into the Energy Conservation Promotion Fund.
28 July 2004 (National Energy Policy Council)	Permits the licensing of factories producing and selling ethanol as fuel.
17 May 2005 (Cabinet)	Targets set to distribute Gasohol 95 nationwide and employ measures to increase ethanol consumption.
22 December 2006 (National Energy Policy Council)	Targets EURO 4 as emission standard by 2012.
5 February 2007 (Committee on Energy Policy Administration)	Sets the price of Gasohol 91 to be less that unleaded gasoline 91 by 1.50 baht/liter.
16 May 2007 (National Committee on Biofuel Development and Promotion	Gasohol Strategic Plan approved to promote ethanol blending in gasoline at 10% and 20% up to 2.4 million liters a day by 2011.
15 December 2007 (Ministry of Energy)	Sets the price of E20 lower than Gasohol 95 E10 by 2 baht/liter and lower than Benzene 95 by 6 baht/liter.

Government incentives for ethanol production and use

The price mechanism is the main way in which the Government promotes gasohol. The sale price of ethanol is set by the Government. Pursuant to Cabinet Resolution, the excise tax and the municipality tax are exempted from the ethanol component of gasohol, allowing the retail price of gasohol to be lower than gasoline (EPPO 2009).

The subsidies for ethanol are as follows: (1) The cost difference between ethanol and gasoline ex refinery + (2) the waiving of all related taxes. The percentage is 10% for E10 and 20% for E20 and 85% for E85. **Appendix R** contains the price structure of petroleum productions in Bangkok, including the reference price for ethanol.

Contribution rates to the Oil Fund from gasohol sales are lower than for gasoline, resulting in a lower retail price of Gasohol 95 compared with unleaded gasoline. At present, the gap is 4 baht (US$0.11)/liter; the price gap between Gasohol 91 and unleaded gasoline is 3.50 baht (US$1)/liter (EPPO 2009).

The Cane and Sugar Act (1984) outlines a sugarcane revenue sharing system, whereby the cane planters are entitled to 70% and the cane millers to 30% of the revenue generated in the sugar industry.

Since 2006, the Government has prioritized the promotion and production of biofuels. The Thailand Board of Investment (BOI) drew up incentives in accordance with the ***Investment Promotion Act (1977)*** to stimulate investment into the Thai ethanol industry. These incentives include:

- Import duty exemptions for necessary equipment (Although the equipment and technology required for gasohol production are available in Thailand, several joint-venture ethanol projects between Thai companies and foreign investors stipulate the condition that the required machinery be imported from the investor's countries of origin. Hence the import duty benefits offered by the Board of Investment).
- 8-year corporate tax exemptions with no limitations.
- Additional benefits for producers located in Zone 3 (Northeast and Southern Thailand), such as deductions for infrastructure costs and public utility costs, an additional 50% reduction in corporate income tax for up to ten years and further deductions for infrastructure installation and construction costs (The zoning

requirement was to encourage industrial clusters and foster development in the least developed areas) (WTO 2007:82).

- Expanded land ownership rights for foreign investors beyond the provisions in the Land Code (1954).
- Permission to bring in foreign experts and technicians.
- Work permits and visa facilitation.

The Board of Investment is currently supporting nearly 30 ethanol projects situated throughout Thailand that have a combined capacity of nearly 6 million liters/day. In 2008, there were several projects seeking promotional privileges from the Board of Investment to develop ethanol from cassava in the Northeast of Thailand. Five Board of Investment-approved cassava-based ethanol projects, amounting to 16.5 billion baht (US$48 million) (some of which are joint-venture projects between Thai and foreign partners), are expected to be built in Nakhon Ratchasima, Ubon Ratchathani, Kalasin and Chaiyaphum. Cassava production has expanded by 12% since 2005, and is predicted to continue to grow to provide ethanol feedstocks.

In December 2008, the Board of Investment approved 10 large-scale projects to stimulate development, including an ethanol production project by Petro Green Co., Ltd. For 200,000 million liters per day from molasses sugarcane, 80% of which will be sold to domestic energy companies, such as PPT, Chevron, Bangchak and Shell (BOI 2008).

Investment in the production of more fuel-efficient cars is increasing with the support of Thailand's Board of Investment. Thailand is integrated into the global chain of production for cars, with the majority of export growth in Europe, Australia, and the Middle East, with ASEAN an increasingly major market. After electronic and electrical components, the automotive industry accounted for the second highest contribution to export revenue in 2005; between 2002 and 2005, exports of motor vehicles and motorcycles grew by an average of 35.31% (WTO 2007:115). The auto industry is a key driver of Thailand's two-fold increase in investments to 644.5 billion baht in 2007 (US$18 billion), primarily from Japan.

There is a significant possibility that Thailand can serve as the manufacturing hub for Flexible Fuel Vehicles (FFVs) in Southeast Asia. Ford, Volvo, Saab and Honda are expected to produce FFVs in Thailand. FFVs are vehicles designed to use fuel blended up to 85% ethanol. In January 2008, Toyota introduced a new 10th generation model into the Thai market

(Corolla Altis) which will reduce volatile organic compounds by over 80% from the previous model. This model is also designed to run on E20 gasohol. Ford, Honda, Mazda, Mitsubishi and Nissan have also introduced E20 models in Thailand. Mitsubishi, General Motors and Volvo make FFVs locally. There is a 60% import tax reduction for completely built FFVs that use E85 (85% ethanol with 15% petroleum).

There are several initiatives by the private sector and other industry actors to raise public awareness concerning biofuels. Petroleum companies have joined the Ministry of Energy in promoting the benefits of gasohol by providing guarantees for cars using gasohol.

In order to promote gasohol compatible cars, in 2007, the Ministry of Finance revised the excise tax. Since January 2008, the excise tax was reduced by 5% up to a ceiling rate of 50% for cars fuelled by ethanol blended with gasoline, at not less than 20%. To benefit from these rates, cars fuelled by E20 gasohol need to complete three performance requirements:

- An engine designed for at least 20% ethanol directly manufactured by the car company.
- A warrantee from the manufacturer for an engine fuelled by 20% ethanol.
- Able to meet the Pollution Standard Accreditation from the Thailand Industrial Standard Institute (TISI) at not lower than TISI 2160-2546.

Trade-related issues

As of 2007, Thailand began to promote exports of ethanol as fuel. The Government is contemplating how to revise the current regulatory framework to enable greater flexibility to export ethanol. Alcohol production is strictly controlled under the ***Cane and Sugar Act (1984)***. Ethanol producers in Thailand must declare whether the ethanol they produce is for biofuel use or for liquor. The export of ethanol for liquor is allowed. The export of Thai-produced ethanol for energy purposes to foreign consumers is currently prohibited. Given excess domestic supply, in 2008, approximately 71 million liters of ethanol were authorized for export to Singapore, the Philippines, Taiwan, Korea, Australia and the Netherlands. There are only five ethanol producers authorized to export (Khon Kaen Alcohol, Petrogreen, Thai Alcohol, Akarat Patana and Thai Sugar Alcohol) (DEDE 2009).

Domestic agricultural producers benefit from product and non-specific support, including market price intervention, soft loans, price controls for certain inputs, and

subsidized electricity tariffs. The *Trade Policy Review* of Thailand undertaken in 2007 by the World Trade Organisation calculated this support to be equivalent to approximately 1% of GDP and over 6% of total government expenditure (WTO 2007).

The sustainability of the entire chain of production of agro-fuels will affect trade and have development implications, particularly for developing countries. Compliance with EU and Roundtable on Sustainable Biofuel guidelines may provide a sufficient incentive to address negative environmental impacts of ethanol. As with the evolution of eco-labelling and certification over the past two decades, sustainability criteria are deemed to be a *central* yet controversial aspect of trade in biofuels.

Summary

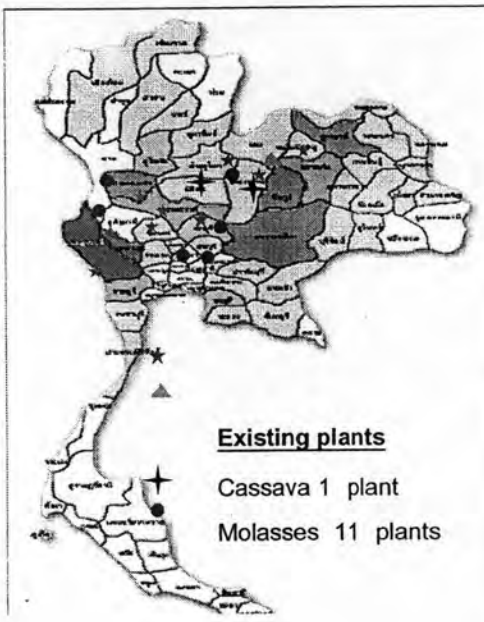
The following is a summary of the current status of ethanol production, promotion and use.

- The plan is to replace 10% of all gasoline with gasohol and increase the use of ethanol from 2.4 million liters/day by 2011 to 9 million liters/day by 2022.
- A new Gasohol 95 (E20) has been recently introduced. This E20 blend contains 20% ethanol as opposed to the more common E10 blend with 10% ethanol. Generally, automobiles do not need any engine alterations when switching from regular gasoline to gasohol as long as the ethanol content of the gasohol does not exceed 10%. However, car manufacturers have recently released car models with engines that tolerate a 20% gasohol mix.
- Gasohol 95 (E10) is priced at 1.5 baht (US$0.44) lower per liter than unleaded gasoline (ULG), with the E20 blend being priced at 3 baht (US$0.87) cheaper per liter.
- The number of gas stations selling gasohol nation-wide is 4,179 (November 2009).
- The Government licensed 48 ethanol plants, with 17 ethanol plants in operation.
- The Government has recognised several crucial problems facing the ethanol industry:
    1) Need for greater coordination between different government ministries and departments involved in the ethanol industry
    2) An excess of supply leading to intermittent ethanol production suspensions
    3) A domestic price of ethanol that is currently *lower* than the production cost
- The Government resolved these issues by pursuing the following measures:
    1) Creating a joint committee with representatives from related ministries.

2)4 Increasing gasohol distribution nationwide to stimulate demand.

3)4 Promoting ethanol production, including for export.

Figure 14: Ethanol plants in Thailand, 2009



As of November 2009:

- 17 existing plants with a capacity of 1.725 million l/day
- 11 plants are operating to produce 1.33 million l/day
- 5 planned plants by 2010 with a capacity of 0.85 million l/day

Source: DEDE (2009)

Biodiesel production and use

With the mandatory use of B2 diesel nationwide as of February 2008, the biodiesel industry in Thailand is poised for rapid growth to meet domestic demand. The main feedstock for biodiesel in Thailand is palm oil, with increasing production of Jatropha *curcas*. Thailand is located next to Malaysia, the world's largest palm oil producer and exporter, and benefits from the right climate and soil conditions for palm oil. Notwithstanding the steady increase of palm oil production in Thailand since 1995, the Government's target to produce 3 million liters by 2012 is ambitious as set out in the table below (DEDE 2009).

Table 22: Biodiesel production capacity (2009)

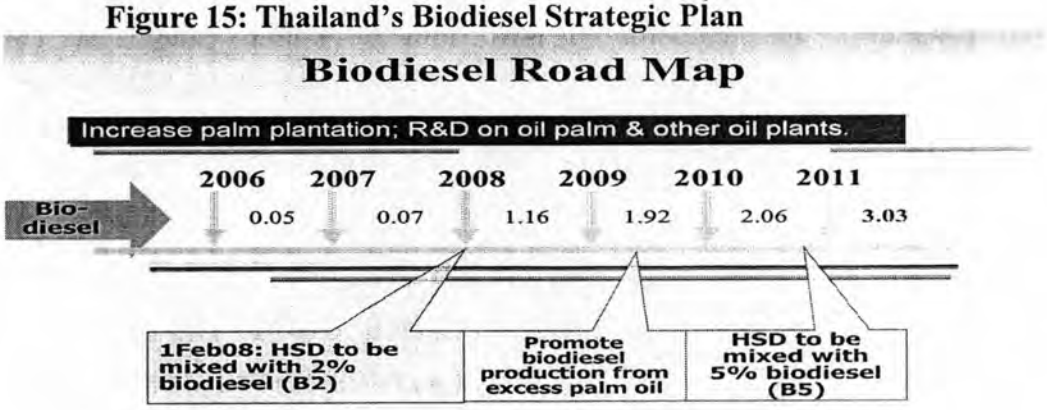
Potential (palm oil, Jatropha, used vegetable oil and Dimethyl ether (DME)	4.45 Million litres/day
Existing	1.49 Million litres/day

Source: DEDE (2009).

The ***Biodiesel Development and Promotion Strategy*** outlined in 2005 consists of the following key elements (see Figure below):

- Increase biodiesel production to 3 million liters/ day by 2011.
- Substitute 5% of all diesel consumption with biodiesel by 2011.
- In order to ensure the nationwide distribution of B10 by 2011, adopt a two-stage policy to introduce B5 (5% biodiesel mix) in Bangkok and southern Thailand in 2008 and extend the availability of B5 to all regions of the country by 2011.
- As of 1 February 2008, B2 replaced all available diesel in Thailand (2% biodiesel), with plans to increase this to 5% biodiesel (B5 blend) in 2011.

Figure 15: Thailand's Biodiesel Strategic Plan



Source: DEDE, 2008

To meet the rising demand, the Ministry of Agriculture and Cooperatives plans to increase palm oil plantations by 400,000 hectares, primarily in the North and Northeast of Thailand. According to the ***National Palm Oil Development Plan (2008-2012)***, the objective is to increase productivity of oil palm from 19 tons per hectare to 22 tons, as well as to increase the crushing rate of crude palm oil from 17% to 18.5% by 2012.

Table 24 sets out the recent National Energy Policy Council and Cabinet resolutions related to biodiesel.

Table 23: Recent national resolutions relating to biodiesel

Date & approving body	Summary of resolution
26 Nov 2005 (Cabinet)	Ministry of Agriculture to: - complete the zoning of palm planting areas within 6 months - establish the biodiesel purchasing price/liter as an incentive for producers (with the Government to pay the difference between the actual price of diesel and purchasing price).
5 February 2007 (Committee on Energy Policy Administration)	Sets the price of biodiesel B5 to be less than diesel by 1 baht/liter.
24 April 2007 (National Energy Policy Council)	B5 biodiesel price fixed at 0.70 baht/liter lower than diesel.
9 April 2007 (National Energy Policy Council)	Mandates the comprehensive usage of B2 by 1 February 2008

Source: Compiled by the author as of 2009

Thailand needs to expand its production of palm oil to meet the current target of 1.39 million liters/day as established by the Ministry of Energy. The Ministry of Agriculture has calculated that to facilitate this expansion an additional 5 million *rai* (800,000 hectares) of land is needed for palm oil cultivation. Plans are to cultivate 4 million *rai* (640,000 hectares) in Thailand, with another 1 million *rai* (160,000 hectares) to be leased or subcontracted from the neighbouring countries of Cambodia, Lao People's Democratic Republic (PDR) and Myanmar (DEDE 2009).

In contrast to the situation of ethanol (where supply exceeds current demand), there was insufficient domestic production of biodiesel to meet the target of replacing all regular diesel with B2 nationwide on 1 February 2008. At the request of the Ministry of Energy, the Ministry of Commerce agreed to suspend the import prohibition on crude palm oil to permit the entry of 30,000 tons of crude palm oil (pursuant to a Cabinet Resolution passed on 22 January 2008). As of May 2009, there are 9 operational biodiesel plants in Thailand.

Government incentives for biodiesel production

Thailand's biodiesel sector benefits from both production and consumption subsidies. The Ministry of Energy provides a subsidy by guaranteeing the price of biodiesel to be lower than the price of standard diesel. The production subsidy is contained in the price differential supported by the Energy Fund (i.e.., biodiesel (B100) price = 0.97 CPO + 0.15 Methanol + Bt 3.34 (margin). Consumption subsidies include the foregone revenue from waiving all taxes (i.e., VAT + municipal tax + energy fund contribution + excise tax). This is why biodiesel production (primary standard) is growing. Without these subsidies schemes, the informant confirms, biodiesel would not be economically viable.

The subsidies for Commercial BDF are as follows: (1) The 2% of the cost of BDF and the mineral Diesel (ex refinery) + (2) waiving of all taxes (Excise + Vat + Energy fund tax) on 2% BDF for B2. The percentage will be 5% for B5 and 10% for B10. **Appendix R** contains the price structure of petroleum productions in Bangkok, including the reference price for biodiesel.

The Ministry of Energy and the Bank for Agriculture and Agricultural Cooperatives have allocated a budget of 7,000 million baht (US$20 million) to provide loans for farmers to invest in palm oil production. Another 1,200 million baht (US$3 million) has been set aside by the Ministry of Energy to provide loans to commercial-scale biodiesel plants.

The Ministry of Energy has undertaken research and development on various aspects of biodiesel together with other ministries. These include:

- Research on the production and utilization of biodiesel from oil plants and animal fat.
- Research into the designing and installation of pilot community-based biodiesel plants.
- Studies to promote biodiesel in the transport sector.
- Research into biodiesel production and use for passenger pick-ups in Chiang Mai province. This demonstration project for biofuel production at community level is the first of its kind in Asia (EPPO 2008).

The Ministry of Agriculture and Cooperatives is also undertaking research to increase palm oil productivity (EPPO 2008, Pitisant 2007).

Community-based biodiesel production

Non-commercial biodiesel development is also promoted in local communities in Thailand. In 2006, the Government launched the ***Community Biodiesel Production Plan*** with

a budget of 100 million baht (US$2.8 million) to promote biodiesel production and use in 72 communities in Thailand. The objectives of the plan are:

- *To reduce local communities expenses on energy* by producing and using biodiesel from used cooking oil or other oil plants grown in the community (e.g. Jatropha) to replace diesel use (Samai 2007).
- *To promote and support the community to be self-reliant* in terms of energy supply and to enhance local community unity through the establishment of cooperatives for biodiesel production and distribution.
- *To create prototype communities* for further dissemination of community-based biodiesel production and utilization.

The second phase of the plan expanded the coverage to 400 communities, with an additional 155 million baht (US$4.3 million) to purchase oil pressing and processing machines (DEDE 2009).

Financial support from the Ministry of Energy encourages small-scale community biodiesel production and use at the local level with the objective of enhancing community energy sufficiency. Jatropha curcas, an oil-bearing, drought-resistant perennial plant, is being used as the feedstock for these community biodiesel projects. Already extensively in use as a biodiesel feedstock in India, Jatropha is considered to grow easily on marginal lands, thereby not necessarily competing with food crops. The benefits are dependent on the availability of marginal land and improvements in the oil content. Critics note that neither of these conditions can easily be met. More work is needed to increase oil content and to identify appropriate land for Jatropha cultivation (Samai 2007). Whilst its use at the community level is being developed, Jatropha is not yet considered to be commercially viable as a feedstock for the biodiesel industry in Thailand.

Trade–related issues

In January 2008, given an abrupt shortage of palm oil both for cooking oil and as an input for biodiesel, the Ministry of Energy requested the Ministry of Commerce to allow increased imports of palm oil. Crude palm oil imports and exports are restricted under the ***Fuel Trade Act (2000)***. According to the latest Trade Policy Review undertaken by the World Trade Organisation, Thailand has a tariff-rate quota regime for palm oil imports (see table below) (WTO 2007:42).Tariff quotas do not apply to imports from ASEAN countries, which may, upon legal enactment by the Ministry of Finance, supply items benefiting from

preferential ASEAN Free Trade Area (AFTA) duty rates; this is the case, for example, with palm oil imports (WTO 2007:52).

Table 24: Tariff quota commitments, actual imports under tariff quotas, and Most Favoured Nation (MFN)/bound tariffs, 2005 and 2006

Description (HS Code)	Tariff quota 2005 (tonnes)		In-quota tariff (2006)		Out of quota rate (2006)	
	Quota level	Actual imports	WTO bound	MFN applied	WTO bound	MFN applied
Palm oil and its fractions, whether or not refined	4,860	0.00	20%	B 2.5/l; B 1.32/l	143 %	B 2.5/l; B 1.32/l

Source: WTO (2007)

Legislative authority for regulating imports is provided by the **Export and Import Act (1979)**. The Act empowers the Minister of Commerce, with the approval of the Cabinet, to restrict imports for reasons of economic stability, public interest, public health, national security, peace and order, morals, or for any other reason in the national interest. Imports may be "absolutely" or "conditionally" prohibited; in the latter case (e.g. those requiring non-automatic licensing), they are allowed if specified conditions are satisfied. Palm oil is among the imports that may be prohibited under the various laws in place for health and safety reasons (see **Table below**).

Table 25: Products subject to import licensing and prohibition in Thailand, 2007

Commodity	HS code	Rationale	Measures and condition
Palm oil and its fractions	1511, 1513.210004, 1513.29.0007	Comply with market access commitment under the WTO Agreement on Agriculture	Tariff quota.

Source: WTO (2007)

Summary

The following is a summary of the current status of biodiesel promotion, production and use:

14 The current stocks of pure biodiesel (B100) within the country is struggling to meet the demand created by the mandatory requirement to replace all available diesel

nationwide with the B2 blend by 1 February 2008 (notwithstanding the Cabinet's decision to permit imports of 30,000 tons of palm oil).

- Several key Ministry of Energy Departmental Announcements between 2006 and 2008 established standards for industrial and community grade biodiesel, which were subsequently approved by Cabinet Resolution (DEDE 2009).
- The number of gas stations selling B5 nationwide is 3,126 (as of November 2009).
- The Government recognises several problems concerning biodiesel promotion, production and use:
    1) Increase in the price of crude palm oil
    2) Lack of sufficient supply of crude palm oil to meet biodiesel production targets
    3) Lack of consistency of quality in biodiesel production
- Due to these concerns, in the context of the Energy Policy and Development Plan, Thailand is pursuing the following measures to address the problems involved with biodiesel production:
    1) The Ministry of Energy is working with the Ministries of Commerce and Agriculture and Cooperatives to establish a mechanism, similar to the one in place for ethanol, for the procurement and management of raw materials needed for biodiesel production.
    2) The Ministry of Energy is coordinating with the Bank for Agriculture and Agricultural Cooperatives to accelerate loan authorizations to farmers in order to encourage expansion of, and investment in palm oil production.
    3) The Ministry of Energy is inspecting the quality of biodiesel to ensure consistency of production, with more stringent quality controls and quality tests to be conducted prior to registration.

Biogas, biomass-to-liquid and bagasse

Thailand has been promoting biogas production and use for over thirty years, mainly for pollution control as opposed to energy efficiency. In Thailand, biogas is mostly derived from domestic pig manure to be used as fuel in cooking and for small-scale power generation. Recently, there have been initiatives to generate power from other biodegradable organic

matter, including industrial wastewater and municipal solid waste. Methane from solid waste has a significant environmental impact, around 21 times that of carbon dioxide. At the forefront of biogas projects in Thailand are those from palm oil refineries, cassava wastewater and rice husks through to innovative projects for elephant dung (e.g., the Thai Elephant Conservation Center). The Ministry of Energy estimates that actual production of biogas for heat generation has reached 79 ktoe and 13 ktoe for electricity (DEDE 2009). There is a huge potential to expand biogas production, as well as reduce methane gas emissions contributing to climate change.

The Government's Energy Conservation Promotion Fund stimulated research and development of biogas generation from wastewater treatment systems in industrial factories starting in 1995. The development of a ***National Biogas Strategy*** provides information to pig and dairy farms to facilitate more efficient biogas utilization. The Ministry of Energy has initiated pilot projects throughout the country to raise awareness on the use of biogas technology with support from the Energy Fund (EPPO 2008).

Biogas benefits from measures to increase the purchase of power from renewable energy producers under the Alternative Energy Development Plan (2008-2022), whereby energy from biogas is expected to triple from 224 to 600 Ktoe by 2022. As mandated by Cabinet Resolution, biogas producers also benefit from the **Renewable Portfolio Standard** that requires 5% of power generated from new power plants to be generated from renewable energy. In addition, a power purchase program was established for Small Power Producers in 1992. A budget of over 3 billion baht (US$ 87 million) from the Energy Conservation Promotion Fund was set aside in 2001 to subsidize Small Power Producers using renewable energy. This policy raised the purchase price of electricity from small power producers to 1.96 baht/KW. Biogas benefits from a feed-in tariff of 0.3 baht per kilowatt hour (EGAT 2009). A program for Very Small Renewable Energy Power Producers was put in place in 2002.

Pursuant to the Enhancement and Conservation of National Environmental Quality Act (1992), factories, farms and communities are required by law to process their wastewater to a certain quality before being released into waterways. The Ministry of Natural Resources and Environment has established technical standards for wastewater. For example, the Announcement on 7 November 2005 deals with agricultural and livestock waste; the Ministry

of Science and Technology Announcement on 3 January 1996 sets the standards for wastewater from factories; and another Announcement on 3 January 2004 addresses the wastewater standards for communities.

The process of electricity cogeneration from bagasse is considered to be greenhouse gas neutral, whereby the CO_2 emissions burnt in this process are equivalent to the amount of CO_2 absorbed by standing sugarcane. Research is focusing on the use of cellulosic-rich bagasse to produce ethanol. The development of biogas is also being stimulated by projects approved by the Thailand Greenhouse Gas Management Organisation (TGO) under the Clean Development Mechanism (CDM) of the Kyoto Protocol. CDM credits have spurred innovation in second generation biofuels technology in Thailand. As of May 2009, Thailand has approved 74 CDM projects, including 52 for biogas and 13 for biomass operations, based on requirements for sustainable development as noted above (TGO 2009).

While first generation biofuel technologies focused on agricultural crops as the feedstock, second generation ***biomass-to-liquid (BTL)*** energy production is less reliant on crops and more dependent on the overall plant biomass. Biomass waste is also used as feedstock in the production process. In Thailand, several potential biomass sources have been identified by the Thailand Institute of Scientific and Technological Research (TISTR), including agricultural and wood residues, waste water from livestock farms and municipal solid waste. It is estimated that over 600 million tons of agricultural and wood residues (e.g., rice husks, bagasse, palm oil residues) are available each year for conversion into heat and power. This results in a contribution of approximately one-fifth of energy consumption annually. Consequently, the potential for biomass residues contributing to power production and cogeneration is significant.

Biogas technology has increased significantly in large and small-sized livestock farms because the production of biogas helps to deal with associated pollution problems. Chiang Mai University estimates that there is a significant capacity to generate biogas from wastewater produced from the approximately 5.4 million pigs in Thailand (EPPO 2007).

As a country with abundant agriculture, Thailand is well positioned to utilize the residues generated from agroindustrial production as an energy source. Biomass power plants generate electricity from agricultural wastes or production processes such as rice husks, bagasse, corn residue, starch, palm residues and woodchips. In recent decades, agricultural

producers in Thailand have gained experience in the use of farm and factory waste material to generate power. For example, saw mills burn wood chips or rice husks to create steam which is used to generate electricity via a turbine system. In April 2008, the Thai Board of Investment approved a 1.9 billion baht (US$55 million) investment by the Global Biodiesel Company to convert organic waste into energy.

Thailand is a leading sugarcane producer and the second largest global exporter of sugar. The byproducts from the production process of sugar are used to produce ethanol and bagasse from the agricultural waste residues. Molasses is used to produce ethanol. Bagasse is mainly utilised in Thailand for steam and power production in domestic sugar mills, with the surplus bagasse used in cogeneration electricity production to feed into the grid. There are seasonal limitations for bagasse. The Office of the Cane and Sugar Board determines the annual milling season, which varies from region to region and only lasts between 3-4 months.

The private sector in Thailand is taking the lead in developing technologies to generate power from biogas from waste material. For example, Ta Chang Industrial Group is pursuing a biogas venture worth 80 million baht (US$ 2.3 million). This company plans to recycle its waste to generate 1.4 megawatts of electricity from biogas, which would help to reduce production costs and manufacturing emissions.

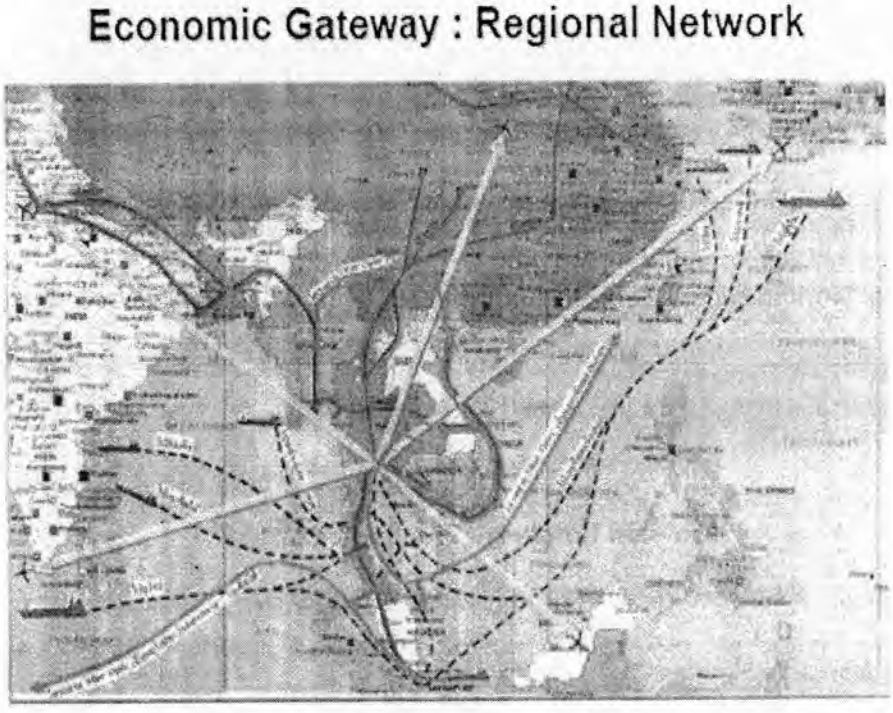
Industrial factories, such as cassava processing plants, have incurred problems with wastewater disposal. The organic content in the wastewater from the production process is substantial and is required by law to be processed before being released into waterways. As a result of the substantial costs of processing wastewater, many factories used to manage waste water cheaply by leaving it in unprocessed in open tanks. However, the majority of the existing 77 cassava processing plants in Thailand already has or is in the process of acquiring biogas technology as a more cost effective alternative to processing wastewater (EPPO 2007).

4.4 Regional energy framework

A driving force to stimulate development in the bioenergy sector is the intensifying regional cooperation underway between Thailand and its neighbours. In 2004, Prime Minister Thaksin Shinawatra put forward the vision of Thailand as the Bioenergy Hub of Asia. There are several energy initiatives contained in Thailand's regional trade agreements that could be geared towards enhancing alternative energy sources, including through the promotion of

South-South technology transfer for ethanol and biodiesel production and use. These frameworks are likely to stimulate trade and investment in bioenergy in Thailand. With the rapid growth of the bioenergy sector in the Asia Pacific region, food security is on the top of the agenda linking agriculture, energy and trade cooperation.

Map 2: Thailand's regional network



Source: National Economic and Social Development Board, 2009

The following regional trade agreements and initiatives are outlined below: (1) Association of Southeast Asian Nations (ASEAN) Free Trade Area; (2) Asia-Pacific Economic Cooperation (APEC); (3) Greater Mekong Subregion (GMS); (4) Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS); (5) Japan-Thailand Economic Partnership Agreement (JTEPA); and (6) Indonesia-Malaysia-Thailand Growth Triangle.

As outlined in Chapter 3, Thailand has a significant agricultural capacity to produce biofuel feedstock inputs, such as sugarcane and cassava for ethanol, and palm oil for biodiesel. A major factor in the push to increase production of bioenergy is to contribute to domestic consumption, as a substitute for imported petroleum. In contrast to Malaysia and Indonesia, Thailand has yet to development exports of biofuels to any great extent. However,

there is a growing expectation that Thailand may emerge as a regional exporter of biofuels. To this end, Thailand is actively engaged in regional cooperation in the biofuels sector.

1. Association of Southeast Asian Nations

The Association of Southeast Asian Nations (ASEAN) Free Trade Area (AFTA) was launched in 1992 to eliminate tariffs and integrate regional economies into a single production base and regional market of 550 million people between the ten member countries. Established in 1967, the ten member ASEAN consists of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam (ASEAN, 2008). An ASEAN Economic Community (AEC) is envisaged by 2015.

ASEAN-China Free Trade Agreement

The ASEAN-China Free Trade Area (ACFTA), the world's largest free trade area, was established on 1 January 2010. ACFTA will be an important driving force for greater economic cooperation and integration between China and ASEAN and contribute to realising the ASEAN Community by 2015. Under the agreement, China and the six founding ASEAN countries, Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand, will eliminate barriers to investment and tariffs on 90% of products. The CLMV countries have until 2015 to follow suit.

Under ACFTA, the average tariff on goods from ASEAN countries to China is reduced from 9.8% to 0.1%. The six original ASEAN members, Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand slashed the average tariff on Chinese goods from 12.8% to 0.6%. By 2015, the policy of a zero-tariff rate for 90% of Chinese goods is expected to extend to the four new ASEAN members, Cambodia, Lao PDR, Myanmar and Vietnam.

The trade agreement between ASEAN and China is the world's biggest FTA in terms of market size with a combined population of 1.9 billion and a combined GDP of US$5.8 trillion with total trade volume of US$4.5 trillion. It is the world's third largest trading arrangement after the European Union and the North American FTA (NAFTA). ASEAN-China trade with the rest of the world has reached 4.3 trillion dollars, or about 13.3% of global trade. Moreover, it is an opportunity to establish a regionally-based supply chain for market reach and growth.

On the one hand, there is concern about the rate of China's demand for Asian raw materials like palm oil, timber and rubber, and opening up regional markets for its manufactured products, steel and textiles.

On the other hand, China and ASEAN countries are all export-oriented economies, with a large proportion of the exports targeted to US and EU markets. Nevertheless, critics argue that ASEAN countries will struggle to adjust to competition from Chinese imports. Under the FTA framework, China and six ASEAN nations - Brunei, the Philippines, Indonesia, Malaysia, Thailand and Singapore - will cut to zero the tariff on 90% of imported goods, or 7,000 product categories. Industries in China and ASEAN complement each other. China imports resource-related products such as copper and rubber, and exports ships, steel, garments and ceramics.

ASEAN-India FTA

The ASEAN-India (AIFTA) will phase-in tariff eliminate on 80% of trade between ASEAN members and India by 2016 and by 2021 for new ASEAN members. The schedule to reduce tariffs is complex and consists of five components: (i) normal track; (ii) sensitive track; (iii) special products; (iv) highly-sensitive lists; and (v) exclusion list. Crude palm oil and refined palm oil were among the more controversial products included in the special category.

Agriculture in ASEAN

There is significant concern, however, on both sides. The agricultural sector remains a sensitive sector and the Thai government announced its intention to take precautions to help farmers from the fall in farm product prices after tariffs are cut under the ASEAN Free Trade Area (AFTA) at the beginning of 2010 (Bangkok Post 28 December 2009). Innovative techniques to raise awareness in the farming community include the distribution of cartoon books with information about free trade. As of 1 January 2010, Thailand liberalised the market for 23 farm items, with the exclusion of four products - cut flowers, potatoes, coconut meat and coffee beans, which have been classified as sensitive items. The most sensitive item for most ASEAN countries is rice – which has political significance as it involves more than 20 million farmers.

Notwithstanding Thailand's strong competitiveness in the rice sector, as the primary global exporter, imports remain a sensitive issue.

Bioenergy in ASEAN

Bioenergy issues were addressed for the first time at the 26th ASEAN Ministers on Energy Meeting (AMEM) in Bangkok on 7 August 2008. With respect to expanding external energy cooperation, Ministers noted the solid progress to foster sustainable energy development in the region and agreed to deal with rising energy costs through coordinated efforts to enhance: (a) energy efficiency and conservation; (b) biofuels for transportation and other purposes; (c) energy market integration; (d) alternative and renewable energy sources; and (e) oil stockpiles. Specifically, the growing importance of biofuels was recognised as an alternative to reduce ASEAN's fossil fuel consumption. Ministers emphasised the need for closer cooperation and exchange of experience in promoting biofuel production and use, including relevant fiscal incentives, funding facilities and regulatory infrastructure.

The Ministerial Statement concludes by stating that "[g]iven the great potential of the ASEAN Member States it is envisioned that ASEAN can be the regional hub for biofuel production and trade, both intra-ASEAN and inter-region" (ASEAN-AMEM, 2008). Biofuels is also being addressed in the context of ASEAN cooperation to respond to the impacts of climate change, including a new initiative on "ASEAN Strategy in Addressing the Impact of Climate Change on Agriculture, Fisheries and Forestry."

At the 14th ASEAN Summit in Cha-am, Thailand on 1 March 2009, Leaders embraced food security as a matter of "permanent and high priority policy." In a "Statement on Food Security in the ASEAN Region," ASEAN Government agreed to prioritize food security issues and to:

1.4 Adopt the ASEAN Integrated Food Security (AIFS) Framework and the Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) (2009-2013) to be implemented by ASEAN Ministers on Agriculture and Forestry (AMAF).

2.4 Support development of agricultural productivity through greater investment, improved research and development, enhanced agricultural innovation and knowledge management, and strengthened farmers' organisations.

3.4 Consider the development of biofuels through science and technology advancement without adverse impacts to regional food security.

The ASEAN Integrated Food Security Framework will review the status and trends in biofuel development in the region and its potential impacts on food security (Strategic Thrust 6, AIFS). This work will be reviewed by Senior Officials Meeting of the ASEAN Ministers on Agriculture and Forestry (SOM-AMAF) and in the context of the *Ad Hoc* ASEAN Task Force on Task Force on Food Security established in 2008.

ASEAN energy cooperation

ASEAN members agreed to achieve a collective target of 15% of renewable energy in the total regional power capacity by 2015. There has been increasing attention to energy cooperation in order to secure a reliable supply of energy, including biofuel through which to sustain economic and industrial activities. To this end, regional collaboration in the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN Power Grid (APG) has been agreed to support the region's energy resources for greater security.

ASEAN has also recognised that due to "the limited global reserve of fossil energy and the unstable world prices of fuel oil, it is essential for ASEAN to emphasise the need to strengthen renewable energy development, such as biofuels, as well as to promote open trade, facilitation and cooperation in the renewable energy sector and related industries as well as investment in the requisite infrastructure for renewable energy development."

At the 27th ASEAN Ministers on Energy Meeting (AMEM) in Mandalay, Myanmar, 29 July 2009, Ministers focused on the need to develop "a cleaner, more efficient and sustainable energy community" as a key to support the ASEAN Economic Community by 2015. ASEAN members adopted the ASEAN Plan of Action for Energy Cooperation (APAEC) 2010-2015 to guide energy cooperation. It was also agreed to increase energy efficiency is one of the most cost effective ways to enhance energy security and address climate change in the region. To this end, it was agreed to reduce regional energy intensity by at least 8% by 2015 based on 2005 levels. Ministers recognised the need to strengthen cooperation in the development of renewable and alternative energy, including hydropower and biofuels, as well as in the promotion of more use of renewable energy in the total energy mix to achieve energy security both at regional and national levels.

2. Asia-Pacific Economic Cooperation

The Asia-Pacific Economic Cooperation (APEC) was launched in 1989 to liberalise trade and investment amongst 21 member countries, including Australia, Brunei Darussalam, Canada, Chile, China, Hong Kong, China, Indonesia, Japan, South Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Chinese Taipei, Thailand, United States and Vietnam.

Since May 2006, the Biofuels Task Force of the Asia-Pacific Economic Cooperation (APEC) Energy Working Group has facilitated member economies to understand the potential for biofuels to replace petroleum in the transportation sector. It is in the process of establishing standards for ethanol and biodiesel. APEC has also set up demonstration projects to encourage second generation biofuels (APEC 2008a).

The objective of the APEC Energy Working Group is to maximize the contribution of the energy sector to the region's economic and social well-being through activities in energy supply and demand; energy and the environment; energy efficiency and conservation; new and renewable energy technologies; and liquid biofuel production and development (APEC 2008b).

3. Greater Mekong Subregion

Thailand is an active participant in increasing subregional integration, with implications for the development of biofuels. The first Greater Mekong Subregion Summit in 2002 endorsed a Strategic Framework of the GMS, including emphasis on focused on achieving connectivity, competitiveness and community. Agriculture Ministers of the six members of the GMS met for the first time in Beijing, China in April 2007 to endorse a *Strategic Framework for Subregional Cooperation in Agriculture*. The GMS members are Cambodia, China (Yunnan Province and Guangxi Autonomous Region), Lao People's Democratic Republic, Myanmar, Thailand and Vietnam. This is part of a larger GMS integration framework initiated by the Asian Development Bank's economic corridors initiative in 1992 (ADB 2008). With an emphasis on infrastructure development and promotion of freer flow of goods and people, the GMS has emerged as a significant regional forum for cooperation across a variety of issues, including agriculture, ***energy***, transportation and the environment.

The Core Agricultural Support Programme (CASP) endorsed by the six GMS Ministers of Agriculture in April 2007 deals with increasing trade and investment in agriculture in the GMS. It focuses on helping farmers reap the benefits of new energy crops and related technologies. A key component is to ensure that the benefits from new opportunities in agricultural energy crops. The programme targets smallholder farmers and the rural poor in the GMS in order to foster crossborder trade and investment in agriculture, contribute to food security and poverty reduction and promote environmental protection and sustainable use of natural resources.

Against a backdrop of high energy dependence, the agricultural sector is increasingly viewed as a source of fuel as well as food. In order to manage and share agricultural information and technology, GMS Governments launched an *Agriculture Information Network Service*. The GMS Rural Renewable Energy Initiative (RREI) was initiated byt he GMS Working Group on Agriculture in 2007 to encourage biofuel production and use. The ADB is also examining the feasibility of using biofuels in the transport sector in the Mekong region (ADB 2009).

At the GMS energy ministerial in Mandalay, Myanmar in mid-2009, the Roadmap for Expanded Energy Cooperation in the GMS was agreed. Mekong governments have agreed to undertake an "integrated approach to deliver sustainable, secure and competitive energy" as: (i) "an effective way to ensure cost-effective energy supply;" and (ii) an effective way to mitigate climate change, and that a medium term thrust is to promote utilisation of biofuels (ADB 2009a).

4. Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy

Established in November 2003, this economic cooperation framework includes Cambodia, Lao PDR, Myanmar, Thailand and Vietnam and "acts as a building block and move ASEAN forward at a more even pace, on the basis of self-reliance and mutual prosperity". The objectives of the Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy (ACMECS) are to bridge the economic gap between the five countries and to promote prosperity on a sustainable level. One of the main aims is to build partnerships to transform the border areas of the five members into zones of economic growth and social progress and achieve sustainable development through South-South cooperation. The ACMECS framework has initiated over 40 common development projects as well as over 200

bilateral projects to enhance trade and investment, agriculture and industry, transport and ***energy*** linkages.

There are several bioenergy initiatives in the framework of ACMECS that have stimulated Thailand's development of biofuels. In September 2005, Thailand hosted a workshop with representatives from the five ACMECS countries to discuss the possibilities for cooperation on biofuels and to initiate a project on community-based biofuel for ACMECS members. ACMECS economies are mainly agricultural and land capacity is considered to be underutilised. Certain agricultural areas are not conducive to farming of cash crops. Therefore, farming of oil crops, such as Jatropha and physic nuts represent a viable alternative source of biodiesel for local use. This would reduce farmer's expenses and dependence on oil imports and potentially lead to sustainable development and energy sufficiency. Given its advanced capacity in biofuels, Thailand has taken the lead in technical cooperation for small-scale community biodiesel development. This assistance includes establishing learning centres in each ACMEC country to demonstrate physic nut oil and biodiesel production and financing pressing and biodiesel processing machines, as well as conducting training and information sharing on farming oil crops in local communities (ACMECS 2008).

Thailand provides "One Way Free Trade" with Cambodia, Lao PDR, Myanmar and Vietnam, which entails the application of a zero-five % tariff rate on nine agricultural exports from these four countries, some of which can be used in the production of bioenergy (e.g. soy beans and maize) (BOI 2009). Thailand also provides technical assistance to promote market incentives for contract farming and increased agricultural productivity, which is relevant in the context of expanding areas for cultivating bioenergy crops (ACMECS 2008). At the ACMECS Foreign Ministers' meeting in Mandalay, Myanmar in May 2007, it was agreed to expedite six key activities, including the development of Jatropha plantations and biofuel production in ACMECS countries.

Within the ACMECS framework, agricultural subcontracting has increased substantially. The Thai private sector has been encouraged to invest in bioenergy in the neighbouring countries of Cambodia, Lao PDR, Myanmar and Vietnam. To this end, Thailand signed a Memorandum of Understanding with Myanmar on 2 December 2005 in which

Thailand gained access to 7 million hectares of arable land for the planting of energy crops, such as sugarcane, cassava, palm oil and Jatropha.

Thai private sector subcontracting of agricultural land is widely held to be transforming agricultural production and land use in the Mekong region. In this respect, ACMECS governments need to monitor the socio-environmental impacts of subcontracting in order to work towards sustainable development in the bioenergy sector.

5. Japan-Thailand Economic Partnership Agreement

In April 2007, Thailand and Japan agreed on a Japan-Thailand Economic Partnership Agreement (JTEPA) to promote cooperation in trade and investment and create a free trade agreement between the countries. The Thailand Development Research Institute (TDRI) finalised a study on the potential impacts and opportunities of JTEPA for the Thai economy (TDRI 2006). The results indicated the potential for Thailand to benefit from energy cooperation.

Bioenergy issues have not been explicitly addressed in JTEPA. However, there is provision in Chapter 13 of JTEPA for Cooperation in the Field of Science, Technology, Energy and Environment, with a Sub-Committee established to deal with these issues. In this context, Thailand and Japan have agreed to discuss technology transfer related to bioenergy.

6. Indonesia-Malaysia-Thailand Growth Triangle

Energy is one of the ten major areas of cooperation in the Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT). Established in 1993, the IMT-GT aims to accelerate trilateral economic cooperation in the geographical triangle that encompasses southern Thailand, northern Malaysia and Sumatra, Indonesia. The main objective of the IMT-GT Roadmap (2007-2011) is to accelerate private sector-led growth and investment to contribute to achieving the ASEAN Economic Community by 2020. Improvements in basic infrastructure corridors will reduce transportation costs and increase the Triangle's competitiveness.[27]

The Joint Ministerial Statement of the 4th IMT-GT Summit, convened on 28 February 2009 back-to-back with the 14th ASEAN Summit in Cha-am (Thailand), refers to cooperative

[27] See www.adb.org/IMT-GT/roadmap.asp

efforts to address food security, volatility of energy prices and climate change (ASEAN 2009).

Future prospects for regional agroenergy integration

Increased regional cooperation has stimulated trade and investment in bioenergy in Asia, particularly in the Mekong region. The bioenergy sector is being developed with scant regard to socio-environmental considerations. As a direct result, greater attention is needed on the social and environmental sustainability of bioenergy generation and use. Providing legal clarity and consistency of implementation for trade and investment in bioenergy would address mounting concerns about food and fuel competition for agricultural land, as well as biodiversity and forest conservation related to the expansion of agroindustrial energy crops. Policymakers need to provide a stable and predictable framework to stimulate investment in bioenergy development in the region.

4.5 Conclusion: challenges and opportunities in bioenergy development

Bioenergy is not new to Thailand. The King's Royal Chitralada alternative energy projects initiated in the 1950s have allowed Thailand to gain considerable experience with biofuel production and use. As a leading agricultural producer, Thailand is in a favourable position to benefit from the emerging opportunities in the bioenergy sector and diversify its energy sources. It is located in a region that is rapidly expanding trade and investment integration, with a consequent increasing demand for alternative energy sources. Thailand has already revealed itself to be a leader in "green" energy by being the first country in ASEAN to introduce gasohol. Nevertheless, continued political turmoil is magnifying the effects of the economic slowdown in Thailand, both of which have implications for bioenergy development.

Thailand is supporting biofuel production and use to contribute to diversifying the fuel mix in the transport sector, including measures mandating biodiesel, providing tax incentives for biofuel producers and automobile manufacturers, as well as low interest loans to palm oil producers. Thailand has commercialised gasohol and biodiesel. Gasohol already accounts for nearly 60% of petrol sold nationwide and biodiesel production has reached over 3 million litres. Nevertheless, a surplus in ethanol supply has caused many plants to suspend production. Conversely, while the government policy guarantees the price of palm oil and

mandates biodiesel use, the plan is to increase plantations, including in neighbouring countries, to maintain sufficient supply to meet the national targets. The Government plans to continue to subsidise gasohol and biodiesel in addition to using the Oil Fund to support a competitive price in relation to conventional gasoline.

Whilst Thailand has signalled a new era with its renewable energy strategies, it has yet to fully assess the socio-environmental effects of biofuels. Studies illustrate that first generation biofuels are neither environmentally-efficient, nor cost effective ways to reduce greenhouse gas emissions. Therefore, while the increased use of bioenergy in Thailand may address immediate energy needs, it may have unintentional implications for sustainable development. It may lead to increased food prices and encourage farmers to expand agriculture in environmentally unsustainable areas. There is thus a continuous need for Thailand to monitor and assess the implementation of its bioenergy policies and regulations. Thailand recognises that the next decade represents a transition to more efficient and cost-effective second generation biofuels. The Government is concentrating efforts to finance research to develop the necessary technologies. These efforts include collaboration with other developing countries, such as Brazil, to stimulate south-south bioenergy cooperation and technology transfer.

The creation of a Committee on Food Security in 2008 has enabled a coordinated national debate on how to ensure that a switch in demand for fuel does not impact negatively on agricultural production for food. Given that Thailand is among the world's largest producers and exporters of rice, sugar and tapioca, the issue of food security takes on a multilateral dimension. This entails that a switch from food to fuel cultivation has the potential not only to potentially impact upon food security in the Thailand, but to disrupt the global food supply chain. With increasing emphasis on shifting from fossil to bio-based fuels, there will be competition for the use of land for food and energy crops, as well as a substitute for petrochemical products (plastics and fertilizers). There is a need for the Government to ensure an appropriate balance between production of agricultural crops for food and fuel. Thailand would benefit from legislation ensuring the country's food security and restricting the cultivation of energy crops to marginal land.

The intention in Thailand is to develop the biofuels sector to contribute to a domestic demand stimulated by blending requirements for ethanol and biodiesel in transportation. As

described in this chapter, while there is insufficient palm oil to meet the domestic demand, exports of ethanol began in 2007. This differs from the scenario in Malaysia and Indonesia's well established palm oil capacity for exports. Malaysia and Indonesia account for nearly 90% of global exports of palm oil, primarily to the EU.

Whilst already firmly established in the European context, sustainability criteria for bioenergy are only now being developed in the Asian region. The development of these criteria for ethanol and biodiesel production and use in Thailand would address basic sustainability issues and deflect environmental criticism. Building a bioenergy sector based on internationally recognised sustainability criteria would also better enable Thailand to trade in biofuels in the future. As outlined in this chapter, regional frameworks need to place greater emphasis on establishing and implementing quality standards and sustainability criteria in the bioenergy sector.

There are several strengths and a few weaknesses in the emerging legislative and policy frameworks for bioenergy in Thailand. First and foremost, Thailand is actively pursuing alternative energy sources and has emerged as a leader in biofuel development in Southeast Asia. As outlined in this chapter, the Government is engaging with the private sector and local communities to put in place national roadmaps for ethanol, biodiesel and biogas. This is a strength of the process and will assist in developing the legal and policy structure based on a deeper understanding of the impacts of various alternative energy options in practice.

Government policies on a range of biofuels-related issues need to be closely coordinated with respect to the development of bioenergy legislation. Prime examples are between agriculture, land-use, forestry and environmental policies to implement national targets for biofuels. Thailand needs to work towards greater policy integration between different government ministries that deal with the various aspects of bioenergy policies and regulations. Recognising the need for strengthening policy coordination between the various ministries involved in bioenergy decision making, a new National Biofuels Organisation is expected to be formed. This would solidify the importance of the role of the National Biofuels Committee that was established to coordinate and formulate national bioenergy policy in 2005.

While the Board of Investment of Thailand provides investment incentives for renewable energy, private sector interest in biofuels is also predicated on consistent implementation of targets and greater regulatory clarity and predictability. Thailand needs to regain the political momentum to ensure the legal framework supports bioenergy, for example by removing trade restrictions on ethanol and biodiesel. Notably, ethanol can only be exported based on case-by-case approval from the Ministry of Commerce. The removal of trade barriers would also allow Thailand to harness the opportunities arising from the ASEAN Free Trade Area. The regional dimensions of biofuel expansion are important and require coordinated policies, for example concerning Thailand's energy crop subcontracting in the Mekong region.

Whilst the push for bioenergy in Thailand may have been less fuelled by environmental concerns than by visions of energy security and economic stability, this situation is changing. There is increasing recognition of the importance of environmental sustainability to underpin economic growth and prosperity. Nevertheless, environmental impact assessments are not required to be undertaken for biofuel plants or projects in Thailand. The country has also not sufficiently assessed whether the possible negative impacts of replacing petroleum with gasohol and biodiesel outweigh the benefits in terms of land use. One way to further this assessment would be to specifically address the need for an environmental impact assessment for bioenergy projects, as well as work to develop and implement biofuels sustainability standards. There is also a need to enhance enforcement of environment-related legislation in the biofuels sector.

The Clean Development Mechanism of the Kyoto Protocol is stimulating renewable energy projects in Thailand. Thailand recognises the need to establish clear and consistent requirements and approval procedures to encourage CDM investors. To this end, the approval process for CDM projects no longer requires Cabinet endorsement. The newly created Thailand Greenhouse Gas Management Organisation can approve project proposals. The TGO has also moved quickly to establish procedures and criteria for guiding CDM projects (TGO 2009). While Thailand is in the process of establishing the mechanisms to capitalize on CDM projects, further emphasis should be placed on strengthening the legal framework in which these projects are implemented to ensure that sustainable development criteria are met.

The King's Sufficiency Economy concept serves as an underlying stimulus for Thailand's development of alternative energy sources. Royal endorsement of energy efficiency and conservation will continue to act as a powerful incentive for the general public to embrace renewable energy sources. The King of Thailand, Bhumiphol Adulyadej has called for an increased use of biodiesel, gasohol and other alternative energy sources to reduce oil imports, which cost the country over 10% of its GDP annually. Royal endorsement is sufficient to ensure that the issue remains at the top of the Government's agenda.

Three observations are worth highlighting in conclusion. First, demand for bioenergy in Thailand, as in most countries, is driven by domestic regulatory mandates, with production costs subsidised or promoted by the Government. To support the goals and targets for bioenergy, Thailand needs to develop implementing legislation for the acts and plans discussed in this chapter.

Second, Thailand will continue to develop its agricultural sector for food, fibre and fuel in close cooperation with its Asian and Mekong neighbours. The expansion of biofuels production and use raises environmental and social concerns that have yet to be factored into the equation in Thailand, including diversion of land to energy crops and away from food, fiber and biodiversity.

Third, there are two tracks for biofuels development in Thailand signaled by the recently finalised standards for commercial and community use. The potential is to increase energy sufficiency and resiliency at the community level, while adding value and reducing inputs to agricultural production for commercialized biofuels. However, the difficulty is to distinguish between the two in the regulatory system. Greater use of first generation and, importantly, second generation biofuels may promote greater energy security, revitalise rural economies and reduce greenhouse gas emissions ***if*** implemented consistently in a stable political milieu.